READ ME

This "READ ME" file is presented to facilitate the review of the Department of Energy *Waste Isolation Pilot Plant Hazardous Waste Facility Permit Amended Renewal Application,* September 2009 (Renewal Application). It is intended to provide information on the organization of the Renewal Application. The organization of the Renewal Application was developed to identify the regulatory requirements for a renewal application and provide the information that addresses those regulatory requirements.

A *Regulatory Requirements Crosswalk* identifies New Mexico Hazardous Waste Management Regulation citations that are to be addressed in a renewal application. It contains not only the relevant requirement citations, but also a description of the requirement and the Renewal Application location where the requirement is addressed. If the requirement is not applicable to the Waste Isolation Pilot Plant (**WIPP**) facility, an explanation is provided.

The WIPP Renewal Application contains two parts: the Part A and the Part B applications; it also contains other information the Permittees believe will be helpful in the review of the Renewal Application. To address the requirements in the Part A and Part B applications, two documents are presented with the *verbatim* requirements for the different applications:

- *Necessary Information for the WIPP Ten Year Renewal Application, Part A*
- *Necessary Information for the WIPP Ten Year Renewal Application, Part B*

The necessary information for the Part A application addresses the requirements for Part A and provides the basic and general information about the facility, processes, and waste to be treated, stored or disposed. The WIPP facility has storage and disposal units which are the subject of the Renewal Application. The WIPP facility does not treat hazardous waste.

The necessary information for the Part B addresses the requirements for Part B and contains specific information regarding how waste is managed, stored, and disposed, including the various aspects of how the WIPP facility is operated (e.g., safety, training, monitoring). Information regarding the Permittees' plans to analyze waste to ensure that it meets the acceptance criteria for the WIPP facility is also presented. The necessary information for the Part B contains three distinct sections:

- General and specific facility requirements found in 20.4.1.500 NMAC incorporating 40 CFR 264 Subparts A through G
- Specific requirements for containers found in 20.4.1.500 NMAC incorporating 40 CFR 264 Subpart I
- Specific requirements for miscellaneous units found in 20.4.1.500 NMAC incorporating 40 CFR 264 Subpart X

The text in the necessary information for the Part B will point the reviewer to where the requirement is fully addressed in the Part B chapters, appendices, and addenda. The Part B chapters and appendices are based upon the WIPP Hazardous Waste Facility Permit.

In the chapters and appendices of the Renewal Application, the terms "Module" and "Attachment" are used in the context of identifying the May 22, 2009 version of the Permit requirement or condition. Furthermore, when the terms "chapter" or "appendix" are used in this Renewal Application, they refer to permit applications, either the original 1997 WIPP Part B Application or this Renewal Application. When the New Mexico Environment Department (**NMED**) writes the draft Permit, the chapters and appendices will be identified as permit "Attachments." The NMED will write the permit "Modules."

Three addenda to the Chapters are included in the Renewal Application to provide significant information pertaining to topic(s) contained in the associated chapters and appendices. The addenda and the reasons for including them are as follows:

- Addendum B1, *Dispute Resolution* (This is a provision that is contained in Module I of the Permit that the Permittees wish to retain in the renewed Permit)
- Addendum L1, *Site Characterization* (This updates information referenced extensively in Attachment L of the Permit)
- Addendum N1, *300-year Performance Demonstration Re-Evaluation* (This updates information that was used to prepare the Permit. The original analysis and the updated information reach the same conclusion that the only significant pathway from the miscellaneous unit is the air pathway involving the release of volatile organic compounds from containers prior to final facility closure.)

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

LIST OF TABLES

CHAPTER B
WASTE ANALYSIS PLAN

APPENDIX B1
WASTE CHARACTERIZATION SAMPLING METHODS

APPENDIX B3
QUALITY ASSURANCE OBJECTIVES AND DATA VALIDATION TECHNIQUES FOR WASTE CHARACTERIZATION SAMPLING AND ANALYTICAL METHODS

APPENDIX B6
WASTE ISOLATION PILOT PLANT PERMITTEES' AUDIT AND SURVEILLANCE PROGRAM

CHAPTER D
INSPECTION SCHEDULE, PROCESS AND FORMS

CHAPTER F
RCRA CONTINGENCY PLAN

CHAPTER G
TRAFFIC PATTERNS

ATTACHMENT I
CLOSURE PLAN

APPENDIX I1
DETAILED DESIGN REPORT FOR AN OPERATION PHASE PANEL CLOSURE SYSTEM

APPENDIX I2
WASTE ISOLATION PILOT PLANT
SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

APPENDIX I2A
MATERIAL SPECIFICATION
SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

APPENDIX I3
RADIOLOGICAL SURVEYS TO INDICATE POTENTIAL HAZARDOUS WASTE RELEASES

CHAPTER L
WIPP GROUNDWATER DETECTION MONITORING PROGRAM PLAN

ADDENDUM L1
SITE CHARACTERIZATION

APPENDIX M1
CONTAINER STORAGE

APPENDIX M2
GEOLOGIC REPOSITORY

CHAPTER N
VOLATILE ORGANIC COMPOUND MONITORING PLAN

CHAPTER Q
WIPP MINE VENTILATION RATE MONITORING PLAN

LIST OF FIGURES
PART A APPLICATION

CHAPTER B
WASTE ANALYSIS PLAN

APPENDIX B1
WASTE CHARACTERIZATION SAMPLING METHODS

APPENDIX B2
STATISTICAL METHODS USED IN SAMPLING AND ANALYSIS

APPENDIX B3
QUALITY ASSURANCE OBJECTIVES AND DATA VALIDATION TECHNIQUES FOR WASTE CHARACTERIZATION SAMPLING AND ANALYTICAL METHODS

APPENDIX B4
TRU MIXED WASTE CHARACTERIZATION USING ACCEPTABLE KNOWLEDGE

APPENDIX B7
PERMITTEE LEVEL TRU WASTE CONFIRMATION PROCESSES

CHAPTER D
INSPECTION SCHEDULE, PROCESS AND FORMS

CHAPTER F
RCRA CONTINGENCY PLAN

CHAPTER G
TRAFFIC PATTERNS

CHAPTER H
PERSONNEL TRAINING

CHAPTER I
CLOSURE PLAN

APPENDIX I1
DETAILED DESIGN REPORT FOR AN OPERATION PHASE PANEL CLOSURE SYSTEM

APPENDIX I1G
TECHNICAL SPECIFICATIONS PANEL CLOSURE SYSTEM

APPENDIX I2
WASTE ISOLATION PILOT PLANT
SHAFT SEALING SYSTEM COMPLIANCE SUBMITTAL DESIGN REPORT

APPENDIX I2A
MATERIAL SPECIFICATION

SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

APPENDIX I2B
SHAFT SEALING CONSTRUCTION PROCEDURES
SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

APPENDIX J1
ACTIVE INSTITUTIONAL CONTROLS DURING POST-CLOSURE

CHAPTER L
WIPP GROUNDWATER DETECTION MONITORING PROGRAM PLAN

ADDENDUM L1
SITE CHARACTERIZATION

APPENDIX M1
CONTAINER STORAGE

APPENDIX M2
GEOLOGIC REPOSITORY

CHAPTER N
VOLATILE ORGANIC COMPOUND MONITORING PLAN

APPENDIX N1
HYDROGEN AND METHANE MONITORING PLAN

ADDENDUM N1
300-YEAR PERFORMANCE DEMONSTRATION RE-EVALUATION

LIST OF PHOTOGRAPHS
PART A APPLICATION

LIST OF DRAWINGS

PART A
APPLICATION

PART B
APPLICATION

CHAPTER F
RCRA CONTINGENCY PLAN

APPENDIX I1H
DESIGN DRAWINGS PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT CARLSBAD, NEW MEXICO

762447-E4	Panel closure system, air exhaust drift, construction details
762447-E5	Panel closure system, construction and explosion walls, construction details
762447-E6	Panel closure system, air intake and exhaust drifts, grouting and miscellaneous details

APPENDIX I2E
DESIGN DRAWINGS
SHAFT SEALING SYSTEM COMPLIANCE SUBMITTAL DESIGN REPORT

Design Drawings

Shaft Location Plan, Abbreviations, General Notes and Legend

Near-Surface/Rustler Formations Waste Shaft Stratigraphy and AS-Built Elements

Salado Formation Waste Shaft Stratigraphy and AS-Built Elements

Near-Surface/Rustler Formations Waste Shaft Stratigraphy and Sealing Subsystem Profile

Salado Formation Waste Shaft Stratigraphy and Sealing Subsystem Profile

Waste Shaft Station Monolith

Near-Surface / Rustler Formations Air Intake Shaft Stratigraphy and AS-Built Elements

Salado Formation Air Intake Shaft Stratigraphy and AS-Built Elements

Near-Surface / Rustler Formations Air Intake Shaft Stratigraphy and Sealing Subsystem Profile

Salado Formation Air Intake Shaft Stratigraphy and Sealing Subsystem Profile

Air Intake Shaft Station Monolith

Near-Surface / Rustler Formations Exhaust Shaft Stratigraphy and AS-Built Elements

Salado Formation Exhaust Shaft Stratigraphy and AS-Built Elements

Near-Surface / Rustler Formations Exhaust Shaft Stratigraphy and Sealing Subsystem Profile

Salado Formation Exhaust Shaft Stratigraphy and Sealing Subsystem Profile

Exhaust Shaft Station Monolith

Near-Surface / Rustler Formations Salt Handling Shaft Stratigraphy and AS-Built Elements

Salado Formation Salt Handling Shaft Stratigraphy and AS-Built Elements

Near-Surface / Rustler Formations Salt Handling Shaft Stratigraphy and Sealing Subsystem Profile

Salado Formation Salt Handling Shaft Stratigraphy and Sealing Subsystem Profile

Salt Handling Shaft Shaft Station Monolith

Concrete-Asphalt Water Stop in Salado Formation

Asphalt Column

Upper and Lower Salado Compacted Clay Columns

Compacted Salt Column

WIPP Shaft Sealing System Plug

Rustler Compacted Clay Column

Compacted Earthen Fill and Concrete Plug

Equipment and Construction Sketches

WIPP Shaft Sealing System Smaller Galloway General Arrangement Plans and Sections

WIPP Shaft Sealing System Larger Galloway General Arrangement Plans and Sections

WIPP Shaft Sealing System Typical Headframe Plans and Sections

WIPP Shaft Sealing System Typical Headframe and Associated Surface Facilities

WIPP Shaft Sealing Design System UC721 Distribution List

APPENDIX M3
DRAWING NUMBER 51-W-214W
UNDERGROUND FACILITIES TYPICAL DISPOSAL PANEL

51-W-214-W Underground Facilities Typical Disposal Panel

ABBREVIATIONS AND ACRONYMS

AA	Atomic Absorption
AASHTO	American Association of State Highway and Transportation Officials
ACA	Agency for Conservation Archaeology
ACI	American Concrete Institute
ACOW	Assistant Chief Office Warden
AD	automatic dry chemical extinguishing system
ADT	average daily traffic
AIS	Air Intake Shaft
AISC	American Institute for Steel Construction
AK	acceptable knowledge
AKSD	Acceptable Knowledge Sufficiency Determination
ALARA	as low as reasonably achievable
ALI	annual limit on intake
AMM	asphalt mastic mix
AMWTP	Advanced Mixed Waste Treatment Project
ANSI	American National Standards Institute
API	American Petroleum Institute
AR	Action Request
ARM	area radiation monitor
AS	automatic wet pipe sprinkler system
ASER	Annual Site Environmental Report
ASTM	American Society for Testing and Materials
BDR	Batch Data Reports
BFB	bromofluorobenzene
BGS	below ground surface
BLM	(U. S. Department of the Interior) Bureau of Land Management
BS/BSD	blank spike/blank spike duplicates
BSEP	Brine Sampling and Evaluation Program
CA	controlled area
CAM	continuous airborne monitor
CAR	Corrective Action Report
CAS	Chemical Abstract Service
CBFO	Carlsbad Field Office
CCC	calibration check compounds
CCP	Central Characterization Project
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH	contact-handled
CHAMPS	Computerized History and Maintenance Planning System (WIPP automated maintenance management tracking program)
CIS	Characterization Information Summary
CMR	Central Monitoring Room
CMRO	Central Monitoring Room Operator

CMS	Central Monitoring System
COC	concentrations of concern
COC	chain-of-custody
CofC	chain-of-custody
COW	Chief Office Warden
CPR	cardio pulmonary resuscitation
CQC	contractor's quality control
CRQL	Contract Required Quantitation Limits
CTD	cumulative trauma disorder
D&D	decontamination and decommissioning
DA	Data Administrator
DAC	derived air concentration
DAC	drum age criteria
D/H	deuterium/hydrogen
DHV	design hourly volume
DI	deionozed
DOE	U. S. Department of Energy
DOI	U. S. Department of the Interior
DOT	U. S. Department of Transportation
DPS	Department of Public Safety
DQO	data quality objective
DRZ	disturbed rock zone
DZ	disturbed zone
EAL	expanded average load
ECP	Engineering Change Proposal
EDD	electronic data deliverable
EEG	Environmental Evaluation Group
EM	environmental monitoring
EOC	Emergency Operations Center
EPA	U. S. Environmental Protection Agency
ERDA	U.S. Energy Research and Development Administration
ERT	Emergency Response Team
ESP	electric submersible pump
EST	Emergency Services Technician
FAS	fixed air sampler
FEIS	Final Environmental Impact Statement
FID	Flame Ionization Detector
FIRST	Facility Inspection, Repair, and Service Team
FLAC	Fast Lagrangian Analysis of Continua
FLIRT	First Line Initial Response Team
FPT	Fire Protection Technician
FSM	Facility Shift Manager
FTIRS	Fourier transform infrared spectrometry
GC/FID	gas chromatography/flame ionization
GC/MS	gas chromatography/mass spectrometry

GERT	General Employee Radiological Training
GET	General Employee Training
GIS	Geomechanical Instrumentation System
GMS	Geomechanical Monitoring System
GWSP	Groundwater Surveillance Program
HDM	Highway Design Manual
HEPA	high efficiency particulate air (filter)
HERE	Horizontal Emplacement and Retrieval Equipment
HMAC	hot mix asphalt concrete
HMT	Hazardous Materials Table
HPLC	High Pressure Liquid Chromatography
HSG	headspace gas
HVAC	heating, ventilation (and) air-conditioning (systems)
HWDU	Hazardous Waste Disposal Unit
HWMU	hazardous waste management unit
HWN	hazardous waste number
HWO	hazardous waste operations
HWW	Hazardous Waste Worker
IC	instrument calibration
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectrometry
ICP-MS	Inductively Coupled Plasma—Mass Spectrometry
ICV	inner containment vessel
ID	identification
IDL	instrument detection limits
INEL	Idaho National Engineering Laboratory
INL	Idaho National Laboratory
JPM	job performance measure
LAN	local area network
LCS	laboratory control samples, laboratory control spikes
LD	limit of detection
LDR	Land Disposal Restrictions
LET	linear energy transfer
LSA	low-specific activity
LWA	Land Withdrawal Act
M&DC	monitoring and data collection
MB117	Marker Bed 117
MB139	Marker Bed 139
M-D	Munson-Dawson (creep model)
MDCF	multimechanism deformation coupled fracture
MDL	method detection limit
MOC	Management and Operating Contractor
MOU	Memorandum of Understanding
MPS	manual pull stations
MRL	method reporting limits
MRT	Mine Rescue Team

MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NCR	nonconformance report
NDE	non-destructive examination
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMAC	New Mexico Administrative Code
NMBMMB	New Mexico Bureau of Mines and Mineral Resources
NMED	New Mexico Environment Department
NRC	U. S. Nuclear Regulatory Commission
NTIS	National Technical Information Service
OCA	outer containment assembly
OHP	Operational Health Physics
OJT	on-the-job training
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
PA	public address
PA	performance assessment
PAS	portable air sampler
PBT	performance based training
PCB	polychlorinated biphenyl
PDP	Performance Demonstration Program
PEL	Permissible Exposure Limit
PFE	portable fire extinguishers
PM	preventive maintenance
PMP	probable maximum precipitation
POC	pipe overpack container
POD	plan of the day
PPA	Property Protection Area
PPE	personal protective equipment
PRDL	program required detection limits
PRQL	program required quantitation limit
PRS	Project Records Service
PTM	Plug Test Matrix
PVA	poly-vinyl alcohol
QA	quality assurance
QAO	quality assurance objectives
QAPD	Quality Assurance Program Description
QAPjP	Quality Assurance Project Plan
QC	quality control
R&D	Research and Development
RADCON	radiological control
RBA	radiological buffer areas

RC	radiological control
RCM	Radiological Control Manual
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RFA	request for analysis
RH	remote-handled
RIDS	records inventory and disposition schedule
RPD	relative percent difference
RRF	relative response factor
RT	retention time
RTL	regulatory threshold limit
RW	roving watch
RWP	radiological work permit
SAA	satellite accumulation area
SARA	Superfund Amendments and Reauthorization Act
SAT	Systematic Approach to Training
SATCOM	Satellite Communications
SC	specific conductance
SCBA	self-contained breathing apparatus
SHPO	State Historic Preservation Officer
SI	System International d'Unites
SMC	Salado Mass Concrete
SME	subject matter expert
SNS	site notification system
SOP	standard operating procedure
SPCC	System Performance Check Compound
SPDV	site and preliminary design validation
SPM	Site Project Manager
SPS	Southwestern Public Service
SRD	self-reading dosimetry
SSSPT	Small-Scale Seal Performance Tests
STLB	sample tracking logbook
SVOC	semi-volatile organic compound
SWB	standard waste box
SWP	safe work permit
TAP	training accreditation program
TC	toxicity characteristic
TCLP	toxicity characteristic leaching procedure
TDOP	ten-drum overpack
TDS	total dissolved solids
TEAL	total expanded average load
TI	traffic index
TIC	tentatively identified compound
TLD	thermoluminescent dosimeters
TOC	total organic carbon

TOX	total organic halogens
TRU	transuranic
TRUDOCK	TRUPACT-II unloading dock
TRUPACT-II	Transuranic Package Transporter-II
TSDF	treatment, storage, and disposal facility
TSS	total suspended solids
UN	United Nations
UPS	uninterruptible power supply
UST	underground storage tank
VE	visual examination
VHS	vent-hood system
VOA	volatile organic analysis
VOC	volatile organic compound
VOCMP	Volatile Organic Compound Monitoring Plan
WAC	waste acceptance criteria
WAP	waste analysis plan
WGES	Westinghouse Government Environmental Services Company LLC
WGI	Washington Group International
WHB	Waste Handling Building
WIPP	Waste Isolation Pilot Plant
WQSP	Water Quality Sampling Program
WSPF	Waste Stream Profile Form
WTS	Washington TRU Solutions LLC
WTWBIR	WIPP Transuranic Waste Baseline Inventory Report
WWIS	WIPP Waste Information System

UNITS OF MEASURE

%C	percent complete
%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation
°C	degrees Celsius
°F	degrees Fahrenheit
ac	acre(s)
AC	alternating current
acfm	actual cubic feet per minute
cc/s	cubic centimeter(s) per second
cm	centimeter(s)
cm^3	cubic centimeter(s)
dpm	disintegration(s) per minute
f'c	psi compressive strength
ft	foot (feet)
ft^3	cubic foot (feet)
ft^2	square foot (feet)
g	gram(s)
gal	gallon(s)
ha	hectare(s)
hr	hour(s)
in.	inch(es)
in^2	square inch(es)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
kph	kilometer(s) per hour
kV	kilovolt(s)
L	liter(s)
lb	pound(s)
LD_{50}	lethal dose 50%
m	meter(s)
m^3	cubic meter(s)
mg	milligram(s)
mg/kg	milligram(s) per kilogram
mi	mile(s)
min	minute(s)
ml	milliliter(s)
mm	millimeter(s)
MPa	MegaPascal(s)
mph	mile(s) per hour
msl	mean sea level
mV	milliVolt(s)

oz	ounce(s)
ppbv	part(s) per billion by volume
ppm	part(s) per million
ppmv	part(s) per million by volume
psi	pound(s) per square inch
psig	pound(s) per square inch gauge
RAD	radiation absorbed dose
REM	roentgen equivalent man
RPD	relative percent difference
s	second(s)
scfm	standard cubic foot (feet) per minute
UCL_{90}	upper 90-percent confidence limit
V	volt(s)
wt %	weight percent
wt.	weight
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)
µg	microgram(s)
µm	micrometer(s)

Introduction

The Waste Isolation Pilot Plant (**WIPP**) facility is designed, constructed, and operated for the management, storage and disposal of transuranic (**TRU**) mixed waste. Both contact-handled (**CH**) and remote-handled (**RH**) TRU mixed wastes are permitted for storage and disposal at the WIPP facility. The WIPP facility consists of a 16-section Federal land area under the jurisdiction of the US Department of Energy (**DOE**). The WIPP facility includes a mined geologic repository, defined as a "miscellaneous unit" under 40 CFR §260.10. "Miscellaneous unit" means a hazardous waste management unit where hazardous waste is treated, stored, or disposed of and that is not a container, tank, surface impoundment, waste pile, land treatment unit, landfill, incinerator, containment building, boiler, industrial furnace, or underground injection well with appropriate technical standards under 40 CFR Part 146, corrective action management unit, or unit eligible for research, development, and demonstration permit under 40 CFR §270.65. Some of the TRU mixed waste disposed of at the WIPP facility contains hazardous wastes as co-contaminants. The geologic repository has been divided into ten discrete hazardous waste disposal units (**HWDU**s), known as "panels," which are being permitted under 40 CFR Part 264, Subpart X. Additionally, one storage unit, known as a hazardous waste management unit (**HWMU**) is inside the Waste Handling Building (**WHB**) and consists of the CH bay, conveyance loading room, waste hoist entry room, RH bay, cask unloading room, hot cell, transfer cell, and facility cask loading room. Outside the WHB there is another HWMU know as the Parking Area Unit. These two HWMUs are permitted as storage units.

This Renewal Application is submitted to address the requirements of the New Mexico Administrative Code Title 20, Chapter 4, Part 1 (20.4.1 NMAC) specific to the mixed waste operations of the WIPP facility. The WIPP facility currently has three permitted HWMUs and seven permitted HWDUs.

Pursuant to the New Mexico Hazardous Waste Regulations and Permit Condition I.E.3.:

> *If the Permittees wish to continue an activity regulated by this Permit after the expiration date of this Permit, the Permittees shall apply for and obtain a new Permit. The Permittees shall submit an application for a new Permit at least one hundred eighty (180) calendar days before the expiration date of this Permit. [20.4.1.900 NMAC (incorporating 40 CFR §§270.10(h), 270.30(b))]*

The term of the Permit is ten years from the date of issuance. The Renewal Application was originally submitted to the New Mexico Environment Department (**NMED**) on May 28, 2009. On August 19, 2009, the Permittees requested an extension to amend the Renewal Application. The Permittees and NMED received extensive public comments at and subsequent to the pre-application public meetings. Based on these comments, the Permittees determined that the submittal of an amended Renewal Application would facilitate the permit renewal process.

Part A of the Renewal Application includes the information required by 40 CFR §270.13, *Contents of Part A of the permit application*. Additionally, Part B of the Renewal Application includes general WIPP facility information required by 40 CFR §270.14, *Contents of Part B:*

General Requirements, as well as WIPP facility specific information required by 40 CFR §270.15, 40 *Specific Part B information requirements for containers;* and CFR §270.23, *Specific Part B information requirements for miscellaneous units*.

In this Renewal Application the Permittees are seeking the following changes or providing new/revised information:

- Changes to the Permit necessary to incorporate authorization to dispose of TRU mixed waste in Panel 8

- Formal inclusion of the WIPP Mine Ventilation Rate Monitoring Plan

- Updated information in the form of revised drawings, site geological, hydrological and demographic information and the miscellaneous unit performance demonstration

Portions of the original Part B Permit Application that were incorporated into the Permit by reference.

The following are **not** included in the Renewal Application:

- Permit Modules. These are written by the NMED as part of the new permit.

- Pending and future permit modification notifications or requests. Approved modifications will be incorporated into the draft and final permits by the NMED.

- Editorial corrections in portions of the Permit unchanged by this Renewal Application.

Three addenda to the Chapters are included in the Renewal Application to provide significant information pertaining to topic(s) contained in the associated chapters and appendices. The addenda and the reasons for including them are as follows:

- Addendum B1, Dispute Resolution (This is a provision that is contained in Module I of the Permit that the Permittees wish to retain in the renewed Permit)

- Addendum L1, Site Characterization (This updates information referenced extensively in Attachment L of the Permit as Appendix D6 of the 1997 RCRA Part B Application [DOE 1997])

- Addendum N1, 300-year Performance Demonstration Re-Evaluation (This updates information that was used to prepare the Permit. The original analysis and the updated information reach the same conclusion that the only significant pathway from the miscellaneous unit is the air pathway involving the release of volatile organic compounds from containers prior to final facility closure.)

When identifying the parts of either the Renewal Application or original Part B Permit Application, the terms “chapters” and “appendices” are used. The terms “chapters” and “appendices” are to distinguish between the current Permit “attachments” and permit application “chapters” and “appendices.” The Renewal Application contains no Modules as the NMED writes the Modules for draft and final permits.

Other “supplemental information” was provided in an electronically retrievable format, including an index of the referenced information in the May 28, 2009, submittal of the Renewal Application. The Supplemental Information contains references that are cited in the Renewal Application with the exception of regulations, codes and standards and copyrighted materials. In these cases, links to where these materials may be viewed or purchased are included. References that are classified as “sensitive” may be viewed at the WIPP site by US citizens. One seven volume document: *Data Field Report – ERDA-6 and WIPP-12 Testing*, 1982, contains several fold out maps and is not amenable to electronic digitization. It can also be viewed at the WIPP site.

Additionally, the Permittees are representing proposed changed text from the current Permit in redline/~~strike out~~ format. For those who wish to print the document and do not have a color printer, proposed replacement text is also double underlined and shaded so that proposed text can be readily identified. For example, the resulting text appears as: new proposed text.

The version of the Permit used to create the Renewal Application is the latest version the NMED has posted on its web page, May 22, 2009.

Regulatory Requirements Crosswalk
Introduction

This crosswalk is intended to assist the reviewer in locating relevant information in the Renewal Application. To see the regulatory language and more information about how compliance is documented in the Renewal Application, see the information under *Necessary Information Part A* or *Necessary Information Part B.*

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Regulatory Requirements Crosswalk

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.13	Revised Part A application	Part A Application	
§270.14(b)(1)	General facility description	Chapter A	
§270.14(b)(2)	Chemical and physical analyses of waste	Chapter B and Appendices B1-B7	
§270.14(b)(3)	Waste analysis plan	Chapter B and Appendices B1-B7	
§270.14(b)(4)	Security procedures	Chapter C	
§270.14(b)(5)	Inspection schedule	Chapter D	
§270.14(b)(6)	Preparedness & prevention waiver	N/A	The Permittees are not requesting a preparedness and prevention waiver.
§270.14(b)(7)	Contingency plan	Chapter F	
§270.14(b)(8)(i)	Prevent hazards in unloading operations	Chapter E	
§270.14(b)(8)(ii)	Prevent runoff from hazardous waste handling areas	Chapter E	
§270.14(b)(8)(iii)	Prevent contamination of water supplies	Chapter E	

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.14(b)(8)(iv)	Mitigate effects of equipment failure and power outages	Chapter E	
§270.14(b)(8)(v)	Prevent undue exposure of personnel to hazardous waste	Chapter E	
§270.14(b)(8)(vi)	Prevent releases to atmosphere	Chapter E	
§270.14(b)(9)	Description of precautions to prevent accidental ignition or reaction of ignitable, reactive, or incompatible wastes	Chapter E	
§270.14(b)(10)	Traffic patterns, estimated volume, and control	Chapter G	
§270.14(b)(11)(i)	Facility location information	Chapter A	

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.14(b)(11)(ii)	Seismic standard requirements	N/A	The requirement asks the applicant to determine the applicability of the seismic standard based on the location of the facility. For the applicant to determine the applicability of this requirement, they must refer to Appendix VI of Part 264, *Political Jurisdictions in Which Compliance With §264.18(a) Must Be Demonstrated*. The Waste Isolation Pilot Plant facility is located in Eddy County, New Mexico. Eddy County, New Mexico, is not listed in Part 264, Appendix VI. No further information is required to demonstrate compliance with §264.18(a), *Location Standards*.
§270.14(b)(11)(ii)(A)	No fault within 3,000 feet (ft) with displacement in Holocene time	N/A	As the WIPP facility is not listed in a political jurisdiction in which compliance with § 264.18(a) must be demonstrated, this requirement is not applicable.
§270.14(b)(11)(ii)(B)	If faults that have displacement in Holocene time are present within 3,000 ft, no faults pass within 200 ft of portions of the facility	N/A	As the WIPP facility is not listed in a political jurisdiction in which compliance with § 264.18(a) must be demonstrated, this requirement is not applicable.
§270.14(b)(11)(iii), (iv)	100-year floodplain standard	N/A	As the WIPP facility is not in a 100-year floodplain, this requirement is not applicable.

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.14(b)(11)(v)	Compliance with 264.18(b)	N/A	As the WIPP facility is not in a 100-year floodplain, this requirement is not applicable.
§270.14(b)(12)	Personnel training program	Chapter H, Appendices H1 & H2	
§270.14(b)(13)	Closure and post-closure plans	Chapter I and its appendices; Chapter J, Appendix J1	
§270.14(b)(14)	Documentation of closed units (264.119)	N/A	As the WIPP facility has no closed units, this requirement is not applicable.
§270.14(b)(15)	Closure cost estimate (264.142);and documentation (264.143)	N/A	Pursuant to 40 CFR 264.140(c), the Federal government is exempt from §264 Subpart H, *Financial Requirements*. Additionally, and in accordance with the Military Construction Appropriations Act, 2001, Pub. L. No.106-246, 114 Stat. 511 (2000), Washington TRU Solutions LLC (the co-operator) is not required to post bond or fulfill any other financial responsibility requirement relating to closure or post-closure care and monitoring of the WIPP facility. Therefore, this provision is not applicable.

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.14(b)(16)	Post closure cost estimate (264.144); and documentation (264.145)	N/A	Pursuant to 40 CFR 264.140(c), the Federal government is exempt from §264 Subpart H, *Financial Requirements*. Additionally, and in accordance with the Military Construction Appropriations Act, 2001, Pub. L. No.106-246, 114 Stat. 511 (2000), Washington TRU Solutions LLC (the co-operator) is not required to post bond or fulfill any other financial responsibility requirement relating to closure or post-closure care and monitoring of the WIPP facility. Therefore, this provision is not applicable.
§270.14(b)(17)	Documentation of insurance (264.147)	N/A	Pursuant to 40 CFR 264.140(c), the Federal government is exempt from §264 Subpart H, *Financial Requirements*. Additionally, and in accordance with the Military Construction Appropriations Act, 2001, Pub. L. No.106-246, 114 Stat. 511 (2000), Washington TRU Solutions LLC (the co-operator) is not required to post bond or fulfill any other financial responsibility requirement relating to closure or post-closure care and monitoring of the WIPP facility. Therefore, this provision is not applicable.

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.14(b)(18)	Proof of financial coverage (264.149-150)	N/A	Pursuant to 40 CFR 264.140(c), the Federal government is exempt from §264 Subpart H, *Financial Requirements*. Additionally, and in accordance with the Military Construction Appropriations Act, 2001, Pub. L. No.106-246, 114 Stat. 511 (2000), the NMED has concluded that the management and operating contractor (the co-operator under the HWFP) is not required to post bond or fulfill any other financial responsibility requirement relating to closure or post-closure care and monitoring of the WIPP facility. Therefore, this provision is not applicable.
§270.14(b)(19)	Topographic map requirements	Part A Application, Figure 2-3	
§270.14(b)(19)(i)	Map scale and date	Part A Application, Figure 2-3	
§270.14(b)(19)(ii)	100-year floodplain area	N/A	As the WIPP facility is not in a 100-year floodplain, this requirement is not applicable.
§270.14(b)(19)(iii)	Surface waters	Part A Application, Figure 2-3	
§270.14(b)(19)(iv)	Surrounding land uses	Part B Application, Maps and Illustrations	
§270.14(b)(19)(v)	Wind rose	Part B Application, Maps and Illustrations	
§270.14(b)(19)(vi)	Map orientation	Part A Application, Figure 2-3	

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.14(b)(19)(vii)	Legal boundaries	Part A Application, Figure 2-3	
§270.14(b)(19)(viii)	Access control	Part B Application, Maps and Illustrations	
§270.14(b)(19)(ix)	Injection and withdrawal wells	Part A Application, Figure 2-3	
§270.14(b)(19)(x)	Buildings and structures	Part B Application, Maps and Illustrations	
§270.14(b)(19)(xi)	Barriers for drainage and flood control	Part B Application, Maps and Illustrations	
§270.14(b)(19)(xii)	Location of operational units	Part B Application, Maps and Illustrations	
§270.14(b)(20)	Additional information required by regulator	N/A	The Permittees will submit information necessary to enable the Secretary to carry out his duties under other Federal laws as required in § 40 CFR 270.3, as requested. Until an information request is made by the Secretary, this requirement is not applicable to this application.
§270.14(b)(21)	Extension or petition for land disposal facilities	N/A	The WIPP Land Withdrawal Act Amendment of 1996 exempts waste designated by the Secretary of Energy for disposal at the WIPP facility from the Land Disposal Restrictions 40 CFR 268. Therefore, this requirement is not applicable.
§270.14(b)(22)	Summary of the pre-application meeting	Part B Application, Public Process Information	

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.14(c)(1)	Summary of groundwater monitoring data obtained during interim status	N/A	The Permittees have not collected groundwater data under interim status.
§270.14(c)(2)	Identification of the uppermost aquifer	Chapter L and Addendum L1	
§270.14(c)(3)	Delineation of waste management area, property boundary, point of compliance, and groundwater monitoring wells	Part A Application, Figure 2-3, Part B Application, Maps and Illustrations	
§270.14(c)(4)	Description of any plume of contamination	N/A	No plume of contamination has entered the groundwater from a regulated unit.
§270.14(c)(5)	Describe proposed groundwater monitoring program to meet requirements of 40 CFR §264.97	N/A	No contamination has entered the groundwater from a regulated unit.

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.14(c)(6)	Describe proposed detection monitoring program to meet requirements of 40 CFR §264.98	Chapter L and Addendum L1	
§270.14(c)(7)	Information relative to contamination	N/A	No contamination has entered the groundwater from a regulated unit.
§270.14(c)(8)	Information relative to contamination in excess of limits	N/A	No contamination has entered the groundwater from a regulated unit.
§270.14(d)	Information on SWMUs	N/A	The NMED determined that no further action is necessary to investigate fifteen Solid Waste Management Units (**SWMUs**) and eight Areas of Concern (**AOCs**) at the WIPP facility. A Class 3 permit modification request to remove SWMUs and AOCs from their Permit was approved by the NMED on October 23, 2008. No new SWMUs or AOCs have been identified for inclusion in the Renewal Application.
§270.15(a)	Description of containment system	Part B Application, Maps and Illustrations, Appendix M1	

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.15(b)	For storage areas that store containers holding waste that does not contain free liquids, a demonstration of compliance with 40 CFR §264.175(c)	N/A	The DOE manages all TRU mixed waste containers in the Parking Area and the Waste Handling Building as though they contain up to one percent residual liquids. Appropriate secondary containment calculations are provided in Appendix M1 of the Renewal Application. Consequently, the requirements in 20 4.1.500 NMAC, incorporating 40 CFR §264.175(c) do not apply to the WIPP facility.
§270.15(c)	Location of ignitable, reactive, and incompatible waste in compliance with 40 CFR §264.176 and §264.177(c)	N/A	All waste received at the WIPP facility will be determined to be compatible prior to being received at the WIPP. Ignitable, reactive, or corrosive waste (i.e., compressed gases and liquids in excess of the TSDF-WAC) are prohibited in accordance with the TSDF-WAC. Therefore, a buffer zone for containers holding ignitable or reactive wastes and incompatible wastes is not needed.
§270.15(d)	Description of procedures to ensure compliance with 40 CFR §§264.177(a) and (b), and §§264.17(b) and (c) for incompatible waste	Chapter B, Chapter F	

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.15(e)	Information on air emission control equipment as required in §270.27	N/A	Pursuant to 40 CFR §264.1080(a)(6), air emission controls for containers do not apply to radioactive mixed waste. Therefore, this requirement is not applicable.
§270.23(a)	Detailed description of the unit	Appendix M2, Chapter N, Appendix N1, Addendum N1, Part B Application, Maps and Illustrations	
§270.23(b)	Detailed hydrologic, geologic, and meteorologic assessments in land use map for regions surrounding the site	Addendum L1, Appendix M2, Addendum N1	
§270.23(c)	Information on the potential pathways of exposure	Addendum L1, Appendix M2, Chapter N, Appendix N1, Addendum N1	
§270.23(d)	Demonstration of treatment effectiveness	N/A	The Waste Isolation Pilot Plant facility does not operate treatment units.

20.4.1.900 NMAC Regulatory Requirement	Description of Requirement	Location in the Renewal Application	Explanation Why Requirement is Not Applicable (N/A)
§270.23(e)	Any additional information determined by the director	Any additional information determined by the Secretary to be necessary for evaluation of compliance of the unit with the environmental performance standards of §264.601 will be provided as requested.	

Summary of Proposed Changes

Page	Line	Change	Discussion/Justification
CHAPTER A			
		Revised text to include disposal in Panel 8 in facility description	Request authorization for disposal of TRU mixed waste in Panel 8. It is expected that waste disposal in Panel 8 will be required within the next ten years.
Chapter I			
		Revised text to include Panel 8 in closure plan	See above.
Appendix M2			
		Revised text to include disposal in Panel 8 in description of the geologic repository	See above.
Chapter N			
		Revised text to include Panel 8 in the VOC monitoring plan	See above.
Chapter Q			
entire chapter		Inclusion of the WIPP mine ventilation rate monitoring plan	Include the WIPP Mine Ventilation Rate Monitoring Plan into the Permit per Condition IV.J.4., Approval of the Plan.

Necessary Information for the WIPP Ten Year Renewal Application, Part A

§270.13 Contents of part A of the permit application

Part A of the RCRA application shall include the following information:

(a) The activities conducted by the applicant which require it to obtain a permit under RCRA.

> No changes are being proposed to the activities conducted at the Waste Isolation Pilot Plant (**WIPP**) facility that entail receiving, unloading, and transferring radioactive-mixed waste from the surface of the site to the underground hazardous waste management units. Waste will be emplaced in an underground geologic repository horizon located in a deep-bedded salt formation 2,150 feet beneath the surface.

(b) Name, mailing address, and location, including latitude and longitude of the facility for which the application is submitted.

> Waste Isolation Pilot Plant
>
> P.O. Box 3090
>
> Carlsbad, New Mexico, 88221
>
> 30 miles east of Carlsbad, New Mexico, on the Jal Highway in Eddy County
>
> Geographic location:
>
> > 32° 22′ 30″ N
> > 103° 47′ 30″ W

(c) Up to four SIC codes which best reflect the principal products or services provided by the facility.

> North American Industry Classification System Code for the WIPP facility: 562211

(d) The operator's name, address, telephone number, ownership status, and status as Federal, State, private, public, or other entity.

> Owner and Operator:
>
> > U.S. Department of Energy
> >
> > P.O. Box 3090
> >
> > Carlsbad, New Mexico, 88221
> >
> > Phone Number: 575-234-7300

The WIPP facility is a Federal facility

Co-operator:

Washington TRU Solutions LLC

P.O. Box 2078

Carlsbad, New Mexico, 88221

Phone Number: 575-234-7300

(e) The name, address, and phone number of the owner of the facility.

U.S. Department of Energy

P.O. Box 3090

Carlsbad, New Mexico, 88221

Phone Number: 575-234-7300

(f) Whether the facility is located on Indian lands.

The WIPP facility is not located on Indian lands.

(g) An indication of whether the facility is new or existing and whether it is a first or revised application.

The Waste Isolation Pilot Plant facility is an existing facility renewing its Hazardous Waste Facility Permit # NM4890139088-TSDF.

(h) For existing facilities, (1) a scale drawing of the facility showing the location of all past, present, and future treatment, storage, and disposal areas; and (2) photographs of the facility clearly delineating all existing structures; existing treatment, storage, and disposal areas; and sites of future treatment, storage, and disposal areas.

Please see Part A Application Figures:

- Figure 2-1, *General Location of the WIPP Facility*
- Figure 2-2, *Planimeteric Map-WIPP Facility Boundaries*
- Figure 2-2a, *Legend to Figure 2-2*
- Figure 2-3, *Topographic Map with Underground Facilities*

- Figure 3-1, *Spatial View of the WIPP Facility*
- Figure 3-2, *Repository Horizon*
- Figure 3-3, *Waste Handling Building*
- Figure 3-3a, *Waste Handling Building - CH TRU Mixed Waste Container Storage and Surge Areas*
- Figure 3-3b, *Waste Handling Building - RH TRU Mixed Waste Container Storage*
- Figure 3-3c, *Waste Handling Building - RH Storage, Hot Cell Storage Area (above grade)*
- Figure 3-3d, *Waste Handling Building - RH Canister Transfer Cell Storage Area, (below grade)*
- Figure 3-4, *Parking Area – Container Storage and Surge Areas*
- Renewal Application, Drawing 51-W-214-W *Underground Facilities Typical Disposal Panel*
- Photographs 4-1 through 4-11

(i) A description of the processes to be used for treating, storing, and disposing of hazardous waste, and the design capacity of these items.

> The Permittees propose no change in the manner in which they store or dispose of transuranic (**TRU**) mixed waste, except for requesting the authorization for the disposal of TRU-mixed waste in Panel 8. The Permittees do not treat TRU mixed waste.

(j) A specification of the hazardous wastes listed or designated under 40 CFR part 261 to be treated, stored, or disposed of at the facility, an estimate of the quantity of such wastes to be treated, stored, or disposed annually, and a general description of the processes to be used for such wastes.

> The Permittees propose no change from the existing list of hazardous waste numbers. This information is found in the completed EPA Form OMB # 2050-0034 for hazardous waste numbers, estimates of annual quantity disposed per hazardous waste number, and process codes. Other information required by the form is included.

(k) A listing of all permits or construction approvals received or applied for under any of the following programs:

(1) Hazardous Waste Management program under RCRA.

(2) UIC program under the SWDA.

(3) NPDES program under the CWA.

(4) Prevention of Significant Deterioration (PSD) program under the Clean Air Act.

(5) Nonattainment program under the Clean Air Act.

(6) National Emission Standards for Hazardous Pollutants (NESHAPS) preconstruction approval under the Clean Air Act.

(7) Ocean dumping permits under the Marine Protection Research and Sanctuaries Act.

(8) Dredge or fill permits under section 404 of the CWA.

(9) Other relevant environmental permits, including State permits.

Please see Part A Application Appendix 1, Table Part A-1 - *Active Environmental Permits for the Waste Isolation Pilot Plant* for an updated list of other relevant environmental permits, including the number and status of individual permits.

(l) A topographic map (or other map if a topographic map is unavailable) extending one mile beyond the property boundaries of the source, depicting the facility and each of its intake and discharge structures; each of its hazardous waste treatment, storage, or disposal facilities; each well where fluids from the facility are injected underground; and those wells, springs, other surface water bodies, and drinking water wells listed in public records or otherwise known to the applicant within1/4mile of the facility property boundary.

A topographic map has been provided (see Figure 2-3) that depicts the facility and wells extending one mile beyond the property boundary. Because of the size of the facility and the scale of the map, intake and discharge structures; and each hazardous waste storage, or disposal facility are not shown on the map, however, they are shown in Figures 3-1 to 3-4. Fluids from the facility are not injected underground. There are no springs, other surface water bodies, and drinking water wells listed in public records or otherwise known to the applicant within ¼ mile of the facility property boundary.

(m) A brief description of the nature of the business.

The WIPP facility geologic repository is defined as a “miscellaneous unit” under 40 CFR §260.10. “Miscellaneous unit” means a hazardous waste management unit where hazardous waste is treated, stored, or disposed of and that is not a container, tank, surface impoundment, waste pile, land treatment unit, landfill, incinerator, containment building, boiler, industrial furnace, or underground injection well with appropriate technical standards under 40 CFR Part 146, corrective action management unit, or unit eligible for research, development, and demonstration permit under 40 CFR §270.65. Some of the TRU wastes disposed of at the WIPP facility contain hazardous wastes as co-contaminants. The geologic repository has been divided into ten discrete hazardous waste disposal units (**HWDU**s) which are being permitted under 40 CFR Part 264, Subpart X.

During the Disposal Phase of the facility, which is expected to last 25 years, the total amount of waste received from off-site generators and any derived waste will be limited to 175,600 m^3 of TRU waste of which up to 7,080 m^3 may be remote-handled (**RH**) TRU mixed waste. For purposes of this application, all TRU waste is managed as though it were mixed.

The process design capacity for the miscellaneous unit (composed of ten underground HWDUs in the geologic repository) shown in Section 8B of EPA Form 8700-23, is for the maximum amount of waste that may be received from off-site generators plus the maximum expected amount of derived wastes that may be generated at the WIPP facility. In addition, two hazardous waste management units (**HWMU**s) have been designated as container storage units (S01) in Section 8B of EPA Form 8700-23. One is inside the Waste Handling Building (**WHB**) and consists of the contact-handled (**CH**) bay, conveyance loading room, waste hoist entry room, RH bay, cask unloading room, hot cell, transfer cell, and facility cask loading room. This HWMU will be used for waste receipt, handling, and storage (including storage of derived waste) prior to emplacement in the underground geologic repository. No treatment or disposal will occur in this S01 HWMU. The capacity of this S01 unit for storage is 194.1 m^3, based on 36 ten-drum overpacks on 18 facility pallets, four CH packages at the TRUDOCKs, one standard waste box of derived waste, two loaded casks and one 55-gallon drum of derived waste in the RH Bay, one loaded cask in the Cask Unloading Room, thirteen 55-gallon drums in the Hot Cell, one canister in the Transfer Cell and one canister in the Facility Cask Unloading Room. The second S01 HWMU is the parking area outside the WHB where the trailers containing the CH packages or the road cask trailers containing RH packages will be parked awaiting waste handling operations. The capacity of this unit is 50 CH packages and twelve RH packages with a combined volume of 242 m^3.

During the term of this and the preceding Permit, the volume of CH TRU mixed waste emplaced in the repository will not exceed 4,920,746 ft^3 (139,340 m^3) and the volume of RH TRU mixed waste shall not exceed 93,050 ft^3 (2,635 m^3). CH TRU mixed waste will be disposed of in Underground HWDUs identified as Panels 5 through 8 and in any currently active HWDU. The RH TRU mixed waste may be disposed of in Panels 4 through 8.

(n) For hazardous debris, a description of the debris category(ies) and contaminant category(ies) to be treated, stored, or disposed of at the facility.

Debris Wastes at WIPP

The debris waste category (S5000) includes waste that is at least 50 percent by volume materials that meet the New Mexico Administrative Code (**NMAC**) criteria for classification as debris (20.4.1.800 NMAC (incorporating 40 CFR §268.2)). Debris means solid material exceeding a 2.36 inch (60 millimeter) particle size that is intended for disposal and that is: 1) a manufactured object, 2) plant or animal matter, or 3) natural geologic material. The debris category includes metal debris containing lead, inorganic nonmetal debris, asbestos debris, combustible debris, graphite debris, heterogeneous debris, and composite filters, as well as other minor waste streams. Particles smaller than 2.36 inches (60 millimeters) in size may be considered debris if the debris is a manufactured object and if it is not a particle of homogeneous solids (S3000) or soils/gravel (S4000) material.

RENEWAL APPLICATION
HAZARDOUS WASTE FACILITY PERMIT APPLICATION
PART A

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RENEWAL APPLICATION
HAZARDOUS WASTE FACILITY PERMIT APPLICATION
PART A

TABLE OF CONTENTS

SEND COMPLETED FORM TO: The Appropriate State or EPA Regional Office.	United States Environmental Protection Agency **RCRA SUBTITLE C SITE IDENTIFICATION FORM**	

1. Reason for Submittal (See instructions on page 14.) MARK ALL BOX(ES) THAT APPLY	**Reason for Submittal:** ☐ To provide Initial Notification of Regulated Waste Activity (to obtain an EPA ID Number for hazardous waste, universal waste, or used oil activities) ☑ To provide Subsequent Notification of Regulated Waste Activity (to update site identification information) ☐ As a component of a First RCRA Hazardous Waste Part A Permit Application ☑ As a component of a Revised RCRA Hazardous Waste Part A Permit Application (Amendment # 23) ☐ As a component of the Hazardous Waste Report
2. Site EPA ID Number (page 15)	**EPA ID Number** N M 4 8 9 0 1 3 9 0 8 8
3. Site Name (page 15)	**Name:** Waste Isolation Pilot Plant
4. Site Location Information (page 15)	**Street Address:** 30 miles east of Carlsbad on Jal Highway **City, Town, or Village:** Carlsbad — **State:** NM **County Name:** Eddy — **Zip Code:** 88221
5. Site Land Type (page 15)	**Site Land Type:** ☐ Private ☐ County ☐ District ☑ Federal ☐ Indian ☐ Municipal ☐ State ☐ Other
6. North American Industry Classification System (NAICS) Code(s) for the Site (page 15)	**A.** 5 6 2 2 1 1 — **B.** ___ **C.** ___ — **D.** ___
7. Site Mailing Address (page 16)	**Street or P. O. Box:** P.O. Box 3090 **City, Town, or Village:** Carlsbad **State:** NM **Country:** USA — **Zip Code:** 88221
8. Site Contact Person (page 16)	**First Name:** David — **MI:** C — **Last Name:** Moody **Phone Number:** (575) 234-7300 **Extension:** — **Email address:** dave.moody@wipp.ws
9. Operator and Legal Owner of the Site (pages 16 and 17)	**A. Name of Site's Operator:** U.S. Department of Energy — **Date Became Operator (mm/dd/yyyy):** 05/18/1981 **Operator Type:** ☐ Private ☐ County ☐ District ☑ Federal ☐ Indian ☐ Municipal ☐ State ☐ Other **B. Name of Site's Legal Owner:** U.S. Department of Energy — **Date Became Owner (mm/dd/yyyy):** 05/18/1981 **Owner Type:** ☐ Private ☐ County ☐ District ☑ Federal ☐ Indian ☐ Municipal ☐ State ☐ Other

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9. Legal Owner (Continued) Address	Street or P. O. Box: P.O. Box 3090	
	City, Town, or Village: Carlsbad	
	State: NM	
	Country: USA	Zip Code: 88221

10. Type of Regulated Waste Activity
Mark "Yes" or "No" for all activities; complete any additional boxes as instructed. (See instructions on pages 18 to 21.)

A. Hazardous Waste Activities
Complete all parts for 1 through 6.

Y ☑ N ☐ **1. Generator of Hazardous Waste**
If "Yes", choose only one of the following - a, b, or c.

☑ a. LQG: Greater than 1,000 kg/mo (2,200 lbs./mo.) of non-acute hazardous waste; or

☐ b. SQG: 100 to 1,000 kg/mo (220 - 2,200 lbs./mo.) of non-acute hazardous waste; or

☐ c. CESQG: Less than 100 kg/mo (220 lbs./mo.) of non-acute hazardous waste

In addition, indicate other generator activities.

Y ☐ N ☑ d. United States Importer of Hazardous Waste

Y ☑ N ☐ e. Mixed Waste (hazardous and radioactive) Generator

Y ☐ N ☑ **2. Transporter of Hazardous Waste**

Y ☑ N ☐ **3. Treater, Storer, or Disposer of Hazardous Waste (at your site)** Note: A hazardous waste permit is required for this activity.

Y ☐ N ☑ **4. Recycler of Hazardous Waste (at your site)**

Y ☐ N ☑ **5. Exempt Boiler and/or Industrial Furnace**
If "Yes", mark each that applies.
☐ a. Small Quantity On-site Burner Exemption
☐ b. Smelting, Melting, and Refining Furnace Exemption

Y ☐ N ☑ **6. Underground Injection Control**

B. Universal Waste Activities

Y ☐ N ☑ **1. Large Quantity Handler of Universal Waste (accumulate 5,000 kg or more) [refer to your State regulations to determine what is regulated]. Indicate types of universal waste generated and/or accumulated at your site. If "Yes", mark all boxes that apply:**

	Generate	Accumulate
a. Batteries	☐	☐
b. Pesticides	☐	☐
c. Thermostats	☐	☐
d. Lamps	☐	☐
e. Other (specify) ________________	☐	☐
f. Other (specify) ________________	☐	☐
g. Other (specify) ________________	☐	☐

Y ☐ N ☑ **2. Destination Facility for Universal Waste**
Note: A hazardous waste permit may be required for this activity.

C. Used Oil Activities
Mark all boxes that apply.

Y ☐ N ☑ **1. Used Oil Transporter**
If "Yes", mark each that applies.
☐ a. Transporter
☐ b. Transfer Facility

Y ☐ N ☑ **2. Used Oil Processor and/or Re-refiner**
If "Yes", mark each that applies.
☐ a. Processor
☐ b. Re-refiner

Y ☐ N ☑ **3. Off-Specification Used Oil Burner**

Y ☐ N ☑ **4. Used Oil Fuel Marketer**
If "Yes", mark each that applies.
☐ a. Marketer Who Directs Shipment of Off-Specification Used Oil to Off-Specification Used Oil Burner
☐ b. Marketer Who First Claims the Used Oil Meets the Specifications

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11. Description of Hazardous Wastes (See instructions on page 22.)

A. Waste Codes for Federally Regulated Hazardous Wastes. Please list the waste codes of the Federal hazardous wastes handled at your site. List them in the order they are presented in the regulations (e.g., D001, D003, F007, U112). Use an additional page if more spaces are needed.

F001	F002	F003	F004	F005	F006	F007
F009	D004	D005	D006	D007	D008	D009
D010	D011	D018	D019	D021	D022	D026

B. Waste Codes for State-Regulated (i.e., non-Federal) Hazardous Wastes. Please list the waste codes of the State-regulated hazardous wastes handled at your site. List them in the order they are presented in the regulations. Use an additional page if more spaces are needed for waste codes.

12. Comments (See instructions on page 22.)

13. Certification. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.
For the RCRA Hazardous Waste Part A Permit Application, all operator(s) and owner(s) must sign (see 40 CFR 270.10 (b) and 270.11).
(See instructions on page 22.)

Signature of operator, owner, or an authorized representative	Name and Official Title (type or print)	Date Signed (mm/dd/yyyy)
	David C. Moody, Manager - DOE	
	Farok Sharif, President and General Manager - WTS	

Hazardous Waste Codes
(Continued)

EPA ID No.: NM4890139088
Hazardous Waste Numbers
D027
D028
D029
D030
D032
D034
D035
D036
D037
D038
D039
D040
D043
P015
U002
U019
U037
U043
U044
U052
U070
U072
U078
U079
U105
U122
U133
U151
U154
U159
U196
U209
U210
U220
U226
U228
U239
P120
U134
D033
P030
P098
P099
P106
U003
U103
U108

EPA ID NO: N M 4 8 9 0 1 3 9 0 8 8

OMB #: 2050-0034 Expires 11/30/2005

United States Environmental Protection Agency

HAZARDOUS WASTE PERMIT INFORMATION FORM

1. Facility Permit Contact (See instructions on page 23)	**First Name:** David	**MI:** C	**Last Name:** Moody
	Phone Number: (575) 234-7300		**Phone Number Extension:**
2. Facility Permit Contact Mailing Address (See instructions on page 23)	**Street or P.O. Box:** P.O. Box 3090		
	City, Town, or Village: Carlsbad		
	State: NM		
	Country: USA		**Zip Code:** 88221
3. Operator Mailing Address and Telephone Number (See instructions on page 23)	**Street or P.O. Box:** P. O. Box 3090		
	City, Town, or Village: Carlsbad		
	State: NM		
	Country: USA	**Zip Code:** 88221	**Phone Number** (575) 234-7300
4. Legal Owner Mailing Address and Telephone Number (See instructions on page 23)	**Street or P.O. Box:** P.O. Box 3090		
	City, Town, or Village: Carlsbad		
	State: NM		
	Country: USA	**Zip Code:** 88221	**Phone Number** (575) 234-7300
5. Facility Existence Date (See instructions on page 24)	**Facility Existence Date (mm/dd/yyyy):** 05/18/1981		

6. Other Environmental Permits (See instructions on page 24)

A. Permit Type *(Enter code)*	B. Permit Number	C. Description
		See Appendix 1, Active Environmental Permits

7. Nature of Business (Provide a brief description; see instructions on page 24)

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy facility which receives, unloads, and transfers radioactive-mixed waste from the surface of the site to the underground hazardous waste disposal units. Waste is emplaced in an underground geologic repository horizon located in a deep-bedded salt formation approximately 2,150 feet beneath the surface.

8. Process Codes and Design Capacities (See instructions on page 24) - Enter information in the Sections on Form Page 3.

A. **PROCESS CODE** - *Enter the code from the list of process codes in the table below that best describes each process to be used at the facility. Fifteen lines are provided for entering codes. If more lines are needed, attach a separate sheet of paper with the additional information. For "other" processes (i.e., D99, S99, T04 and X99), enter the process information in Item 9 (including a description).*

B. **PROCESS DESIGN CAPACITY**- *For each code entered in Section A, enter the capacity of the process.*

1. **AMOUNT** - *Enter the amount. In a case where design capacity is not applicable (such as in a closure/post-closure or enforcement action) enter the total amount of waste for that process.*

2. **UNIT OF MEASURE** - *For each amount entered in Section B(1), enter the code in Section B(2) from the list of unit of measure codes below that describes the unit of measure used. Select only from the units of measure in this list.*

C. **PROCESS TOTAL NUMBER OF UNITS** - *Enter the total number of units for each corresponding process code.*

PROCESS CODE	PROCESS	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
	Disposal:	
D79	Underground Injection Well Disposal	Gallons; Liters; Gallons Per Day; or Liters Per Day
D80	Landfill	Acre-feet; Hectare-meter; Acres; Cubic Meters; Hectares; Cubic Yards
D81	Land Treatment	Acres or Hectares
D82	Ocean Disposal	Gallons Per Day or Liters Per Day
D83	Surface Impoundment Disposal	Gallons; Liters; Cubic Meters; or Cubic Yards
D99	Other Disposal	Any Unit of Measure in Code Table Below
	Storage:	
S01	Container	Gallons; Liters; Cubic Meters; or Cubic Yards
S02	Tank Storage	Gallons; Liters; Cubic Meters; or Cubic Yards
S03	Waste Pile	Cubic Yards or Cubic Meters
S04	Surface Impoundment Storage	Gallons; Liters; Cubic Meters; or Cubic Yards
S05	Drip Pad	Gallons; Liters; Acres; Cubic Meters; Hectares; or Cubic Yards
S06	Containment Building Storage	Cubic Yards or Cubic Meters
S99	Other Storage	Any Unit of Measure in Code Table Below
	Treatment:	
T01	Tank Treatment	Gallons Per Day; Liters Per Day
T02	Surface Impoundment Treatment	Gallons Per Day; Liters Per Day
T03	Incinerator	Short Tons Per Hour; Metric Tons Per Hour; Gallons Per Hour; Liters Per Hour; Btu Per Hour; Pounds Per Hour; Short Tons Per Day; Kilograms Per Hour; Gallons Per Day; Liters Per Day; Metric Tons Per Hour; or Million Btu Per Hour
T04	Other Treatment	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; Btu Per Hour; Gallons Per Day; Liters Per Hour; or Million Btu Per Hour
T80	Boiler	Gallons; Liters; Gallons Per Hour; Liters Per Hour; Btu Per Hour; or Million Btu Per Hour

PROCESS CODE	PROCESS	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
	Treatment (continued):	
T81	Cement Kiln	For T81-T93:
T82	Lime Kiln	
T83	Aggregate Kiln	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; Btu Per Hour; Liters Per Hour; Kilograms Per Hour; or Million Btu Per Hour
T84	Phosphate Kiln	
T85	Coke Oven	
T86	Blast Furnace	
T87	Smelting, Melting, or Refining Furnace	
T88	Titanium Dioxide Chloride Oxidation Reactor	
T89	Methane Reforming Furnace	
T90	Pulping Liquor Recovery Furnace	
T91	Combustion Device Used In The Recovery Of Sulfur Values From Spent Sulfuric Acid	
T92	Halogen Acid Furnaces	
T93	Other Industrial Furnaces Listed In 40 CFR §260.10	
T94	Containment Building - Treatment	Cubic Yards; Cubic Meters; Short Tons Per Hour; Gallons Per Hour; Liters Per Hour; Btu Per Hour; Pounds Per Hour; Short Tons Per Day; Kilograms Per Hour; Metric Tons Per Day; Gallons Per Day; Liters Per Day; Metric Tons Per Hour; or Million Btu Per Hour
	Miscellaneous (Subpart X):	
X01	Open Burning/Open Detonation	Any Unit of Measure in Code Table Below
X02	Mechanical Processing	Short Tons Per Hour; Metric Tons Per Hour; Short Tons Per Day; Metric Tons Per Day; Pounds Per Hour; Kilograms Per Hour; Gallons Per Hour; Liters Per Hour; or Gallons Per Day
X03	Thermal Unit	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; Btu Per Hour; or Million Btu Per Hour
X04	Geologic Repository	Cubic Yards; Cubic Meters; Acre-feet; Hectare-meter; Gallons; or Liters
X99	Other Subpart X	Any Unit of Measure Listed Below

UNIT OF MEASURE	UNIT OF MEASURE CODE
Gallons	G
Gallons Per Hour	E
Gallons Per Day	U
Liters	L
Liters Per Hour	H
Liters Per Day	V

UNIT OF MEASURE	UNIT OF MEASURE CODE
Short Tons Per Hour	D
Metric Tons Per Hour	W
Short Tons Per Day	N
Metric Tons Per Day	S
Pounds Per Hour	J
Kilograms Per Hour	R
Million Btu Per Hour	X

UNIT OF MEASURE	UNIT OF MEASURE CODE
Cubic Yards	Y
Cubic Meters	C
Acres	B
Acre-feet	A
Hectares	Q
Hectare-meter	F
Btu Per Hour	I

EPA ID NO: N M 4 8 9 0 1 3 9 0 8 8 OMB #: 2050-0034 Expires 11/30/2005

8. Process Codes and Design Capacities (Continued)

EXAMPLE FOR COMPLETING Item 8 (shown in line number X-1 below): A facility has a storage tank, which can hold 533.788 gallons.

Line Number		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY (1) Amount (Specify)	(2) Unit of Measure (Enter code)	C. Process Total Number of Units	For Official Use Only
X	1	S	0	2	5 3 3 . 7 8 8	G	0 0 1	
	1	X	0	4	175600 . 0	C	010	
	2	S	0	1	194 . 1	C	001	
	3	S	0	1	242 . 0	C	001	
	4				.			
	5				.			
	6				.			
	7				.			
	8				.			
	9				.			
1	0				.			
1	1				.			
1	2				.			
1	3				.			
1	4				.			
1	5				.			

NOTE: If you need to list more than 15 process codes, attach an additional sheet(s) with the information in the same format as above. Number the lines sequentially, taking into account any lines that will be used for "other" processes (i.e., D99, S99, T04 and X99) in Item 9.

9. Other Processes (*See instructions on page 25 and follow instructions from Item 8 for D99, S99, T04 and X99 process codes*)

Line Number (Enter #s in sequence with Item 8)		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY (1) Amount (Specify)	(2) Unit of Measure (Enter code)	C. Process Total Number of Units	D. Description of Process
X	2	T	0	4	1 0 0 . 0 0 0	U	0 0 1	In-situ Vitrification
					.			
					.			
					.			
					.			
					.			

10. Description of Hazardous Wastes (See instructions on page 25) - Enter information in the Sections on Form Page 5.

A. **EPA HAZARDOUS WASTE NUMBER** - ***Enter the four-digit number from 40 CFR, Part 261 Subpart D of each listed hazardous waste you will handle. For hazardous wastes which are not listed in 40 CFR, Part 261 Subpart D, enter the four-digit number(s) from 40 CFR Part 261, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.***

B. **ESTIMATED ANNUAL QUANTITY** - ***For each listed waste entered in Section A, estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in Section A, estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.***

C. **UNIT OF MEASURE** - ***For each quantity entered in Section B, enter the unit of measure code. Units of measure which must be used and the appropriate codes are:***

ENGLISH UNIT OF MEASURE	*CODE*	*METRIC UNIT OF MEASURE*	*CODE*
POUNDS	*P*	*KILOGRAMS*	*K*
TONS	*T*	*METRIC TONS*	*M*

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure, taking into account the appropriate density or specific gravity of the waste.

D. **PROCESSES**

1. **PROCESS CODES:**

For listed hazardous waste: For each listed hazardous waste entered in Section A, select the code(s) from the list of process codes contained in Items 8A and 9A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the listed hazardous wastes.

For non-listed hazardous waste: For each characteristic or toxic contaminant entered in Section A, select the code(s) from the list of process codes contained in Items 8A and 9A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that possess that characteristic or toxic contaminant.

NOTE: THREE SPACES ARE PROVIDED FOR ENTERING PROCESS CODES. IF MORE ARE NEEDED:

1. ***Enter the first two as described above.***
2. ***Enter "000" in the extreme right box of Item 10.D(1).***
3. ***Use additional sheet, enter line number from previous sheet, and enter additional code(s) in Item 10.E.***

2. **PROCESS DESCRIPTION:** ***If a code is not listed for a process that will be used, describe the process in Item 10.D(2) or in Item 10.E(2).***

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER - Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. ***Select one of the EPA Hazardous Waste Numbers and enter it in Section A. On the same line complete Sections B, C and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.***
2. ***In Section A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In Section D(2) on that line enter "included with above" and make no other entries on that line.***
3. ***Repeat step 2 for each EPA Hazardous Waste Number that can be used to describe the hazardous waste.***

EXAMPLE FOR COMPLETING Item 10 (shown in line numbers X-1, X-2, X-3, and X-4 below) - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operations. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

Line Number		*A. EPA Hazardous Waste No. (Enter code)*				*B. Estimated Annual Quantity of Waste*	*C. Unit of Measure (Enter code)*	*D. PROCESSES (1) PROCESS CODES (Enter code)*									*(2) PROCESS DESCRIPTION- (If a code is not entered in D(1))*
X	1	K	0	5	4	900	P	T	0	3	D	8	0				
X	2	D	0	0	2	400	P	T	0	3	D	8	0				
X	3	D	0	0	1	100	P	T	0	3	D	8	0				
X	4	D	0	0	2												Included With Above

EPA ID NO: N M 4 8 9 0 1 3 9 0 8 8 OMB #: 2050-0034 Expires 11/30/2005

10. Description of Hazardous Wastes (Continued. Use the Additional Sheet(s) as necessary; number pages as 5 a, etc.)

Line Number		*A. EPA Hazardous Waste No. (Enter code)*				*B. Estimated Annual Quantity of Waste*	*C. Unit of Measure (Enter code)*	*D. PROCESSES*									
								(1) PROCESS CODES (Enter code)									*(2) PROCESS DESCRIPTION (If a code is not entered in D(1))*
	1	F	0	0	1	1891	M	X	0	4	S	0	1	S	0	1	
	2	F	0	0	2	1860	M	X	0	4	S	0	1	S	0	1	
	3	F	0	0	3	1593	M	X	0	4	S	0	1	S	0	1	
	4	F	0	0	4	26	M	X	0	4	S	0	1	S	0	1	
	5	F	0	0	5	1829	M	X	0	4	S	0	1	S	0	1	
	6	F	0	0	6	915	M	X	0	4	S	0	1	S	0	1	
	7	F	0	0	7	915	M	X	0	4	S	0	1	S	0	1	
	8	F	0	0	9	915	M	X	0	4	S	0	1	S	0	1	
	9	D	0	0	4	903	M	X	0	4	S	0	1	S	0	1	
1	0	D	0	0	5	484	M	X	0	4	S	0	1	S	0	1	
1	1	D	0	0	6	1819	M	X	0	4	S	0	1	S	0	1	
1	2	D	0	0	7	1248	M	X	0	4	S	0	1	S	0	1	
1	3	D	0	0	8	3246	M	X	0	4	S	0	1	S	0	1	
1	4	D	0	0	9	1727	M	X	0	4	S	0	1	S	0	1	
1	5	D	0	1	0	186	M	X	0	4	S	0	1	S	0	1	
1	6	D	0	1	1	1090	M	X	0	4	S	0	1	S	0	1	
1	7	D	0	1	8	749	M	X	0	4	S	0	1	S	0	1	
1	8	D	0	1	9	761	M	X	0	4	S	0	1	S	0	1	
1	9	D	0	2	1	26	M	X	0	4	S	0	1	S	0	1	
2	0	D	0	2	2	1098	M	X	0	4	S	0	1	S	0	1	
2	1	D	0	2	6	609	M	X	0	4	S	0	1	S	0	1	
2	2	D	0	2	7	26	M	X	0	4	S	0	1	S	0	1	
2	3	D	0	2	8	449	M	X	0	4	S	0	1	S	0	1	
2	4	D	0	2	9	478	M	X	0	4	S	0	1	S	0	1	
2	5	D	0	3	0	26	M	X	0	4	S	0	1	S	0	1	
2	6	D	0	3	2	26	M	X	0	4	S	0	1	S	0	1	
2	7	D	0	3	4	26	M	X	0	4	S	0	1	S	0	1	
2	8	D	0	3	5	139	M	X	0	4	S	0	1	S	0	1	
2	9	D	0	3	6	26	M	X	0	4	S	0	1	S	0	1	
3	0	D	0	3	7	26	M	X	0	4	S	0	1	S	0	1	
3	1	D	0	3	8	26	M	X	0	4	S	0	1	S	0	1	
3	2	D	0	3	9	26	M	X	0	4	S	0	1	S	0	1	
3	3	D	0	4	0	140	M	X	0	4	S	0	1	S	0	1	
3	4	D	0	4	3	26	M	X	0	4	S	0	1	S	0	1	
3	5	P	0	1	5	945	M	X	0	4	S	0	1	S	0	1	
3	6	U	0	0	2	344	M	X	0	4	S	0	1	S	0	1	
3	7	U	0	1	9	344	M	X	0	4	S	0	1	S	0	1	
3	8	U	0	3	7	344	M	X	0	4	S	0	1	S	0	1	
3	9	U	0	4	3	344	M	X	0	4	S	0	1	S	0	1	

EPA ID NO: N M 4 8 9 0 1 3 9 0 8 8 OMB #: 2050-0034 Expires 11/30/2005

10. Description of Hazardous Wastes (Continued. Use this Additional Sheet(s) as necessary; number as 5 a, etc.)

Line Number		*A. EPA Hazardous Waste No. (Enter code)*				*B. Estimated Annual Quantity of Waste*	*C. Unit of Measure (Enter code)*	*E. PROCESSES (1) PROCESS CODES (Enter code)*									*(2) PROCESS DESCRIPTION (If a code is not entered in E(1))*
4	0	U	0	4	4	344	M	X	0	4	S	0	1	S	0	1	
4	1	U	0	5	2	344	M	X	0	4	S	0	1	S	0	1	
4	2	U	0	7	0	344	M	X	0	4	S	0	1	S	0	1	
4	3	U	0	7	2	344	M	X	0	4	S	0	1	S	0	1	
4	4	U	0	7	8	344	M	X	0	4	S	0	1	S	0	1	
4	5	U	0	7	9	344	M	X	0	4	S	0	1	S	0	1	
4	6	U	1	0	5	344	M	X	0	4	S	0	1	S	0	1	
4	7	U	1	2	2	344	M	X	0	4	S	0	1	S	0	1	
4	8	U	1	3	3	344	M	X	0	4	S	0	1	S	0	1	
4	9	U	1	5	1	344	M	X	0	4	S	0	1	S	0	1	
5	0	U	1	5	4	344	M	X	0	4	S	0	1	S	0	1	
5	1	U	1	5	9	344	M	X	0	4	S	0	1	S	0	1	
5	2	U	1	9	6	344	M	X	0	4	S	0	1	S	0	1	
5	3	U	2	0	9	344	M	X	0	4	S	0	1	S	0	1	
5	4	U	2	1	0	344	M	X	0	4	S	0	1	S	0	1	
5	5	U	2	2	0	344	M	X	0	4	S	0	1	S	0	1	
5	6	U	2	2	6	344	M	X	0	4	S	0	1	S	0	1	
5	7	U	2	2	8	344	M	X	0	4	S	0	1	S	0	1	
5	8	U	2	3	9	344	M	X	0	4	S	0	1	S	0	1	
5	9	P	1	2	0	3.3	M	X	0	4	S	0	1	S	0	1	
6	0	U	1	3	4	344	M	X	0	4	S	0	1	S	0	1	
6	1	D	0	3	3	344	M	X	0	4	S	0	1	S	0	1	
6	2	P	0	3	0	344	M	X	0	4	S	0	1	S	0	1	
6	3	P	0	9	8	344	M	X	0	4	S	0	1	S	0	1	
6	4	P	0	9	9	344	M	X	0	4	S	0	1	S	0	1	
6	5	P	1	0	6	344	M	X	0	4	S	0	1	S	0	1	
6	6	U	0	0	3	344	M	X	0	4	S	0	1	S	0	1	
6	7	U	1	0	3	344	M	X	0	4	S	0	1	S	0	1	
6	8	U	1	0	8	344	M	X	0	4	S	0	1	S	0	1	

11. Map (See instructions on pages 25 and 26)

Attach to this application a topographic map, or other equivalent map, of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in this map area. See instructions for precise requirements.

12. Facility Drawing (See instructions on page 26)

All existing facilities must include a scale drawing of the facility (see instructions for more detail).

13. Photographs (See instructions on page 26)

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas (see instructions for more detail).

14. Comments (See instructions on page 26)

See attached narrative that provides additional information regarding process codes and design capacities (Section 8B).

NM4890139088

Additional information regarding 8B PROCESS—CODES AND DESIGN CAPACITIES

The Waste Isolation Pilot Plant (**WIPP**) geologic repository is defined as a "miscellaneous unit" under 20.4.1.100 NMAC (incorporating 40 CFR §260.10. "Miscellaneous unit" means a hazardous waste management unit where hazardous waste is treated, stored, or disposed of and that is not a container, tank, surface impoundment, waste pile, land treatment unit, landfill, incinerator, containment building, boiler, industrial furnace, or underground injection well with appropriate technical standards under 40 CFR Part 146, corrective action management unit, or unit eligible for research, development, and demonstration permit under 40 CFR §270.65. The WIPP geologic repository is designed for the disposal of defense-generated transuranic (**TRU**) waste. Some of the TRU wastes disposed of at the WIPP facility contain hazardous wastes as co-contaminants. More than half the waste to be disposed of at the WIPP facility also meets the definition of debris waste. The debris categories include manufactured goods, biological materials, and naturally occurring geological materials. Approximately 120,000 cubic meters (m^3) of the 175,600 m^3 of WIPP waste is categorized as debris waste. The geologic repository has been divided into ten discrete hazardous waste disposal units (**HWDU**) which are being permitted under 40 CFR Part 264, Subpart X.

During the Disposal Phase of the WIPP facility, which is expected to last 25 years, the total amount of waste received from off-site generators and any derived waste will be limited to 175,600 m^3 of TRU waste of which up to 7,080 m^3 may be remote-handled (RH) TRU mixed waste. For purposes of this application, all TRU waste is managed as though it were mixed.

The process design capacity for the miscellaneous unit (composed of ten underground HWDUs in the geologic repository) shown in Section 8B of EPA Form 8700-23, is for the maximum amount of waste that may be received from off-site generators plus the maximum expected amount of derived wastes that may be generated at the WIPP facility. In addition, two hazardous waste management units (**HWMU**s) have been designated as container storage units (S01) in Section 8B of EPA Form 8700-23. One is inside the Waste Handling Building (**WHB**) and consists of the contact-handled (**CH**) bay, waste shaft conveyance loading room, waste shaft conveyance entry room, RH bay, cask unloading room, hot cell, transfer cell, and facility cask loading room. This HWMU will be used for waste receipt, handling, and storage (including storage of derived waste) prior to emplacement in the underground geologic repository. No treatment or disposal will occur in this HWMU (S01 unit). The capacity of this HWMU (S01 unit) for storage is 194.1 m^3, based on 36 ten-drum overpacks on 18 facility pallets, four CH Packages at the Transuranic Package Transporter-II (**TRUPACT-II**) unloading docks (**TRUDOCKs**), one standard waste box of derived waste, 13 55-gallon drums in the Hot Cell, one canister in the Transfer Cell and one canister in the Facility Cask Unloading

Room. The second HWMU (S01 unit) is the parking area outside the WHB where the trailers containing the CH Packages or the road cask trailers containing RH Packages will be parked awaiting waste handling operations. The capacity of this unit is 50 CH Packages and 12 RH Packages with a combined volume of 242 m^3. The HWDUs are shown in Part A, Appendix 3 as Part A Figure 3-2; HWMUs are shown as Figures 3-3, 3-3a, 3-3b, 3-3c, 3-3d and 3-4.

As of May 2009, the Permittees have disposed of 45,590 m^3 of waste in Panels 1 through 3. The Permittees are authorized to dispose of 76,985 m^3 of waste in Panels 4 through 7. The Permittees are requesting to dispose of 19,400 m^3 of waste in Panel 8, for a total of 141,975 m^3 of waste disposed in Panels 1-8. However, the volume capacity of waste for disposal at WIPP may be increased through a permit modification request.

NM4890139088

RCRA PART A APPLICATION CERTIFICATION

The U.S. Department of Energy (**DOE**), through its Carlsbad Field Office, has signed as "owner and operator," and Washington TRU Solutions LLC, the Management and Operating Contractor (**MOC**), has signed this application for the permitted facility as "co-operator."

The DOE has determined that dual signatures best reflect the actual apportionment of Resource Conservation and Recovery Act (**RCRA**) responsibilities as follows:

> The DOE's RCRA responsibilities are for policy, programmatic directives, funding and scheduling decisions, Waste Isolation Pilot Plant (**WIPP**) requirements of DOE generator sites, auditing, and oversight of all other parties engaged in work at the WIPP, as well as general oversight.
>
> The MOC's RCRA responsibilities are for certain day-to-day operations (in accordance with general directions given by the DOE and in the Management and Operating Contract as part of its general oversight responsibility), including, but not limited to, the following: certain waste handling, monitoring, record keeping, certain data collection, reporting, technical advice, and contingency planning.
>
> For purposes of the certification required by Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1, Section 900 (20.4.1.900 NMAC), (incorporating 40 CFR 270.11(d)), the DOE and the MOC representatives certify, under penalty of law that this document and all attachments were prepared under their direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on their inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of their knowledge and belief, true, accurate, and complete for their respective areas of responsibility. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner and Operator Signature: ______________________
Title: Manager, Carlsbad Field Office
for: U.S. Department of Energy
Date: ______________________

Co-Operator Signature: ______________________
Title: President and General Manager
for: Washington TRU Solutions LLC
Date: ______________________

NM4890139088

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The U.S. Department of Energy (**DOE**), through its Carlsbad Field Office, has signed as "owner and operator," and Washington TRU Solutions LLC, the Management and Operating Contractor (**MOC**), has signed this application for the permitted facility as "co-operator."

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>
> The MOC's RCRA responsibilities are for certain day-to-day operations (in accordance with general directions given by the DOE and in the Management and Operating Contract as part of its general oversight responsibility), including, but not limited to, the following: certain waste handling, monitoring, record keeping, certain data collection, reporting, technical advice, and contingency planning.
>
> For purposes of the certification required by Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1, Section 900 (20.4.1.900 NMAC), (incorporating 40 CFR 270.11(d)), the DOE and the MOC representatives certify, under penalty of law that this document and all attachments were prepared under their direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on their inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of their knowledge and belief, true, accurate, and complete for their respective areas of responsibility. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner and Operator Signature: *David Moody*
Title: Manager, Carlsbad Field Office
for: U.S. Department of Energy
Date: ____________________

Co-Operator Signature: *Farok Sharif*
Title: President and General Manager
for: Washington TRU Solutions LLC
Date: ____________________

RENEWAL APPLICATION
APPENDIX 1

ACTIVE ENVIRONMENTAL PERMITS

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Active Environmental Permits

Table Part A-1 - Active Environmental Permits for the Waste Isolation Pilot Plant

	Granting Agency	Type of Permit	Permit Number	Granted	Expiration
1	Department of the Interior, Bureau of Land Management	Right-of-Way for the North Access Road	NM55676	8/24/83	None
2	Department of the Interior, Bureau of Land Management	Right-of-Way for Railroad	NM55699	9/27/83	None
3	Department of the Interior, Bureau of Land Management	Right-of-Way for Dosimetry and Aerosol Sampling Sites	NM63136	7/31/86	7/31/11
4	Department of the Interior, Bureau of Land Management	Right-of-Way for Seven Subsidence Monuments	NM65801	11/7/86	None
5	Department of the Interior, Bureau of Land Management	Right-of-Way for Aerosol Sampling Site	NM77921	8/18/89	8/18/19
6	Department of the Interior, Bureau of Land Management	Right-of-Way for 2 Survey Monuments	NM82245	12/13/89	12/13/19
7	Department of the Interior, Bureau of Land Management	Right-of-Way for telephone cable	NM46092	7/3/90	9/4/11
8	Department of the Interior, Bureau of Land Management	Right-of-Way for Valor Telecon	NM113339	8/9/05	12/31/34
9	Department of the Interior, Bureau of Land Management	Right-of-Way for SPS Powerline	NM43203	2/20/96	10/19/11
10	Department of the Interior, Bureau of Land Management	Right-of-Way for South Access Road	NM46130	8/17/81	8/17/31
11	Department of the Interior, Bureau of Land Management	Right-of-Way for South Access Road Fence	NM94304	3/15/95	none

Table Part A-1 - Active Environmental Permits for the Waste Isolation Pilot Plant

	Granting Agency	Type of Permit	Permit Number	Granted	Expiration
12	Department of the Interior, Bureau of Land Management	Right-of-Way for Duval telephone line	NM60174	11/6/96	3/8/15
13	Department of the Interior, Bureau of Land Management	Right-of-Way for Wells AEC-7 & AEC-8	NM108365	8/30/02	8/30/32
14	Department of the Interior, Bureau of Land Management	Right-of-Way for ERDA-6	NM108365	8/30/02	8/30/32
15	Department of the Interior, Bureau of Land Management	Right-of-Way for Monitoring Well C-2756 (P-18)	NM108365	8/30/02	8/30/32
16	Department of the Interior, Bureau of Land Management	Right-of-way for Monitoring Well C-2664 (Cabin Baby)	NM107944	4/23/02	4/23/32
17	Department of the Interior, Bureau of Land Management	Right-of-Way for Seismic Monitoring Station	NM85426	9/23/91	None
18	Department of the Interior, Bureau of Land Management	Right-of-Way for Wells C-2725 (H-4A), C-2775 (H-4B), & C-2776 (H-4C)	NM108365	8/30/02	8/30/32
19	Department of the Interior, Bureau of Land Management	Right-of-Way for Monitoring Wells C-2723 (WIPP-25), C-2724 (WIPP-26), C-2722 (WIPP-27), C-2636 (WIPP-28), C-2743 (WIPP-29), & C-2727 (WIPP-30)	NM108365	8/30/02	8/30/32
20	Department of the Interior, Bureau of Land Management	Right-of-Way for Monitoring Well WIPP-11	NM108365	9/15/04	9/20/34
21	Department of the Interior, Bureau of Land Management	Right-of-Way easement for WIPP well bore SNL-2	109174	4/15/03	4/15/33
22	Department of the Interior, Bureau of Land Management	Right-of-Way easement for WIPP well bore SNL-9	109175	4/15/03	4/15/33

Table Part A-1 - Active Environmental Permits for the Waste Isolation Pilot Plant

	Granting Agency	Type of Permit	Permit Number	Granted	Expiration
23	Department of the Interior, Bureau of Land Management	Right-of-Way easement for WIPP well bore SNL-12	109176	4/15/03	4/15/33
24	Department of the Interior, Bureau of Land Management	Right-of-Way easement for WIPP well bore SNL-1 and access road	109177	6/17/03	6/17/33
25	Department of the Interior, Bureau of Land Management	Right-of-Way easement for WIPP well bore SNL-11 and access road	110735	10/16/03	10/16/33
26	Department of the Interior, Bureau of Land Management	Right-of-Way easement for WIPP well bore SNL-5 and access road	110735	10/16/03	10/16/33
27	Department of the Interior, Bureau of Land Management	Right-of-Way grant for SNL-16 and 17	NM108365	12/21/05	8/30/32
28	Department of the Interior, Bureau of Land Management	Right-of-Way grant for SNL-18 and 10	NM115315	3/21/06	12/31/35
29	Department of the Interior, Bureau of Land Management	Right-of-way reservation amendment for SNL13 and SNL-14	NM108365	1/25/05	8/30/32
30	Department of the Interior, Bureau of Land Management	Right-of-way reservation amendment for SNL6, SNL-8, and SNL-15	NM108365	3/15/05	8/30/32
31	Department of the Interior, Bureau of Land Management	Right-of-way for 20 radiological stations, 2 aerosol samplers, and 2 weather monitor site.	NM063136	7/3/86	7/2/11
32	U.S. Department of the Interior, Fish and Wildlife Service	Concurrence that WIPP construction activities will have no significant impact on federally-listed threatened or endangered species	None	5/29/80	None
33	New Mexico Commissioner of Public Lands	Right-of-Way for High Volume Air Sampler	RW-22789	10/3/85	10/3/20

Table Part A-1 - Active Environmental Permits for the Waste Isolation Pilot Plant

	Granting Agency	Type of Permit	Permit Number	Granted	Expiration
34	New Mexico Commissioner of Public Lands	Monitoring Well SNL-3	RW-28537	7/31/03	7/31/38
35	New Mexico Commissioner of Public Lands	Monitoring Well SNL-1	RW-28535	8/27/03	8/27/38
36	New Mexico Commissioner of Public Lands	Right-of-Way Easement for Accessing State Trust Lands in Eddy & Lea Counties	RW-25430	9/28/04	9/28/14
37	New Mexico Environment Department Air Quality Bureau	Operating Permit for two backup diesel generators	310-M-2	12/7/93	None
38	New Mexico Department of Game and Fish	Concurrence that WIPP construction activities will have no significant impact on state-listed threatened or endangered species	None	5/26/89	None
39	New Mexico Environment Department-UST Bureau	Underground Storage Tanks	Facility No. 31539	7/1/07	6/30/10
40	New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2801	2/23/01	None
41	New Mexico State Engineer Office	Monitoring Well	C-2811	3/2/02	None
42	New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2802	2/23/01	None
43	New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2803	2/23/01	None
44	New Mexico State Engineer Office	Appropriation: WQSP-1 Well	C-2413	10/21/96	None
45	New Mexico State Engineer Office	Appropriation: WQSP-2 Well	C-2414	10/21/96	None
46	New Mexico State Engineer Office	Appropriation: WQSP-3 Well	C-2415	10/21/96	None
47	New Mexico State Engineer Office	Appropriation: WQSP-4 Well	C-2416	10/21/96	None

Table Part A-1 - Active Environmental Permits for the Waste Isolation Pilot Plant

	Granting Agency	Type of Permit	Permit Number	Granted	Expiration
48	New Mexico State Engineer Office	Appropriation: WQSP-5 Well	C-2417	10/21/96	None
49	New Mexico State Engineer Office	Appropriation: WQSP-6 Well	C-2418	10/21/96	None
50	New Mexico State Engineer Office	Appropriation: WQSP-6a Well	C-2419	10/21/96	None
51	New Mexico State Engineer Office	Monitoring Well AEC-7	C-2742	11/6/00	None
52	New Mexico State Engineer Office	Monitoring Well AEC-8	C-2744	11/6/00	None
53	New Mexico State Engineer Office	Monitoring Well Cabin Baby	C-2664	7/30/99	None
54	New Mexico State Engineer Office	Monitoring Well DOE-1	C-2757	11/6/00	None
55	New Mexico State Engineer Office	Monitoring Well DOE-2	C-2682	4/17/00	None
56	New Mexico State Engineer Office	Monitoring Well ERDA-9	C-2752	11/6/00	None
57	New Mexico State Engineer Office	Monitoring Well H-1	C-2765	11/6/00	None
58	New Mexico State Engineer Office	Monitoring Well H-2A	C-2762	11/6/00	None
59	New Mexico State Engineer Office	Monitoring Well H-2B1	C-2758	11/6/00	None
60	New Mexico State Engineer Office	Monitoring Well H-2B2	C-2763	11/6/00	None
61	New Mexico State Engineer Office	Monitoring Well H-2C	C-2759	11/6/00	None
62	New Mexico State Engineer Office	Monitoring Well H-3B1	C-2764	11/6/00	None
63	New Mexico State Engineer Office	Monitoring Well H-3B2	C-2760	11/6/00	None
64	New Mexico State Engineer Office	Monitoring Well H-3B3	C-2761	11/6/00	None
65	New Mexico State Engineer Office	Monitoring Well H-3D	C-3207	11/6/00	None
66	New Mexico State Engineer Office	Monitoring Well H-4A	C-2725	11/6/00	None
67	New Mexico State Engineer Office	Monitoring Well H-4B	C-2775	11/6/00	None
68	New Mexico State Engineer Office	Monitoring Well H-4C	C-2776	11/6/00	None
69	New Mexico State Engineer Office	Monitoring Well H-5A	C-2746	11/6/00	None

Table Part A-1 - Active Environmental Permits for the Waste Isolation Pilot Plant

	Granting Agency	Type of Permit	Permit Number	Granted	Expiration
70	New Mexico State Engineer Office	Monitoring Well H-5B	C-2745	11/6/00	None
71	New Mexico State Engineer Office	Monitoring Well H-5C	C-2747	11/6/00	None
72	New Mexico State Engineer Office	Monitoring Well H-6A	C-2751	11/6/00	None
73	New Mexico State Engineer Office	Monitoring Well H-6BR	C-3362	12/27/07	None
74	New Mexico State Engineer Office	Monitoring Well H-6C	C-2750	11/6/00	None
75	New Mexico State Engineer Office	Monitoring Well H-7A	C-2694	4/17/00	None
76	New Mexico State Engineer Office	Monitoring Well H-7B1	C-2770	11/6/00	None
77	New Mexico State Engineer Office	Monitoring Well H-7B2	C-2771	11/6/00	None
78	New Mexico State Engineer Office	Monitoring Well H-7C	C-2772	11/6/00	None
79	New Mexico State Engineer Office	Monitoring Well H-8A	C-2780	11/6/00	None
80	New Mexico State Engineer Office	Monitoring Well H-8B	C-2781	11/6/00	None
81	New Mexico State Engineer Office	Monitoring Well H-8C	C-2782	11/6/00	None
82	New Mexico State Engineer Office	Monitoring Well H-9A	C-2785	11/6/00	None
83	New Mexico State Engineer Office	Monitoring Well H-9B	C-2783	11/6/00	None
84	New Mexico State Engineer Office	Monitoring Well H-9C	C-2784	11/6/00	None
85	New Mexico State Engineer Office	Monitoring Well H-10A	C-2779	11/6/00	None
86	New Mexico State Engineer Office	Monitoring Well H-10B	C-2778	11/6/00	None
87	New Mexico State Engineer Office	Monitoring Well H-10C	C-2695	4/17/00	None
88	New Mexico State Engineer Office	Monitoring Well H-11B1	C-2767	11/6/00	None
89	New Mexico State Engineer Office	Monitoring Well H-11B2	C-2687	4/17/00	None
90	New Mexico State Engineer Office	Monitoring Well H-11B3	C-2768	11/6/00	None
91	New Mexico State Engineer Office	Monitoring Well H-11B4	C-2769	11/6/00	None

Table Part A-1 - Active Environmental Permits for the Waste Isolation Pilot Plant

	Granting Agency	Type of Permit	Permit Number	Granted	Expiration
92	New Mexico State Engineer Office	Monitoring Well H-12	C-2777	11/6/00	None
93	New Mexico State Engineer Office	Monitoring Well H-14	C-2766	11/6/00	None
94	New Mexico State Engineer Office	Monitoring Well H-15	C-2685	4/17/00	None
95	New Mexico State Engineer Office	Monitoring Well H-15R	C-3361	12/27/07	None
96	New Mexico State Engineer Office	Monitoring Well H-16	C-2753	11/6/00	None
97	New Mexico State Engineer Office	Monitoring Well H-17	C-2773	11/6/00	None
98	New Mexico State Engineer Office	Monitoring Well H-18	C-2683	4/17/00	None
99	New Mexico State Engineer Office	Monitoring Well P-17	C-2774	11/6/00	None
100	New Mexico State Engineer Office	Monitoring Well WIPP-11	C-3365	12/27/07	None
101	New Mexico State Engineer Office	Monitoring Well WIPP-12	C-2639	1/12/99	None
102	New Mexico State Engineer Office	Monitoring Well WIPP-13	C-2748	11/6/00	None
103	New Mexico State Engineer Office	Monitoring Well WIPP-18	C-2684	4/17/00	None
104	New Mexico State Engineer Office	Monitoring Well WIPP-19	C-2755	11/6/00	None
105	New Mexico State Engineer Office	Monitoring Well WIPP-21	C-2754	11/6/00	None
106	New Mexico State Engineer Office	Monitoring Well WIPP-25	C-2723	7/26/00	None
107	New Mexico State Engineer Office	Monitoring Well WIPP-26	C-2724	11/6/00	None
108	New Mexico State Engineer Office	Monitoring Well WIPP-27	C-2722	11/6/00	None
109	New Mexico State Engineer Office	Monitoring Well WIPP-28	C-2636	1/12/99	None
110	New Mexico State Engineer Office	Monitoring Well WIPP-29	C-2743	11/6/00	None
111	New Mexico State Engineer Office	Monitoring Well WIPP-30	C-2727	8/4/00	None
112	New Mexico State Engineer Office	Monitoring Well SNL-2	C-2948	2/14/03	None
113	New Mexico State Engineer Office	Monitoring Well SNL-9	C-2950	2/14/03	None

Table Part A-1 - Active Environmental Permits for the Waste Isolation Pilot Plant					
	Granting Agency	**Type of Permit**	**Permit Number**	**Granted**	**Expiration**
114	New Mexico State Engineer Office	Monitoring Well SNL-12	C-2954	2/25/03	None
115	New Mexico State Engineer Office	Monitoring Well SNL-1	C-2953	2/25/03	None
116	New Mexico State Engineer Office	Monitoring Well SNL-3	C-2949	2/14/03	None
117	New Mexico State Engineer Office	Monitoring Well WTS-4	C-2960	3/18/03	None
118	New Mexico State Engineer Office	Monitoring Well SNL-5	C-3002	10/1/03	None
119	New Mexico State Engineer Office	Monitoring Well IMC-461	C-3015	11/25/03	None
120	New Mexico State Engineer Office	Monitoring Well SNL-11	C-3003	10/1/03	None
121	New Mexico State Engineer Office	Monitoring Well SNL10	C03221	7/26/05	None
122	New Mexico State Engineer Office	Monitoring Well SNL16	C03220	7/26/05	None
123	New Mexico State Engineer Office	Monitoring Well SNL17	C03222	7/26/05	None
124	US Environmental Protection Agency Region 6	Conditions of Approval for Disposal of PCB/TRU and PCB/TRU Mixed Waste at the US Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) Carlsbad, New Mexico	NA	4/30/08	4/30/13
125	US Fish and Wildlife Service	Migratory Bird Special Purpose-Relocate	MB155189-0	6/01/09	5/31/10
126	New Mexico Environment Department	Groundwater Quality Bureau Permit	DP-831	9/9/08	9/9/13

1

RENEWAL APPLICATION
APPENDIX 2

MAPS

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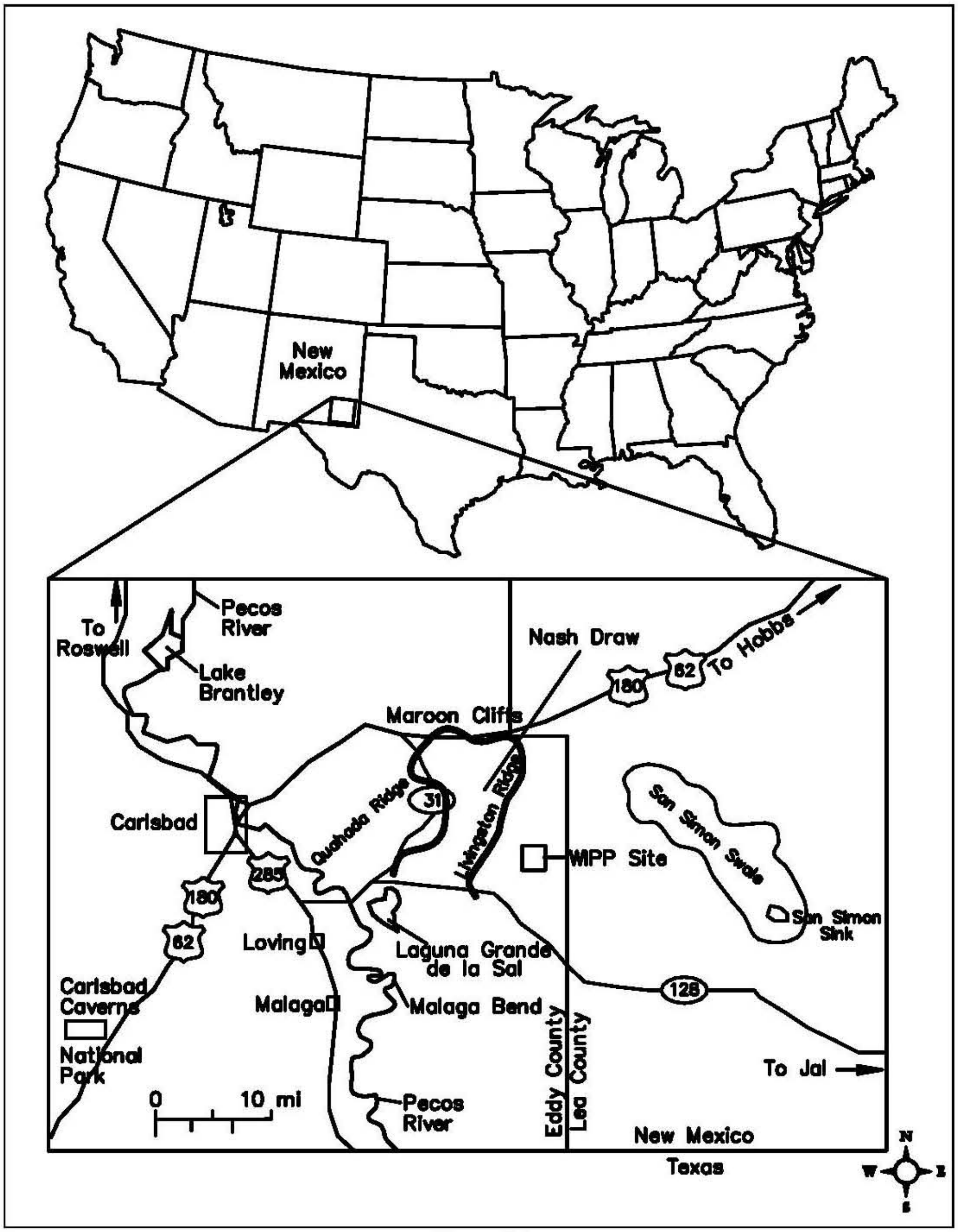


Figure 2-1
General Location of the WIPP Facility

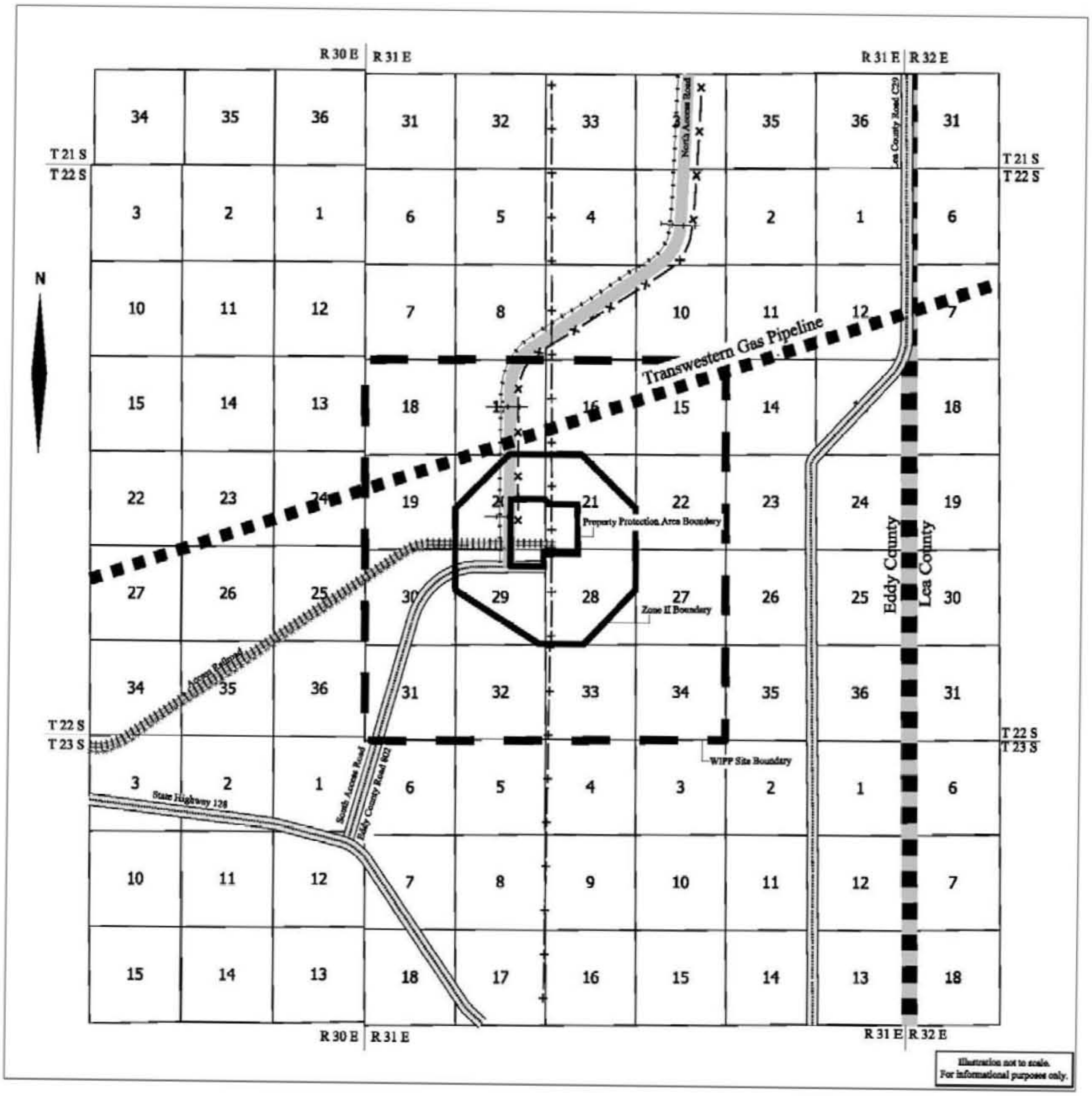


Figure 2-2
Planimetric Map – WIPP Facility Boundaries

LEGEND

WIPP Site Boundry 10, 240 acres.

Right-of-Way for City of Carlsbad water pipeline, 50 feet wide.

Stock Water Tanks and tap lines connected to the main WIPP waterline.

Excel Energy Right-of-Way Number NM-43203 for power 60 feet wide.

Windstream Communications Right-of-Way for telephone line 30 feet wide. Located within the North Access Road Right-of-Way.

Windstream Communications Right-of-Way NM-60174 for telephone line, 30 feet wide, located within the railroad Right-of-Way.

U.S. DOE Right-of-Way Number NM-55675 for North Access Road , 170 feet wide

Transwestern Pipeline Company Right-of-Way for gas pipeline, 30 feet wide in Section 16, 50 feet wide elsewhere.

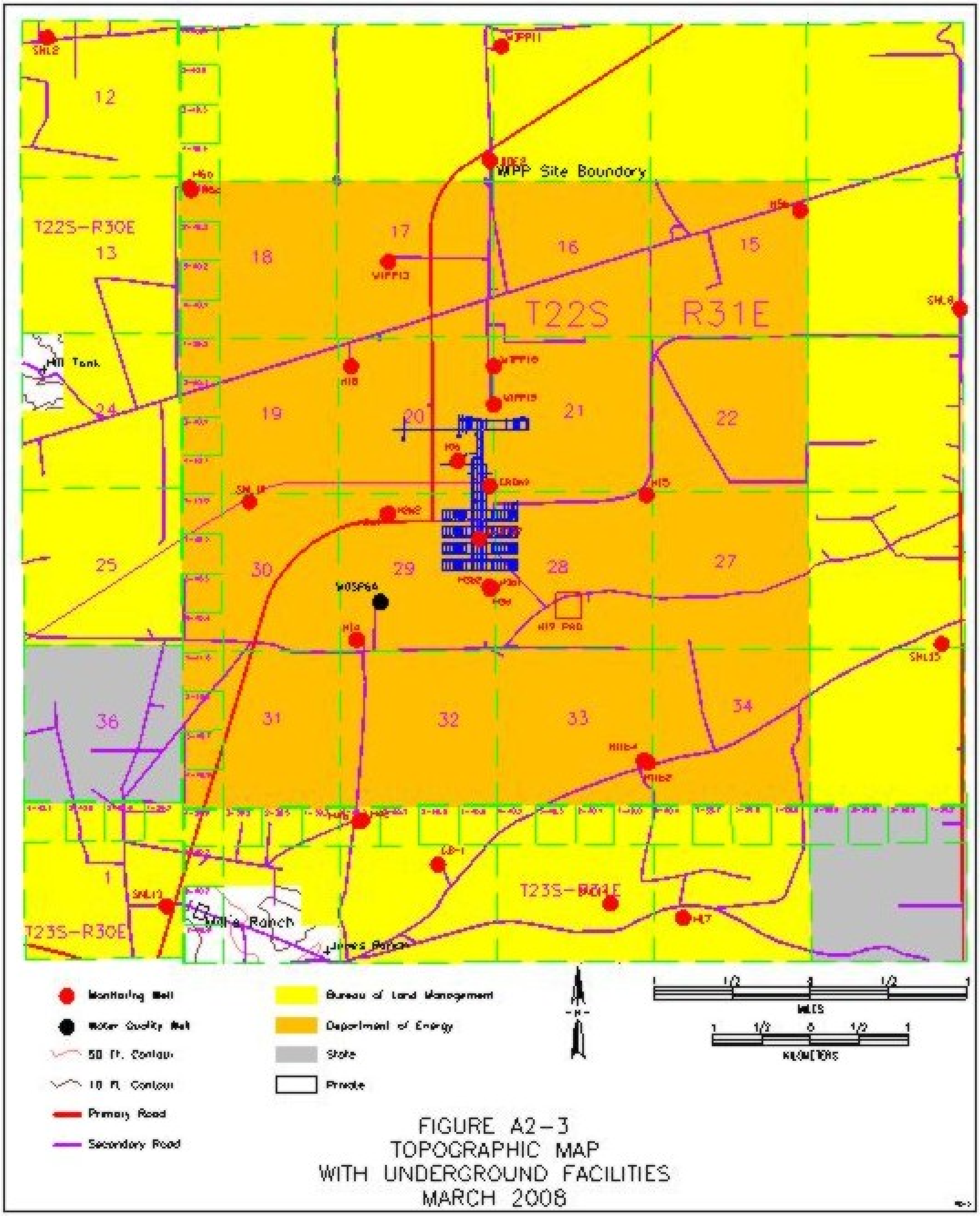
U.S. DOE Right-of-Way Number NM-55699 for Access Railroad, 150 feet wide.

Eddy County Right-of-Way for access roads includes Right-of-Way Number NM-4130 for the South Access Road which is 150 feet wide.

NOTES

1. The Property Protection Area is a fenced area of approximately 35 acres. It contains most surface facilities with the exception of salt storage piles, parking lot, construction landfill, and waste water stabilization lagoons.
2. Zone II overlies the maximum extent of the area available for underground development.
3. WIPP site boundary (WSB) provides a one-mile buffer around the area available for underground development.

Figure 2-2a
Legend to Figure 2-2



This figure was submitted as a full-sized map in a jacket behind this page.
This is for illustrative purposes only.

Figure 2-3
Topographic Map with Underground Facilities

RENEWAL APPLICATION
APPENDIX 3

FACILITIES

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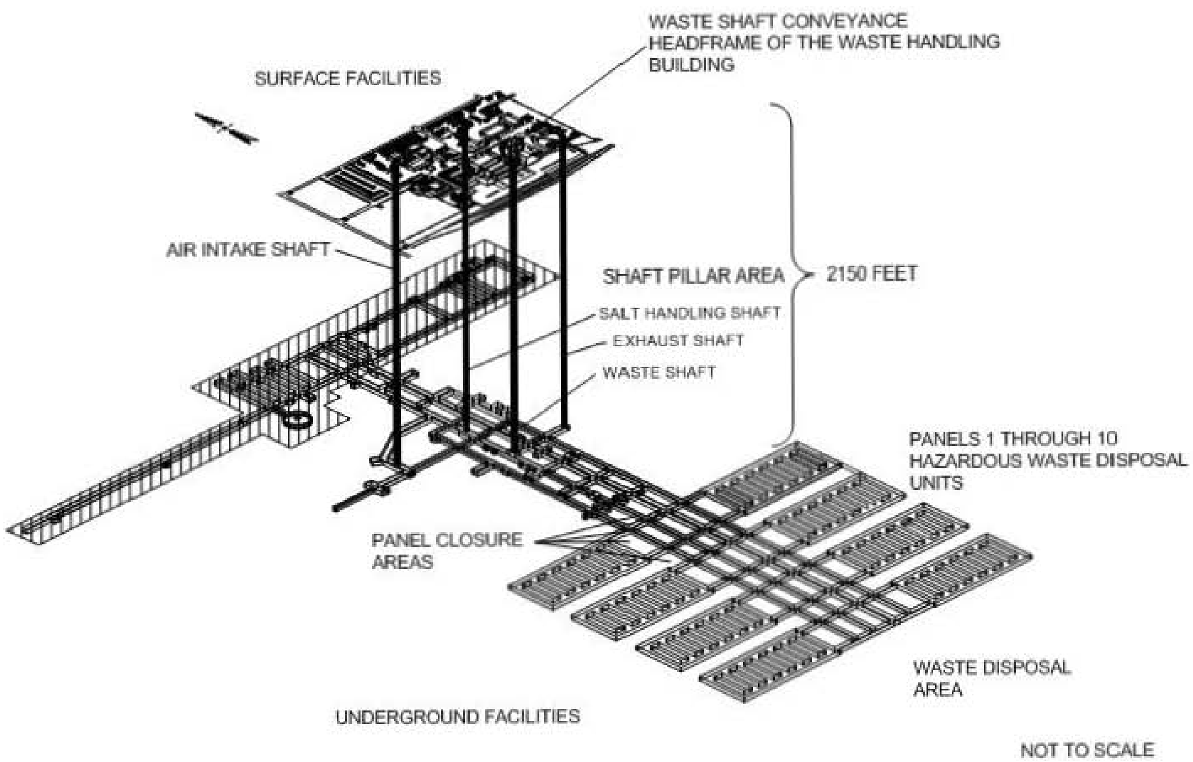


Figure 3-1
Spatial View of the WIPP Facility

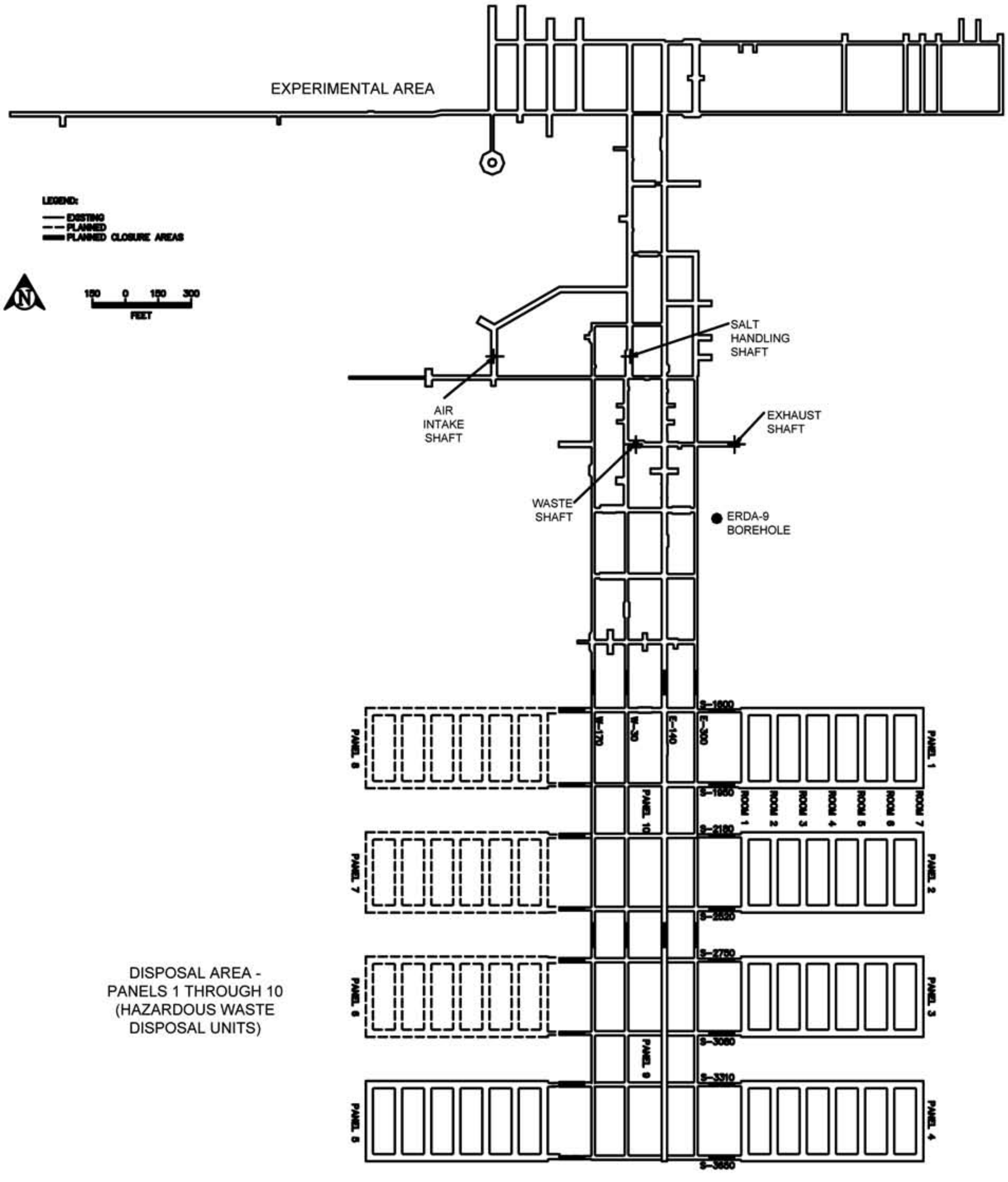
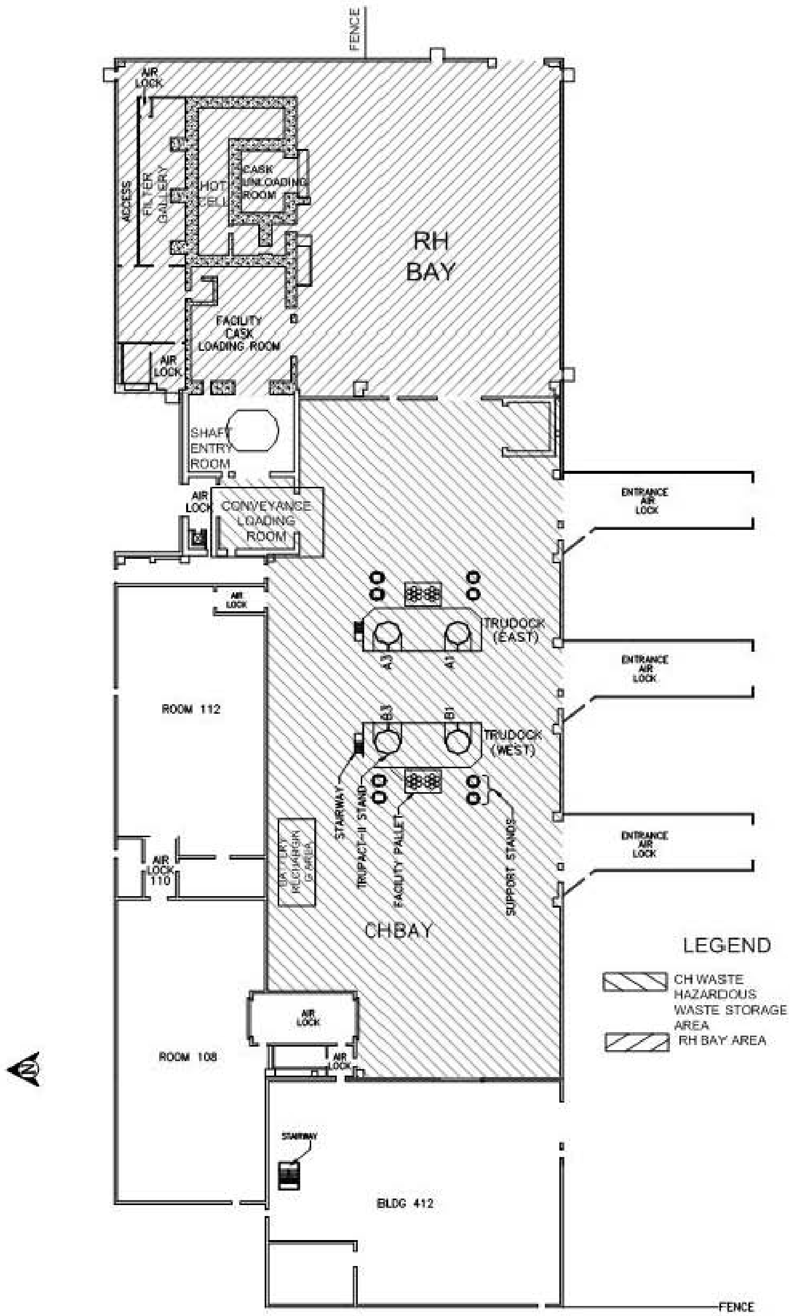


Figure 3-2
Repository Horizon



1

2 Figure 3-3
3 Waste Handling Building

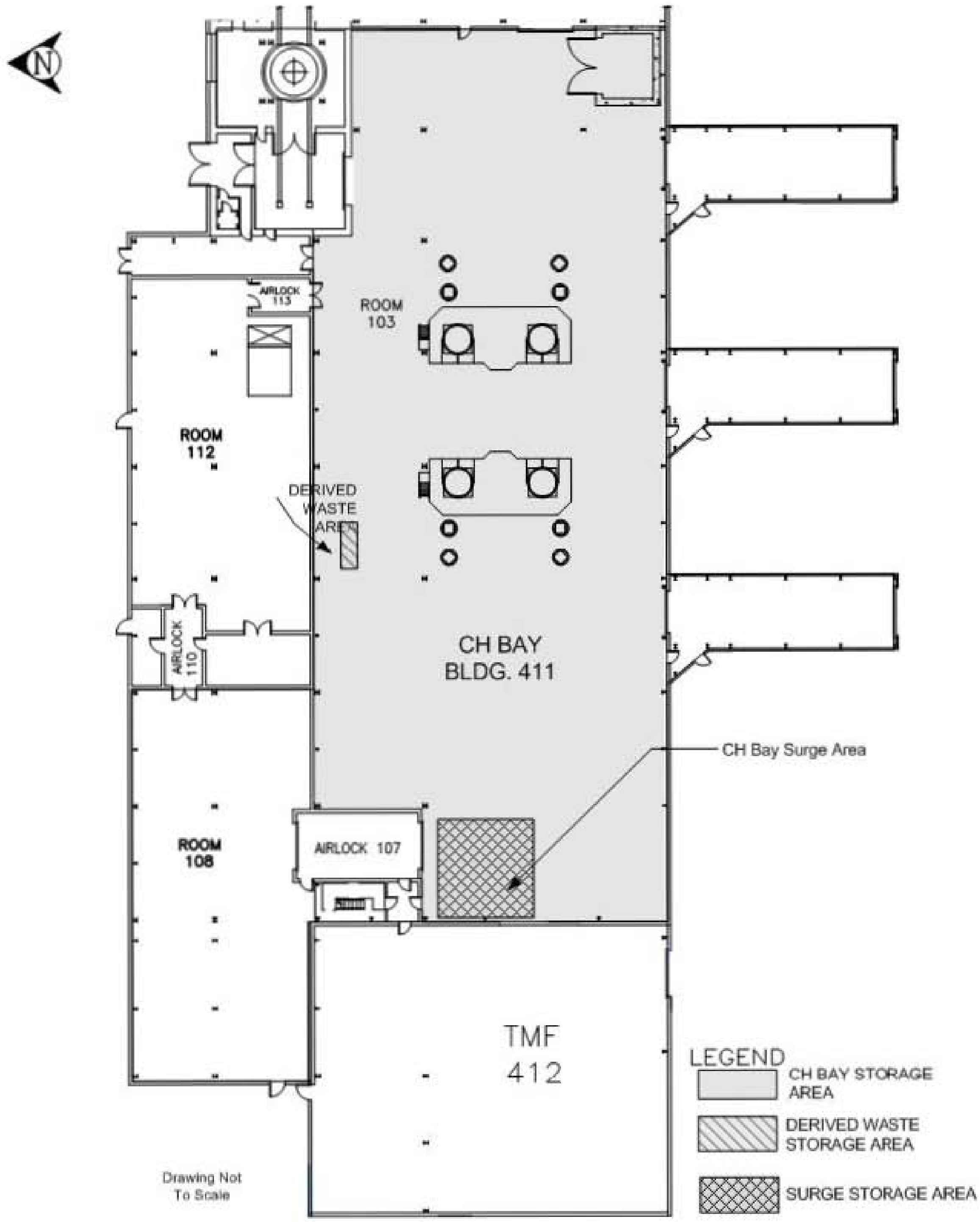


Figure 3-3a
Waste Handling Building – CH TRU Mixed Waste Container Storage and Surge Areas

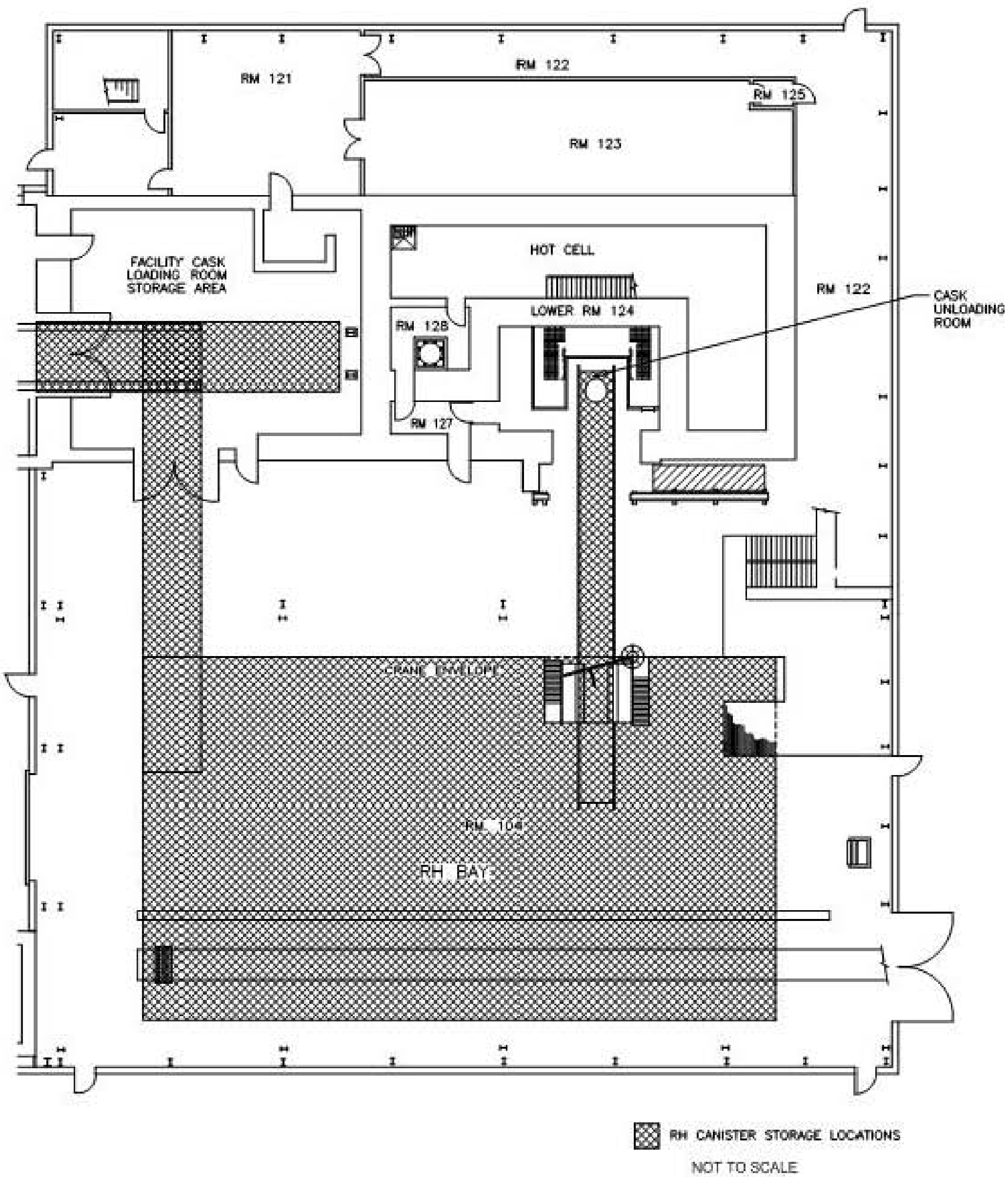


Figure 3-3b
Waste Handling Building – RH TRU Mixed Waste Container Storage

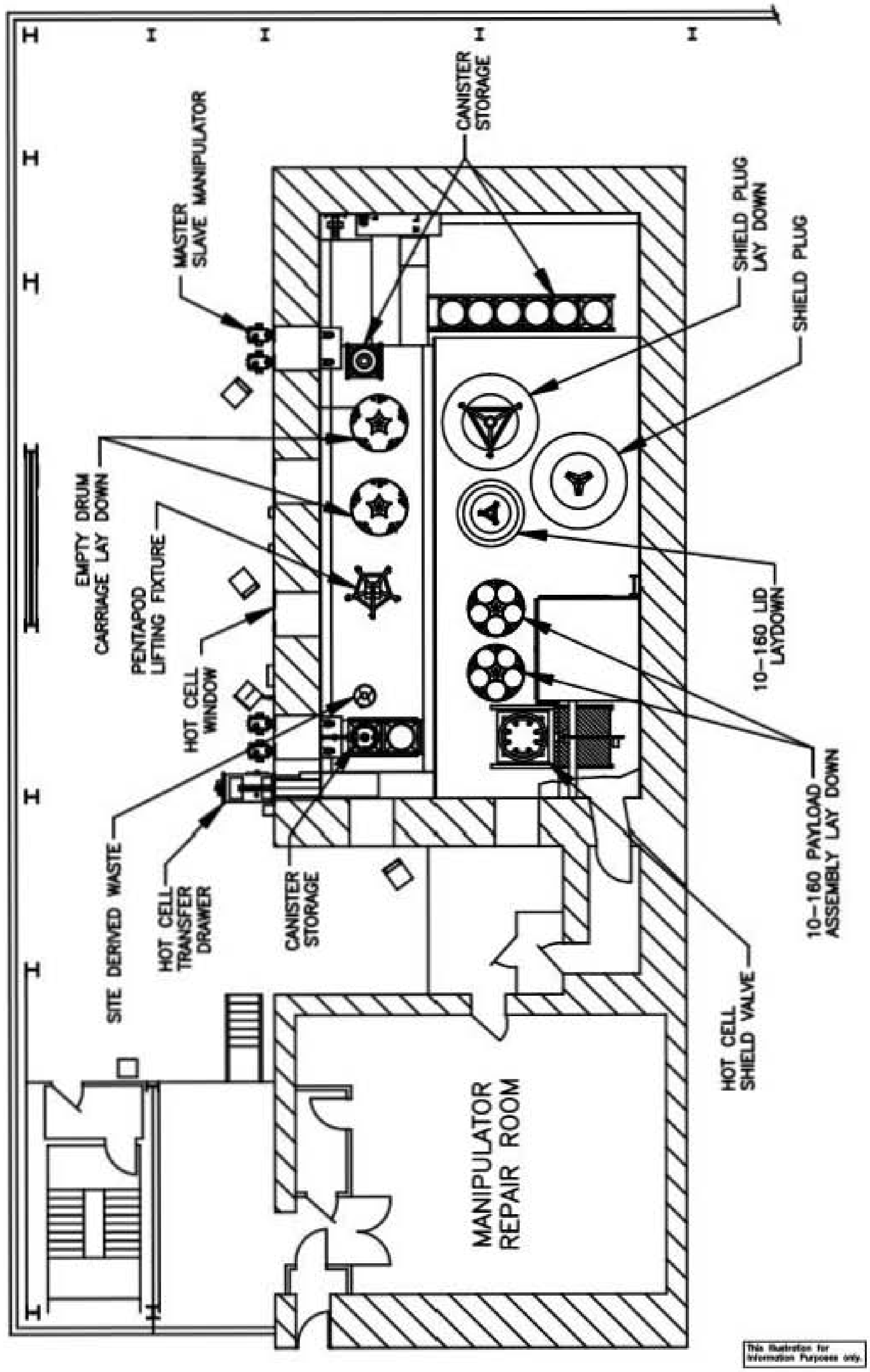


Figure 3-3c
Waste Handling Building – RH Storage, Hot Cell Storage Area (above grade)

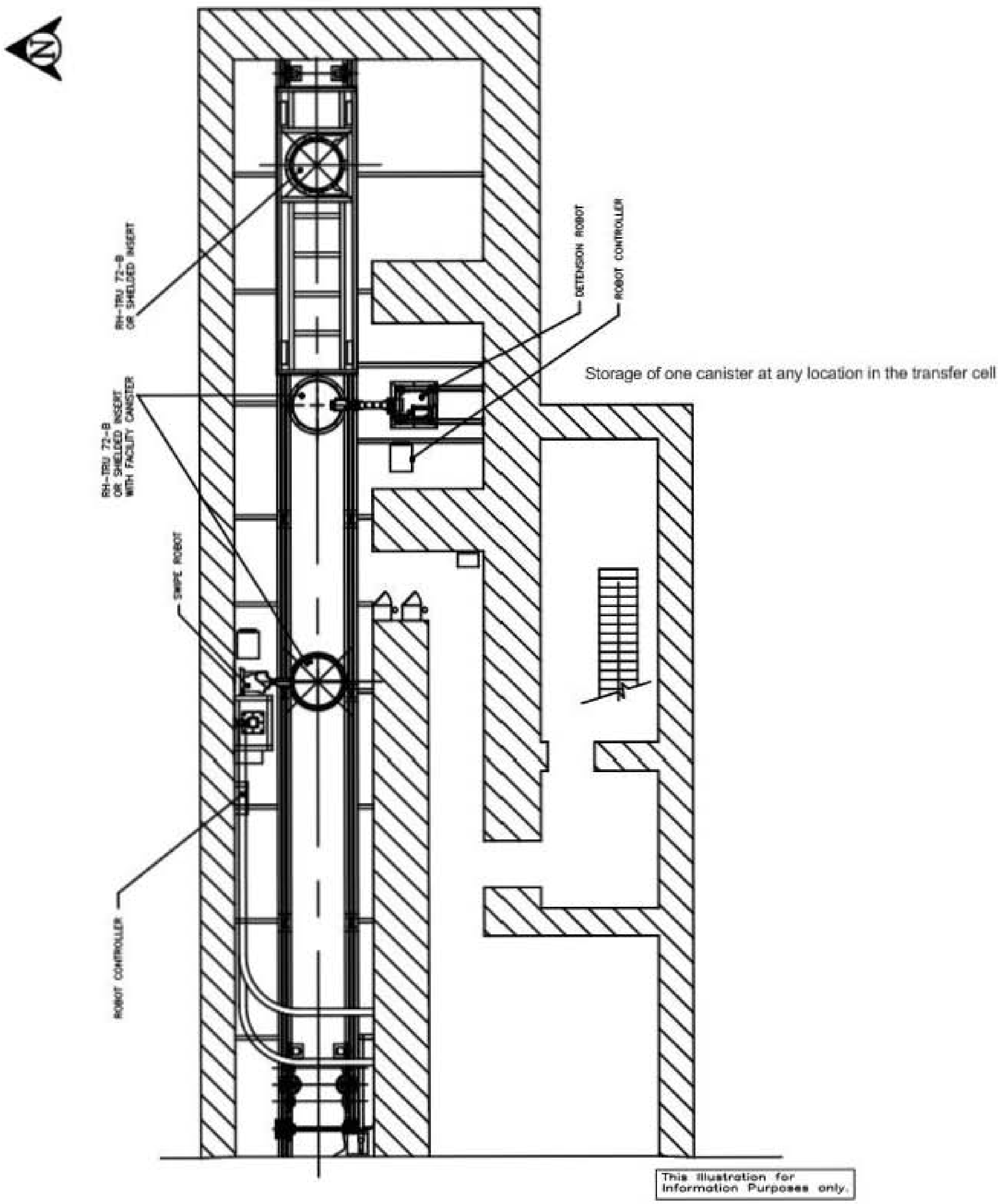


Figure 3-3d
Waste Handling Building – RH Canister Transfer Cell Storage Area (below grade)

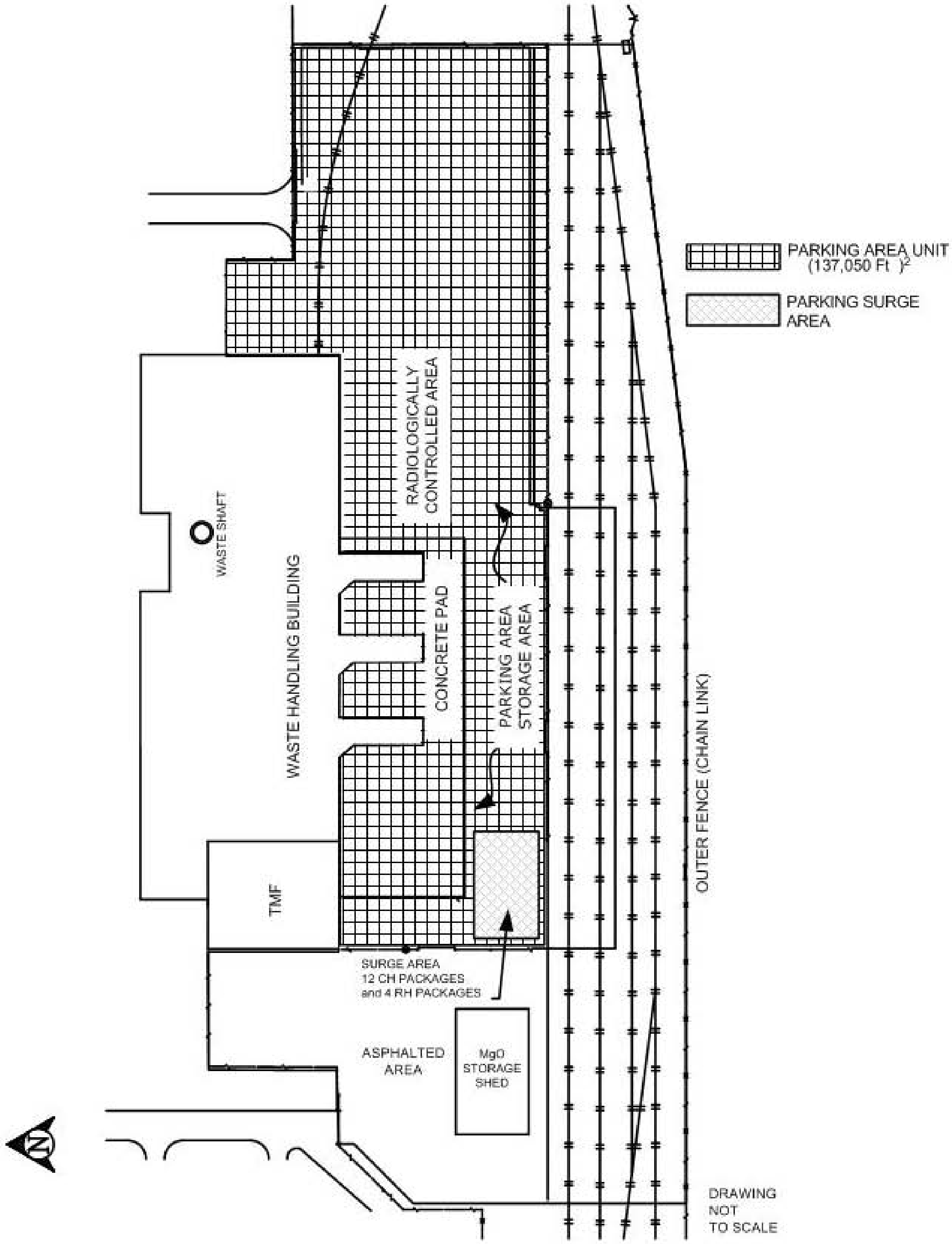


Figure 3-4
Parking Area – Container Storage and Surge Areas

RENEWAL APPLICATION
APPENDIX 4

PHOTOGRAPHS

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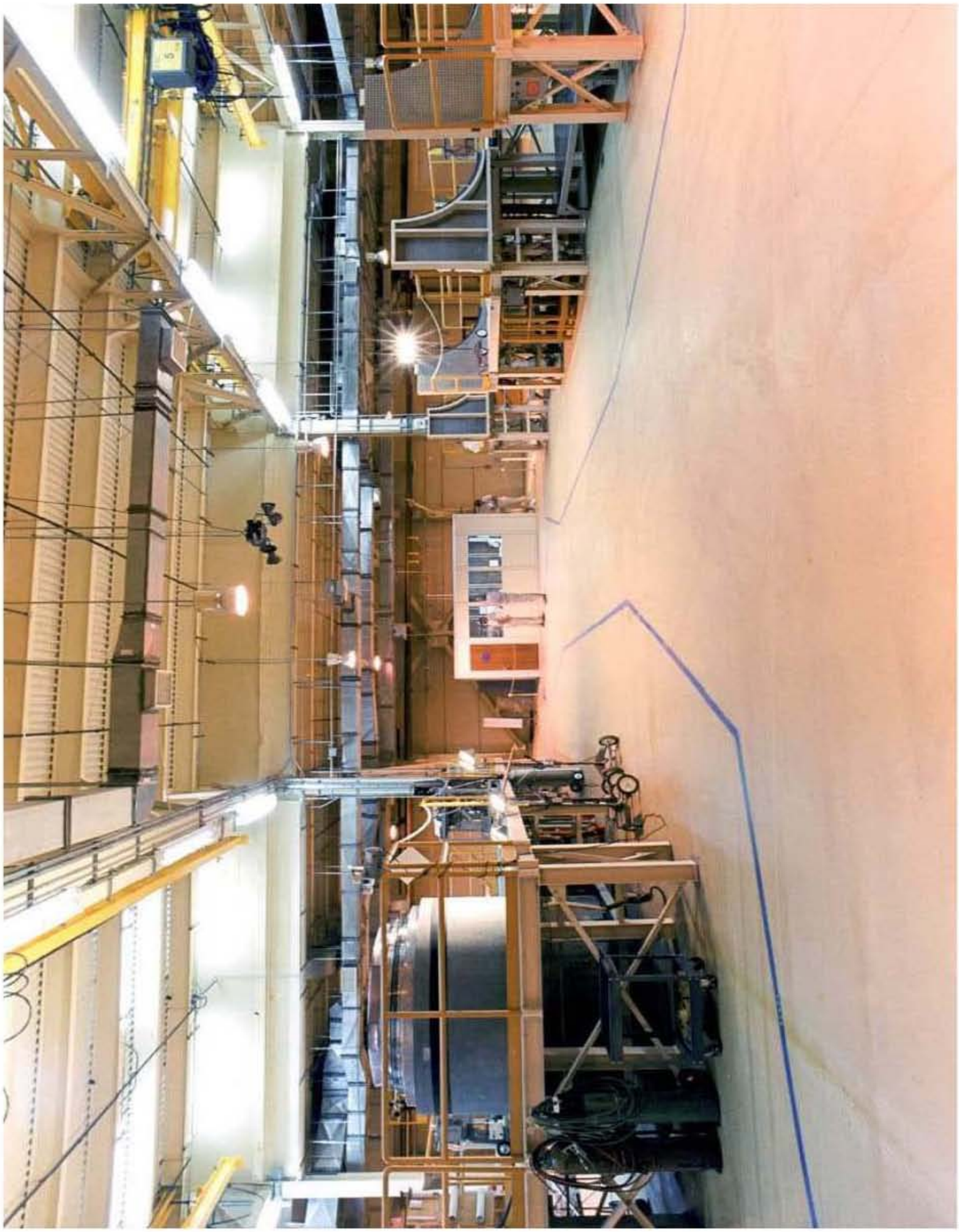
Photograph 4-1
Aerial Photograph of the Waste Isolation Pilot Plant Facility

Photograph 4-2
Underground – Waste Disposal Room (Typical)



Photograph 4-3
TRUDOCKs in CH Bay of the Waste Handling Building

Photograph 4-4
CH TRU Waste Stored on Facility Pallets in the Waste Handling Building

Photograph 4-5
Westward View of CH Bay of the Waste Handling Building

Photograph 4-6
Loading Facility Pallet with CH Waste onto the Waste Conveyance - Waste Handling Building

Photograph 4-7
RH Bay

Photograph 4-8
Cask Unloading Room and Bridge Crane

Photograph 4-9
Hot Cell

Photograph 4-10
Transfer Cell

Photograph 4-11
Facility Cask and Facility Cask Rotating Device

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Necessary Information for the WIPP Facility Ten Year Renewal Application, Part B

The New Mexico Hazardous Waste Act requires general and specific information when either applying or reapplying for a hazardous waste permit. General and specific information requirements are addressed in the order they appear in the federal regulations as adopted by the New Mexico Hazardous Waste Management regulations and are identified by the number of the federal hazardous waste management citation.

§270.14 Contents of part B: General requirements

(a) Part B of the permit application consists of the general information requirements of this section and the specific information requirements in §§270.14 through 270.29 applicable to the facility. The part B information requirements presented in §§270.14 through 270.29 reflect the standards promulgated in 40 CFR part 264. These information requirements are necessary in order for NMED to determine compliance with the part 264 standards. If owners and operators of HWM facilities can demonstrate that the information prescribed in part B cannot be provided to extent required, the Secretary of the NMED may make allowance for submission of such information on a case-by-case basis. Information required in Part B shall be submitted to the Secretary and signed in accordance with the requirements of §270.11. Certain technical data, such as, design drawings and specifications, and engineering studies shall be certified by a qualified Professional Engineer. For post-closure permits, only the information specified in §270.28 is required in part B of the permit application.

The Permittees have determined that none of the information submitted in this Renewal Application requires a certification beyond that required by §270.11.

(b) *General information requirements.* The following information is required for all HWM facilities, except as §264.1 provides otherwise:

(1) A general description of the facility.

There is no proposed change to the description of the facility in the *Waste Isolation Pilot Plant Hazardous Waste Facility Permit*, Permit # NM489019088-TSDF, as modified in accordance with NMAC 20.4.1.901 incorporating §40 CFR 270.42. The Renewal Application requests authorization for disposal of transuranic (**TRU**) mixed waste in Panel 8. Currently, only the construction and certification of Panel 8 is allowed by the Waste Isolation Pilot Plant (**WIPP**) Permit. See Renewal Application Appendices M2 and M3 for a specific description of the construction of the disposal panels (hazardous waste disposal units (**HWDUs**)). See Renewal Application Chapter A, Appendices M1, M2, and M3 for a description of the facility.

In this Renewal Application, the U.S. Department of Energy (**DOE**) is seeking authorization to continue the disposal of TRU mixed waste at the WIPP facility. Waste disposal has occurred in the underground portion of the WIPP facility in areas designated as Panels 1 through 5. Currently, TRU mixed waste disposal is permitted in Panels 1 through 7 and construction of Panel 8 is also permitted. Each panel consists of seven rooms and two access drifts mined in a salt bed 2,150 ft (655 m) below the surface. The legal description of the facility is:

- Township 22 South, Range 31 East;
  - Sections 15 to 22
  - Sections 27 to 34

During the term of this and the preceding Permit, the volume of contact-handled (**CH**) TRU mixed waste emplaced in the repository will not exceed 4,920,746 ft^3 (139,340 m^3) and the volume of remote-handled (**RH**) TRU mixed waste shall not exceed 93,050 ft^3 (2,635 m^3). CH TRU mixed waste will be disposed of in Underground HWDUs identified as Panels 5 through 8 and in any currently active panel. The RH TRU mixed waste may be disposed of in Panels 4 through 8.

Descriptions of the containers to be used and associated operations during the Disposal Phase are presented in Renewal Application Appendix M1, *Container Storage*. The TRU mixed waste that will be disposed at the WIPP facility results primarily from activities related to the reprocessing of plutonium-bearing reactor fuel and fabrication of plutonium-bearing weapons, as well as from research and development. This TRU mixed waste consists largely of such items as paper, cloth, and other organic material; laboratory glassware and utensils; tools; scrap metal; shielding; and solidified sludges from the treatment of wastewater. Much of this TRU mixed waste is also contaminated with substances that are defined as hazardous under 20.4.1.200 NMAC.

(2) Chemical and physical analyses of the hazardous waste and hazardous debris to be handled at the facility. At a minimum, these analyses shall contain all the information which must be known to treat, store, or dispose of the wastes properly in accordance with part 264 of this chapter.

The Permittees are proposing no changes to the Waste Analysis Plan (**WAP**). The Permittees are not proposing a change to the list of hazardous waste numbers for disposal at the WIPP facility. The Permittees are not proposing to change the methods used to conduct chemical and physical analysis of the waste. The Permittees are not proposing to change the chemical or physical characteristics of waste expected for disposal at the WIPP facility.

Please see Renewal Application Waste Analysis Plan (Chapter B, Appendices B1 through B7, and Addendum B1) for complete information on the chemical and physical analysis of hazardous waste.

The Permittees will continue to ensure that there are no incompatible wastes by ensuring that only waste with acceptable hazardous waste numbers (**HWNs**) are shipped to the WIPP facility and that there are no prohibited items as specified in the Treatment, Storage, Disposal Facility-Waste Acceptance Criteria (**TSDF-WAC**), such as liquids in excess of TSDF-WAC limits; compressed gases; or ignitable, corrosive, or reactive waste. Identification of the chemical and physical properties of the waste will be done by use of Acceptable Knowledge, representative chemical sampling, visual examination, and/or radiography. The Permittees will continue to review Waste Stream Profile Forms to ensure that the waste contains no ignitable, corrosive, or reactive waste; and that only allowed U.S. Environmental Protection Agency (**EPA**) hazardous waste numbers are accepted for storage and disposal at the WIPP. The Permittees will continue to monitor airborne volatile organic compounds underground to demonstrate compliance with the environmental performance standards.

(3) A copy of the waste analysis plan required by §264.13(b) and, if applicable §264.13(c).

The Permittees are providing a copy of their waste analysis plan as required by §264.13 in Renewal Application Chapter B, and Appendices B1 through B7. Also included with the Waste Analysis Plan is Addendum B1, *Dispute Resolution*.

(4) A description of the security procedures and equipment required by §264.14, or a justification demonstrating the reasons for requesting a waiver of this requirement.

The Permittees propose no modifications to security procedures and equipment as detailed in the Renewal Application Chapter C, *Security*; and Chapter D, *Inspection Schedule, Process and Forms,* Table D-1, *Inspection Schedule/Procedures*.

(5) A copy of the general inspection schedule required by §264.15(b) of this part. Include where applicable, as part of the inspection schedule, specific requirements in §§264.174, 264.193(i), 264.195, 264.226, 264.254, 264.273, 264.303, 264.602, 264.1033, 264.1052, 264.1053, 264.1058, 264.1084, 264.1085, 264.1086, and 264.1088 of this part.

The Permittees propose no change in the general inspection schedule. The Permittees inspect the WIPP facility for malfunctions and deterioration, operator errors, and discharges which may cause or lead to a release of hazardous waste constituents to the environment or threaten human health in accordance with 40 CFR §264.602, §264.15(b), and the weekly inspection requirements of §264.174. The general inspection schedule is identified in Renewal Application Chapter D, *Inspection Schedule, Process and Forms,* Renewal Application Table D-1, *Inspection Schedule/Procedures;* Renewal Application Table D-1A, *RH TRU Mixed Waste Inspection Schedule/Procedures*; Renewal Application Table D-2, *Monitoring Schedule*.

Black Text = Regulatory Citation   Blue Text = Permittees' Response

The Permittees do not manage hazardous waste in tanks, surface impoundments, waste piles, by land treatment, or in landfills, have no process vents, have no equipment that contains or contacts hazardous waste, and are exempt from Subpart CC standards for containers, therefore the requirements of §§264.193(i), 264.195, 264.226, 264.254, 264.273, 264.1033, 264.1052, 264.1053, 264.1058, 264.1084, 264.1085, 264.1086, 264.1088 are not applicable.

(6) A justification of any request for a waiver(s) of the preparedness and prevention requirements of part 264, subpart C.

No waivers of the preparedness and prevention requirements of part 264, Subpart C are being sought by the Permittees.

(7) A copy of the contingency plan required by part 264, subpart D. Note: Include, where applicable, as part of the contingency plan, specific requirements in §§264.227, 264.255, and 264.200.

A copy of Renewal Application Chapter F, *RCRA Contingency Plan*, is included. The WIPP facility does not manage hazardous waste in surface impoundments, therefore the requirements of §264.227 are not applicable. The WIPP facility does not manage waste in waste piles, therefore, the requirements of §264.255 are not applicable. The WIPP facility does not manage waste in tanks, therefore the requirements of §264.200 are not applicable.

(8) A description of procedures, structures, or equipment used at the facility to:

(i) Prevent hazards in unloading operations (for example, ramps, special forklifts);

The Permittees propose no change in the manner in which they prevent hazards in unloading operations as detailed in Renewal Application Chapter E, *Preparedness and Prevention*, Section E-2a, *Unloading Operations*; Renewal Appendix M1, *Container Storage*; and Renewal Application Appendix M2, *Geologic Repository*.

(ii) Prevent runoff from hazardous waste handling areas to other areas of the facility or environment, or to prevent flooding (for example, berms, dikes, trenches);

The Permittees propose no change in the manner in which they prevent runoff from hazardous waste handling areas to other areas of the facility or environment or to prevent flooding as described in Renewal Application Chapter E, *Preparedness and Prevention*, Section E-2b, *Runoff.*

(iii) Prevent contamination of water supplies;

The Permittees propose no change in the manner in which they prevent contamination of water supplies as detailed in Renewal Application Chapter E, *Preparedness and Prevention*, Section E-2c, *Water Supplies*.

(iv) Mitigate effects of equipment failure and power outages;

The Permittees propose no change in the manner in which they mitigate effects of equipment failure and power outages as detailed in Renewal Application Chapter E, *Preparedness and Prevention*, Section E-2d, *Equipment and Power Failure*.

(v) Prevent undue exposure of personnel to hazardous waste (for example, protective clothing);

The Permittees propose no change in the manner in which they prevent undue exposure of personnel to hazardous waste as detailed in Renewal Application Chapter E, *Preparedness and Prevention*, Section E-2e, *Personnel Protection*.

(vi) Prevent releases to atmosphere.

The Permittees propose no change in the manner in which they prevent releases to the atmosphere as detailed in Renewal Application Chapter E, *Preparedness and Prevention*, Section E-2f, *Releases to the Atmosphere*.

(9) A description of precautions to prevent accidental ignition or reaction of ignitable, reactive, or incompatible wastes as required to demonstrate compliance with §264.17 including documentation demonstrating compliance with §264.17(c).

The Permittees propose no change in the manner in which they take precautions to prevent accidental ignition or reaction of ignitable, reactive, or incompatible wastes as required to demonstrate compliance with §264.17 including documentation demonstrating compliance with §264.17(c) as detailed in Renewal Application Chapter E, *Preparedness and Prevention*, Section E-2g, *Flammable Gas Concentration Control*, and Section E-2f¸ *Prevention of Reaction of Ignitable, Reactive, and Incompatible Waste*.

(10) Traffic pattern, estimated volume (number, types of vehicles) and control (for example, show turns across traffic lanes, and stacking lanes (if appropriate); describe access road surfacing and load bearing capacity; show traffic control signals).

The Permittees propose no change in traffic patterns and no change is proposed in access road surfacing and load bearing capacity or traffic control signals as detailed in Renewal Application Chapter G, *Traffic Pattern*.

(11) Facility location information;

(i) In order to determine the applicability of the seismic standard [§264.18(a)] the owner or of a new facility must identify the political jurisdiction (e.g., county, township, or election district) in which the facility is proposed to be located.

[*Comment:* If the county or election district is not listed in appendix VI of part 264, no further information is required to demonstrate compliance with §264.18(a).]

There is no change in the applicability of the seismic standard. The WIPP facility is located in Eddy County, New Mexico. Eddy County is not listed in Part 264, Appendix VI; therefore, no further information is required to demonstrate compliance with § 264.18(a).

(ii) If the facility is proposed to be located in an area listed in appendix VI of part 264, the owner or operator shall demonstrate compliance with the seismic standard. This demonstration may be made using either published geologic data or data obtained from field investigations carried out by the applicant. The information provided must be of such quality to be acceptable to geologists experienced in identifying and evaluating seismic activity. The information submitted must show that either:

(A) No faults which have had displacement in Holocene time are present, or no lineations which suggest the presence of a fault (which have displacement in Holocene time) within 3,000 feet of a facility are present, based on data from:

(*1*) Published geologic studies,

(*2*) Aerial reconnaissance of the area within a five-mile radius from the facility.

(*3*) An analysis of aerial photographs covering a 3,000 foot radius of the facility, and

(*4*) If needed to clarify the above data, a reconnaissance based on walking portions of the area within 3,000 feet of the facility, or

The WIPP facility is located in Eddy County, New Mexico. Eddy County is not listed in Part 264, Appendix VI; therefore, no further information is required to demonstrate compliance with § 264.18(a).

(B) If faults (to include lineations) which have had displacement in Holocene time are present within 3,000 feet of a facility, no faults pass within 200 feet of the portions of the facility where treatment, storage, or disposal of hazardous waste will be conducted, based on data from a comprehensive geologic analysis of the site. Unless a site analysis is otherwise conclusive concerning the absence of faults within 200 feet of such portions of the facility data shall be obtained from a subsurface exploration (trenching) of the area within a distance no less than

200 feet from portions of the facility where treatment, storage, or disposal of hazardous waste will be conducted. Such trenching shall be performed in a direction that is perpendicular to known faults (which have had displacement in Holocene time) passing within 3,000 feet of the portions of the facility where treatment, storage, or disposal of hazardous waste will be conducted. Such investigation shall document with supporting maps and other analyses, the location of faults found.

[*Comment:* The Guidance Manual for the Location Standards provides greater detail on the content of each type of seismic investigation and the appropriate conditions under which each approach or a combination of approaches would be used.]

The WIPP facility is located in Eddy County, New Mexico. Eddy County is not listed in Part 264, Appendix VI; therefore, no further information is required to demonstrate compliance with § 264.18(a).

(iii) Owners and operators of all facilities shall provide an identification of whether the facility is located within a 100-year floodplain. This identification must indicate the source of data for such determination and include a copy of the relevant Federal Insurance Administration (FIA) flood map, if used, or the calculations and maps used where an FIA map is not available. Information shall also be provided identifying the 100-year flood level and any other special flooding factors (e.g., wave action) which must be considered in designing, constructing, operating, or maintaining the facility to withstand washout from a 100-year flood.

[*Comment:* Where maps for the National Flood Insurance Program produced by the Federal Insurance Administration (FIA) of the Federal Emergency Management Agency are available, they will normally be determinative of whether a facility is located within or outside of the 100-year floodplain. However, where the FIA map excludes an area (usually areas of the floodplain less than 200 feet in width), these areas must be considered and a determination made as to whether they are in the 100-year floodplain. Where FIA maps are not available for a proposed facility location, the owner or operator must use equivalent mapping techniques to determine whether the facility is within the 100-year floodplain, and if so located, what the 100-year flood elevation would be.]

The WIPP facility does not lie within a 100-year floodplain as defined in 20.4.1.500 NMAC, [incorporating 40 CFR 264.18(b)(2)(i)] and as regulated under 20.4.1.500 NMAC, [incorporating 40 CFR 264.18(b)(1)].

The Federal Emergency Management Agency (**FEMA**) has not issued flood maps for the WIPP site. The WIPP site lies in FEMA Panel 350120 0675 B. In a search of this Panel for flood maps, this Panel shows up under the heading "Non-printed panels" indicating it is a geographic area for which FEMA has not identified a flooding risk. The closest panel for which FEMA has evaluated flood risk is south of State Highway 128. Portions of this area have been designated as Zone X which FEMA defines as follows: "Zones B, C, and X -- Areas outside the 1-percent annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees.

No Base Flood Elevations or depths are shown within this zone. Insurance purchase is not required in these zones."

The Permittees characterization of the flooding potential is in Addendum L1, which references the DOE Final Environmental Impact Statement, Section 7.4.1. The DOE used data from the United States Geological Survey, which reported the maximum flood stage for an August 23, 1966, event at monitoring station # 08406500 at Malaga, New Mexico. This elevation was subtracted from the minimum elevation at the WIPP site to determine that there is no flooding potential from the Pecos River. The DOE used a regional topographic map to identify the closest approach of the Pecos River and the minimum elevation of the WIPP site. A similar topographic map is shown in Renewal Application Addendum L1, Figure L1-25. The Permittees used the general ground elevation in the vicinity of the surface facilities to calculate the height above the 100-year floodplain to be over 400 feet. The Permittees have modified Renewal Application Addendum Figure L1-25 to indicate the location of the USGS reporting station on the Pecos River that is closest to the WIPP facility and that is used to determine the height above the maximum reported historical flood.

To estimate the potential for overland flow and sheet flooding, the Permittees included Appendix D7 in the original Part B Permit Application as the calculation of the Probable Maximum Precipitation (PMP) event and used the information in the design of berms, dikes and ditches. This information has not changed, so the Permittees have not resubmitted or updated the PMP calculations in the Renewal Application.

(iv) Owners and operators of facilities located in the 100-year floodplain must provide the following information:

(A) Engineering analysis to indicate the various hydrodynamic and hydrostatic forces expected to result at the site as consequence of a 100-year flood.

(B) Structural or other engineering studies showing the design of operational units (e.g., tanks, incinerators) and flood protection devices (e.g., floodwalls, dikes) at the facility and how these will prevent washout.

(C) If applicable, and in lieu of paragraphs (b)(11)(iv) (A) and (B) of this section, a detailed description of procedures to be followed to remove hazardous waste to safety before the facility is flooded, including:

(*1*) Timing of such movement relative to flood levels, including estimated time to move the waste, to show that such movement can be completed before floodwaters reach the facility.

(*2*) A description of the location(s) to which the waste will be moved and demonstration that those facilities will be eligible to receive hazardous waste in accordance with the regulations under parts 270, 271, 124, and 264 through 266 of this chapter.

(*3*) The planned procedures, equipment, and personnel to be used and the means to ensure that such resources will be available in time for use.

(*4*) The potential for accidental discharges of the waste during movement.

The WIPP facility does not lie within a 100-year floodplain as defined in 20.4.1.500 NMAC, [incorporating 40 CFR 264.18(b)(2)(i)] and as regulated under 20.4.1.500 NMAC, [incorporating 40 CFR 264.18(b)(1)].

The FEMA has not issued flood maps for the WIPP site. The WIPP site lies in FEMA Panel 350120 0675 B. In a search of this Panel for flood maps, this Panel shows up under the heading "Non-printed panels" indicating it is a geographic area for which FEMA has not identified a flooding risk. The closest panel for which FEMA has evaluated flood risk is south of State Highway 128. Portions of this area have been designated as Zone X which FEMA defines as follows: "Zones B, C, and X -- Areas outside the 1-percent annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone. Insurance purchase is not required in these zones."

The Permittees characterization of the flooding potential is in Addendum L1, which references the DOE Final Environmental Impact Statement, Section 7.4.1. The DOE used data from the United States Geological Survey, which reported the maximum flood stage for an August 23, 1966, event at monitoring station # 08406500 at Malaga, New Mexico. This elevation was subtracted from the minimum elevation at the WIPP site to determine that there is no flooding potential from the Pecos River. The DOE used a regional topographic map to identify the closest approach of the Pecos River and the minimum elevation of the WIPP site. A similar topographic map is shown in Renewal Application Addendum L1, Figure L1-25. The Permittees used the general ground elevation in the vicinity of the surface facilities to calculate the height above the 100-year floodplain to be over 400 feet. The Permittees have modified Renewal Application Addendum Figure L1-25 to indicate the location of the USGS reporting station on the Pecos River that is closest to the WIPP facility and that is used to determine the height above the maximum reported historical flood.

To estimate the potential for overland flow and sheet flooding, the Permittees included Appendix D7 in the original Part B Permit Application as the calculation of the

Probable Maximum Precipitation (PMP) event and used the information in the design of berms, dikes and ditches. This information has not changed, so the Permittees have not resubmitted or updated the PMP calculations in the Renewal Application.

(v) Existing facilities NOT in compliance with §264.18(b) shall provide a plan showing how the facility will be brought into compliance and a schedule for compliance.

(12) An outline of both the introductory and continuing training programs by owners or operators to prepare persons to operate or maintain the HWM facility in a safe manner as required to demonstrate compliance with §264.16. A brief description of how training will be designed to meet actual job tasks in accordance with requirements in §264.16(a)(3).

The Permittees propose no changes to the training program as detailed in Renewal Application Appendix H1, *RCRA Hazardous Waste Management Job Titles and Descriptions*, and Renewal Application Appendix H2, *Training Course and Qualification/Certification Card Outlines*.

(13) A copy of the closure plan and, where applicable, the post-closure plan required by §§264.112, 264.118, and 264.197. Include, where applicable, as part of the plans, specific requirements in §§264.178, 264.197, 264.228, 264.258, 264.280, 264.310, 264.351, 264.601, and 264.603.

A copy of the closure plan, Renewal Application Chapter I, and Appendix I1 through I3, and the post closure plan, Renewal Application Chapter J and Appendix J1 are included as part of the Renewal Application.

(14) For hazardous waste disposal units that have been closed, documentation that notices required under §264.119 have been filed.

At the time of submittal of this Renewal Application, no HWDUs have been closed and no notices required under §264.119 have been filed.

(15) The most recent closure cost estimate for the facility prepared in accordance with §264.142 and a copy of the documentation required to demonstrate financial assurance under §264.143. For a new facility, a copy of the required documentation may be submitted 60 days prior to the initial receipt of hazardous wastes, if that is later than the submission of the part B.

Pursuant to 40 CFR 264.140(c), the Federal government is exempt from §264 Subpart H, *Financial Requirements*. Additionally, and in accordance with the Military Construction Appropriations Act, 2001, Pub. L. No.106-246, 114 Stat. 511 (2000), Washington TRU Solutions LLC (the co-operator) is not required to post bond or fulfill any other financial responsibility requirement relating to closure or post-closure care and monitoring of the WIPP facility. Therefore, this provision is not applicable.

(16) Where applicable, the most recent post-closure cost estimate for the facility prepared in accordance with §264.144 plus a copy of the documentation required to demonstrate financial assurance under §264.145. For a new facility, a copy of the required documentation may be submitted 60 days prior to the initial receipt of hazardous wastes, if that is later than the submission of the part B.

Pursuant to 40 CFR 264.140(c), the Federal government is exempt from §264 Subpart H, *Financial Requirements*. Additionally, and in accordance with the Military Construction Appropriations Act, 2001, Pub. L. No.106-246, 114 Stat. 511 (2000), Washington TRU Solutions LLC (the co-operator) is not required to post bond or fulfill any other financial responsibility requirement relating to closure or post-closure care and monitoring of the WIPP facility. Therefore, this provision is not applicable.

(17) Where applicable, a copy of the insurance policy or other documentation which comprises compliance with the requirements of §264.147. For a new facility, documentation showing the amount of insurance meeting the specification of §264.147(a) and, if applicable, §264.147(b), that the owner or operator plans to have in effect before initial receipt of hazardous waste for treatment, storage, or disposal. A request for a variance in the amount of required coverage, for a new or existing facility, may be submitted as specified in §264.147(c).

Pursuant to 40 CFR 264.140(c), the Federal government is exempt from §264 Subpart H, *Financial Requirements*. Additionally, and in accordance with the Military Construction Appropriations Act, 2001, Pub. L. No.106-246, 114 Stat. 511 (2000), Washington TRU Solutions LLC (the co-operator) is not required to post bond or fulfill any other financial responsibility requirement relating to closure or post-closure care and monitoring of the WIPP facility. Therefore, this provision is not applicable.

(18) Where appropriate, proof of coverage by a State financial mechanism in compliance with §264.149 or §264.150.

Pursuant to 40 CFR 264.140(c), the Federal government is exempt from §264 Subpart H, *Financial Requirements*. Additionally, and in accordance with the Military Construction Appropriations Act, 2001, Pub. L. No.106-246, 114 Stat. 511 (2000), Washington TRU Solutions LLC (the co-operator) is not required to post bond or fulfill any other financial responsibility requirement relating to closure or post-closure care and monitoring of the WIPP facility. Therefore, this provision is not applicable.

(19) A topographic map showing a distance of 1,000 feet around the facility at a scale of 2.5 centimeters (1 inch) equal to not more than 61.0 meters (200 feet). Contours must be shown on the map. The contour interval must be sufficient to clearly show the pattern of surface water flow in the vicinity of and from each operational unit of the facility. For example, contours with an interval of 1.5 meters (5 feet), if relief is greater than 6.1 meters (20 feet), or an interval of 0.6 meters (2 feet), if relief is less than 6.1 meters (20 feet). Owners and operators of HWM

facilities located in mountainous areas should use large contour intervals to adequately show topographic profiles of facilities. The map shall clearly show the following:

(i) Map scale and date.

Map scale and map date and contour intervals (as appropriate) are identified on individual maps.

(ii) 100-year floodplain area.

The WIPP facility does not lie within a 100-year floodplain as defined in 20.4.1.500 NMAC, [incorporating 40 CFR 264.18(b)(2)(i)] and as regulated under 20.4.1.500 NMAC, [incorporating 40 CFR 264.18(b)(1)].

The FEMA has not issued flood maps for the WIPP site. The WIPP site lies in FEMA Panel 350120 0675 B. In a search of this Panel for flood maps, this Panel shows up under the heading “Non-printed panels” indicating it is a geographic area for which FEMA has not identified a flooding risk. The closest panel for which FEMA has evaluated flood risk is south of State Highway 128. Portions of this area have been designated as Zone X which FEMA defines as follows: “Zones B, C, and X -- Areas outside the 1-percent annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone. Insurance purchase is not required in these zones.”

The Permittees characterization of the flooding potential is in Addendum L1, which references the DOE Final Environmental Impact Statement, Section 7.4.1. The DOE used data from the United States Geological Survey, which reported the maximum flood stage for an August 23, 1966, event at monitoring station # 08406500 at Malaga, New Mexico. This elevation was subtracted from the minimum elevation at the WIPP site to determine that there is no flooding potential from the Pecos River. The DOE used a regional topographic map to identify the closest approach of the Pecos River and the minimum elevation of the WIPP site. A similar topographic map is shown in Renewal Application Addendum L1, Figure L1-25. The Permittees used the general ground elevation in the vicinity of the surface facilities to calculate the height above the 100-year floodplain to be over 400 feet. The Permittees have modified Renewal Application Addendum Figure L1-25 to indicate the location of the USGS reporting station on the Pecos River that is closest to the WIPP facility and that is used to determine the height above the maximum reported historical flood.

To estimate the potential for overland flow and sheet flooding, the Permittees included Appendix D7 in the original Part B Permit Application as the calculation of the

Probable Maximum Precipitation (PMP) event and used the information in the design of berms, dikes and ditches. This information has not changed, so the Permittees have not resubmitted or updated the PMP calculations in the Renewal Application.

(iii) Surface waters including intermittent streams.

There are no major surface waters or intermittent streams within 10 miles of the WIPP facility.

(iv) Surrounding land uses (residential, commercial, agricultural, recreational).

See Figures Demographic A through F in *Maps and Illustrations* for the following surrounding land uses:

- Demographic A: 2007 CY – Active Mines and Inhabited Ranches within a 10-Mile Radius of the WIPP Facility
- Demographic B: 2007 CY - Maximum Yearly Cattle Density within a 50-Mile Radius of the WIPP Facility
- Demographic C: 2007 CY - Natural Gas Pipelines within a 5-Mile Radius of the WIPP Facility
- Demographic D: 2000 CY – Population within a 50-Mile Radius of the WIPP Facility
- Demographic E: 2007 CY – Acres Planted in Edible Agriculture and Commercial Crops within a 50-Mile Radius of the WIPP Facility
- Although there are no areas near the WIPP facility that are designated for public recreation, a map of major parks and recreation areas found in Eddy and Lea Counties has been provided as Demographic F: Major Parks and Recreation Areas in Lea and Eddy Counties. The Permittees are unaware of formally designated recreation areas within a ten-mile radius of the WIPP site. Transient recreational usage (e.g., hunting, camping, off-road vehicle use, bird watching) is permitted under the multiple use policies of the Bureau of Land Management and the State Land Office. Within the WIPP site boundary transient recreational usage is permitted outside the Off Limits Area. See Drawing 23-C-007-W for the Off Limits Area.

(v) A wind rose (i.e., prevailing wind-speed and direction).

Shown in *Maps and Illustrations.*

(vi) Orientation of the map (north arrow).

All maps and appropriate figures contain a north arrow. A table entitled, *Maps and Illustrations*, is provided to direct the reviewer to the drawings, maps, and illustration providing the information required by 40 CFR 270.14(b)(19). The table also directs the reader to other new or revised illustrated information.

(vii) Legal boundaries of the HWM facility site.

Shown on Figure 2-3 in *Part A Application*.

(viii) Access control (fences, gates).

Shown on Drawing 24-C-022-W in *Maps and Illustrations*.

(ix) Injection and withdrawal wells both on-site and off-site.

Shown on Figure 2-3 in *Part A Application*.

(x) Buildings; treatment, storage, or disposal operations; or other structure (recreation areas, runoff control systems, access and internal roads, storm, sanitary, and process sewerage systems, loading and unloading areas, fire control facilities, etc.)

The map for buildings, storage, or disposal operations; or other structures is located on drawings 24-C-022-W, 24-C-066-W1, 23-C-011-W1, and 22-V-001-W in *Maps and Illustrations*.

(xi) Barriers for drainage or flood control.

The map of barriers for drainage or flood control is included on drawing 23-C-011-W1 in *Maps and Illustrations*.

(xii) Location of operational units within the HWM facility site, where hazardous waste is (or will be) treated, stored, or disposed (include equipment cleanup areas).

The map for the location of operational units within the HWM facility site, where hazardous waste is stored or disposed, is located on Figure 2-3, *Topographic Map with Underground Facilities*. Drawings that provide details of the location of the units within the facility include 24-C-022-W, WIPP Site Facility Masterplan, 22-V-001-W, Underground Mine Plan Structure Contour of Base of Orange Marker Band.

(20) Applicants may be required to submit such information as may be necessary to enable the Regional Administrator to carry out his duties under other Federal laws as required in §270.3 of this part.

The Permittees will submit information necessary to enable the Secretary to carry out his duties under other Federal laws as required in § 40 CFR 270.3, as requested.

(21) For land disposal facilities, if a case-by-case extension has been approved under §268.5 or a petition has been approved under §268.6, a copy of the notice of approval for the extension or petition is required.

The WIPP Land Withdrawal Act Amendment of 1996 exempts waste designated by the Secretary of DOE for disposal at the WIPP facility from the Land Disposal Restrictions 40 CFR 268.

(22) A summary of the pre-application meeting, along with a list of attendees and their addresses, and copies of any written comments or materials submitted at the meeting, as required under §124.31(c).

Information to satisfy the requirements of §124.31(c) is submitted with this Renewal Application. Two sets of pre-application meetings were held. The first set of pre-application meetings was held on February 10, 2009, and February 12, 2009, in Carlsbad, New Mexico, and Santa Fe, New Mexico, respectively. The second set of pre-application meetings was held on May 5, 2009, and May 7, 2009, in Carlsbad, New Mexico, and Santa Fe, New Mexico, respectively. Summaries of the meetings, lists of attendees, written comments, and material submitted at the meetings have been included with this Renewal Application.

(c) *Additional information requirements.* The following additional information regarding protection of groundwater is required from owners or operators of hazardous waste facilities containing a regulated unit except as provided in §264.90(b) of this chapter:

(1) A summary of the ground-water monitoring data obtained during the interim status period under §§265.90 through 265.94, where applicable.

The Permittees have not collected groundwater data under interim status.

(2) Identification of the uppermost aquifer and aquifers hydraulically interconnected beneath the facility property, including ground-water flow direction and rate, and the basis for such identification (*i.e.,* the information obtained from hydrogeologic investigations of the facility area).

There has been no change in the identification of the uppermost aquifer or aquifers hydraulically connected beneath the WIPP facility property as detailed in Renewal Application Chapter L, *WIPP Groundwater Detection Monitoring Program Plan*.

(3) On the topographic map required under paragraph (b)(19) of this section, a delineation of the waste management area, the property boundary, the proposed "point of compliance" as

defined under §264.95, the proposed location of groundwater monitoring wells as required under §264.97, and, to the extent possible, the information required in paragraph (c)(2) of this section.

There is no change to the delineation of the waste management area, the property boundary, the point of compliance as defined under §264.95, or the location of groundwater monitoring wells as required under §264.97 as illustrated in the topographic map in Part A Application, Figure 2-3. The information required in paragraph (c)(2) of this section (i.e., identification of the uppermost aquifer and aquifers hydraulically interconnected beneath the facility property, including groundwater flow direction and rate) is not illustrated on this topographic map. This information is provided in detail in Renewal Application Chapter L, *WIPP Groundwater Detection Monitoring Program Plan*.

(4) A description of any plume of contamination that has entered the groundwater from a regulated unit at the time that the application was submitted that:

(i) Delineates the extent of the plume on the topographic map required under paragraph (b)(19) of this section;

No plume of contamination has entered the groundwater from a regulated unit.

(ii) Identifies the concentration of each appendix IX, of part 264 of this chapter, constituent throughout the plume or identifies the maximum concentrations of each appendix IX constituent in the plume.

No plume of contamination has entered the groundwater from a regulated unit.

(5) Detailed plans and an engineering report describing the proposed groundwater monitoring program to be implemented to meet the requirements of §264.97.

No contamination has entered the groundwater from a regulated unit.

(6) If the presence of hazardous constituents has *not* been detected in the groundwater at the time of permit application, the owner or operator must submit sufficient information, supporting data, and analyses to establish a detection monitoring program which meets the requirements of §264.98. This submission must address the following items specified under §264.98:

No hazardous constituents have been detected in groundwater in the vicinity of the WIPP facility. Renewal Application Chapter L, *WIPP Groundwater Detection Monitoring Program Plan*, includes the Detection Monitoring Program that has been established to meet the requirements of §264.98.

(i) A proposed list of indicator parameters, waste constituents, or reaction products that can provide a reliable indication of the presence of hazardous constituents in the ground water;

There are no changes to the indicator parameters, waste constituents, or reaction products that can provide a reliable indication of the presence of hazardous constituents in the groundwater as listed Renewal Application Chapter L, *WIPP Groundwater Detection Monitoring Program Plan*.

(ii) A proposed ground-water monitoring system;

The Permittees' groundwater monitoring system is detailed in Renewal Application Chapter L, *WIPP Groundwater Detection Monitoring Program Plan.*

(iii) Background values for each proposed monitoring parameter or constituent, or procedures to calculate such values; and

There has been no change to the background values for each proposed monitoring parameter. The results of groundwater background measurements taken over a five year period have been reported by the Permittees to establish a statistical baseline. Furthermore, if the Permittees identify additional constituents to be monitored, the first four samples are used to establish background values for that constituent.

(iv) A description of proposed sampling, analysis and statistical comparison procedures to be utilized in evaluating ground-water monitoring data.

The Permittees' sampling, analysis and statistical comparison procedures to be utilized in evaluating groundwater monitoring data are detailed in Renewal Application Chapter L, *WIPP Groundwater Detection Monitoring Program Plan*.

(7) If the presence of hazardous constituents has been detected in the groundwater at the point of compliance at the time of the permit application, the owner or operator must submit sufficient information, supporting data, and analyses to establish a compliance monitoring program which meets the requirements of §264.99. Except as provided in §264.98(h)(5), the owner or operator must also submit an engineering feasibility plan for a corrective action program necessary to meet the requirements of §264.100, unless the owner or operator obtains written authorization in advance from the Regional Administrator to submit a proposed permit schedule for submittal of such a plan. To demonstrate compliance with §264.99, the owner or operator must address the following items:

(i) A description of the wastes previously handled at the facility;

(ii) A characterization of the contaminated groundwater, including concentrations of hazardous constituents;

(iii) A list of hazardous constituents for which compliance monitoring will be undertaken in accordance with §§264.97 and 264.99;

(iv) Proposed concentration limits for each hazardous constituent, based on the criteria set forth in §264.94(a), including a justification for establishing any alternate concentration limits;

(v) Detailed plans and an engineering report describing the proposed groundwater monitoring system, in accordance with the requirements of §264.97; and

(vi) A description of proposed sampling, analysis and statistical comparison procedures to be utilized in evaluating groundwater monitoring data.

No contamination has entered the groundwater from a regulated unit. Therefore, the informational requirements to items (i) through (vi) do not apply.

(8) If hazardous constituents have been measured in the ground water which exceed the concentration limits established under §264.94 Table 1, or if ground water monitoring conducted at the time of permit application under §§265.90 through 265.94 at the waste boundary indicates the presence of hazardous constituents from the facility in ground water over background concentrations, the owner or operator must submit sufficient information, supporting data, and analyses to establish a corrective action program which meets the requirements of §264.100. However, an owner or operator is not required to submit information to establish a corrective action program if he demonstrates to the Regional Administrator that alternate concentration limits will protect human health and the environment after considering the criteria listed in §264.94(b). An owner or operator who is not required to establish a corrective action program for this reason must instead submit sufficient information to establish a compliance monitoring program which meets the requirements of §264.99 and paragraph (c)(6) of this section. To demonstrate compliance with §264.100, the owner or operator must address, at a minimum, the following items:

(i) A characterization of the contaminated ground water, including concentrations of hazardous constituents;

(ii) The concentration limit for each hazardous constituent found in the ground water as set forth in §264.94;

(iii) Detailed plans and an engineering report describing the corrective action to be taken; and

(iv) A description of how the ground-water monitoring program will demonstrate the adequacy of the corrective action.

(v) The permit may contain a schedule for submittal of the information required in paragraphs (c)(8) (iii) and (iv) provided the owner or operator obtains written authorization from the Regional Administrator prior to submittal of the complete permit application.

No contamination has entered the groundwater from a regulated unit. Therefore, this requirement does not apply.

(d) *Information requirements for solid waste management units.* (1) The following information is required for each solid waste management unit at a facility seeking a permit:

(i) The location of the unit on the topographic map required under paragraph (b)(19) of this section.

(ii) Designation of type of unit.

(iii) General dimensions and structural description (supply any available drawings).

(iv) When the unit was operated.

(v) Specification of all wastes that have been managed at the unit, to the extent available.

The NMED determined that no further action is necessary to investigate 15 Solid Waste Management Units (**SWMUs**) and eight Areas of Concern (**AOCs**) at the WIPP facility. A Class 3 permit modification request to remove SWMUs and AOCs from their Permit was approved by the NMED on October 23, 2008. No new SWMUs or AOCs have been identified for inclusion in the Renewal Application.

(2) The owner or operator of any facility containing one or more solid waste management units must submit all available information pertaining to any release of hazardous wastes or hazardous constituents from such unit or units.

The NMED determined that no further action is necessary to investigate 15 SWMUs and eight AOCs at the WIPP facility. A Class 3 permit modification request to remove SWMUs and AOCs from their Permit was approved by the NMED on October 23, 2008. No new SWMUs or AOCs have been identified for inclusion in the Renewal Application.

(3) The owner/operator must conduct and provide the results of sampling and analysis of groundwater, land surface, and subsurface strata, surface water, or air, which may include the installation of wells, where the Director ascertains it is necessary to complete a RCRA Facility Assessment that will determine if a more complete investigation is necessary.

The NMED determined that no further action is necessary to investigate 15 SWMUs and eight AOCs at the WIPP facility. A Class 3 permit modification request to remove SWMUs and AOCs from their Permit was approved by the NMED on October 23, 2008. No new SWMUs or AOCs have been identified for inclusion in the Renewal Application.

§270.15 Specific part B information requirements for containers

Except as otherwise provided in §264.170, owners or operators of facilities that store containers of hazardous waste must provide the following additional information:

(a) A description of the containment system to demonstrate compliance with §264.175. Show at least the following:

(1) Basic design parameters, dimensions, and materials of construction.

In the original Part B Permit Application, the Permittees submitted Appendix D3 which contained detailed engineering information regarding the storage units and associated buildings and structures in the form of drawings and diagrams. These represented the "as-built" condition of the facility. Some of these drawings and diagrams have changed significantly and therefore are being submitted with this Renewal Application. Significant changes are considered to be those that altered a structure, added a new structure, or modified the function of a structure. These drawings and diagrams are:

- 24-C-022-W: WIPP Site Facility Masterplan
- 23-C-011-W1: Salt Pile Infiltration Controls New Design
- 24-C-028-W1: WIPP Site Finish Grading and Paving
- 24-C-028-W2: Site Work Finish Grading and Paving Sections and Details
- 41-S-003-W1: Waste Handling Building 411 Firewater Collection Sprinkler System P & ID [Piping and Instrumentation Diagram]
- 41-S-003-W2: Waste Handling Building 411 Firewater Collection Sprinkler System P & ID [Piping and Instrumentation Diagram]
- 41-S-003-W3: Waste Handling Building 411 Firewater Collection Sprinkler System P & ID [Piping and Instrumentation Diagram]
- 41-S-003-W4: Waste Handling Building 411 Firewater Collection Sprinkler System P & ID [Piping and Instrumentation Diagram]
- 41-M-001-W: Waste Handling Facilities TRUPACT Dock Equipment Arrangement
- 41-B-010-W1: CH Area Constant Volume, CH Area HVAC [Heating, Ventilation, and Air Conditioning] Flow Diagram Supply Air

Containment systems are provided by transportation packaging for unloaded waste and by the concrete floor of the Waste Handling Building as described in Renewal Application Appendix M1, *Container Storage*. The Permittees proposed no changes to the basic design parameters, dimensions, and materials of construction of the containment system.

(2) How the design promotes drainage or how containers are kept from contact with standing liquids in the containment system.

The Permittees propose no changes in the manner in which the containers are kept from contacting standing liquids as detailed Renewal Application Appendix M1, *Container Storage*, Section M1-1f, *Containment*.

(3) Capacity of the containment system relative to the number and volume of containers to be stored.

The Permittees propose no changes in the capacity of the containment system relative to numbers and volume of containers to be stored, as detailed in Renewal Application Appendix M1, *Container Storage*, Section M1-1f, *Containment*.

(4) Provisions for preventing or managing run-on.

The Permittees propose no change in the manner in which they manage run-on as detailed in Renewal Application Chapter E, *Preparedness and Prevention*, Section E-2b *Runoff* and Appendix M1, *Container Storage*, Section M1-1i, *Control of Run On*.

(5) How accumulated liquids can be analyzed and removed to prevent overflow.

The Permittees propose no change to the manner in which accumulated liquids can be analyzed and removed to prevent overflow as described in the Renewal Application Chapter F-4b, *Identification of Hazardous Materials*, and Renewal Application Appendix M1, *Container Storage*.

(b) For storage areas that store containers holding wastes that do not contain free liquids, a demonstration of compliance with §264.175(c), including:

(1) Test procedures and results or other documentation or information to show that the wastes do not contain free liquids; and

The Permittees propose no change. The DOE manages all TRU mixed waste containers in the Parking Area and the Waste Handling Building as though they contain up to one percent residual liquids. Appropriate secondary containment calculations are provided in Appendix M1, *Container Storage* of the Renewal Application. Consequently, the requirements in 20 4.1.500 NMAC, incorporating 40 CFR §264.175(c) do not apply to the WIPP facility.

(2) A description of how the storage area is designed or operated to drain and remove liquids or how containers are kept from contact with standing liquids.

The Permittees propose no change. The DOE manages all TRU mixed waste containers in the Parking Area and the Waste Handling Building as though they contain up to one percent residual liquids. Appropriate secondary containment calculations are provided in Appendix M1, *Container Storage* of the Renewal Application. Consequently, the requirements in 20 4.1.500 NMAC, incorporating 40 CFR §264.175(c) do not apply to the WIPP facility.

(c) Sketches, drawings, or data demonstrating compliance with §264.176 (location of buffer zone and containers holding ignitable or reactive wastes) and §264.177(c) (location of incompatible wastes), where applicable.

All waste received at the WIPP facility will be determined to be compatible prior to being received at the WIPP facility. Ignitable, reactive, or corrosive waste (i.e., compressed gases and liquids in excess of the TSDF-WAC) are prohibited in accordance with the TSDF-WAC. Therefore, a buffer zone for containers holding ignitable or reactive wastes and incompatible wastes is not needed.

(d) Where incompatible wastes are stored or otherwise managed in containers, a description of the procedures used to ensure compliance with §§264.177 (a) and (b), and 264.17 (b) and (c).

The Permittees propose no change to the compatibility determination as identified in Renewal Application Chapter B, *Waste Analysis Plan*. Furthermore, the TSDF-WAC in Renewal Application Chapter B, *Waste Analysis Plan*, prohibits the receipt of incompatible waste and Renewal Application Chapter F, *RCRA Contingency Plan,* requires the evaluation of compatibility.

(e) Information on air emission control equipment as required in §270.27.

Pursuant to 40 CFR 264.1080(a)(6), air emission controls for containers do not apply to radioactive mixed waste. Therefore, this requirement is not applicable.

§270.23 Specific part B information requirements for miscellaneous units

Except as otherwise provided in §264.600, owners and operators of facilities that treat, store, or dispose of hazardous waste in miscellaneous units must provide the following additional information:

(a) A detailed description of the unit being used or proposed for use, including the following:

(1) Physical characteristics, materials of construction, and dimensions of the unit;

In the original Part B Permit Application, the Permittees submitted Appendix D3 which contained detailed engineering information regarding the disposal units and associated buildings and structures in the form of drawings and diagrams. These represented the "as-built" condition of the facility. Some of these drawings and diagrams have changed significantly and therefore are being submitted with this Renewal Application. Significant changes are considered to be those that altered a structure, added a new structure, or modified the function of a structure. These drawings and diagrams are:

- 22-V-001-W: Underground Mine Plan Structure Contour of Base of Orange Marker Band
- 53-J-039-W: Underground Utilities Fire Panel 534-FP-0320
- 53-J-042-W: Underground Utilities Fire Panel 534-FP-00601
- 54-W-009-W: Underground Mine Plan Shaft and Drift Dimensions

This not withstanding, there are no changes in the physical characteristics, materials of construction, and dimensions of the units. Through this Renewal Application, the Permittees are proposing the authorization to dispose of TRU-mixed waste of both CH and RH TRU mixed-waste in Panel 8. In a previously approved Class 3 permit modification request (May 2003), the New Mexico Environment Department approved the construction and use of Panels (i.e., Hazardous Waste Disposal Units) 4 through 7 and the construction of Panel 8. The use of Panel 8 for disposal of TRU mixed waste was not authorized at that time. Prior to using Panel 8 for TRU mixed waste disposal, the Permittees will submit to the Secretary, by certified mail or hand delivery, a letter signed by the Permittees and a New Mexico registered professional engineer stating Panel 8 has been constructed in compliance with the Permit, and the Permittees will not manage any hazardous waste in Panel 8 until the Secretary has either inspected the modified portion of the facility and finds it is in compliance with the conditions of this Permit; or waived the inspection or, within fifteen calendar days of the date of submission of the letter required above, has not notified the Permittees of his intent to inspect.

(2) Detailed plans and engineering reports describing how the unit will be located, designed, constructed, operated, maintained, monitored, inspected, and closed to comply with the requirements of §§264.601 and 264.602; and

The Permittees are not proposing any changes to detailed plans and engineering reports describing how the unit will be located, designed, constructed, operated, maintained, monitored, inspected, and closed to comply with the requirements of 264.601 and

264.602, as described in Renewal Application Appendix M1, *Container Storage*; M2, *Geologic Repository*; Chapter D, *Inspection Schedule, Process and Forms*; Appendix D1, *Inspection Sheets*, Chapter L, *WIPP Groundwater Detection Monitoring Program Plan*; Chapter N, *Volatile Organic Compounds Monitoring Plan*; Appendix N1, *Hydrogen and Methane Monitoring Plan*; and the WIPP facility Closure Plan documents: Renewal Application Chapter I through Appendix I3, and Post-Closure Plan documents: Renewal Application Chapter J and Appendix J1.

(3) For disposal units, a detailed description of the plans to comply with the post-closure requirements of §264.603.

There are no changes to the plans to comply with the post-closure requirements of §264.603 as detailed in Renewal Application Chapter J, *Post-Closure Plan*.

(b) Detailed hydrologic, geologic, and meteorologic assessments and land-use maps for the region surrounding the site that address and ensure compliance of the unit with each factor in the environmental performance standards of §264.601. If the applicant can demonstrate that he does not violate the environmental performance standards of §264.601 and the Director agrees with such demonstration, preliminary hydrologic, geologic, and meteorologic assessments will suffice.

There are no changes to the detailed hydrologic, geologic, and meteorologic assessments and land-use maps for the region surrounding the site that address and ensures compliance of the unit with each factor in the environmental performance standards of §264.601. However, updated information is provided in Renewal Application Addendum L1, *Site Characterization*.

(c) Information on the potential pathways of exposure of humans or environmental receptors to hazardous waste or hazardous constituents and on the potential magnitude and nature of such exposures.

Since the original permit application was submitted, there have been changes to the conceptual models that predict repository behavior. The Permittees have reevaluated the performance demonstration information submitted with the original Part B Application. Accordingly, Illustrations from the original Part B Application regarding the 300-year performance demonstration have been updated. The updated figures are provided in Renewal Application Addendum N1, *300-year Performance Demonstration Re-Evaluation*. The figures illustrate the following information:

- Figure 1 - Predicted Change in Repository Pressure Following Closure for the PABC and Original Performance Demonstrations

- Figure 2 - Predicted Cumulative Moles of Gas Generated Per Drum of Waste for the PABC and Original Performance Demonstrations

- Figure 3 - Predicted Cumulative Brine Inflow into a Closed Waste Panel for the PABC and Original Performance Demonstrations
- Figure 4 - Predicted Change in Panel Pore Volume Due to Creep Closure for the PABC and Original Performance Demonstrations
- Figure 5 - Predicted Average Brine Saturation in the Panel for the PABC and Original Performance Demonstrations

There is no change to the conclusions reached in the original permit application, that is, the only viable mechanism for a release from the repository is the air emissions pathway. This pathway exists prior to final closure. No viable releases along soil or water pathways were identified. There is no change to the potential exposure of humans or environmental receptors to hazardous waste or hazardous constituents or to the magnitude and nature of such exposures.

(d) For any treatment unit, a report on a demonstration of the effectiveness of the treatment based on laboratory or field data.

The Waste Isolation Pilot Plant facility does not operate treatment units.

(e) Any additional information determined by the Director to be necessary for evaluation of compliance of the unit with the environmental performance standards of §264.601.

Any additional information determined by the Secretary to be necessary for evaluation of compliance of the unit with the environmental performance standards of §264.601 will be provided as requested.

Waste Isolation Pilot Plant
Necessary Information for the Hazardous Waste Facility Permit
Renewal Application — Part B
Maps and Illustrations

Regulatory Citation	Requirement	Comment	Identification №
40 CFR §270.14(b)(19)	A topographic map showing a distance of 1,000 feet around the facility at a scale of 2.5 centimeters (1 inch) equal to not more than 61.0 meters (200 feet). Contours must be shown on the map. The contour interval must be sufficient to clearly show the pattern of surface water flow in the vicinity of and from each operational unit of the facility. For example, contours with an interval of 1.5 meters (5 feet), if relief is greater than 6.1 meters (20 feet), or an interval of 0.6 meters (2 feet), if relief is less than 6.1 meters (20 feet). Owners and operators of HWM facilities located in mountainous areas should use large contour intervals to adequately show topographic profiles of facilities. The map shall clearly show the following:	As the Waste Isolation Pilot Plant (**WIPP**) facility is a large facility consisting of 16 sections (each section containing 640 acres) several maps and figures were employed so that the information that is required by 40 CFR §270.14(b)(19) *et seq*. can be better illustrated. Map scale and contours are noted on the appropriate figures and maps. To place all information on one topographic map would make it difficult to review. This table was provided to make it easier for the reviewer to locate the information.	Figure 2-3 This figure is shown under Tab Part A Appendices.
40 CFR §270.14(b)(19)(i)	Map scale and date	There are multiple maps and engineered drawings provided to illustrate the required information. All appropriate maps and figures depict map scale, date. 2007 CY – Active Mines and Inhabited Ranches within a 10-Mile Radius of the WIPP Facility	Figure 2-3. This figure is shown under Tab Part A Appendices. Demographic A

Regulatory Citation	Requirement	Comment	Identification №
		2007 CY - Maximum Yearly Cattle Density within a 50-Mile Radius of the WIPP Facility	Demographic B
		2007 CY - Natural Gas Pipelines within a 5-Mile Radius of the WIPP Facility	Demographic C
		2000 CY – Population within a 50-Mile Radius of the WIPP Facility	Demographic D
		2007 CY – Acres Planted in Edible Agriculture and Commercial Crops within a 50-mile Radius of the WIPP Facility	Demographic E
		Major Parks and Recreation Areas in Lea and Eddy Counties, September 2009	Demographic F
		Land Withdrawal Area Location of Facilities	Drawing 23-C-007-W
		WIPP Site Facility Masterplan	Drawing 24-C-022-W
		Sanitary Sewage Lagoon Liner Replacement project, Site Plan and Details	Drawing 24-C-066-W1
		Salt Pile Infiltration Controls, New Design	Drawing 23-C-011-W1
		Underground Mine Plan Structure of Base of Orange Marker Band	Drawing 22-V-001-W

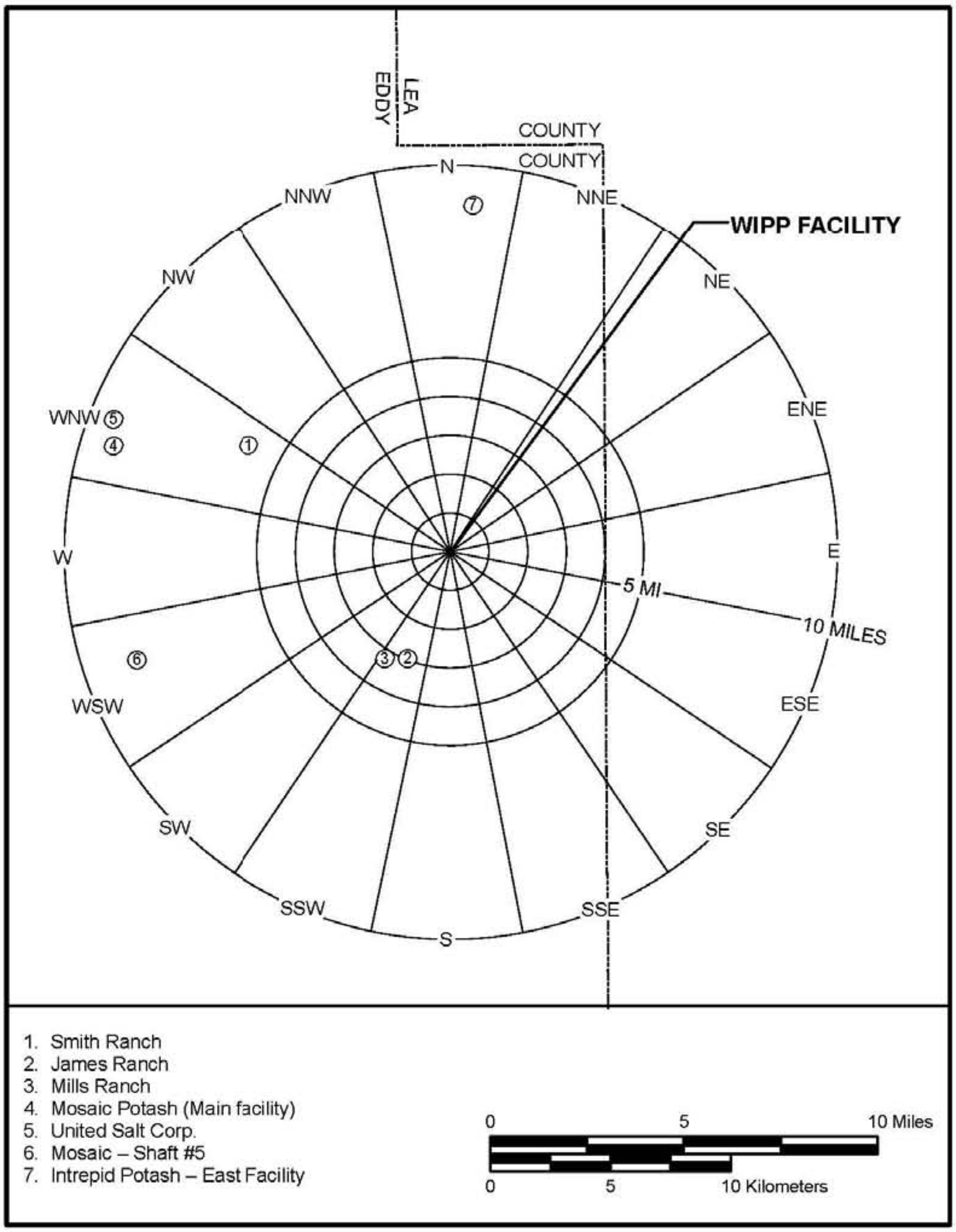
Regulatory Citation	Requirement	Comment	Identification №
40 CFR §270.14(b)(19)(ii)	100-year floodplain area	The WIPP facility is not in the 100-year floodplain	NA
40 CFR §270.14(b)(19)(iii)	Surface waters including intermittent streams	There are no surface waters or intermittent streams	NA
40 CFR §270.14(b)(19)(iv)	Surrounding land uses	2007 CY - Mines and Inhabited Ranches within a 10-Mile Radius of the WIPP Facility 2007 CY - Maximum Yearly Cattle Density within a 50-Mile Radius of the WIPP Facility 2007 CY - Natural Gas Pipelines within a 5-Mile Radius of the WIPP Facility 2000 CY – Population within a 50-Mile Radius of the WIPP Facility 2007 CY – Acres Planted in Edible Agriculture and Commercial Crops within a 50-Mile Radius of the WIPP Facility Major Parks and Recreational Areas in Lea and Eddy Counties	Demographic A Demographic B Demographic C Demographic D Demographic E Demographic F
40 CFR §270.14(b)(19)(v)	A wind rose	Wind Speed Report (meters/second), January 1, 2008 to December 31, 2008, Elevation 10.0 meters	Wind Rose
40 CFR §270.14(b)(19)(vi)	Orientation of the map	Each map contains a north orientation compass	See list in 40 CFR §270.14(b)(19)(i), (iv), and (v)

Regulatory Citation	Requirement	Comment	Identification №
40 CFR §270.14(b)(19)(vii)	Legal boundaries of the HWM facility site	Topographic Map with Underground Facilities and Land Withdrawal Area/Location of Facilities	Part A Application Figure 2-3
40 CFR §270.14(b)(19)(viii)	Access control	WIPP Site Facility Masterplan	Drawing 24-C-022-W
40 CFR §270.14(b)(19)(ix)	Injection and withdrawal wells both on-site and off-site	Topographic Map with Underground Facilities	Part A Application Figure 2-3
40 CFR §270.14(b)(19)(x)	Buildings; treatment, storage, or disposal operations; or other structure (recreation areas, runoff control systems, access and internal roads, storm, sanitary, and process sewerage systems, loading and unloading areas, fire control facilities, etc.)	WIPP Site Facility Masterplan Underground Mine Plan Structure Contour of Base of Orange Marker Band Sanitary Sewage Lagoon Liner Replacement Project Site Plan and Details Salt Pile Infiltration Controls New Design	Drawing 24-C-022-W Drawing 22-V-001-W Drawing 24-C-066-W1 Drawing 23-C-011-W1
40 CFR §270.14(b)(19)(xi)	Barriers for drainage or flood control	Salt Pile Infiltration Controls New Design WIPP Site Finish Grading and Paving	Drawing 23-C-011-W1 Drawing 24-C-028-W1
40 CFR §270.14(b)(19)(xii)	Location of operational units within the HWM facility site, where hazardous waste is treated, stored, or disposed	WIPP Site Facility Masterplan Underground Mine Plan Structure Contour of Base of Orange Marker Band Topographic Map with Underground Facilities	Drawing 24-C-022-W Drawing 22-V-001-W Part A Application: Figure 2-3

Regulatory Citation	Requirement	Comment	Identification №
The Following Drawings Contain New/Revised Information and Are Being Submitted With the Renewal Application – Part B			
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	WIPP Site Facility Masterplan	Drawing 24-C-022-W
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	WIPP Site Finish Grading and Paving	Drawing 24-C-028-W1
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	Site Work Finish Grading and Paving Sections and Details	Drawing 24-C-028-W2
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction	Salt Pile Infiltration Controls New Design	Drawing 23-C-011-W1

Regulatory Citation	Requirement	Comment	Identification №
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	Waste Handling Building 411 Fire Protection Sprinkler System P & ID	Drawing 41-S-003-W1
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	Waste Handling Building 411 Fire Protection Sprinkler System P & ID	Drawing 41-S-003-W2
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	Waste Handling Building 411 Fire Protection Sprinkler System P & ID	Drawing 41-S-003-W3
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	Waste Handling Building 411 Fire Protection Sprinkler System P & ID	Drawing 41-S-003-W4
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	Waste Handling Facilities TRUPACT Dock Equipment Arrangement	Drawing 41-M-001-W

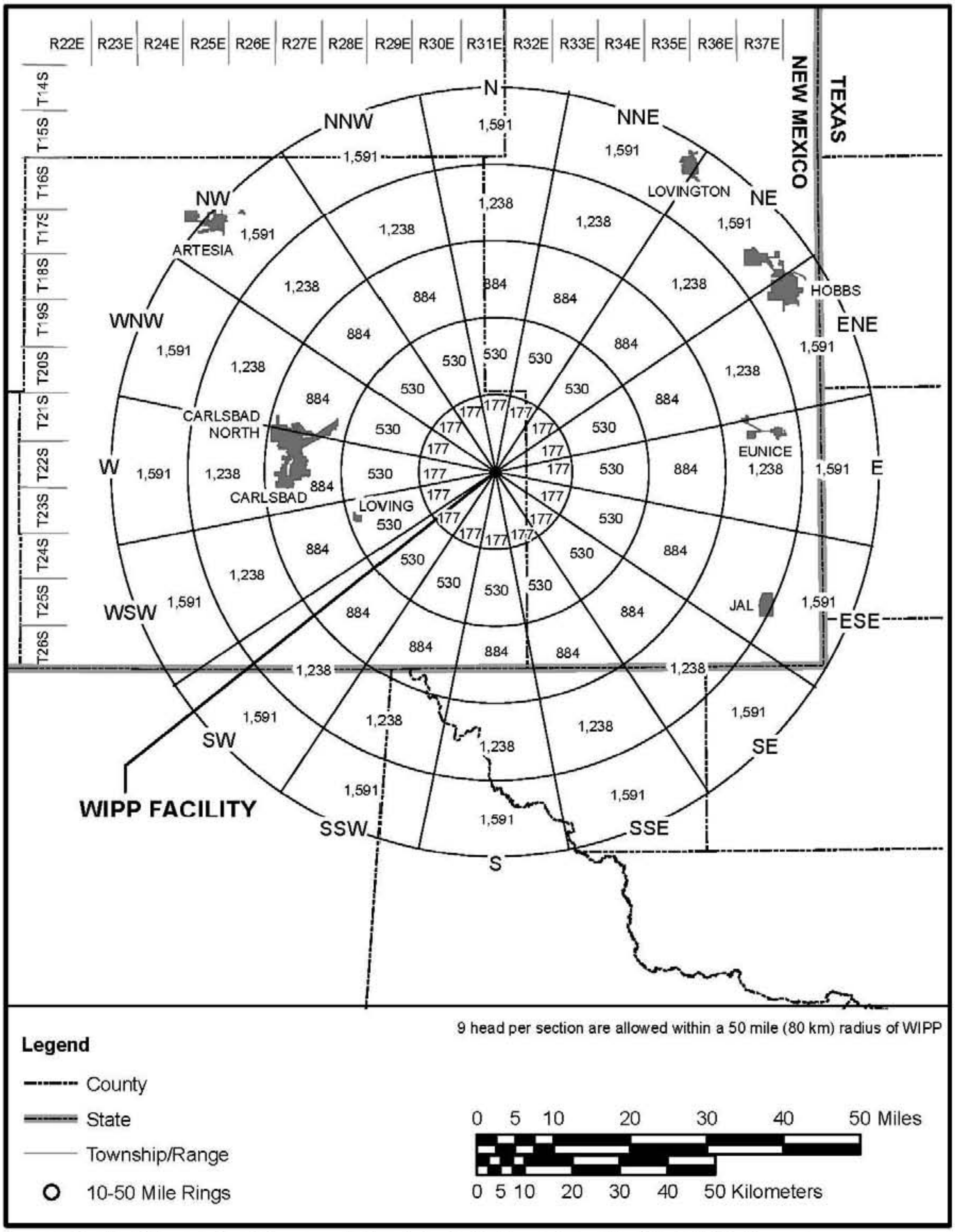
Regulatory Citation	Requirement	Comment	Identification №
40 CFR §270.15(a)(1)	A description of the containment system to demonstrate compliance with §264.175. Show at least the following: (1) Basic design parameters, dimensions, and materials of construction.	CH Area Constant Volume CH Area HVAC Flow Diagram Supply Air	Drawing 41-B-010-W1
40 CFR §270.23(a)(1)	A detailed description of the unit being used or proposed for use, including the following: (1) Physical characteristics, materials of construction, and dimensions of the unit;	Underground Mine Plan Structure Contour of Base of Orange Marker Band Underground Utilities Fire Panel 534-FP-0320 Underground Utilities Fire Panel 534-FP-00601 Underground Mine Plan Shaft and Drift Dimensions	Drawing 22-V-001-W Drawing 53-J-039-W Drawing 53-J-042-W Drawing 54-W-009-W



Sources: Hughes, D.L., Delaware Basin Drilling Services; USA PHOTOMAPS; GOOGLE Earth; Eddy County Planning Department; New Mexico Cattle Growers Association; Artesia Alfalfa Growers

Demographic A

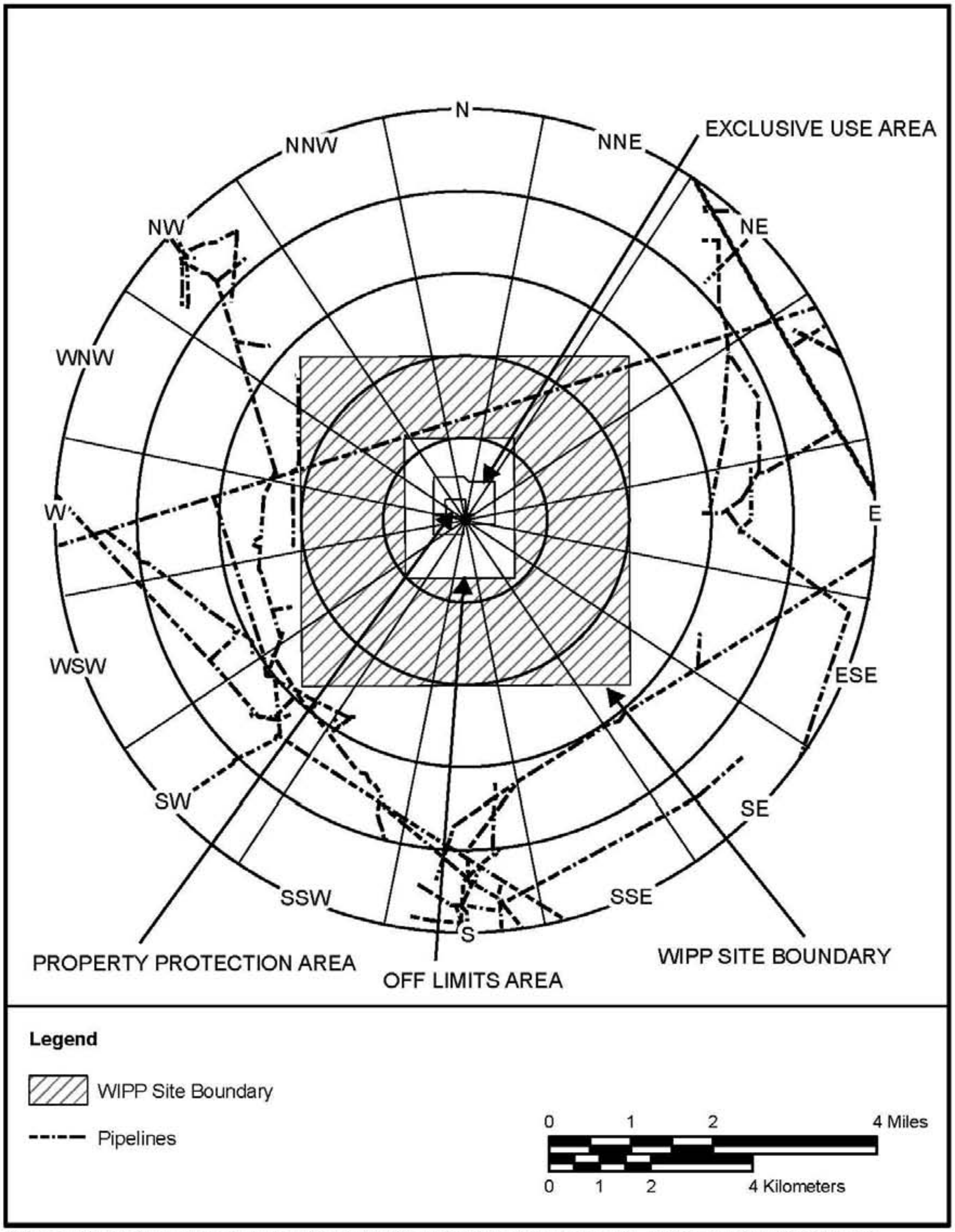
2007 CY - Active Mines and Inhabited Ranches within a 10-Mile Radius of the WIPP Facility



Sources: Pavelik, B. Bureau of Land Management; New Mexico Cattle Growers Association; Artesia Alfalfa Growers

Demographic B

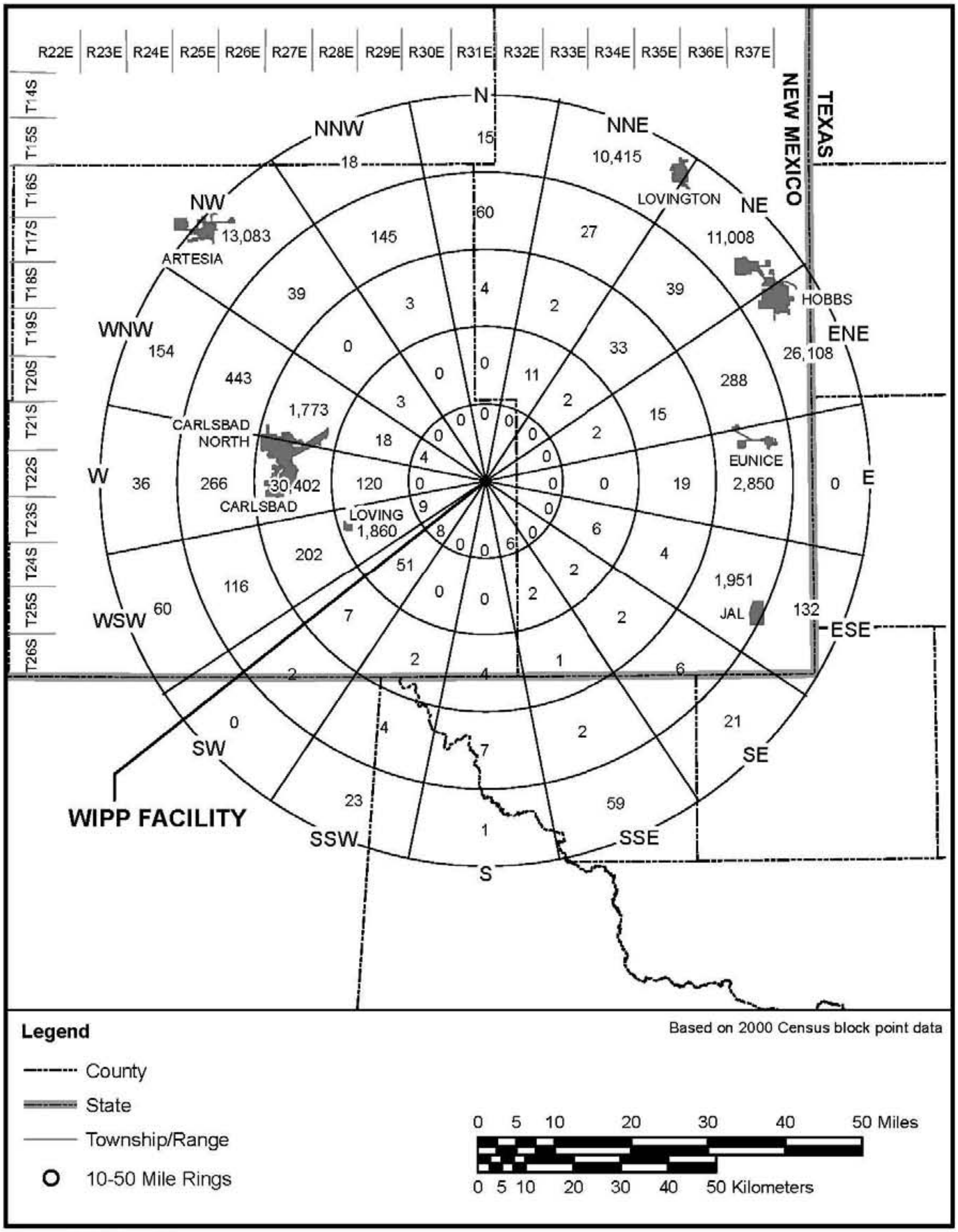
1 **2007 CY - Maximum Yearly Cattle Density within a 50-Mile Radius of the WIPP Facility**



Sources: Bureau of Land Management; El Paso Natural Gas/Mohave Pipeline; Hughes, D.L., Delaware Basin Drilling Services

Demographic C

2007 CY - Natural Gas Pipelines within a 5-Mile Radius of the WIPP Facility

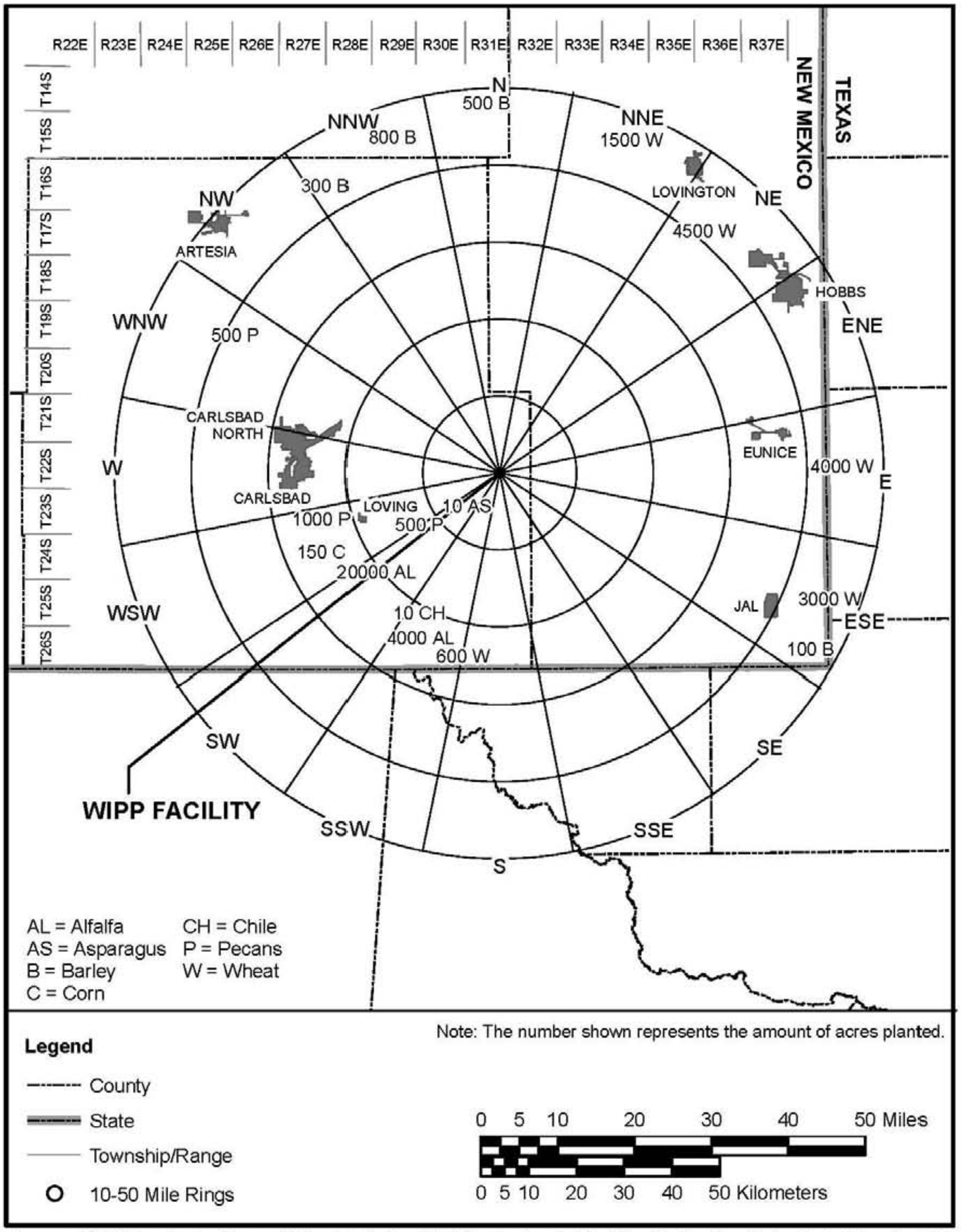


Source: U.S. Census Bureau

Demographic D

2000 CY - Population within a 50-Mile Radius of the WIPP Facility

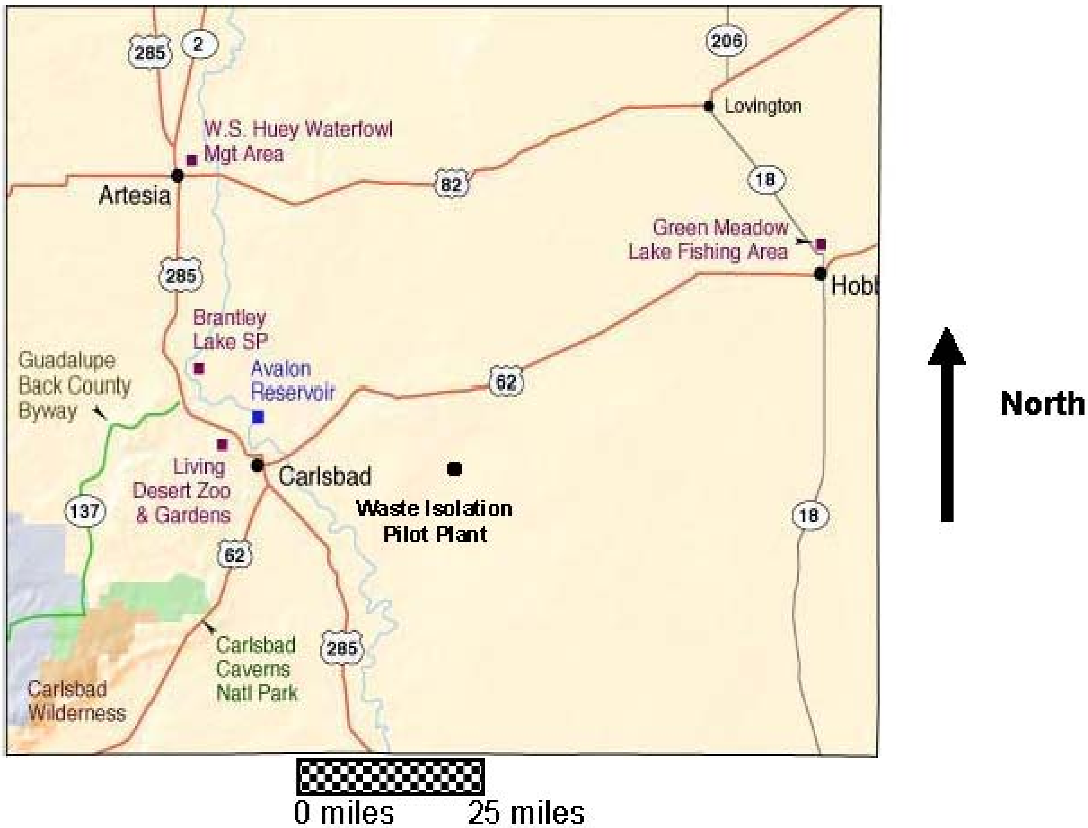
1



Sources: USDA Farm Service Agency; National Agricultural Statistics Service, Carlsbad New Mexico; New Mexico State University; Eddy County Extension Service; Lea County Extension Service; Texas State Technical College - West Texas.

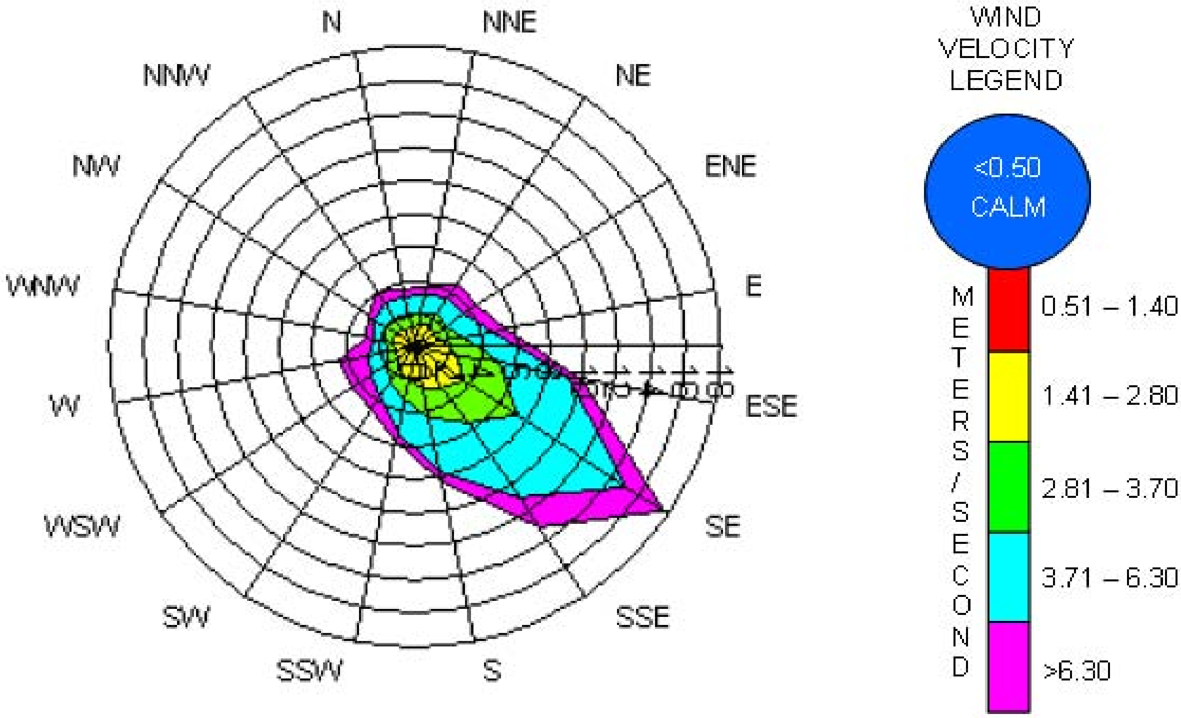
Demographic E

1 **2007 CY - Acres Planted in Edible Agriculture and Commerical Crops within a 50-Mile Radius of the WIPP Facility**



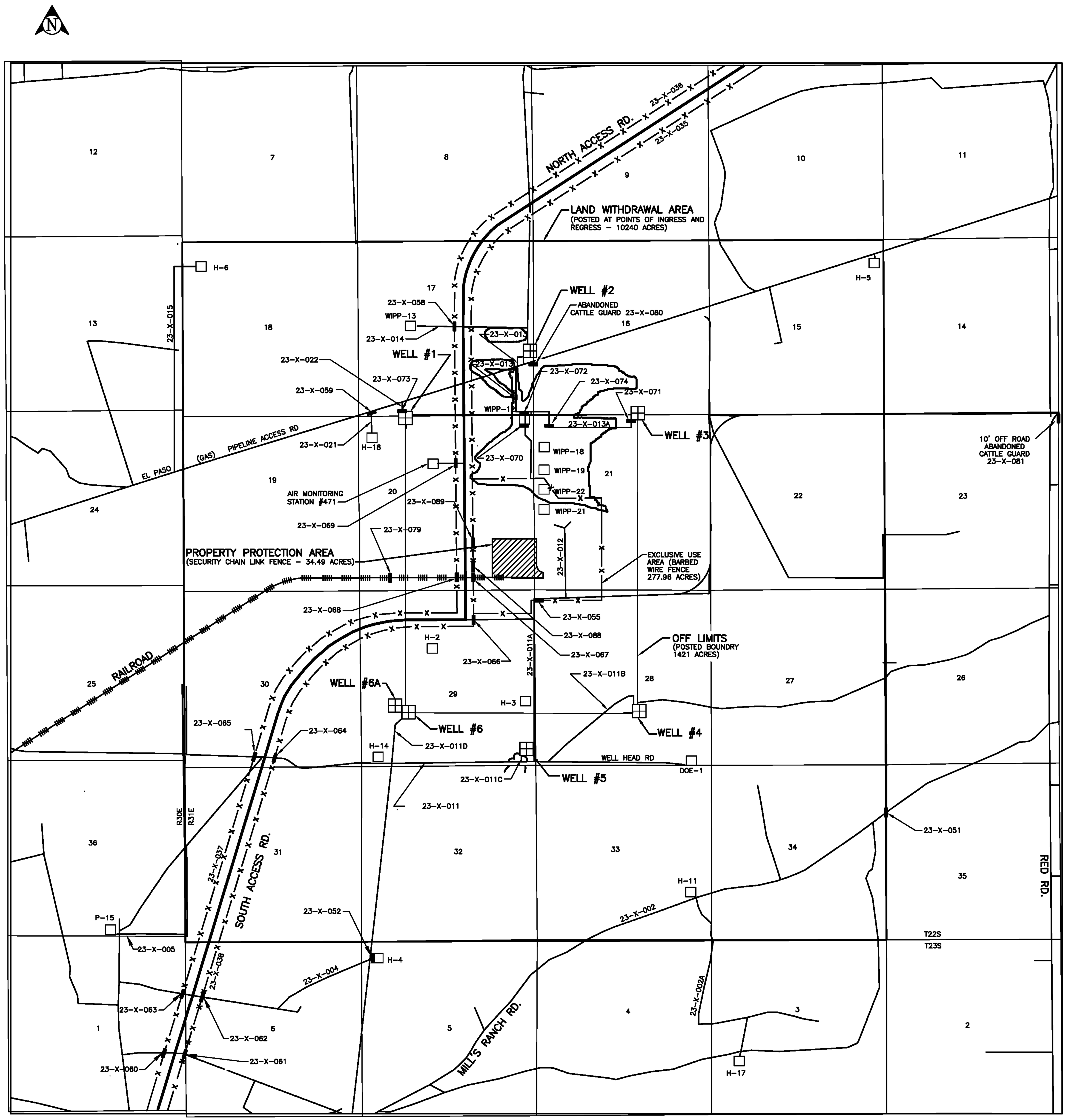
Major Parks and Recreational Areas in Lea and Eddy Counties

Demographic F



2008 CY - Wind Speed Report

23-C-007-W



WELL NO.	EQUIP. NO.	WELL LOCATION	WELL COORDINATES NORTH / EAST	ACCESS ROAD EQUIP. NO.	LENGTH
1	23-X-101	T22S; R31E; SECTION 20 57.33FNL; 1417.55FWL	13786.96 3593.62	23-X-022	120'
2	23-X-102	T22S; R31C; SECTION 17 1650.86FSL; 99.54FEL	15539.93 7579.69	23-X-013	600'
3	23-X-103	T22S; R31E; SECTION 16 50.29FSL; 2170.73FEL	13993.26 10573.72	23-X-013A	3350'
4	23-X-104	T22S; R31E; SECTION 28 1632.64FSL; 2169.50FEL	4986.36 10643.60	23-X-011B	3900'
5	23-X-105	T22S; R31E; SECTION 29 299.83FSL; 347.77FEL	3665.38 7162.57	23-X-011C	140'
6	23-X-106	T22S; R31E; SECTION 29 1629.72FSL; 1433.55FWL	4949.33 3678.27	23-X-011D	1650'
6A	23-X-107	T22S; R31E; SECTION 29 1653FSL; 1395FWL	4975.51 3612.34	23-X-011D	1650'

Table: WATER QUALITY SAMPLING PROGRAM

FENCES

NO.	LOCATION	NO.	LOCATION
23-X-035	EAST SIDE – NORTH ACCESS ROAD	23-X-036	WEST SIDE – NORTH ACCESS ROAD
23-X-038	EAST SIDE – SOUTH ACCESS ROAD	23-X-037	WEST SIDE – SOUTH ACCESS ROAD

ROADS

NO.	LOCATION	NO.	LOCATION
23-X-002	SECTIONS 4,5,34,35,26	23-X-012	SECTIONS 21,28
23-X-004	SECTION 6	23-X-014	SECTION 17
23-X-005	SECTIONS 36	23-X-015	SECTIONS 13,24
23-X-011	SECTION 29,30	23-X-021	SECTION 20
23-X-011A	SECTION 28, 29		

CATTLE GUARDS

NO.	LOCATION	NO.	LOCATION
23-X-050	NOT ON MAP – H-10A & H-10B	23-X-069	SECTION 20 – AIR MONITORING STATION
23-X-051	SECTIONS 34 & 35 – MILLS ROAD	23-X-070	SECTIONS 17 & 21 – SOUTH OF WIPP 12
23-X-052	SECTION 5 – WELL H-4	23-X-071	SECTION 16 – SOUTH OF WQSP-3
23-X-055	SECTIONS 28 & 29 – EAST LINK ROAD	23-X-072	SECTION 17 – WQSP#18
		23-X-073	SECTION 17 – WQSP#1
23-X-059	SECTION 17 – PIPELINE ACCESS ROAD	23-X-074	SECTION 21 – EAST OF WIPP 12
23-X-060	SECTION 1 – JAMES RANCH UNIT #38	23-X-076	NOT ON MAP – DOE 2
23-X-061	SECTION 1 – JAMES RANCH UNIT #4	23-X-077	NOT ON MAP – TO SMITH RANCH
23-X-062	SECTION 6 – JAMES RANCH UNIT #76	23-X-079	SECTION 20 – RR TRACKS
23-X-063	SECTIONS 1 – JAMES RANCH UNIT #84	23-X-080	SECTION 16 – WQSP#2 – ABANDONED
23-X-064	SECTION 30 – DOE 1	23-X-081	SECTION 23 – BOUNDARY – ABANDONED
23-X-065	SECTION 30 – APACHE 25	23-X-088	PARKING LOT – ROAD TO GATE HOUSE
23-X-066	SECTIONS 29 – INTERSECTION – N&S ACCESS ROAD	23-X-089	PARKING LOT – VALOR HUT
23-X-067	SECTION 20 – EAST SIDE – RR TRACKS		
23-X-068	SECTION 20 – WEST SIDE – RR TRACKS		

CATTLE GUARDS ACROSS ACCESS ROAD

NO.	LOCATION	NO.	LOCATION
23-X-090	NORTH ACCESS ROAD – 1.2 MILES NORTH	23-X-095	NORTH ACCESS ROAD – WEST SIDE 12.9 MILES
23-X-091	NORTH ACCESS ROAD – 3.1 MILES NORTH	23-X-096	NORTH ACCESS ROAD – EAST SIDE – 12.9 MILES
23-X-092	NORTH ACCESS ROAD – 8.5 MILES NORTH		
23-X-093	NORTH ACCESS ROAD – 10.8 MILES NORTH		
23-X-094	NORTH ACCESS ROAD – 12.1 MILES NORTH		

LEGEND

- CATTLE GUARD
- ENVIRONMENTAL MONITORING STATION
- WELL
- ROADS NOT MAINTAINED BY WTS
- BARBED WIRE FENCE

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
D	REVISED PER ECO	JC 12/22/06	RS 1/08/07	WEB 1/08/07	BB 1/09/07	11520	N/A
C	REVISED PER ECO	DM 1/05/04	PA 1/26/04	JMK 1/27/04	BB 1/27/04	10829	N/A

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 7298 PWR: 9402570-J

DFTR: PETE ALLEN 10/23/95
CHKR: R.SEXTON 11/2/95
COG: J.KOWALSKI 11/2/95
CM: G.R.MORRISON 11/3/95
DM: L.W.TREADWAY 11/3/95

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions

Waste Isolation Pilot Plant Carlsbad, New Mexico

LAND WITHDRAWAL AREA
LOCATION OF FACILITIES

THIS DRAWING IS UP-TO-DATE AND LATEST REVISON VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE:

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

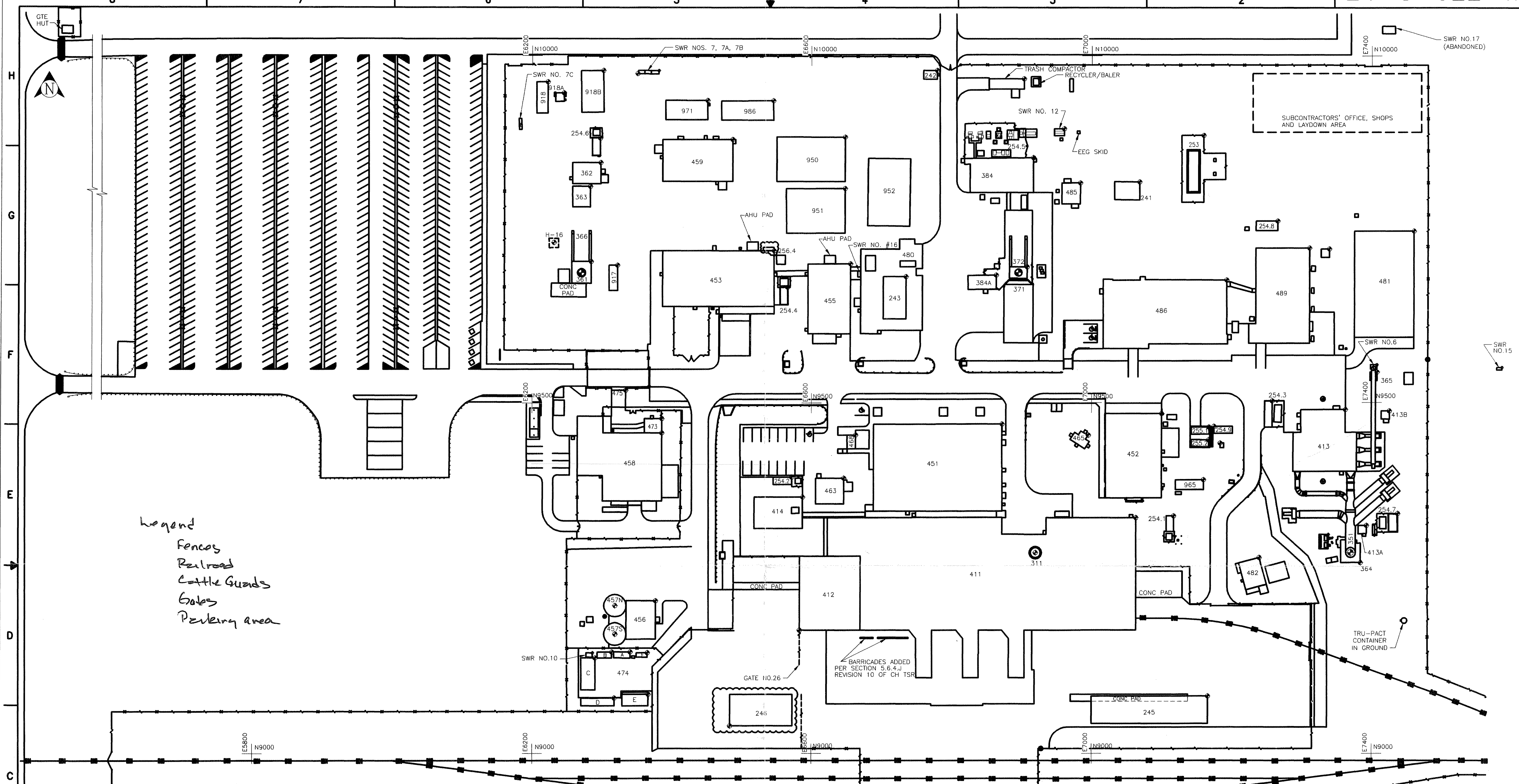
INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
GC00	23	00100	66	240

SCALE: NONE
INTERPRET DWG PER ANSI Y14

SIZE E SYS GC00 DWG NO 23-C-007-W REV D

THIS DRAWING TAKEN FROM: 23-Z-004-W
VENDOR: WTS

24-C-022-W



BLDG./ FAC. #	DESCRIPTION	REFERENCE POINT COORDINATES NORTH	EAST	SQ FEET
SHELTER #241	EQUIPMENT SHED	9817.6622	7067.9871	1008
#242	GUARDSHACK	9978.8201	6779.0000	225
SHELTER #243	SALT HAULING TRUCKS SHELTER	9681.3556	6734.5705	1972
SHELTER #245	TRUPAC TRAILER SHELTER	9081.745	7166.240	905
SHELTER #246	MgO STORAGE SHELTER	9039.256	6482.742	
#253	13.8 KV SWITCHGEAR 25P-SWG15/1	9884.9636	7159.5624	
#254.1	AREA SUBSTATION NO.1 25P-SW15.1	9339.2612	7117.6055	229
#254.2	AREA SUBSTATION NO.2 25P-SW15.2	9393.9684	6572.2471	505.5
#254.3	AREA SUBSTATION NO.3 25P-SW15.3	9502.3793	7257.8804	257.75
#254.4	AREA SUBSTATION NO.4 25P-SW15.4	9666.1474	6565.7933	262
#254.5	AREA SUBSTATION NO.5 25P-SW15.5	9902.9361	6916.0525	76
#254.6	AREA SUBSTATION NO.6 25P-SW15.6	9881.0628	6296.8513	275
#254.7	AREA SUBSTATION NO.7 25P-SW15.7	9342.6898	7438.8627	350
#254.8	AREA SUBSTATION NO.8 25P-SW15.8	9761.2929	7265.1340	404
#254.9	480V SWITCHGEAR (25P-SWG04/9)	9466.0000	7175.0000	265
#255.1	BACK-UP DIESEL GENERATOR #1 25-PE 503	9464.9215	7167.8136	250
#255.2	BACK-UP DIESEL GENERATOR #2 25-PE 504	9446.8110	7167.6241	250
#256.4	SWITCHBOARD #4 (25P-SBD04/4)	9582.0900	7359.2016	X
#311	WASTE SHAFT	9287.2300	6919.8900	X
#351	EXHAUST SHAFT	9287.2300	7370.3900	X
#361	AIR INTAKE SHAFT	9687.4076	6269.9069	366
#362	AIR INTAKE SHAFT/HOIST HOUSE	9845.7059	6297.5511	1200
#363	AIR INTAKE SHAFT/WINCH HOUSE	9811.4189	6282.6384	750
#364	EFFLUENT MONITORING INSTRUMENT SHED A	9273.0230	7384.5707	896
#365	EFFLUENT MONITORING INSTRUMENT SHED B	9543.8433	7407.9056	221
#366	AIR INTAKE SHAFT HEADFRAME	9703.5428	6283.8591	X
#371	SALT HANDLING SHAFT	9687.2300	6894.8900	X
#372	SALT HANDLING SHAFT HEADFRAME	9695.3448	6907.3502	X
#384	SALT HANDLING SHAFT HOISTHOUSE	9852.6805	6916.1393	4410
#384A	MINING OPERATIONS	9683.3922	6863.1621	800
#411	WASTE HANDLING BUILDING	9336.7209	7063.6333	154882
#412	TRUPACT MAINTENANCE BUILDING	9175.8015	6582.9848	11997
#413	EXHAUST SHAFT FILTER BUILDING	9490.0500	7362.6800	5058
#413A	MONITORING STATION A	9325.6000	7393.1100	100
#413B	MONITORING STATION B	9488.0204	7425.6068	144
#414	WATER CHILLER FACILITY & BLDG	9365.7562	6587.2805	80
#451	SUPPORT BUILDING	9469.5568	6872.0504	45632
#452	SAFETY & EMERGENCY SERVICES FACILITY	9484.5394	9484.5394	19240

BLDG./ FAC. #	DESCRIPTION	REFERENCE POINT COORDINATES NORTH	EAST	SQ FEET
#453	WAREHOUSE/SHOPS BUILDING	9718.7978	6546.2807	122760
#455	AUXILLIARY WAREHOUSE BUILDING	9699.9590	6655.3738	6000
#456	WATER PUMPHOUSE	9218.0108	6376.6654	2200
#457	WATER TANK 25-D-001A	9170.5000	6318.6946	X
#457	WATER TANK 25-D-001B	9211.0000	6318.6946	X
#458	GUARD AND SECURITY BUILDING	9457.1771	6385.3615	14640
#459	CORE STORAGE BUILDING	9879.0045	6486.4525	6000
#463	COMPRESSOR BUILDING	9392.6088	6646.3108	1440
#465	AUXILIARY AIR INTAKE	9453.6597	6995.3189	360
#468	TELEPHONE HUT	9453.9939	6663.0378	240
#473	ARMORY BUILDING	9477.8899	6385.3956	429
#474	HAZARDOUS WASTE STORAGE FACILITY	N/A	N/A	N/A
#474A	HAZARDOUS WASTE STORAGE BUILDING	9144.9771	6340.4470	280
#474B	HAZARDOUS WASTE STORAGE BUILDING	9144.6620	6314.1053	200
#474C	OIL & GREASE STORAGE BUILDING	9136.3868	6290.2802	900
#474D	GAS BOTTLE STORAGE BUILDING	9078.9088	6317.6154	450
#474E	HAZARD MATERIAL STORAGE BUILDING	9084.2706	6366.0304	603
#474F	WASTE OIL RETAINER	9143.7197	6364.8580	90
#475	GATEHOUSE	9518.4035	6333.6858	480
#480	VEHICLE FUEL STATION	N/A	N/A	N/A
#481	WAREHOUSE ANNEX	9746.6347	7460.0980	12768
#482	EXHAUST SHAFT HOIST EQUIP. WAREHOUSE	9280.2548	7239.6920	1350
#485	SULLAIR COMPRESSOR BUILDING	9816.2320	6983.1477	780
#486	ENGINEERING BUILDING	9676.0681	7192.4400	16625
#489	TRAINING BUILDING	9722.2749	7310.8119	10549
#H-16	SANDIA TEST WELL	9730.6897	6230.8379	X
#917	AIS MONITORING	9973.6341	6328.6247	444
#918	VOC TRAILER	9962.0881	6222.1074	660
#918A	VOC AIR MONITORING STATION	9946.2026	6245.1185	100
#918B	VOC LAB TRAILER	9978.6466	6301.5732	1915
#950	WORK CONTROL TRAILER	9882.5303	6647.7644	6175
#951	PROCUREMENT/PURCHASING	9808.4009	6647.6685	5200

BLDG./ FAC. #	DESCRIPTION	REFERENCE POINT COORDINATES NORTH	EAST	SQ FEET
#952	TRAILER	9851.0080	6741.1200	5700
#965	SAMPLE LABORATORY TRAILER	9378.2900	7160.2500	X
#971	HUMAN RESOURCES TRAILER	9935.3488	6450.6912	1625
#986	PUBLICATIONS & PROCEDURES TRAILER	9934.9755	6545.6070	2025
SWR NO.6	SWITCHRACK NO. 6	9554.3514	7407.4429	X
SWR NO.7,7A,7B	SWITCHRACK NO. 7, 7A, 7B	9978.5680	6380.7536	X
SWR NO.7C	SWITCHRACK NO. 7C	9978.5680	6380.7536	X
SWR NO.10	SWITCHRACK NO. 10	9143.6425	6286.4822	X
SWR NO.11	SWITCHRACK NO. 11	9312.8690	7338.6302	X
SWR NO.12	SWITCHRACK NO. 12	9894.5651	6960.0448	X
SWR NO.16	SWITCHRACK NO. 16	9689.9590	6669.7071	X
COMPACTOR	25-H-010	9966.7360	6902.9280	X
BALER	25-H-011	9967.3162	6923.9191	X

THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE: ______________

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

REFERENCES	
WIPP SITE FENCING PLAN	24-C-024-W
WIPP SITE FINISH PAVING AND GRADING	24-C-028-W
WIPP SITE UTILITIES	24-C-032-W
WIPP SITE UTILITIES CMS	24-C-033-W
WIPP SITE UTILITIES COMPRESSED AIR SYSTEM	24-C-034-W
WIPP SITE UTILITIES DATA HIGHWAY	24-C-035-W
WIPP SITE UTILITIES ELECTRICAL GROUNDING	24-C-037-W
WIPP SITE UTILITIES ELECTRICAL SECURITY LIGHTING	24-C-038-W
WIPP SITE UTILITIES ELECTRICAL LOW VOLTAGE, 480V	24-C-039-W
WIPP SITE UTILITIES SITE SERVICE POWER 208V/120V SYSTEM 208V 4W 3ø AND 208V/120V 3W SINGLE PHASE	24-C-040-W
WIPP SITE UTILITIES ELECTRICAL PRIMARY POWER, 13.8KV AND 15KV	24-C-041-W
WIPP SITE UTILITIES ELECTRICAL SANDIA UNDERGROUND POWER LOSS ALARM	24-C-042-W
WIPP SITE UTILITIES FIBER OPTIC BACKBONE	24-C-043-W
WIPP SITE UTILITIES INSTRUMENTS	24-C-044-W
WIPP SITE UTILITIES SANITARY SEWER	24-C-045-W
WIPP SITE UTILITIES SECURITY	24-C-046-W
WIPP SITE UTILITIES DOMESTIC WATER	24-C-047-W
WIPP SITE UTILITIES FIRE WATER	24-C-048-W
WIPP SITE UTILITIES COMMUNICATIONS AND PUBLIC ADDRESS	24-C-049-W
WIPP SITE UTILITIES TELEPHONE CABLE	24-C-050-W

INFORMATION ONLY

50' 0 50' 100'

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
GC01	24	00100	99	240

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
AR	REVISED PER ECO	DM 3/31/08	RS 4/03/08	WEB 4/03/08	BB 4/03/08	11405	0510505M
AP	REVISED PER ECO	DM 1/09/08	RS 1/09/08	WEB 1/17/08	BB 1/18/08	11425	0409249

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 5674 PWR: N/A

DFTR: ALSTON/KRAUSE 02/10/93
CHKR: B.BEEMAN 06/08/93
COG: G.W. POHL 06/08/93
CM: R. KUGINSKIE 06/08/93
QA: JAMES F. ALLEN 06/08/93
DM: G.R. CULLUM 06/08/93

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions LLC

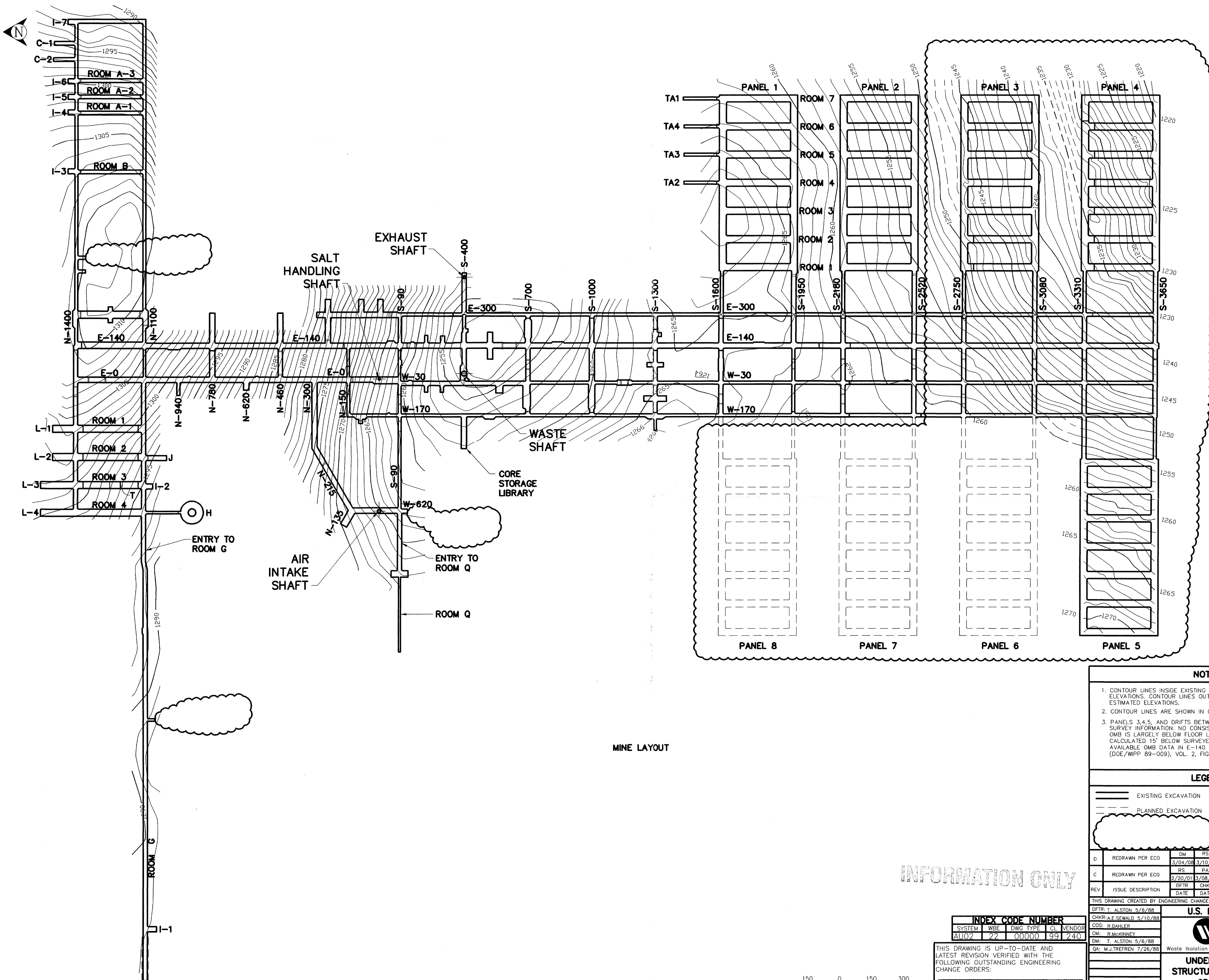
Waste Isolation Pilot Plant Carlsbad, New Mexico

WIPP SITE FACILITY MASTERPLAN

SCALE: 1/50
INTERPRET DWG PER ANSI Y14

SIZE E | SYS GC01 | DWG NO 24-C-022-W | REV AR

THIS DRAWING TAKEN FROM: 24-C-009-W
VENDOR: WTS



NOTES

1. CONTOUR LINES INSIDE EXISTING EXCAVATION LINES ARE KNOWN ELEVATIONS. CONTOUR LINES OUTSIDE OF EXCAVATION LINES ARE ESTIMATED ELEVATIONS.
2. CONTOUR LINES ARE SHOWN IN ONE FOOT INERVALS.
3. PANELS 3,4,5, AND DRIFTS BETWEEN THEM WERE MAPPED FROM MINE SURVEY INFORMATION. NO CONSISTENT DIRECT INFORMATION AVAILABLE OMB IS LARGELY BELOW FLOOR LEVEL. POSITION OF OMB WAS CALCULATED 15' BELOW SURVEYED BACK. THIS ASSUMPTION FIT ALL AVAILABLE OMB DATA IN E-140 AS DOCUMENTED IN 1989 GFDAR (DOE/WIPP 89-009), VOL. 2, FIG. 3-14, PG. 3-24.

LEGEND

EXISTING EXCAVATION

PLANNED EXCAVATION

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
D	REDRAWN PER ECO	DM 3/04/08	RS 3/10/08	TZ 3/10/08	BB 3/10/08	11941	N/A
C	REDRAWN PER ECO	RS 2/20/01	PA 3/08/01	AER 3/08/01	BB 3/08/01	9991	9804109J

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 1743 PWR: N/A

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
AU02	22	00000	99	240

THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE:

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

DFTR: T. ALSTON 5/6/88
CHKR: A.E.SEWALD 5/10/88
COG: R.DAHLER
CM: R.McKINNEY
DM: T. ALSTON 5/6/88
QA: M.J.TREFREN 7/26/88

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions

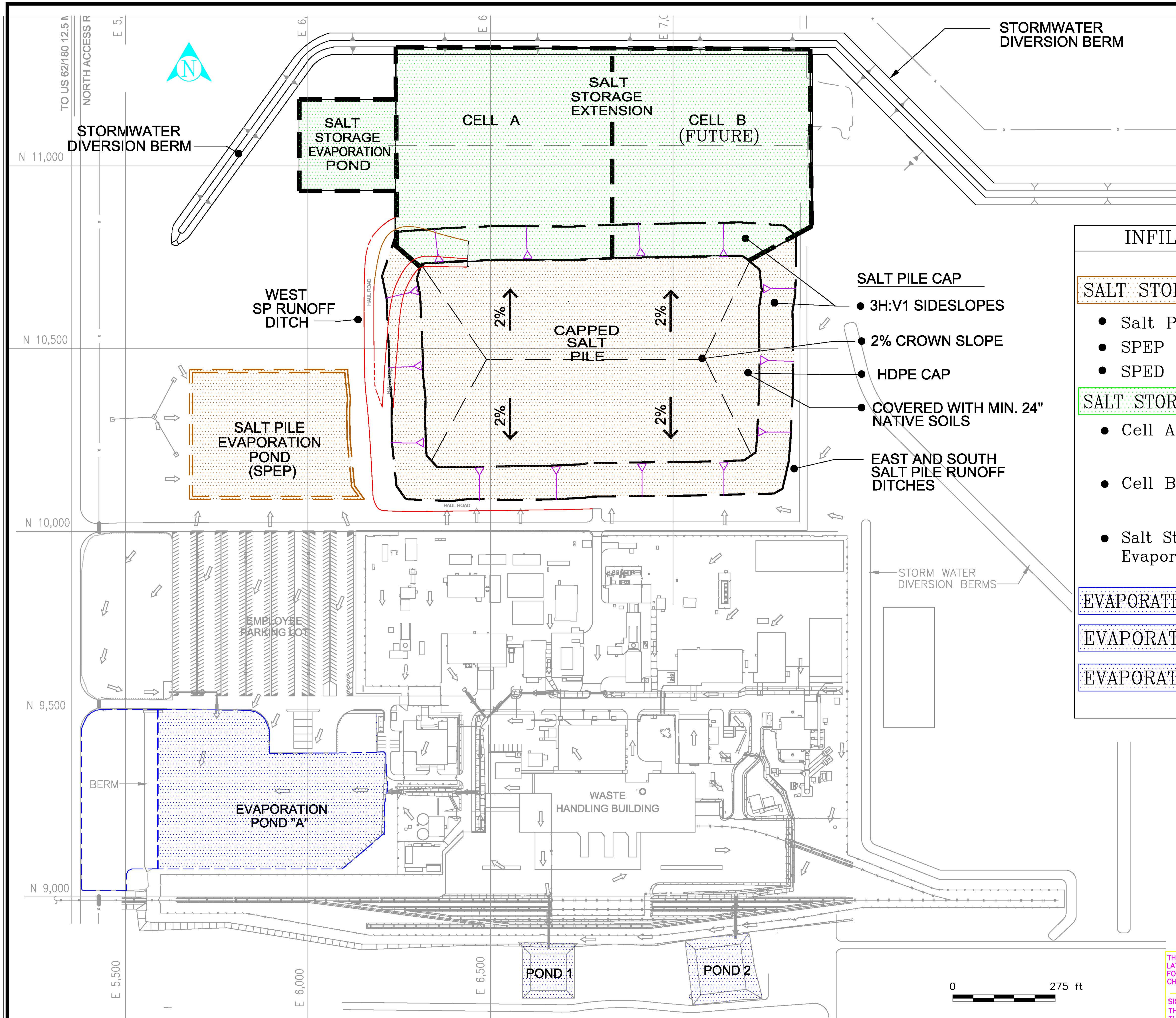
Waste Isolation Pilot Plant — Carlsbad, New Mexico

UNDERGROUND MINE PLAN STRUCTURE CONTOUR OF BASE OF ORANGE MARKER BAND

SCALE: NOTED
INTERPRET DWG PER ANSI Y14

SIZE E | SYS AU02 | DWG NO 22-V-001-W | REV D

THIS DRAWING TAKEN FROM: 22-V-001-W
VENDOR: WTS



INFILTRATION CONTROLS UNITS	Controls	Size (Ac)
SALT STORAGE AREA		
• Salt Pile	HDPE Cap/Soils Cover	18.8
• SPEP	HDPE LINER	3.0
• SPED	HDPE LINER	1.0
SALT STORAGE EXTENSION		
• Cell A	HDPE Liner with water collection	6.2
• Cell B (FUTURE)	HDPE Liner with water collection	5.2
• Salt Storage Evaporation Pond	Double HDPE Liner with leak detection	1.0
EVAPORATION POND "A"	HDPE Liner	7.8
EVAPORATION POND 1	HDPE Liner	0.5
EVAPORATION POND 2	HDPE Liner	1.0

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
GC01	24	00100	99	240

THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE:

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

REV	ISSUE DESCRIPTION	DFTR DATE	CHKR DATE	COG DATE	DFTG MGR DATE	ECO	PWR

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 10716 WO: 0304306M

DFTR: R. SEXTON 8/24/05
CHKR: T.GOODWIN 12/14/05
COG: W.BARNHART 12/14/05
CM: G.MORRISON 12/14/05
DM: B.BEEMAN 12/15/05

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions

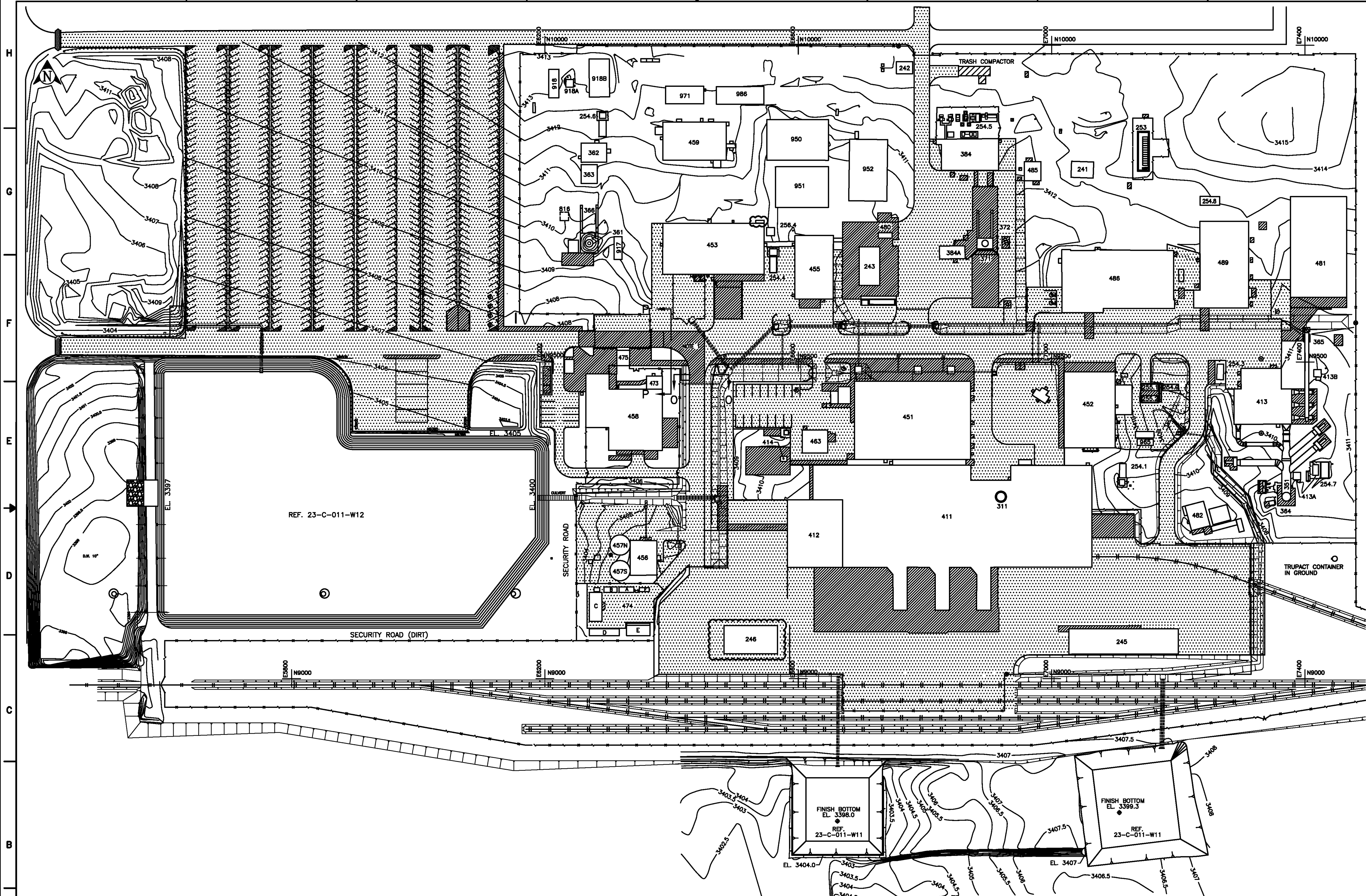
Waste Isolation Pilot Plant Carlsbad, New Mexico

SALT PILE INFILTRATION CONTROLS
NEW DESIGN

SCALE: NONE
INTERPRET DWG PER ANSI Y14

SIZE E SYS GC01 DWG NO 23-C-011-W1 REV NEW

24-C-028-W1



INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
GC01	24	00000	99	240

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
GC01	24	00100	99	240

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
GC01	24	00500	99	240

THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE: ____________

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

LEGEND

- AREAS PAVED WITH ASPHALT
- AREAS PAVED WITH CONCRETE
- —XXXX— INDEX AND INTERMEDIATE CONTOUR LINES
- SWALE

NOTES

1. SEE DRAWING 24-C-028-W3 FOR THE TRANSVERSE AND LONGITUDINAL CROSS SECTIONS OF THE CONCRETE PAVED AREA INDICATED.

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
AC	REVISED PER ECO	DM 3/31/08	RS 4/11/08	WEB 4/11/08	BB 4/15/08	11405	0510505M
AB	REVISED PER ECO	DM 1/09/08	RS 1/17/08	WEB 1/17/08	BB 1/18/08	11425	0409249

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 5674 PWR: N/A

DFTR: M.D.S. ABE 12/21/94
CHKR: B.BEEMAN 12/27/94
COG: J.KOWALSKI 01/09/95
CM: G.MORRISON 01/09/95
QA: H.R.LEOS 01/10/95
DM: G.R.CULLUM 01/11/95

SCALE: 1/50
INTERPRET DWG PER ANSI Y14

U.S. DEPARTMENT OF ENERGY

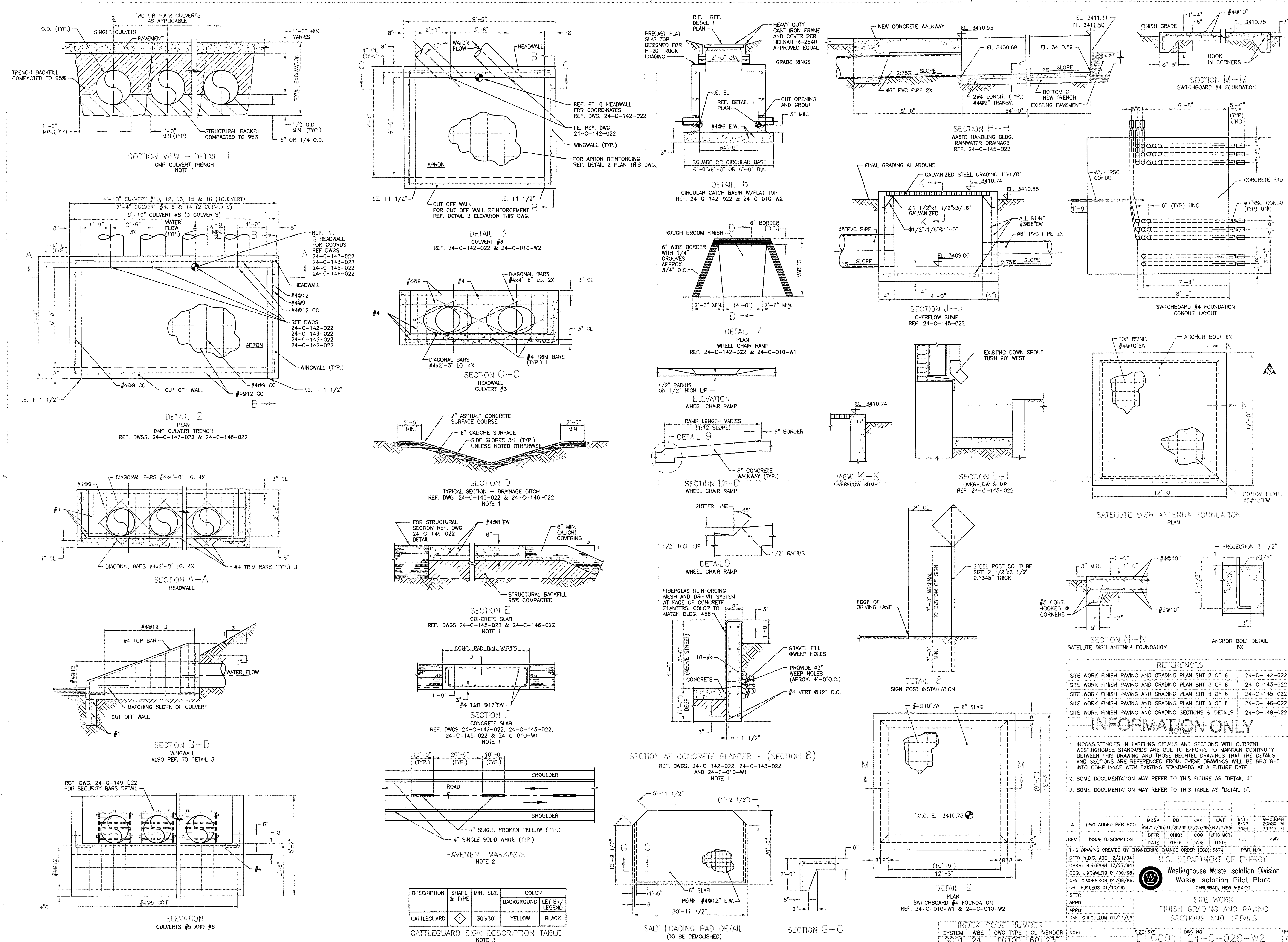
Washington
TRU Solutions LLC

Waste Isolation Pilot Plant Carlsbad, New Mexico

WIPP SITE
FINISH GRADING AND PAVING

SIZE	SYS	DWG NO	REV
E	GC01	24-C-028-W1	AC

THIS DRAWING TAKEN FROM: 24-C-012-W THRU 016-W
VENDOR: WTS



DESCRIPTION	SHAPE & TYPE	MIN. SIZE	COLOR BACKGROUND	COLOR LETTER/ LEGEND
CATTLEGUARD	(1)	30'x30'	YELLOW	BLACK

CATTLEGUARD SIGN DESCRIPTION TABLE
NOTE 3

REFERENCES	
SITE WORK FINISH PAVING AND GRADING PLAN SHT 2 OF 6	24-C-142-022
SITE WORK FINISH PAVING AND GRADING PLAN SHT 3 OF 6	24-C-143-022
SITE WORK FINISH PAVING AND GRADING PLAN SHT 5 OF 6	24-C-145-022
SITE WORK FINISH PAVING AND GRADING PLAN SHT 6 OF 6	24-C-146-022
SITE WORK FINISH PAVING AND GRADING SECTIONS & DETAILS	24-C-149-022

INFORMATION ONLY

NOTES

1. INCONSISTENCIES IN LABELING DETAILS AND SECTIONS WITH CURRENT WESTINGHOUSE STANDARDS ARE DUE TO EFFORTS TO MAINTAIN CONTINUITY BETWEEN THIS DRAWING AND THOSE BECHTEL DRAWINGS THAT THE DETAILS AND SECTIONS ARE REFERENCED FROM. THESE DRAWINGS WILL BE BROUGHT INTO COMPLIANCE WITH EXISTING STANDARDS AT A FUTURE DATE.
2. SOME DOCUMENTATION MAY REFER TO THIS FIGURE AS "DETAIL 4".
3. SOME DOCUMENTATION MAY REFER TO THIS TABLE AS "DETAIL 5".

REV	ISSUE DESCRIPTION	DFTR	CHKR	COG	DFTG MGR	ECO	PWR
A	DWG ADDED PER ECO	MDSA 04/17/95	BB 04/25/95	JMK 04/25/95	LWT 04/27/95	6411 6477 7054	M-20848 20580-M 39247-M

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 5674 PWR: N/A

DFTR: M.D.S. ABE 12/21/94
CHKR: B.BEEMAN 12/27/94
COG: J.KOWALSKI 01/09/95
CM: G.MORRISON 01/09/95
QA: H.R.LEOS 01/10/95
SFTY:
APPD:
APPD:
DM: G.R.CULLUM 01/11/95
DOE:

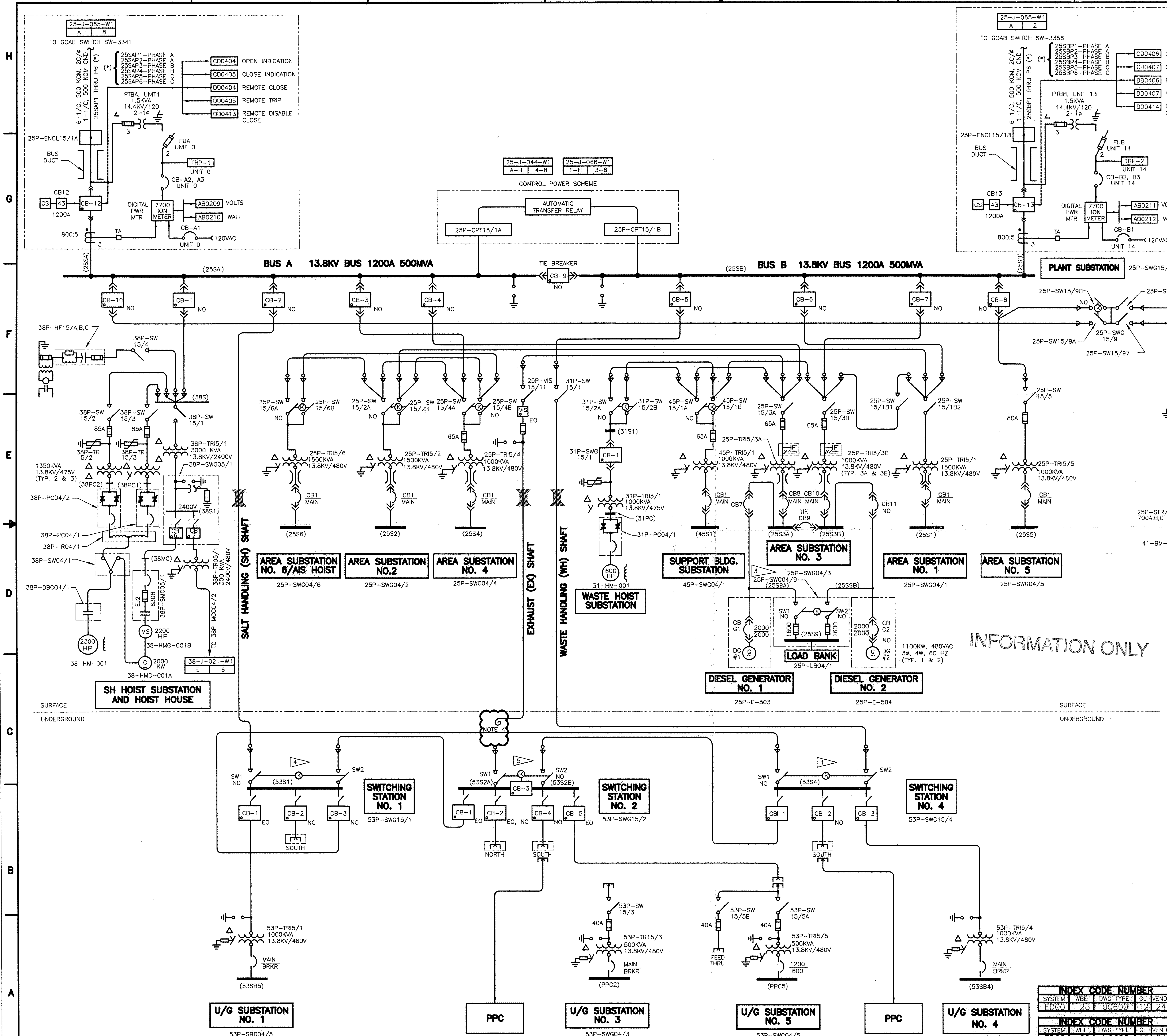
U.S. DEPARTMENT OF ENERGY
Westinghouse Waste Isolation Division
Waste Isolation Pilot Plant
CARLSBAD, NEW MEXICO

SITE WORK
FINISH GRADING AND PAVING
SECTIONS AND DETAILS

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
GC01	24	00100	60	230

SIZE E SYS GC01 DWG NO 24-C-028-W2 REV A
SCALE: NTS INTERPRET DWG PER ANSI Y14 DWG: 2 OF 2
THIS DRAWING TAKEN FROM: 24-C-150-022
VENDOR: BECHTEL

25-J-020-W6



WTS OPERATING PROCEDURES

WP 04-ED1301	DIESEL GENERATOR OPERATION
WP 04-ED1341	SURFACE BACKUP POWER DISTRIBUTION
WP 04-ED1631	UNDERGROUND BACKUP POWER DIRTRIBUTION

NOTES

1. HIGHLIGHTED DIESEL GENERATORS, SUBSTATIONS AND SWITCHING STATIONS, ARE PART OF THE SELECTED LOAD SYSTEM.
2. THIS DRAWING SHOWS THE BACKUP POWER CONFIGURATION, ONLY WHEN 13.8KV CABLE BUS IS USED. CAUTION! USE THIS DRAWING ONLY AS INTENDED.
3. **WARNING!** THIS DRAWING IS NOT AN OPERATION DOCUMENT. THE INTERRUPTER LINEUP IS BASED ON ENGINEERING JUDGEMENT FOR THE WIPP SITE UNDER NORMAL OPERATION CONDITIONS WITH ON SITE BACKUP POWER.
4. EXHAUST SHAFT FEEDER ABANDONED IN PLACE.

THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS: ____

SIGNATURE AND DATE: ____

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
AC	REVISED PER ECO	DM 09/19/05	RS 09/21/05	JA 09/21/05	BB 09/22/05	11360	0508251A
AB	REVISED PER ECO	DM 07/07/04	RS 09/02/04	JA 09/08/04	BB 09/09/04	11027	0403103M

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 3046 PWR: N/A

DFTR: TONY ALSTON 12/19/88
CHKR: A.E.SEWALD 01/09/91
COG: R.L.ALVARAEZ 1/9/91
CM: F. JONES FOR J.M.
QA: R. YOUNGMAN 12/29/88
SFTY: R.N. RATHNOW 12/28/90
DM: G.R.COLLUM 01/10/91
C.ALDRIDGE 06/13/90
DOE: J. LIPPIS 12/30/88

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions

Waste Isolation Pilot Plant Carlsbad, New Mexico

WIPP SITE PRIMARY POWER DISTRIBUTION - ONE LINE SELECTED LOAD SYSTEM INTERRUPTER LINEUP SURFACE & U/G

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
ED00	25	00600	12	240

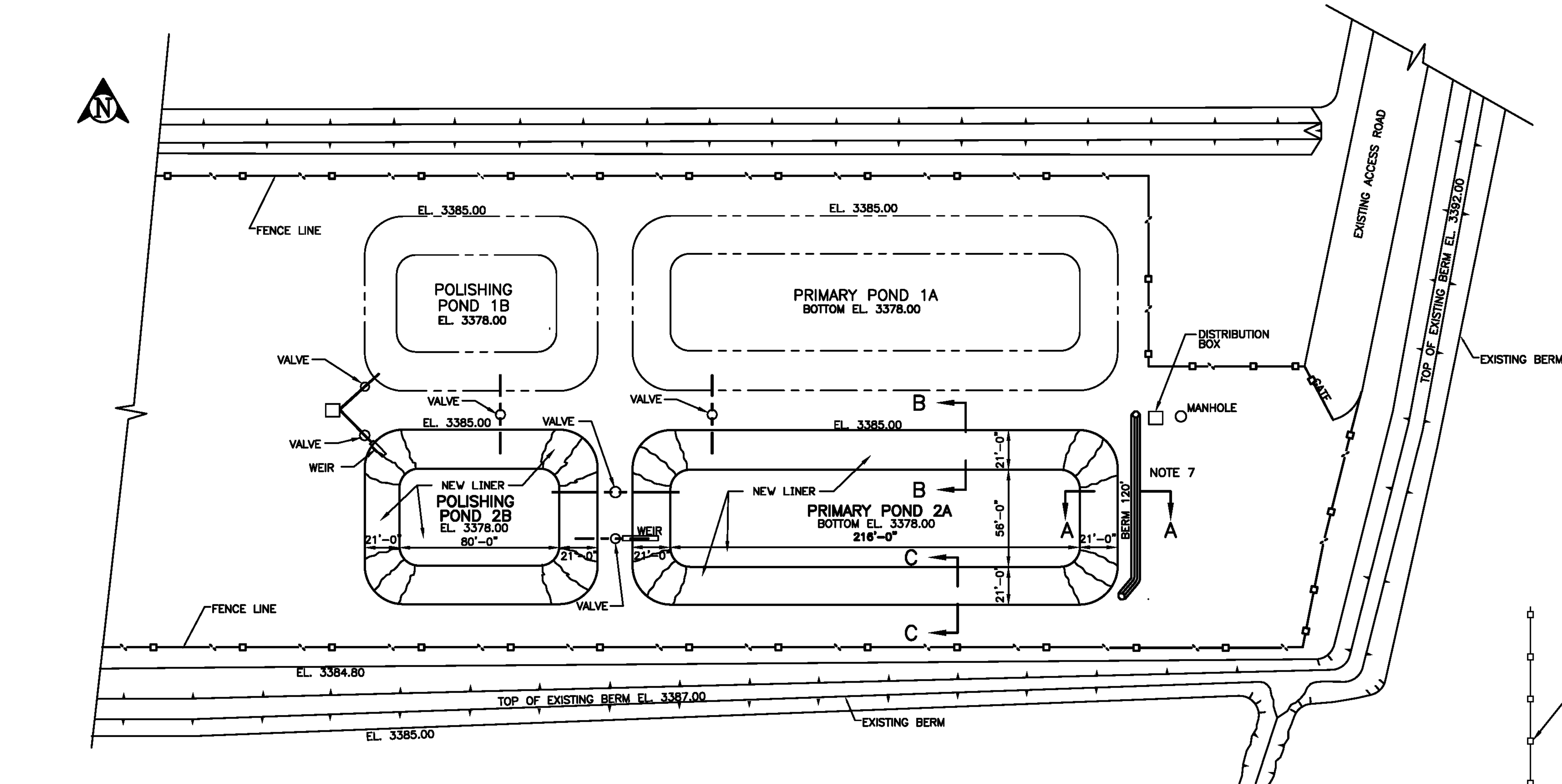
INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
ED00	25	U0650	12	240

SCALE: NONE
INTERPRET DWG PER ANSI Y14

SIZE E | SYS ED00 | DWG NO 25-J-020-W6 | REV AC

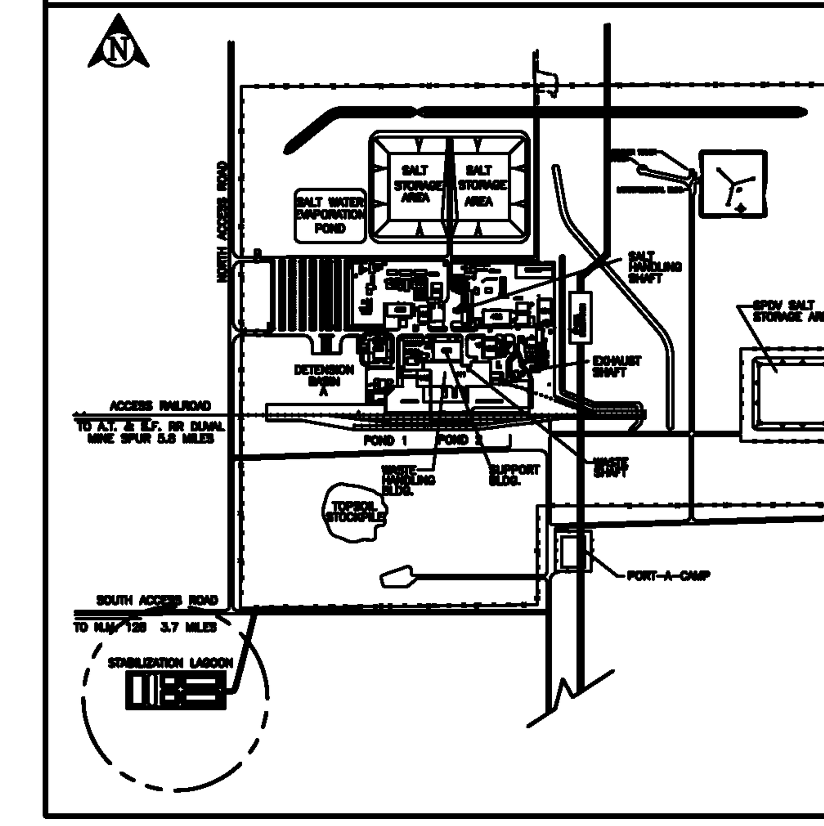
THIS DRAWING TAKEN FROM: 25-J-020-W7 REV L
VENDOR: WTS

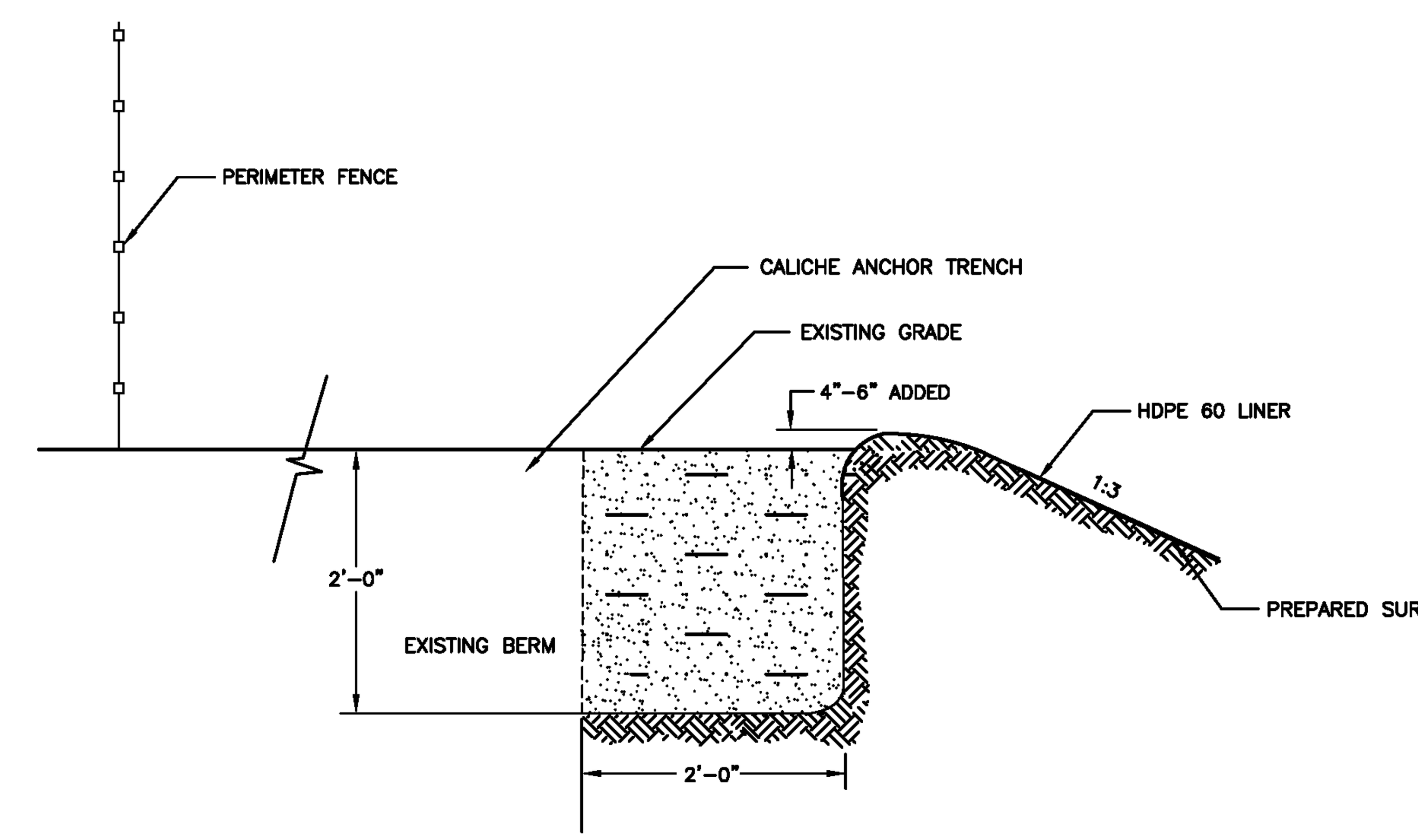
24–C–066–W1



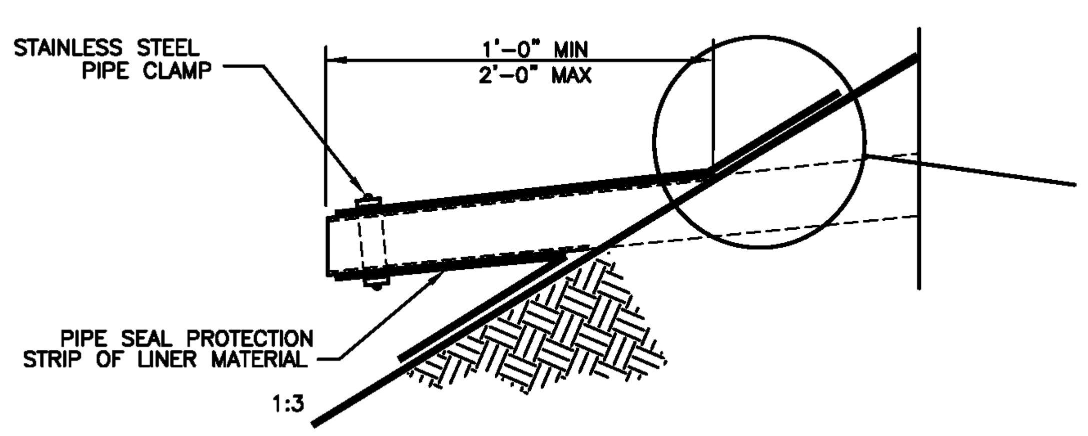
SANITARY SEWAGE LAGOON SITE PLAN

KEY PLAN

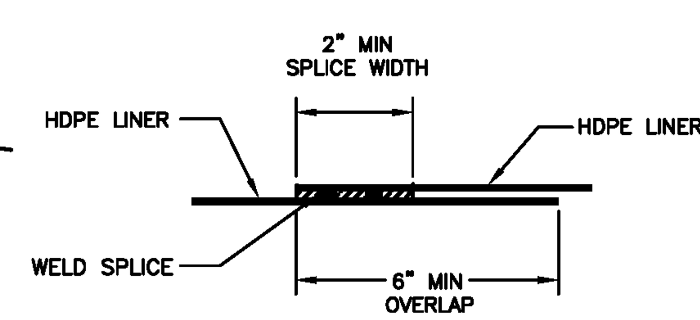




SECTION C–C
CALICHE ANCHOR TRENCH
APPLICABLE TO POND 2A & 2B



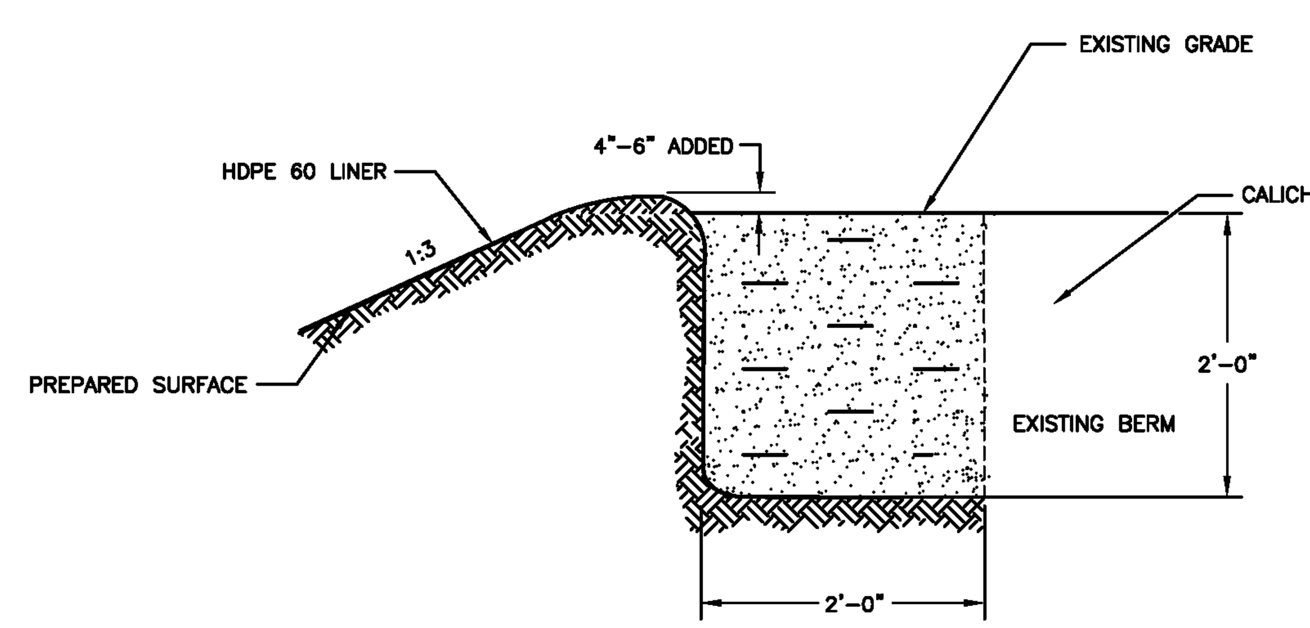
TYP. PIPE PENETRATION



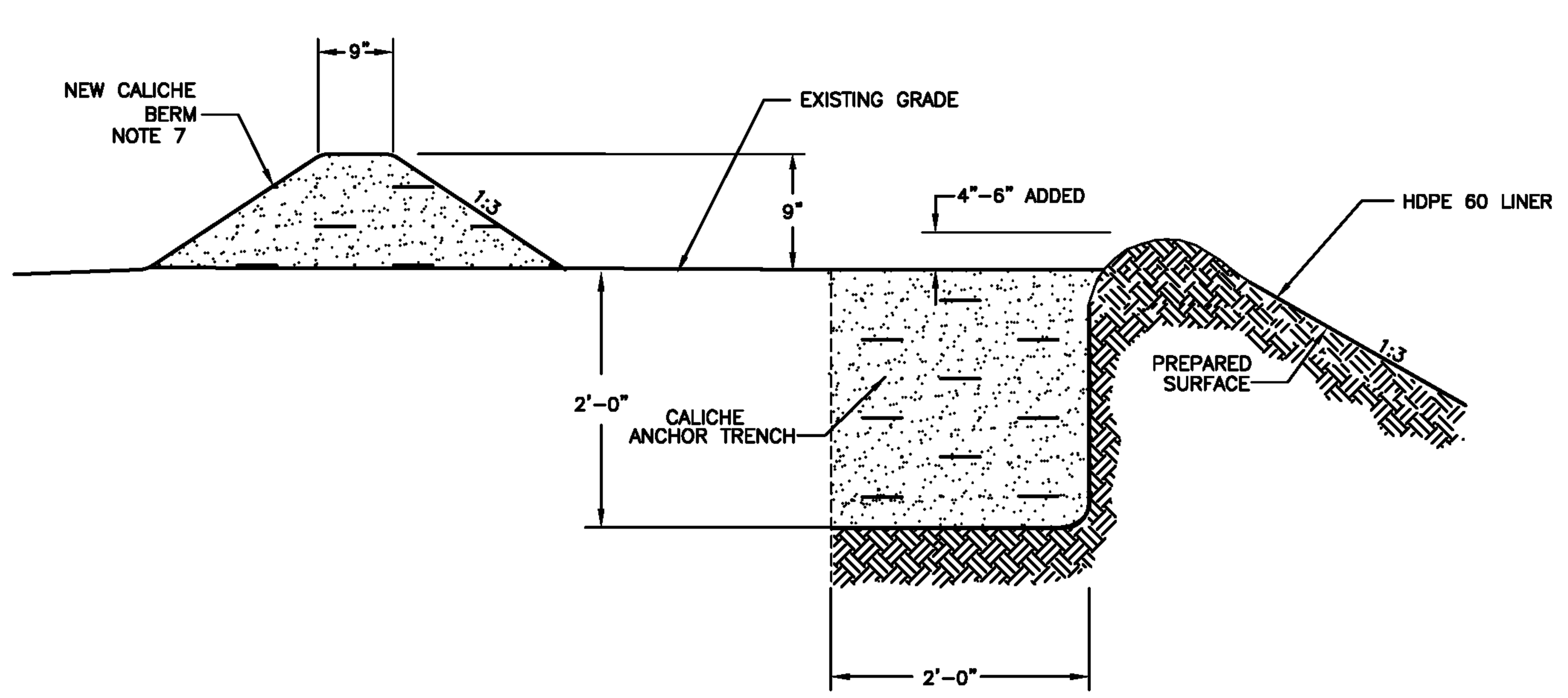
SPLICE DETAIL

NOTES

1. LINER REPLACEMENT, UNDER THIS CONTRACT, WILL EFFECT PONDS 2A & 2B ONLY.
2. THE REPLACEMENT LINER MATERIAL IS HDPE, 60 mil THICK, WHICH SHALL COMPLY WITH THE REQUIREMENTS OF THE WTS SPECIFICATION E–Z–471.
3. THE EXISTING LINERS SHALL BE STRIPPED AND DISPOSED OF BY THE CONTRACTOR.
4. AFTER EACH LINER IS REMOVED, THE BOTTOM OF THE POND SHALL BE INSPECTED FOR DAMAGE CAUSED BY LEAKS. IF ANY ARE DETECTED, THESE AREAS SHALL BE EXCAVATED AND MATERIAL REPLACED WITH NEW CALICHE.
5. THE ENTIRE EXPOSED AREA OF EACH POND SHALL BE ROLLED TO ACHIEVE SMOOTH SURFACE WITH NO PROTRUDING SHARP ROCKS OR ROOTS THAT COULD DAMAGE THE LINER. THE UNDERLINING CALICHE 6" THICK SHALL BE COMPACTED TO AN IN–PLACE DENSITY OF 90% OF THE DRY DENSITY AS DETERMINED BY ASTM D 1557.
6. THERE WILL BE NO CHANGES TO THE SEWER OR DOMESTIC WATER SYSTEMS.
7. THE EXACT LOCATION OF THE BERM SHALL BE FIELD DETERMINED BY THE COG ENGINEER AT TIME OF CONSTRUCTION.



SECTION B–B
CALICHE ANCHOR TRENCH
APPLICABLE TO POND 2A & 2B



SECTION A–A

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
GC03	24	00150	52	240

THIS DRAWING IS UP–TO–DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE:

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 11475 WO: 0601583C

DFTR: D. MEEKS 12/05/07
CHKR: R.SEXTON 12/13/07
COG: W.BARNHART 12/13/07
CM: C.CHESTER 12/13/07
DM: B.BEEMAN 12/13/07

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions

Waste Isolation Pilot Plant — Carlsbad, New Mexico

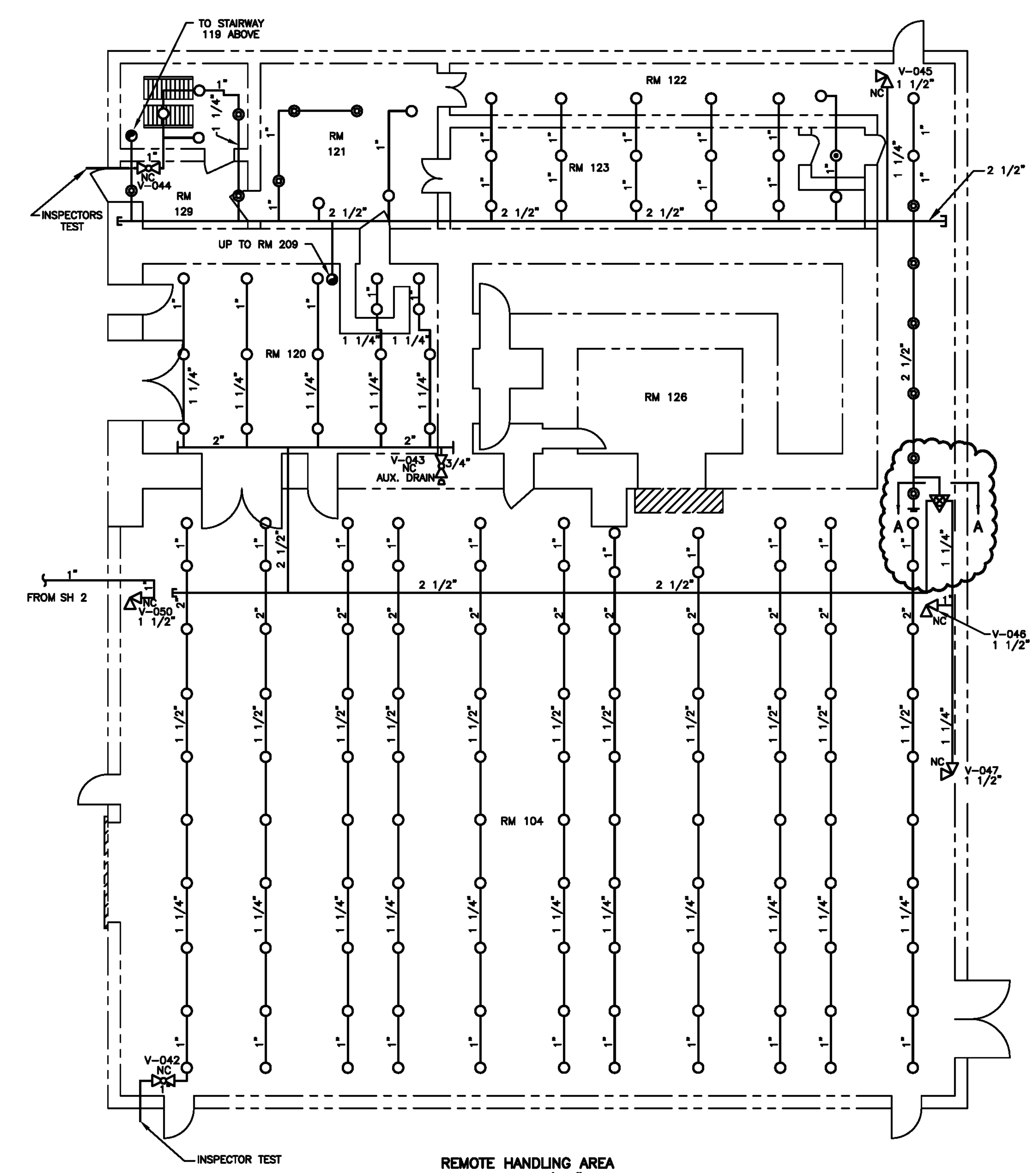
SANITARY SEWAGE LAGOON
LINER REPLACEMENT PROJECT
SITE PLAN & DETAILS

SCALE: 1:30
INTERPRET DWG PER ANSI Y14

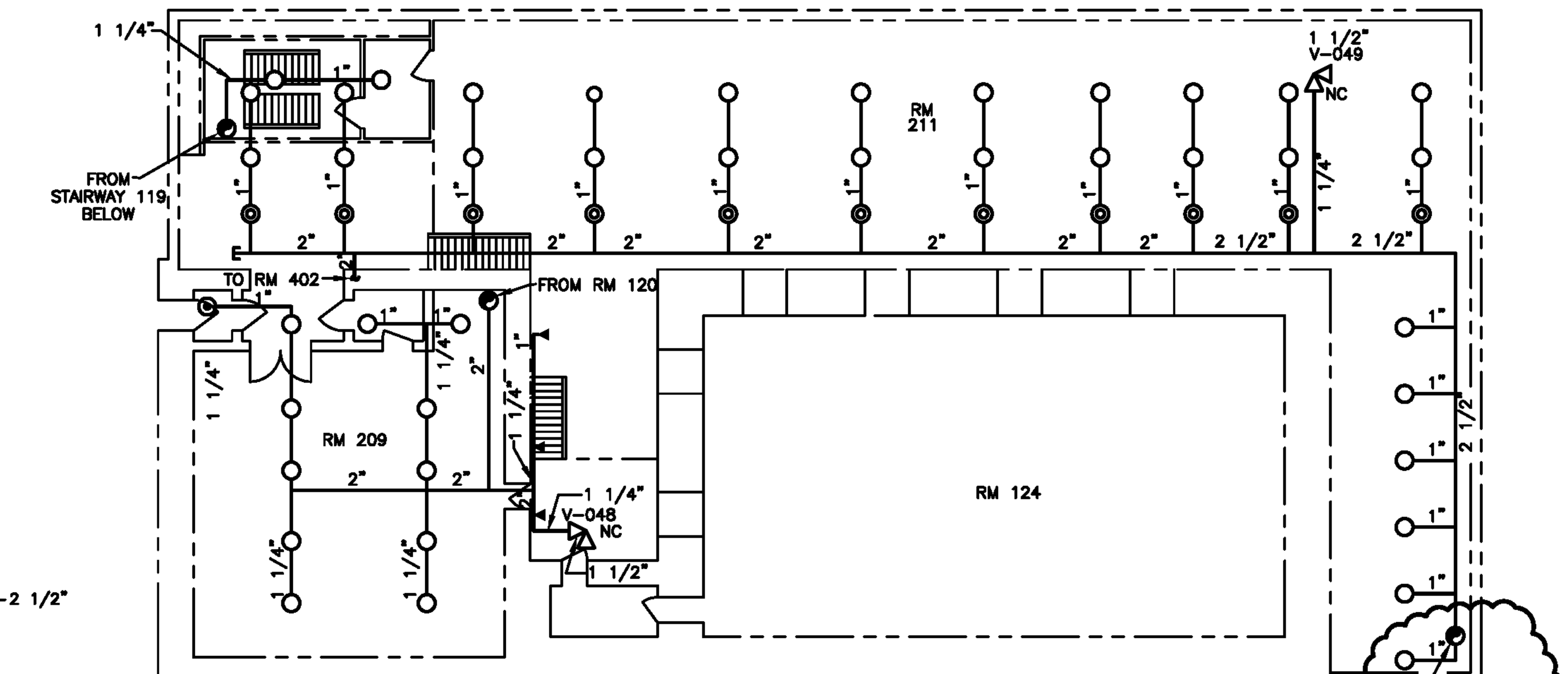
SIZE E | SYS GC03 | DWG NO 24–C–066–W1 | REV NEW

THIS DRAWING TAKEN FROM: 24–Z–029–W1
VENDOR: WTS

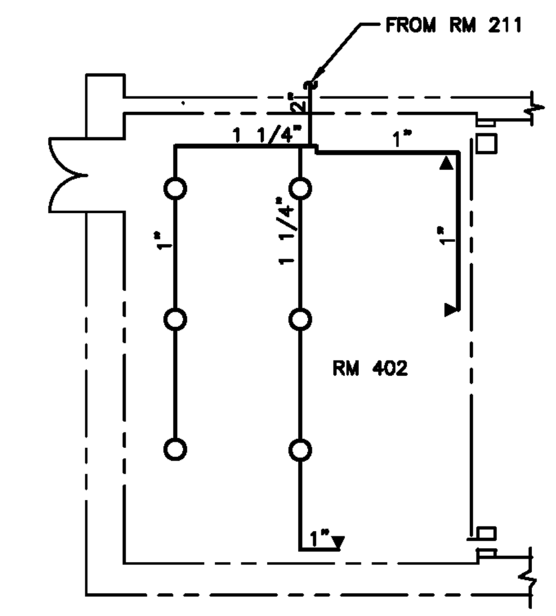
41-S-003-W1



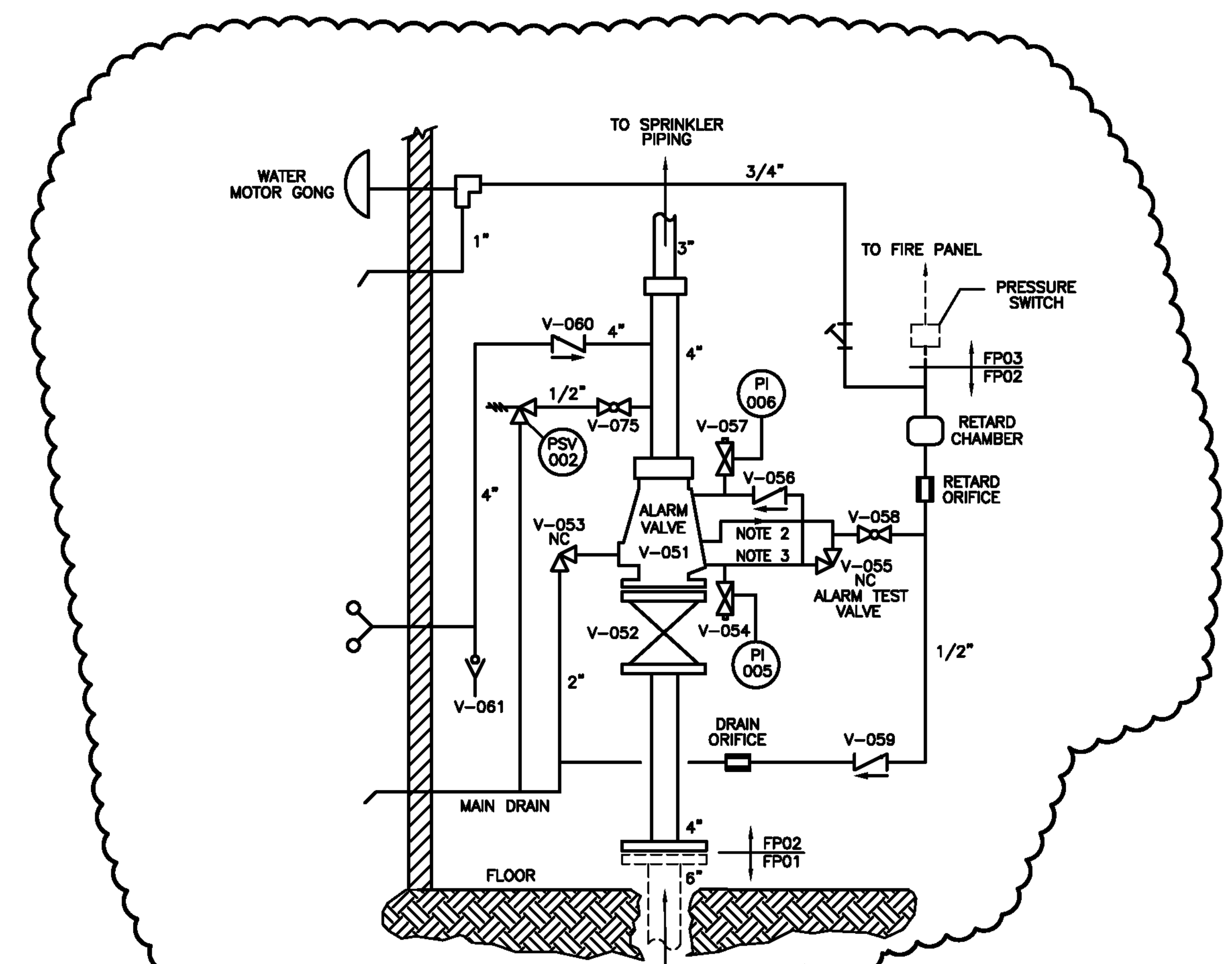
REMOTE HANDLING AREA
AT EL 100'-0"



HOT CELL
AT EL 122'-0"



CRANE MAINTENANCE AREA
AT EL 142'-1"



SECTION A–A
REF DWG 24-C-048-W FOR YARD PIPING TO BLDG 411

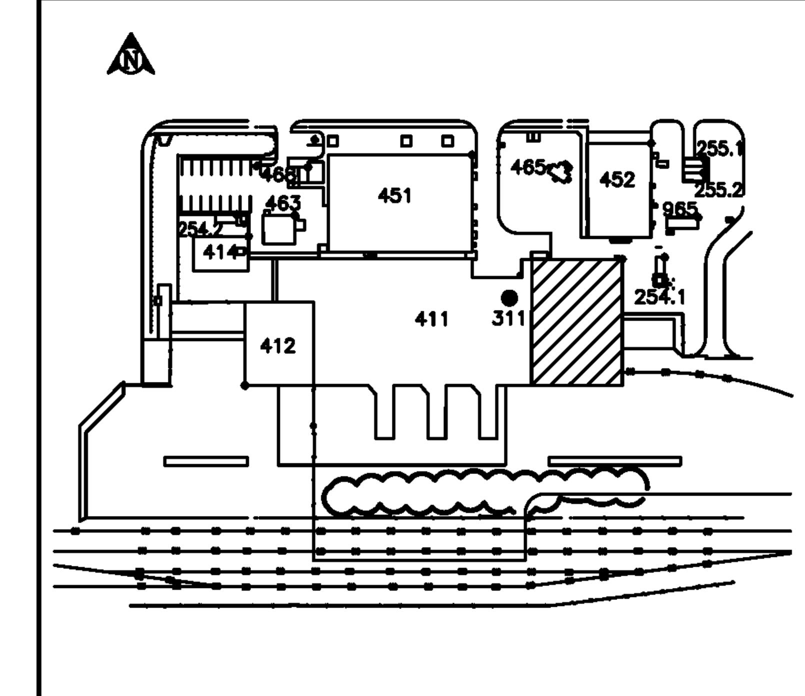
THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE: ______

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
FP02	41	00411	29	240

KEY PLAN



REFERENCES

SITE UTILITIES WATER FIRE WATER	24-C-048-W
WASTE HANDLING BUILDING FIRE PANEL 411-FP-01301	41-J-024-W1 AND W2
TRUPACT MAINTENANCE BUILDING FIRE PROTECTION SPRINKLER SYSTEM P & ID	41-S-001-W
WASTE HANDLING BUILDING 411 FIRE PROTECTION SPRINKLER SYSTEM P & ID	41-S-003-W1, W2, W3 & W4 OF 4
VENDOR DATA: LaDEW FIRE PROTECTION	02-3345
VENDOR DATA: LaDEW FIRE PROTECTION	02-3455
VENDOR DATA: LaDEW FIRE PROTECTION	02-3685
VENDOR DATA: FIRE ENGINEERING CO. INC.	97-604

LEGEND

- UPRIGHT ON 1" RISER
- STANDARD UPRIGHT HEAD
- PENDENT HEAD BELOW CLG.
- MAIN RISER
- CLG. OR FLOOR PENETRATION
- HORIZONTAL HEAD
- FLUSH MOUNTED HEAD ON 1" DROP
- STANDARD PENDENT HEAD

NOTES

1. ALL VALVE TAGS UNLESS OTHERWISE NOTED ARE PREFIXED BY THE SYSTEM DESIGNATOR & BUILDING NUMBER.

   EXAMPLE:

   FW-411-V-018
   - VALVE NUMBER
   - COMPONENT
   - BUILDING NUMBER
   - SYSTEM DESIGNATOR

2. WATER FLOWS IN THIS LINE ONLY WHEN ALARM VALVE OPENS.
3. ALARM VALVE TRIM PIPING SIZE VARIES FROM 1/4" TO 3/4".

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
H	REVISED PER ECO	DM 06/28/04	RS 07/13/04	WEB 07/13/04	BB 07/14/04	10997	N/A
G	REVISED PER ECO	EM 08/04/03	PA 08/06/03	WEB 08/06/03	BB 08/07/03	10786	N/A

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 4303 PWR: N/A

DFTR: CHG/FBB
CHKR: A.E.SEWALD 10/15/90
COG: W.BARNHART 10/15/90
CM: G. POHL 6/05/90
QA: R. YOUNGMAN 6/05/90
DM: H.W.BELLOWS 10/16/90
ASB: R. BIRD 6/05/90

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions

Waste Isolation Pilot Plant — Carlsbad, New Mexico

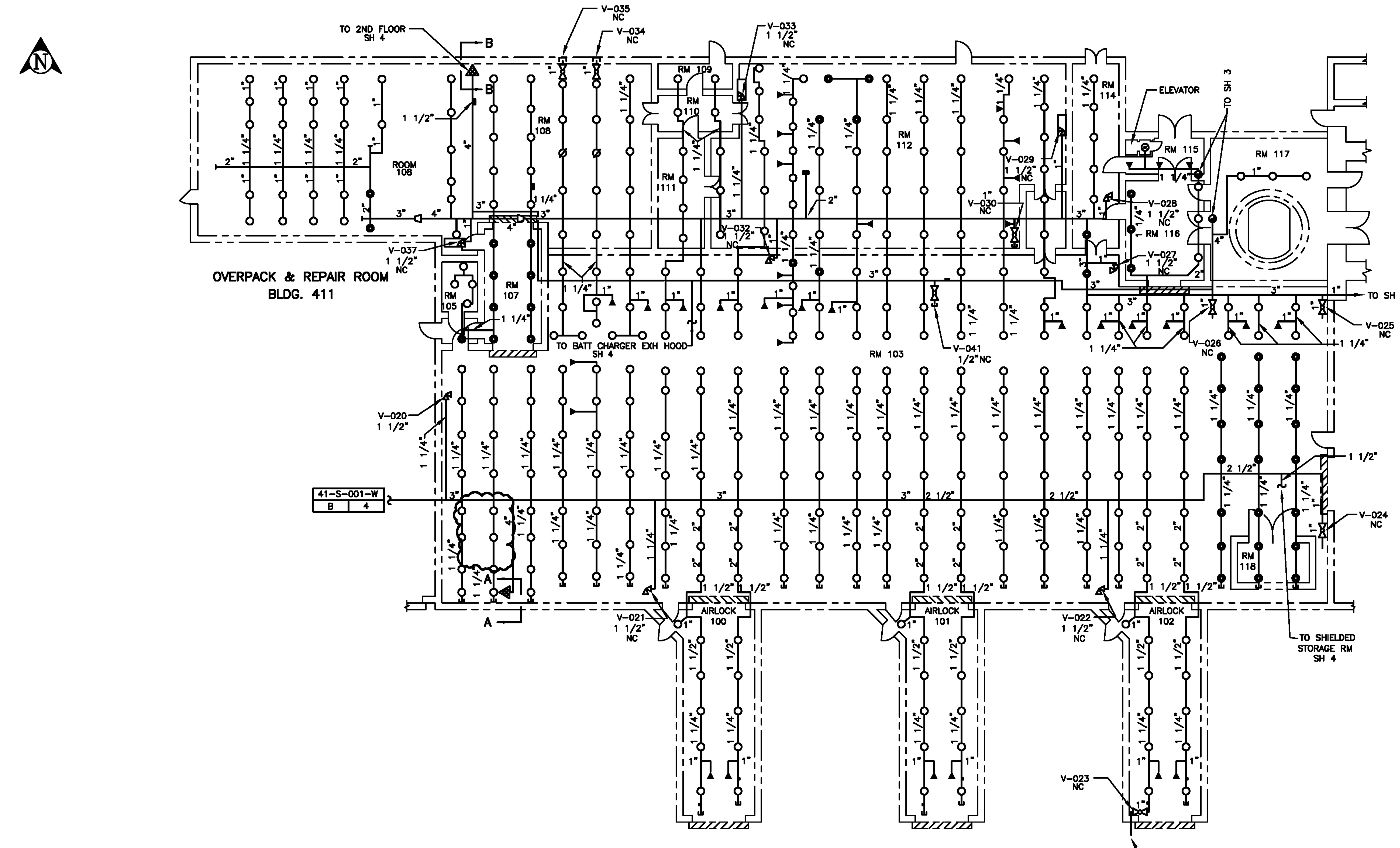
WASTE HANDLING BLDG 411
FIRE PROTECTION
SPRINKLER SYSTEM P & ID

SCALE: NONE
INTERPRET DWG PER ANSI Y14

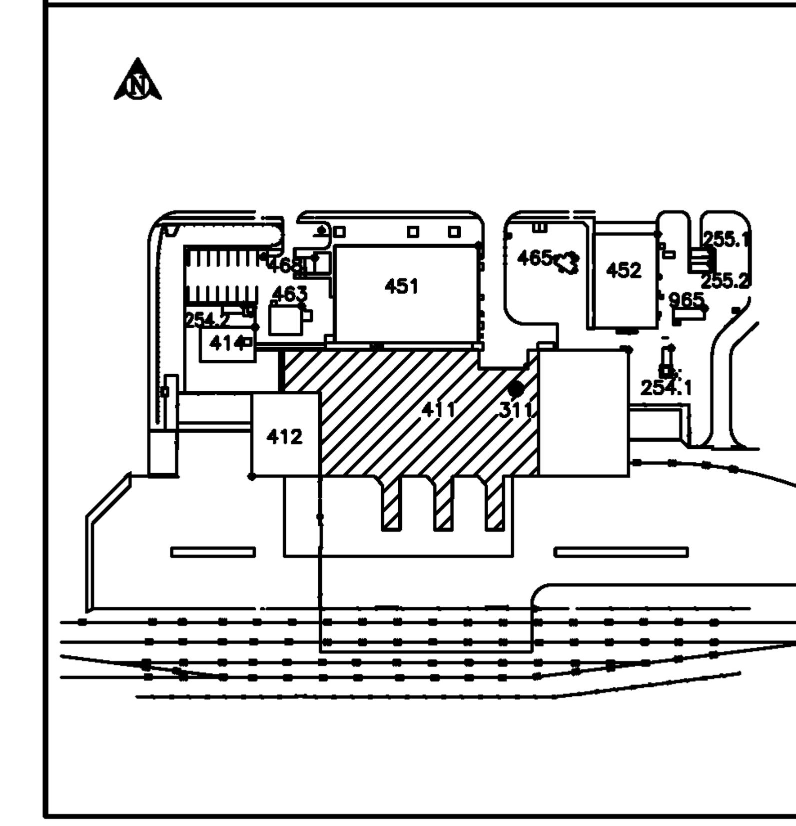
SIZE	SYS	DWG NO	REV
E	FP02	41-S-003-W1	H

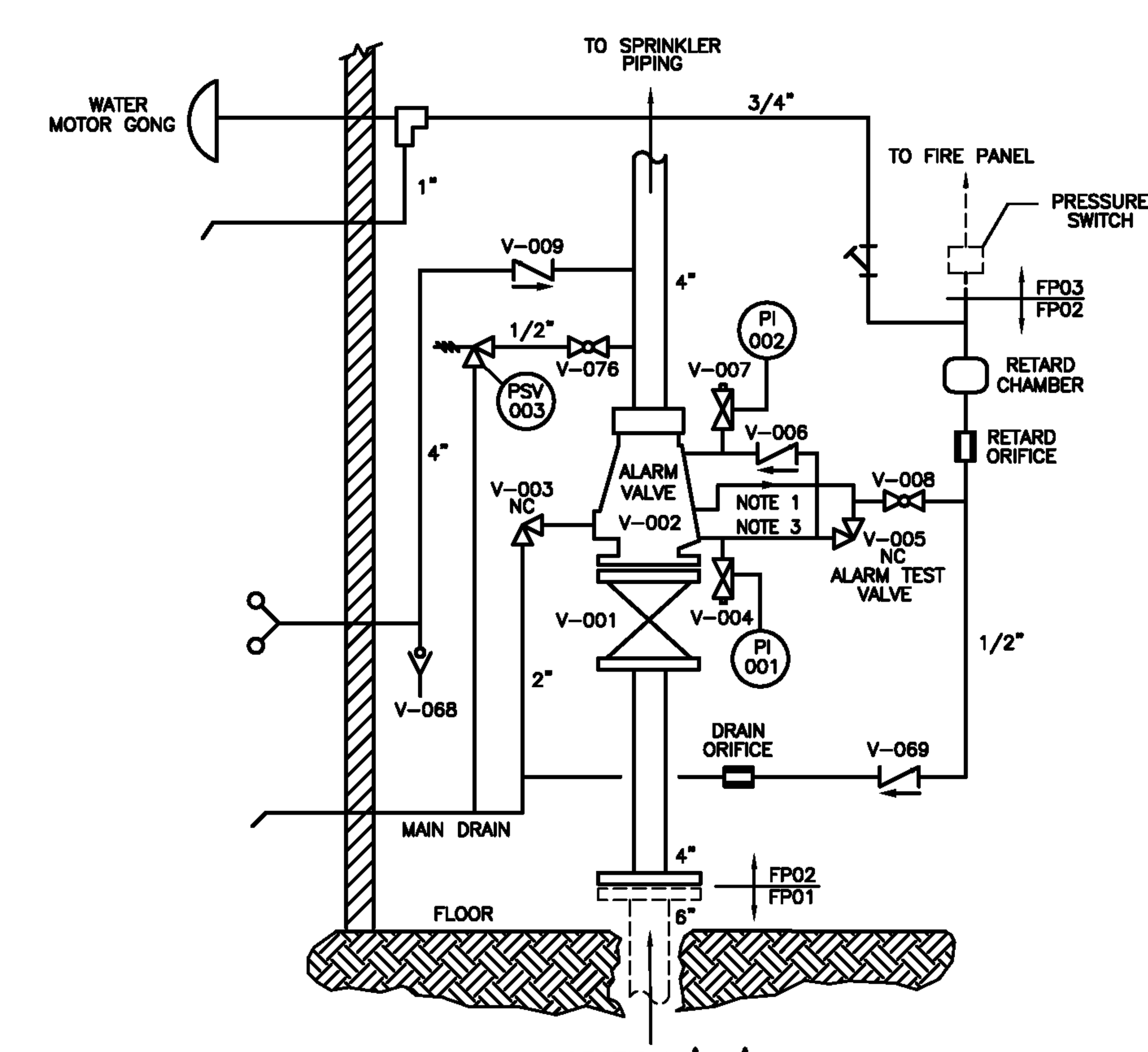
THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

41-S-003-W2

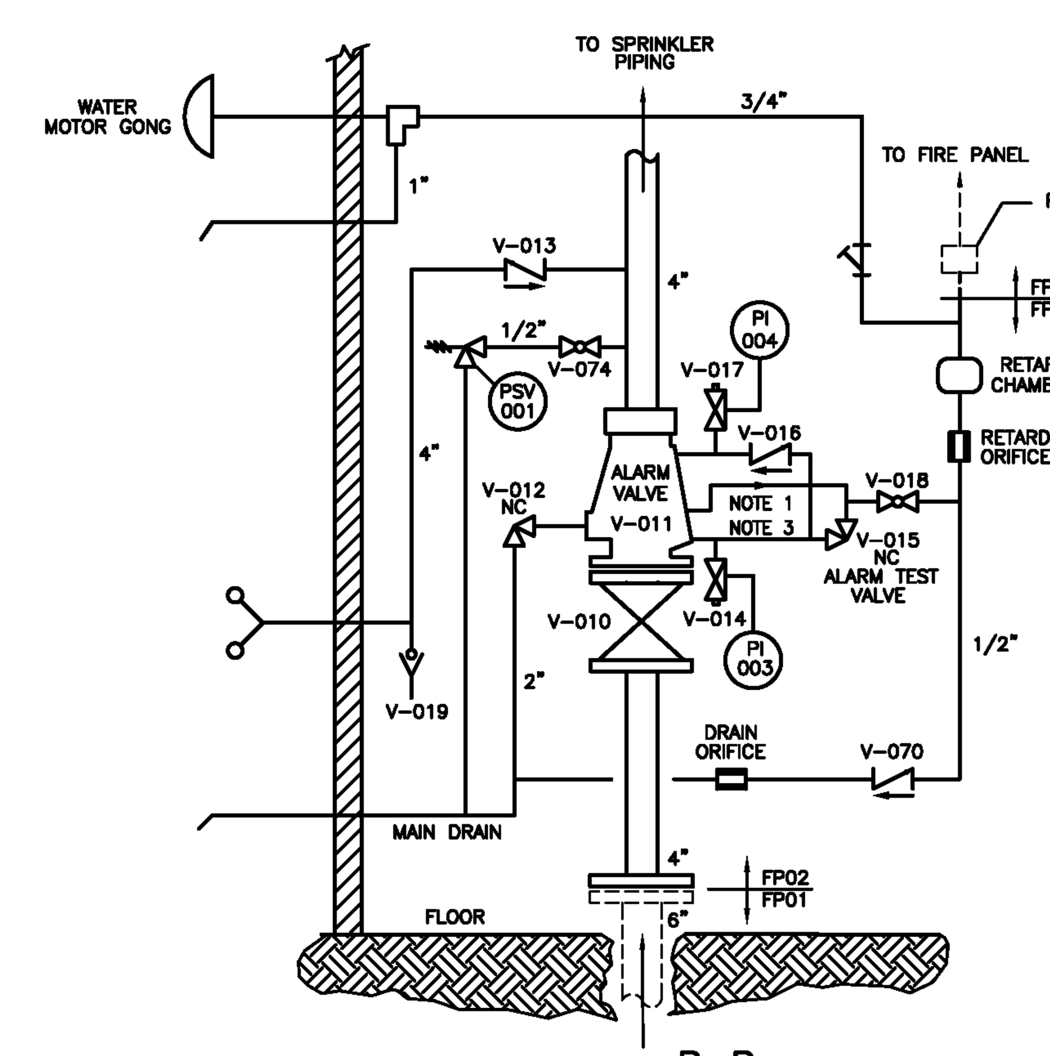


CH AREA
AT EL 100'-0"





SECTION A–A
REF DWG 24-C-048-W FOR
YARD PIPING TO BLDG 411



SECTION B–B
REF DWG 24-C-048-W FOR
YARD PIPING TO BLDG 411

NOTES

1. WATER FLOWS ONLY WHEN ALARM TEST VALVE IS OPEN.
2. ALL VALVE TAGS UNLESS OTHERWISE NOTED ARE PREFIXED BY THE SYSTEM DESIGNATOR AND BLDG. NUMBER.

   EXAMPLE:
   FW–411–V–018
   - VALVE NUMBER
   - COMPONENT
   - BUILDING NUMBER
   - SYSTEM DESIGNATOR
3. ALARM VALVE TRIM PIPING VARIES IN SIZE FROM 1/4" TO 3/4".

THIS DRAWING IS UP–TO–DATE AND LATEST REVISON VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE: ____________
THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
FP03	41	00411	29	240

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
FP02	41	00411	29	240

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
FP01	41	00411	29	240

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
N	REVISED PER ECO	DH 11/28/06	RS 2/19/07	WEB 2/19/07	BB 2/21/07	11658	N/A
M	REVISED PER ECO	DM 06/28/04	RS 07/13/04	WEB 07/13/04	BB 07/14/04	10997 11028	N/A N/A

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 4303 PWR: N/A

DFTR: CHG/FBB
CHKR: A. SEWALD 11/15/90
COG: W.E. BARNHART 10/15/90
CM: WEB FOR G.POHL 10/15/90
QA: J.L. WALKER 6/5/90
DM: H.W. BELLOWS 10/16/90
ASB: ROY BIRD 6/5/90

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions
Waste Isolation Pilot Plant — Carlsbad, New Mexico

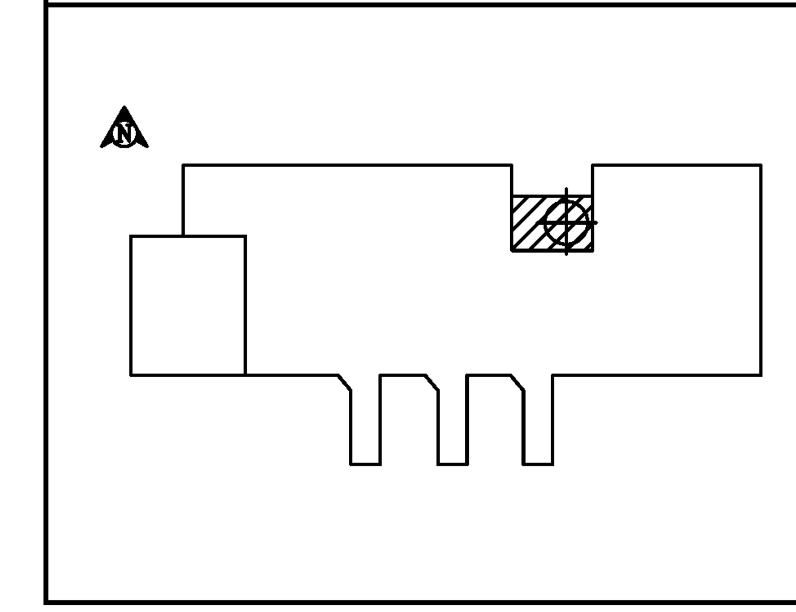
**WASTE HANDLING BLDG 411
FIRE PROTECTION
SPRINKLER SYSTEM P & ID**

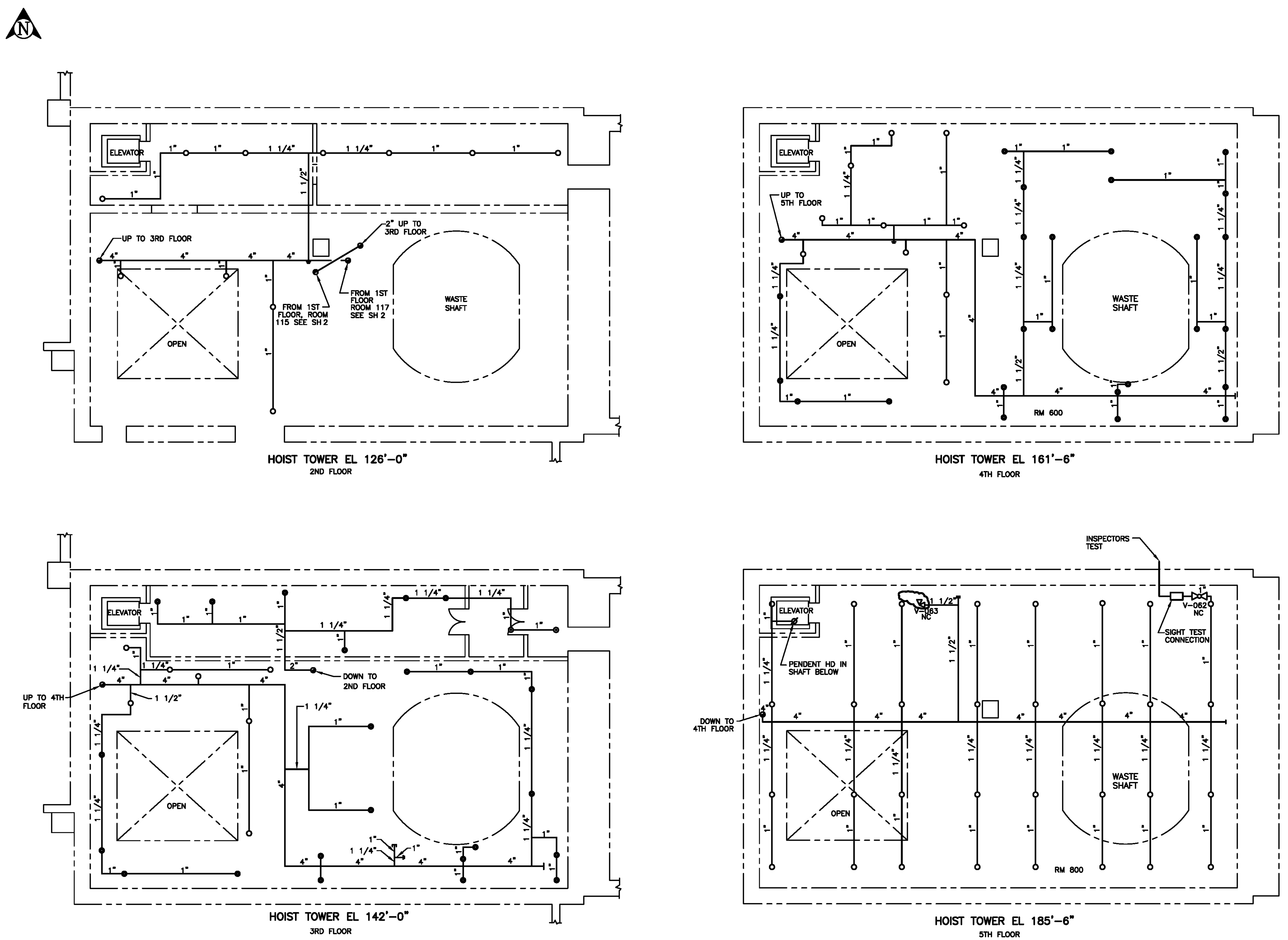
SCALE: NTS
INTERPRET DWG PER ANSI Y14
SIZE: E | SYS: FP02 | DWG NO: 41–S–003–W2 | REV: N

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

41-S-003-W3

KEY PLAN





REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
C	REVISED PER ECO	TB 10/26/99	PA 11/10/99	WEB 11/10/99	BB 11/11/99	9460	9810831J
B	REVISED PER ECO	TRA 08/20/91	DLH 08/21/91	WEB 08/21/91	BA 08/22/91	5296	00377M

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 4303 PWR:

DFTR: CHG/FBB
CHKR: A.E.SEWALD 10/15/90
COG: W.E.BARNHART 10/15/90
CM: WEB FOR G.FOHL 10/15/90
QA: J.L.WALKER 6/15/90
SFTY: N/A
APPD:
APPD:
DM: H.W.BELLOWS 10/16/90
DOE: N/A

U.S. DEPARTMENT OF ENERGY

Westinghouse Waste Isolation Division
Waste Isolation Pilot Plant
CARLSBAD, NEW MEXICO

WASTE HANDLING BLDG 411
FIRE PROTECTION
SPRINKLER SYSTEM P & ID

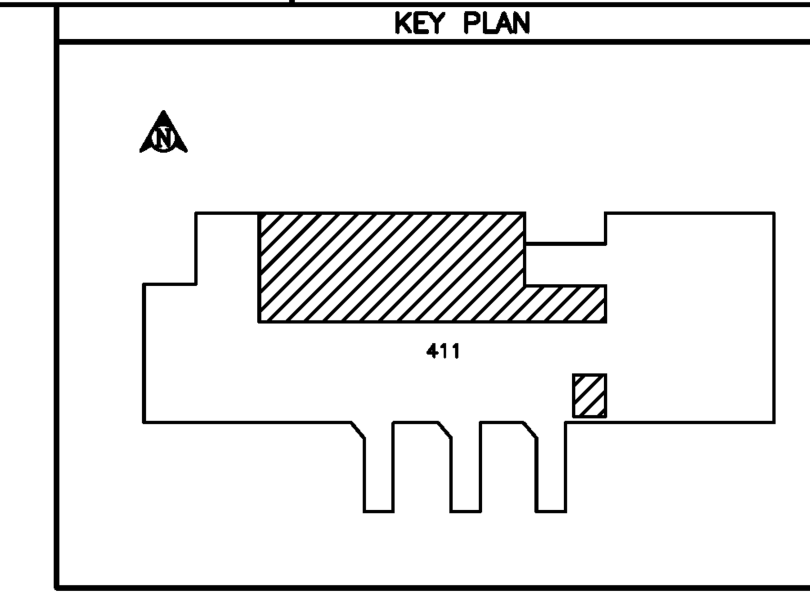
SIZE E | SYS FP02 | DWG NO 41-S-003-W3 | REV C

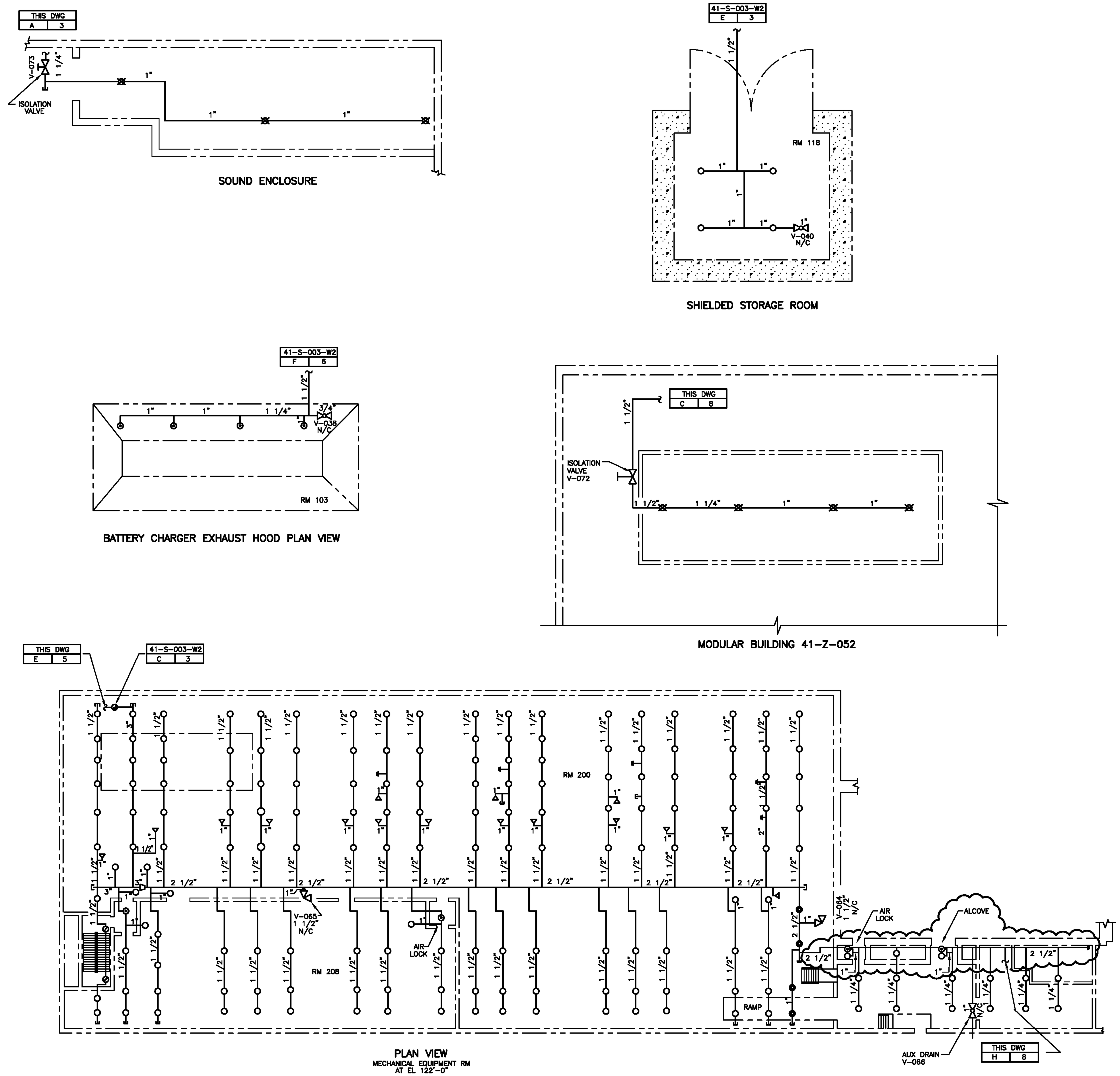
SCALE: NTS | INTERPRET DWG PER ANSI Y14

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

INDEX CODE NUMBER

SYSTEM	WBE	DWG TYPE	CL	VENDOR
FP02	41	00411	29	230





THIS DRAWING IS UP-TO-DATE AND LATEST REVISON VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE: ______

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
H	REVISED PER ECO	DM 6/28/04	RSS 7/13/04	WEB 7/13/04	BB 7/14/04	10997	N/A
G	REVISED PER ECO	TB 9/25/00	PA 9/27/00	WEB 9/27/00	BB 9/27/00	9779	0003654M 0003652M 0003650M

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 4303 PWR: N/A

DFTR: CHG/FBB
CHKR: A. SEWALD 11/15/90
COG: W.E. BARNHART 10/15/90
CM: WEB FOR G.POHL 10/15/90
QA: J.L. WALKER 6/5/90
DM: H.W. BELLOWS 10/16/90
ASB: ROY BIRD 6/5/90

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions
Waste Isolation Pilot Plant — Carlsbad, New Mexico

WASTE HANDLING BLDG. 411 FIRE PROTECTION SPRINKLER SYSTEM P & ID

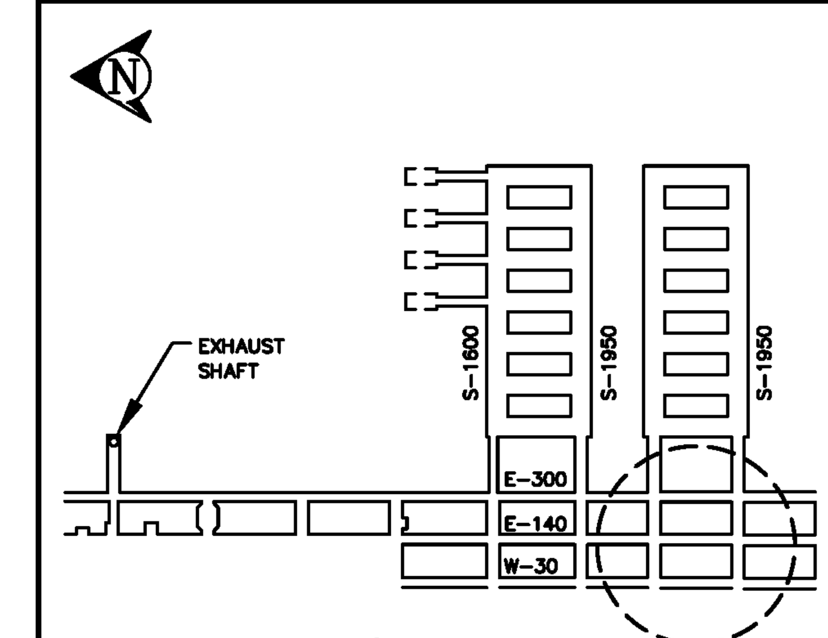
SCALE: NONE
INTERPRET DWG PER ANSI Y14

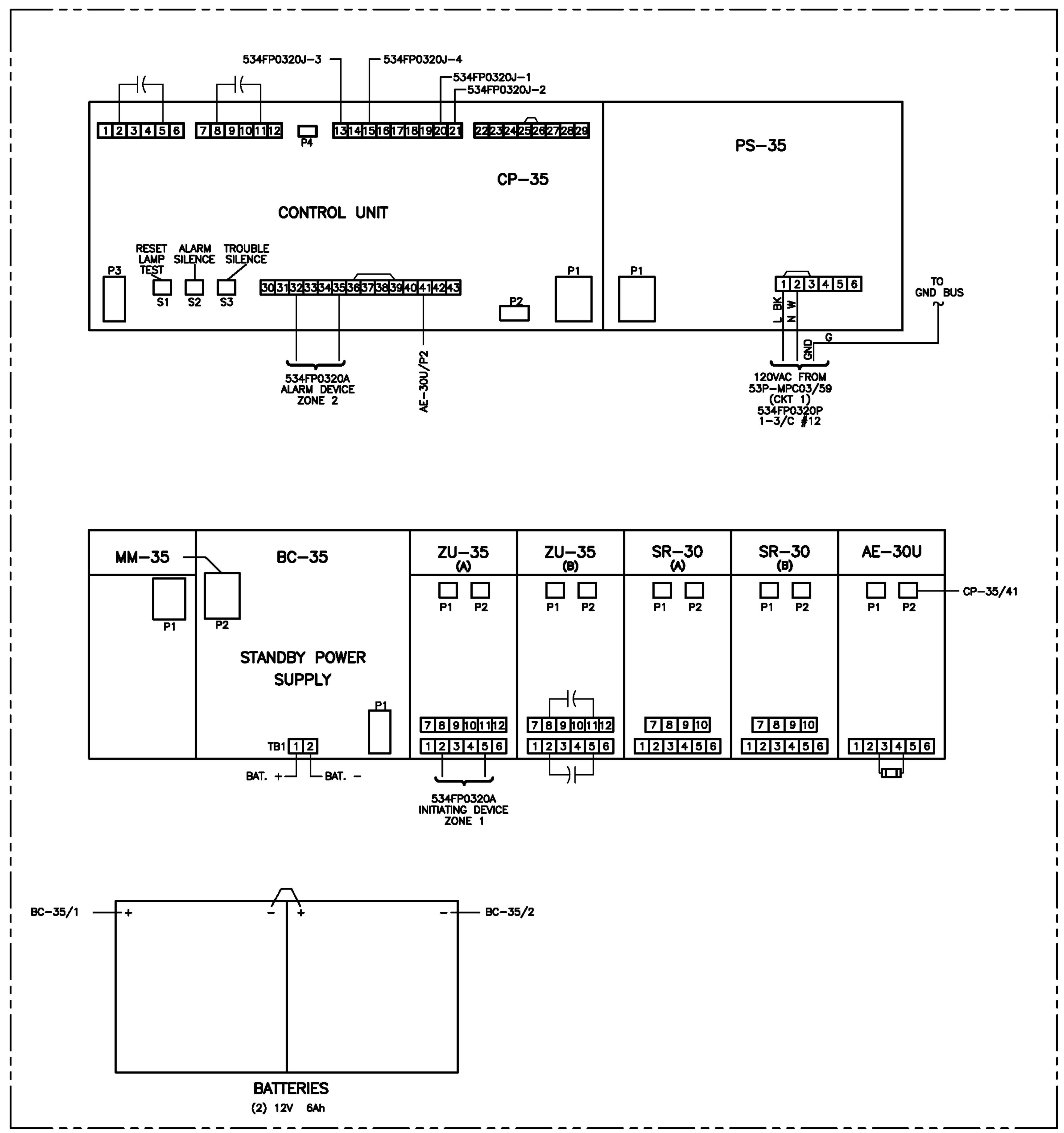
SIZE	SYS	DWG NO	REV
E	FP02	41-S-003-W4	H

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

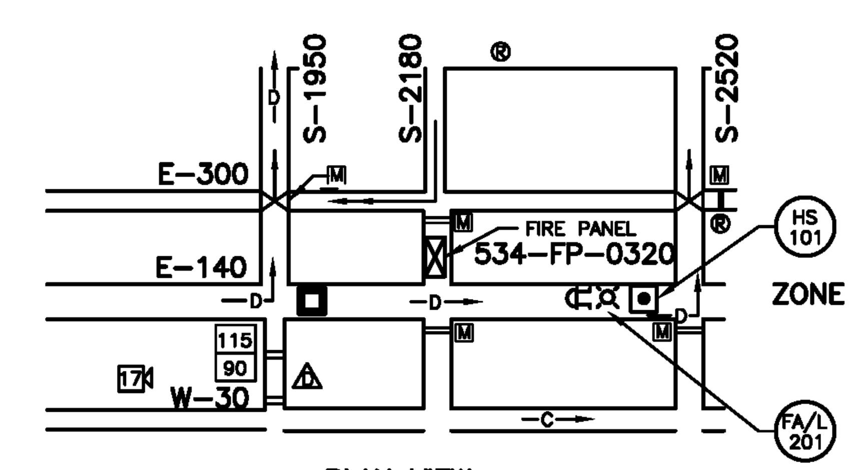
INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
FP02	41	00411	29	240

KEY PLAN



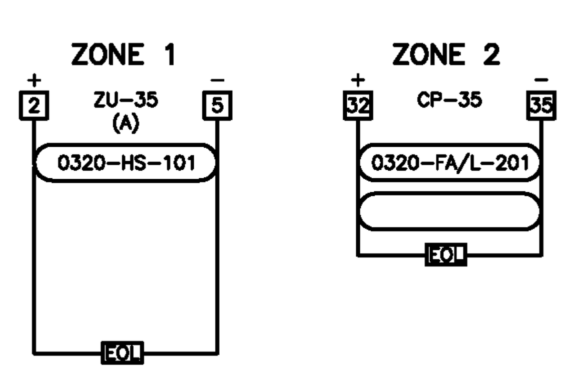


INTERNAL PANEL WIRING FOR FIRE PANEL 534-FP-0320



PLAN VIEW

FIRE DETECTION & ALARM SYSTEM



FIRE PANEL 534-FP-0320

LADDER DIAGRAM

FUNCTION	WIRE NUMBER	PANEL LOCATION	CMS POINT ID.	711-LPU-822 LPU TERM
PANEL 1 U/G FIRE ALARM	534FP0320J-4 534FP0320J-3	CP-35-15 CP-35-13	CM0605 CM0605	A3A-02 A3B-02
FIRE PANEL STATUS	534FP0320J-1 534FP0320J-2	CP-35-20 CP-35-21	CM0613 CM0613	A3A-03 A3B-03

REFERENCES

PANEL SCHEDULE 52P-MPC03/59	52P-MPC03/59
U/G S-1600 E-190 711-LPU-822 CMS INTERCONNECT HALFSHELL A	71-L-022-W1
WIPP SITE FIRE PANEL DRAWING LIST	73-S-001-W
VENDOR DATA: PYROTRONICS SYSTEM 3 UNIVERSAL ALARM CONTROL WIRING DIAGRAM	

NOTES

1. FIRE PROTECTION SYSTEM EQUIPMENT IS LABELED AS FOLLOWS:
   EG: 413-FP-01003 - HS - 3 01
   XXX XX XXXXX - XX - X XX
   FACILITY NUMBER
   FIRE PANEL
   CONTROLLING INSTRUMENT NUMBER
   COMPONENT TYPE
   ZONE
   SEQUENTIAL COMPONENT NUMBER
2. DUE TO PAST LABELING PRACTICES CABLES MAY NOT HAVE THE SAME NUMBER ON EACH END.

THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE: ____________

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
FP03	53	U1050	66	240

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
P	REVISED PER ECO	DM 7/16/08	RS 9/11/08	BB 9/11/08	BB 9/12/08	12061	N/A
N	REVISED PER ECO	DM 3/29/04	RS 3/31/04	BB 4/02/04	BB 4/05/04	10991	N/A

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 3192 PWR: N/A

DFTR: R. SEXTON 3/24/89
CHKR: B.ALLEN 10/01/90
COG: J.WHITE 10/01/90
CM: J.DAVIS 8/3/90
QA: A.GALLEGOS 8/3/90
APPD: T.BATCHELDER 4/27/92
DM: H.W.BELLOWS 10/1/90
ASB: C.E.ALDRIDGE 7/31/90

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions LLC

Waste Isolation Pilot Plant Carlsbad, New Mexico

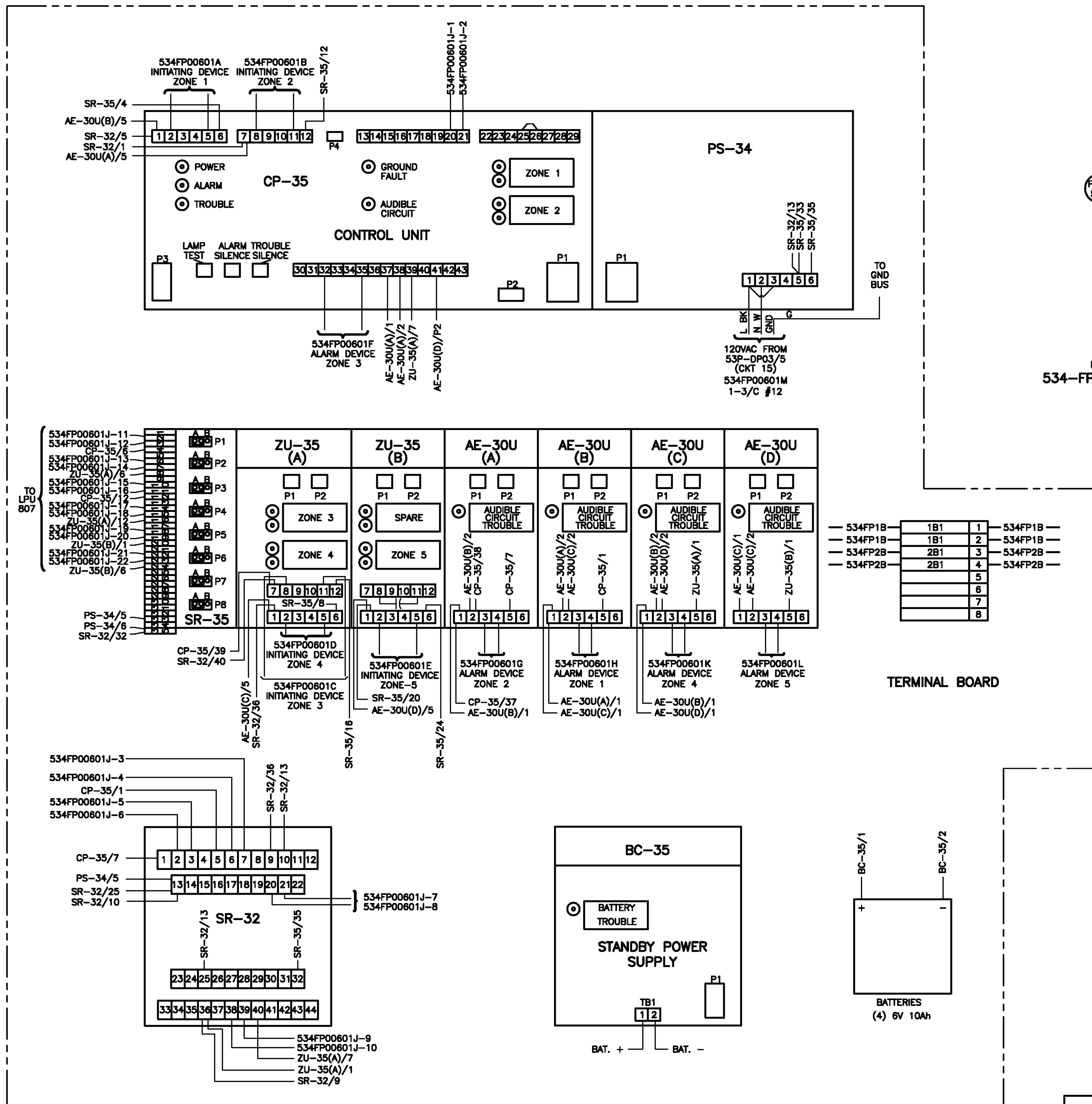
UNDERGROUND UTILITIES
FIRE PANEL 534-FP-0320

SCALE: NONE
INTERPRET DWG PER ANSI Y14

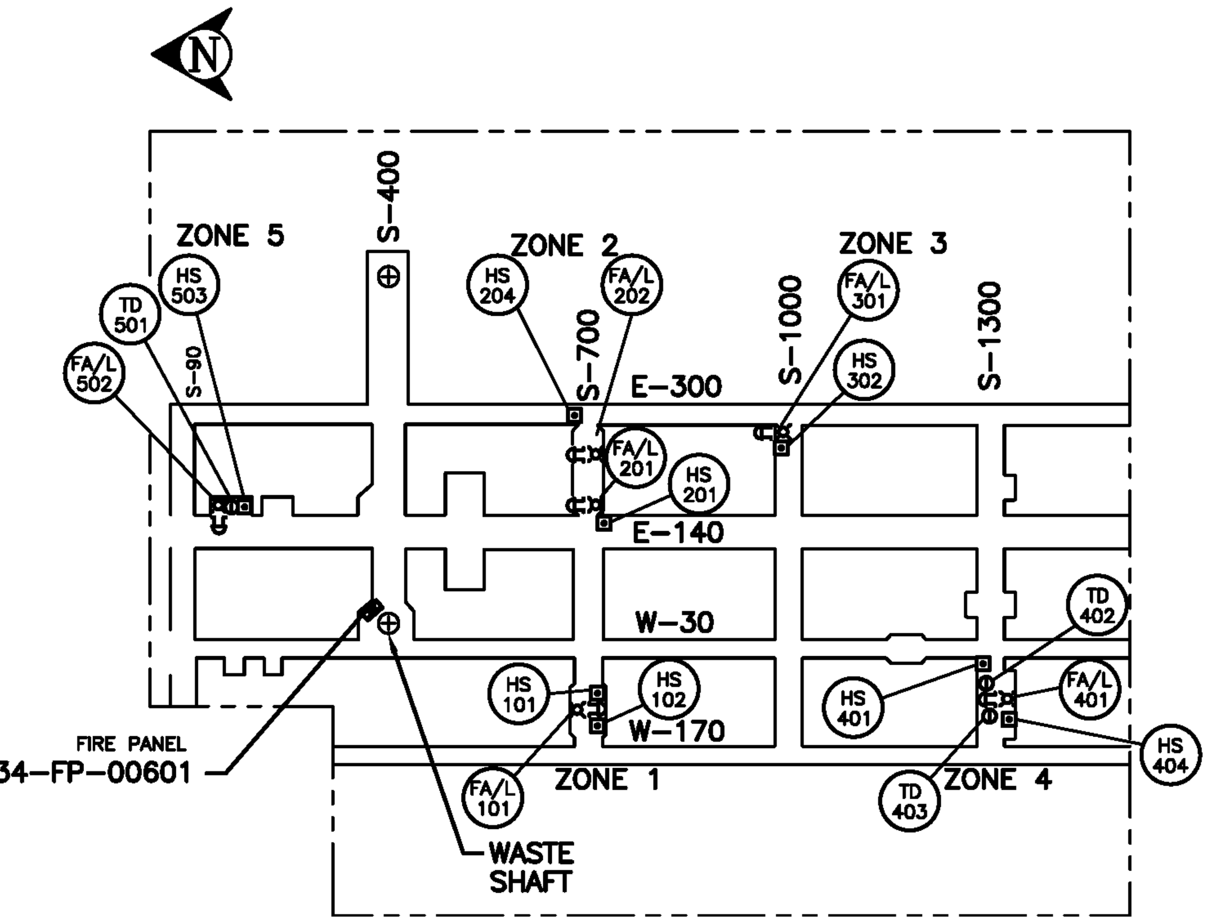
SIZE E | SYS FP03 | DWG NO 53-J-039-W | REV P

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

53-J-042-W



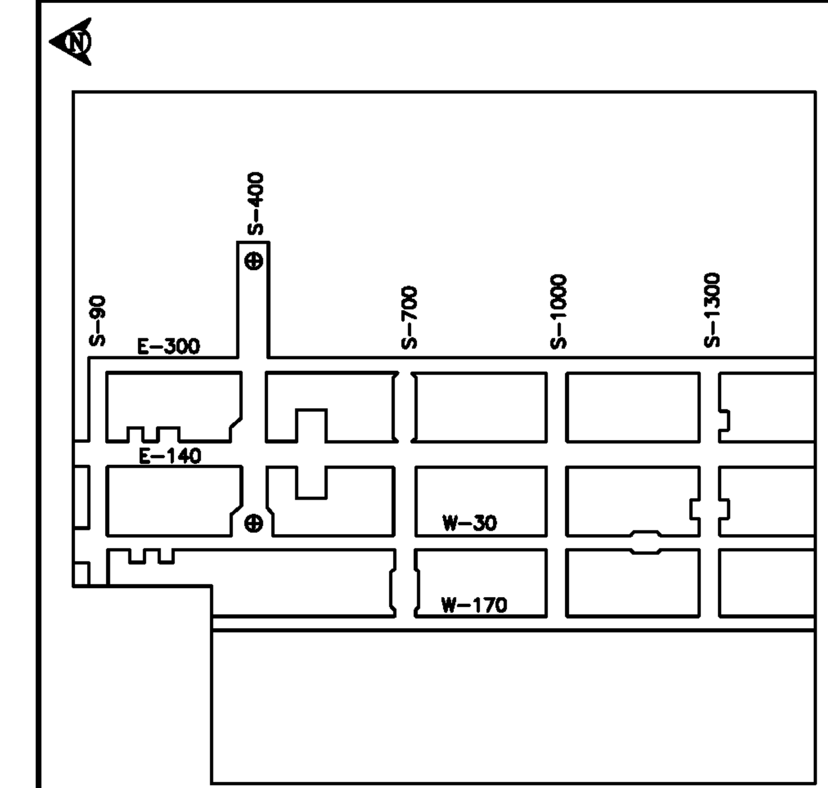
INTERNAL PANEL WIRING FOR FIRE PANEL 534-FP-00601

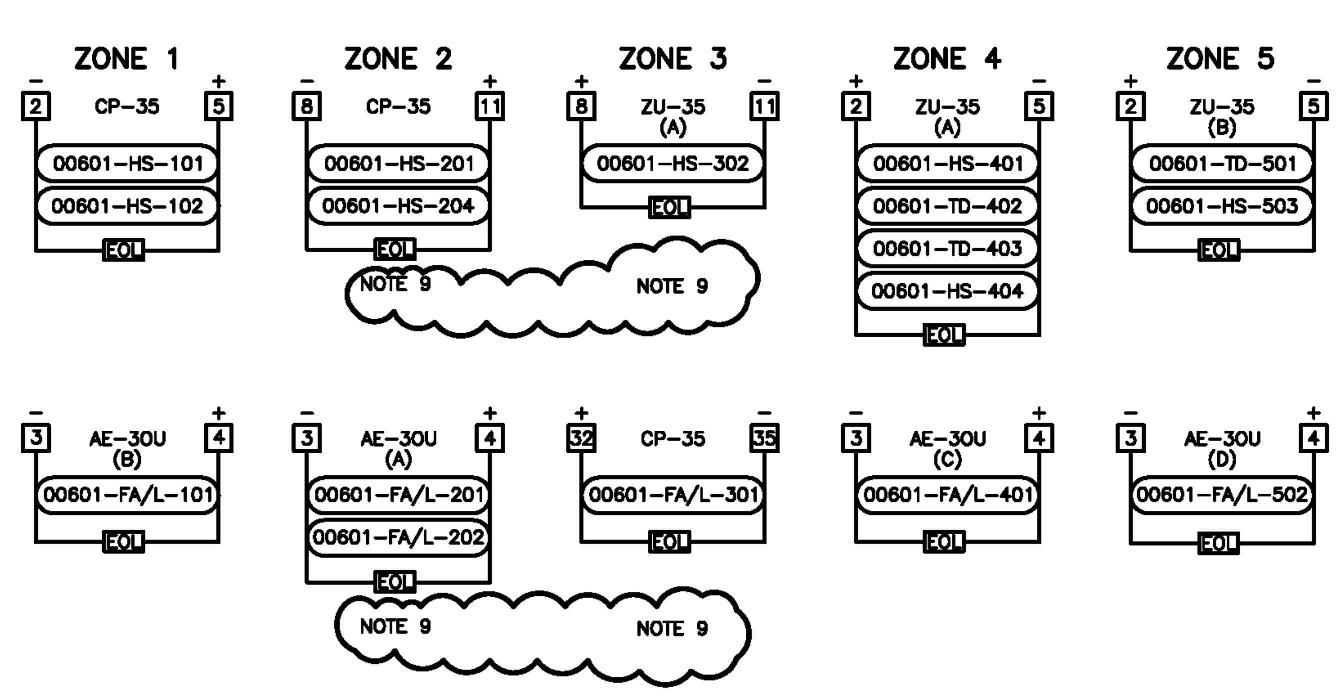


PLAN VIEW

FIRE DETECTION & ALARM SYSTEM

KEY PLAN





FIRE PANEL 534-FP-00601

LADDER DIAGRAM

REFERENCE

UNDERGROUND UTILITIES 53P-DP03/5, 53P-DP04/11 & 53P-MPC03/2 PANEL SCHEDULES	53-J-059-W1
UNDERGROUND S-400/W-30 711-LPU-807 CMS INTERCONNECT HALFSHELLS A,B,C & D	71-L-010-W1-W4
WIPP SITE FIRE PANEL DRAWING LIST	73-S-001-W
REF. WIRING DIAGRAMS PYROTRONICS SYSTEM 3 UNIVERSAL ALARM CONTROL	
UNDERGROUND VENTILATION SYSTEM P & ID	54-A-160-W7

THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE: ____

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

FUNCTION	WIRE NUMBER	PANEL LOCATION	CMS POINT ID.	711-LPU-807 LPU TERM
ZONE 1 ALARM DEVICE	534FP00601J-3 534FP00601J-4	SR-32-07 SR-32-06	CM0602 CM0602	B3A17 B3B17
ZONE 1 TROUBLE ALARM	534FP00601J-15 534FP00601J-16	SR-35-10 SR-35-11	CM0607 CM0607	A4A6 A4B6
ZONE 2 ALARM DEVICE	534FP00601J-5 534FP00601J-6	SR-32-03 SR-32-02	CM0601 CM0601	B3A16 B3B16
ZONE 2 TROUBLE ALARM	534FP00601J-11 534FP00601J-12	SR-35-2 SR-35-3	CM0606 CM0606	A4A5 A4B5
ZONE 3 ALARM DEVICE	534FP00601J-9 534FP00601J-10	SR-32-39 SR-32-38	CM0609 CM0609	D2A11 D2B11
ZONE 3 TROUBLE ALARM	534FP00601J-17 534FP00601J-18	SR-35-14 SR-35-15	CM0611 CM0611	D2A13 D2B13
ZONE 4 ALARM DEVICE	534FP00601J-7 534FP00601J-8	SR-32-21 SR-32-20	CM0603 CM0603	A4A02 A4B02
ZONE 4 TROUBLE ALARM	534FP00601J-13 534FP00601J-14	SR-35-6 SR-35-7	CM0608 CM0608	A4A7 A4B7
ZONE 5 ALARM DEVICE	534FP00601J-19 534FP00601J-20	SR-35-18 SR-35-19	CM0610 CM0610	D2A12 D2B12
ZONE 5 TROUBLE ALARM	534FP00601J-21 534FP00601J-22	SR-35-22 SR-35-23	CM0612 CM0612	D2A14 D2B14
FIRE PANEL STATUS	534FP00601J-1 534FP00601J-2	CP-35-20 CP-35-21	CM0811 CM0811	C2A15 C2B15

NOTES

1. REMOVED
2. THE FIRE ALARM PORTION OF THE FOLLOWING DRAWINGS HAVE BEEN SUPERCEDED PER ECO 4606.
   53-J-572-01E
   53-J-533-01E
   53-J-532-01E
3. THIS DRAWING SUPERCEDES DRAWING GZC 6653-FA-1, PER ECO NO 3210.
4. P1-P8 ON SR-35 IS FOR "HIGH GOING INPUT SIGNAL" (ALARM OUTPUT FROM ZU-35)
5. DUE TO PAST LABELING PRACTICES CABLES MAY NOT HAVE THE SAME NUMBER ON EACH END.
6. REMOVED
7. REMOVED
8. THE FIRE PANEL AND INSTRUMENT NUMBERS WERE DERIVED FROM SUPERCEDED DRAWING NUMBER 53-H-006-01E
9. CABLES FOR ZONE 2 AND ZONE 3 INTIATING AND ALARM DEVICES ARE NOT A CONTINUOUS RUN, A JUNCTION BOX WILL BE USED FOR TERMINATION.

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
FP03	53	U0650	15	240

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
U	REVISED PER ECO	TG 5/17/07	RS 5/21/07	BB 5/22/07	BB 5/22/07	10816	0307038M
T	REVISED PER ECO	TB 06/12/01	PA 06/20/01	BB 06/20/01	BB 06/21/01	10140	N/A

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 3210 PWR:M040677 M40680

DFTR: R.SEXTON
CHKR: B.ALLEN 10/01/90
COG: J.WHITE 10/1/90
CM: J. DAVIS 8/3/90
QA: A. GALLEGOS 8/3/90
APPD:T.BATCHELDER 4/27/92
DM: H.W.BELLOWS 10/1/90
ASB: C. ALDRIDGE 8/2/90

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions

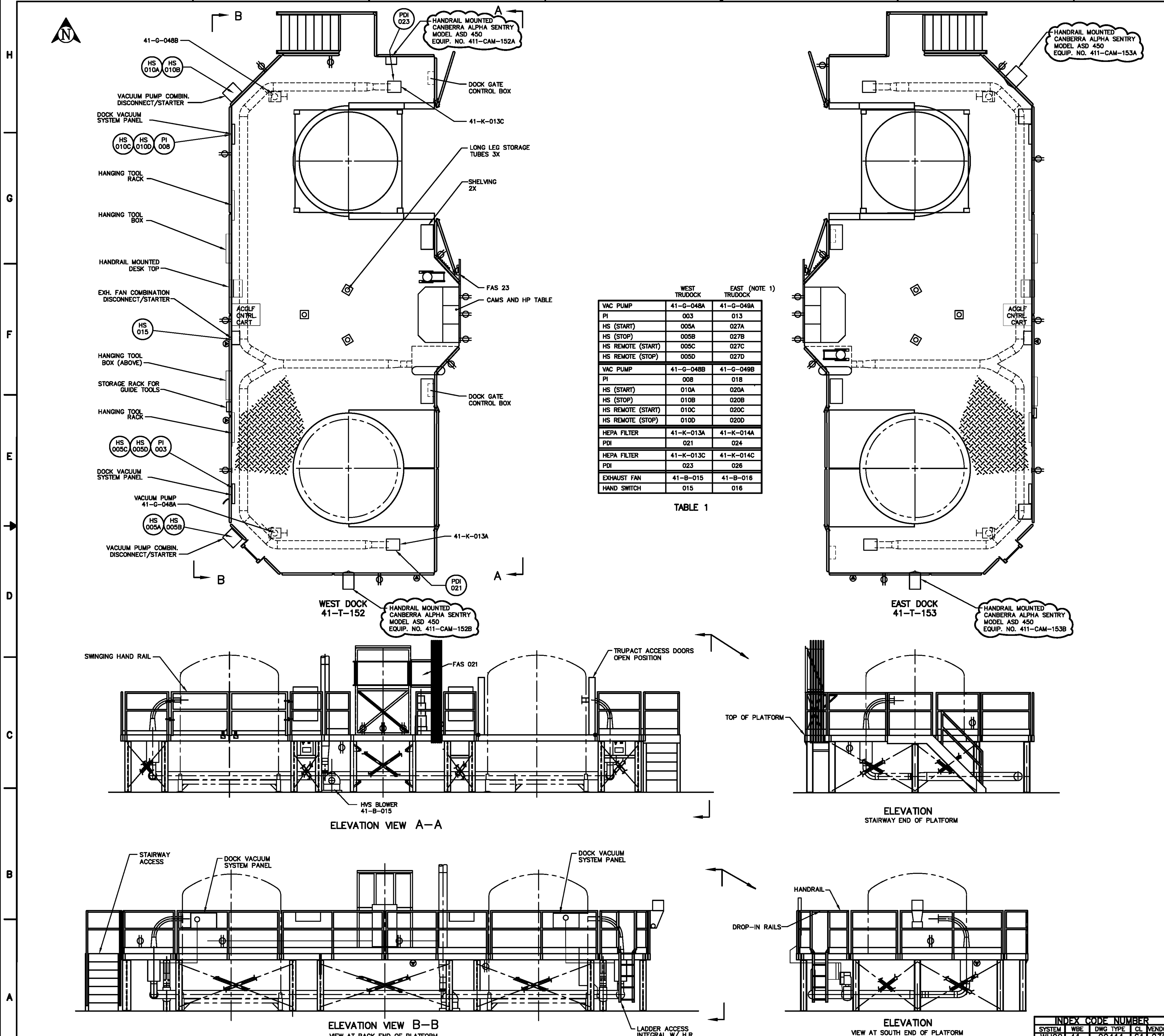
Waste Isolation Pilot Plant Carlsbad, New Mexico

UNDERGROUND UTILITIES
FIRE PANEL 534-FP-00601

SCALE: NONE
INTERPRET DWG PER ANSI Y14

SIZE: E | SYS: FP03 | DWG NO: 53-J-042-W | REV: U

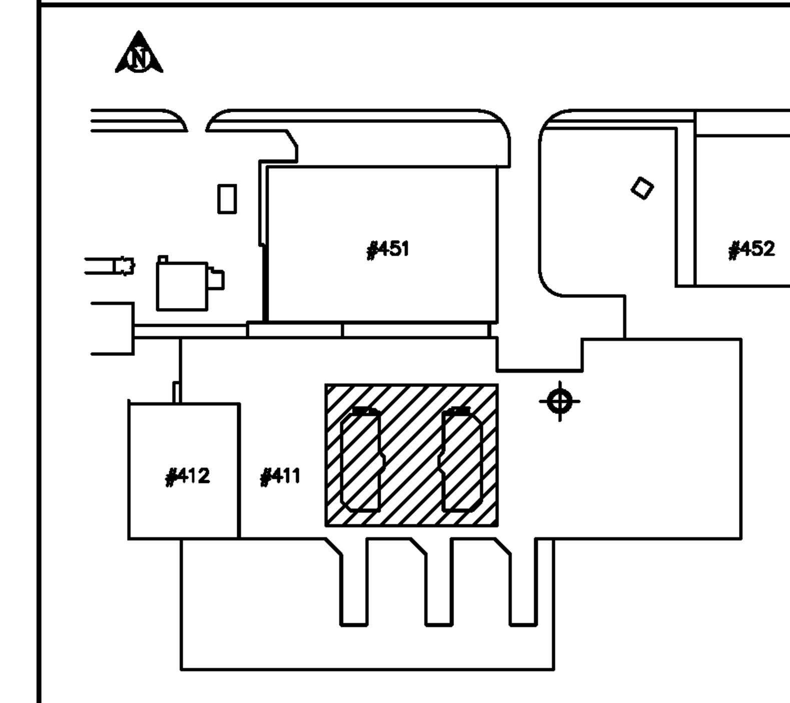
THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A



	WEST TRUDOCK	EAST (NOTE 1) TRUDOCK
VAC PUMP	41-G-048A	41-G-049A
PI	003	013
HS (START)	005A	027A
HS (STOP)	005B	027B
HS REMOTE (START)	005C	027C
HS REMOTE (STOP)	005D	027D
VAC PUMP	41-G-048B	41-G-049B
PI	008	018
HS (START)	010A	020A
HS (STOP)	010B	020B
HS REMOTE (START)	010C	020C
HS REMOTE (STOP)	010D	020D
HEPA FILTER	41-K-013A	41-K-014A
PDI	021	024
HEPA FILTER	41-K-013C	41-K-014C
PDI	023	026
EXHAUST FAN	41-B-015	41-B-016
HAND SWITCH	015	016

TABLE 1

KEY PLAN



REFERENCE

WASTE HANDLING FACILITIES INTERFACE HVAC DUCKWORK WITH HOOD SYSTEM	41-B-002-W
SUPPORT STRUCTURES FOR MIDDLE SECTION OF TRUDOCKS 41-T-152 & 153	41-D-018-W1,W2
TRUDOCK II DOCK PLAN ELECTRICAL PLAN	36-171-D-E-110,210
TRUDOCK II DOCK SINGLE LINE ELECTRICAL	36-171-D-E-101,201
TRUDOCK II DOCKING SYSTEM CENTRAL ENCLOSURE DET.	36-171-D-E-102,202
TRUDOCK II DOCKING SYSTEM CONTROL WIRING	36-171-D-E-103,203
TRUDOCK II DOCK PLAN ERECTION PLAN	36-171-D-S-101,201
TRUDOCK II DOCK PLAN SECTIONS	36-171-D-S-102,202
TRUDOCK II DOCK PLAN FABRICATION DETAILS	36-171-D-S-103,203
TRUDOCK II DOCK PLAN FABRICATION DETAILS	36-171-D-S-104,204
TRUDOCK II DOCK PLAN FABRICATION DETAILS	36-171-D-S-105,205
TRUDOCK II DOCK PLAN REMOVABLE HANDRAIL DETAILS	36-171-D-S-106,206
TRUDOCK II DOCK PLAN LADDER & STAIR FAB. DETAILS	36-171-D-S-107,207
TRUDOCK II DOCK PLAN WELDMENTS	36-171-D-S-108,208
TRUDOCK II DOCK PLAN FABRICATION DETAILS	36-171-D-S-109,209
TRUDOCK II DOCK PLAN FABRICATION DETAILS	36-171-D-S-110,210
TRUDOCK II DOCK PLAN BRACING FABRICATION DETAILS	36-171-D-S-111,211
TRUDOCK II DOCK PLAN BRACING FABRICATION DETAILS	36-171-D-S-112,212
TRUDOCK II DOCK PLAN ACCESS DOOR DETAIL	36-171-D-S-113,213
TRUDOCK II DOCK PLAN LEVER ARM & MISC. DETAILS	36-171-D-S-114,214
TRUDOCK II DOCK PLAN GATE FRAME ASSEMBLY	36-171-D-S-115,215
TRUDOCK II DOCK PLAN DOOR FRAMING DETAILS	36-171-D-S-116,216
TRUDOCK II DOCK PLAN FABRICATION DETAILS	36-171-D-S-117,217
TRUDOCK II DOCK PLAN FLOOR DECKING PLAN	36-171-D-S-118,218
TRUDOCK II DOCK PLAN DECK PLATE CUT DIAGRAMS	36-171-D-S-119,219
TRUDOCK II DOCK PLAN STAIR FABRICATION DETAILS	36-171-D-S-120,220
TRUDOCK II DOCK PLAN DETAILS-CONTAINER POCKET COVER	36-171-D-S-121,221
FABRICATION AND ASSEMBLY TDHVS INSTALLATION TRUPACT DOCK HOOD VENT SYSTEM	EDS 2001-100 PG.1-6
FABRICATION AND ASSEMBLY HOOD VENT CONTAINMENT CHAMBER TRUPACT DOCK HOOD VENT SYSTEM	EDS 2001-101 PG.1-4
FABRICATION AND ASSEMBLY FILTER HOUSING TRUPACT DOCK HOOD VENT SYSTEM	EDS 2001-102 PG.1-3
ASSEMBLY AIR BLOWER TRUPACT DOCK HOOD VENT SYSTEM	EDS 2001-103 PG.1-2
FABRICATION DETAILS MISCELLANEOUS COMPONENTS TRUPACT DOCK HOOD VENT SYSTEM	EDS 2001-104 PG.1-3
ELECTRICAL SCHEMATIC HVCC CONTROL TRUPACT DOCK HOOD VENT SYSTEM	EDS 2001-105 PG.1
ASSEMBLY HOSE TRUPACT DOCK HOOD VENT SYSTEM	EDS 2001-106 PG.1-3
FABRICATION AND ASSEMBLY WASTE BOX VENT CONTAINMENT CHAMBER TRUPACT DOCK HOOD VENT SYSTEM	EDS 2001-107 PG.1-6
WASTE HANDLING BUILDING TRUDOCK II SYSTEM LAYOUT	41-F-003-W
TRUDOCK II PLAN, ELEVATIONS, & DETAILS	41-F-004-W
WASTE HANDLING BUILDING 411 TRUPACT DOCK VACUUM AND EXHAUST P & ID	41-F-070-W

NOTES

1. THE DRAWING SHOWS THE INSTRUMENT AND EQUIPMENT NUMBERS ON THE WEST DOCK, 41-T-152, ONLY. TABLE 1 SHOWS THE CORESPONDING INSTRUMENT AND EQUIPMENT NUMBERS FOR THE EAST DOCK 41-T-153.

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
E	REVISED PER ECO	TB 12/20/00	PA 01/29/01	CAC 01/29/01	BB 02/01/01	9568	9909151
D	REVISED PER ECO	JN 12/29/99	PA 01/13/00	JLJ 01/13/00	BB 01/13/00	8923	9706210J, 9706211J

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 6918 PWR: N/A

DFTR: A.E.SEWALD 4/6/90
CHKR: B.BEEMAN 11/04/93
COG: L.JACKSON 11/04/93
CM: G.W.POHL 11/05/93
QA: H.R.LEOS 11/09/93
SFTY: N.CARSEY 11/10/93
APPD: R.BRITAIN 11/16/93
APPD:
DM: G.R.CULLUM 11/17/93
DOE:

U.S. DEPARTMENT OF ENERGY

Westinghouse Waste Isolation Division
Waste Isolation Pilot Plant
CARLSBAD, NEW MEXICO

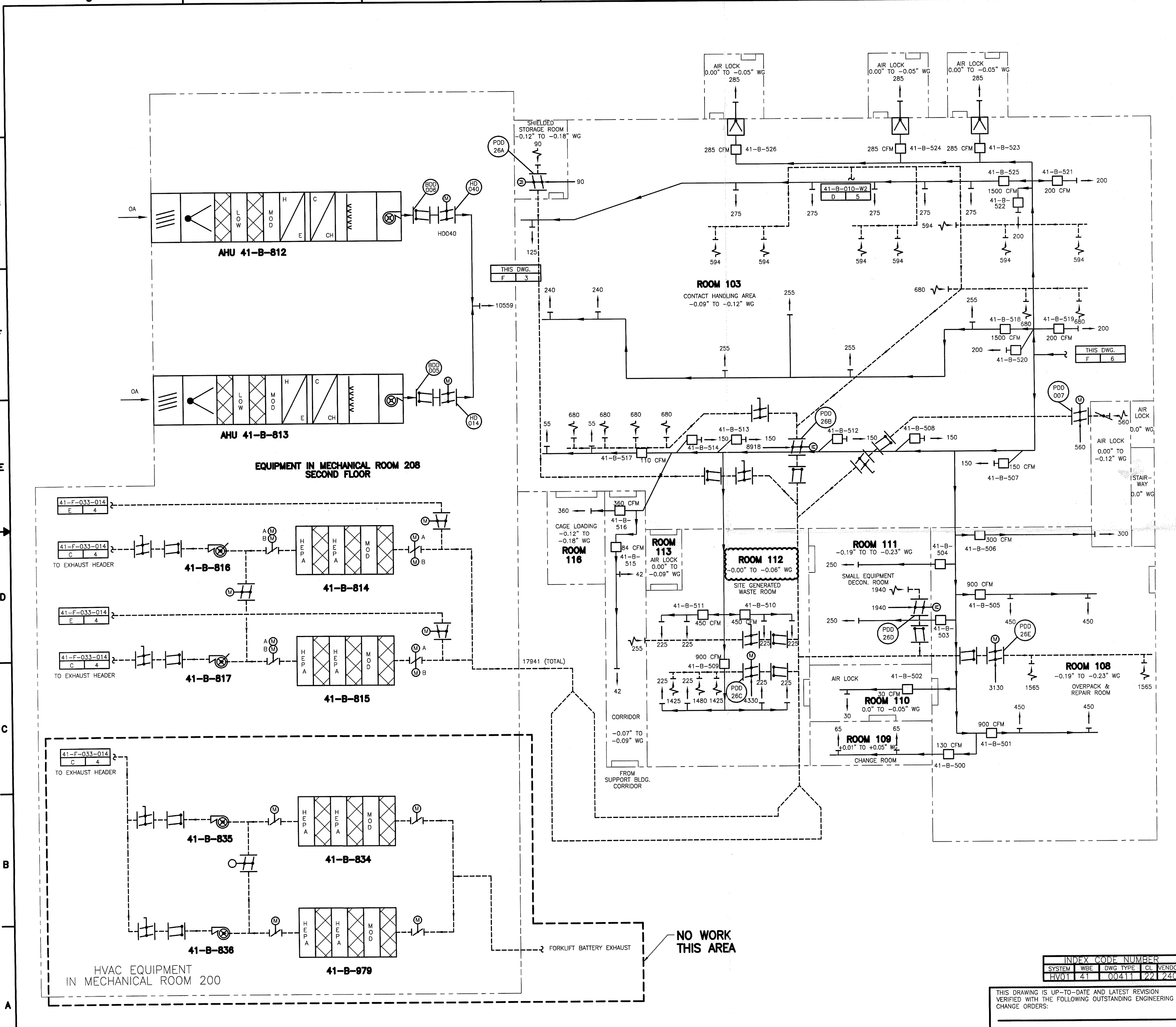
WASTE HANDLING FACILITIES TRUPACT DOCK EQUIPMENT ARRANGEMENT

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
WH02	41	00411	61	230

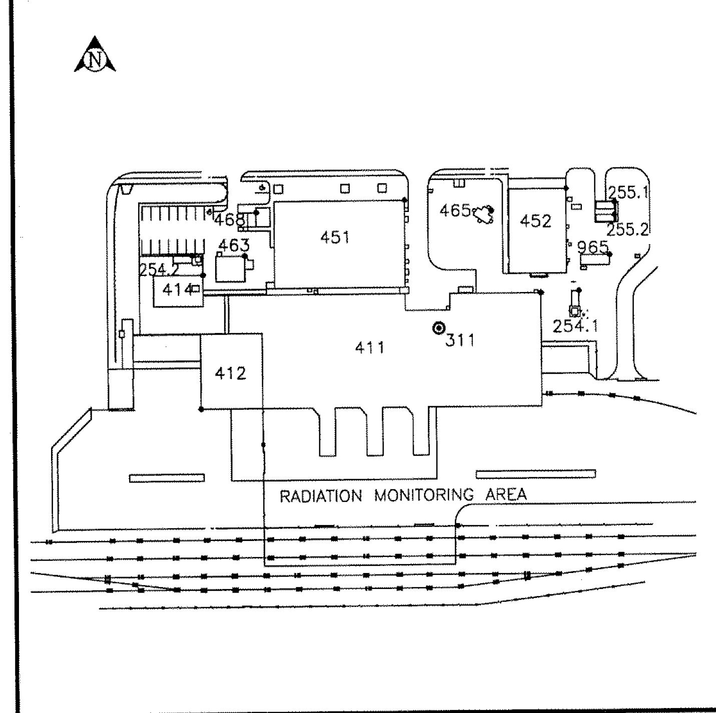
SIZE	SYS	DWG NO	REV
E	WH02	41-M-001-W	E

SCALE: 3/8"=1'-0" INTERPRET DWG PER ANSI Y14

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A



KEY PLAN



REFERENCES

WASTE HANDLING BUILDING 411 CH AREA HVAC PIPING & INSTRUMENT DIAGRAM	41-F-052-W1
WASTE HANDLING BUILDING 411 CH AREA HVAC ROOM DIFFERENTIAL PRESSURE AND EXHAUST P&ID	41-F-059-W
WASTE HANDLING BUILDING 411 CHILLED WATER SYSTEM P & ID	41-F-068-W
WASTE HANDLING BLDG. 411 TRUPACT DOCK VACUUM AND EXHAUST P & ID	41-F-070-W
WASTE HANDLING BUILDING 411 RH AND CH AREAS HVAC INSTRUMENT LOOP & DIAGRAM SHEET 2 OF 4	41-H-352-014
WASTE HANDLING BUILDING 411 INSTRUMENT LOCATION PLAN @ ELEV. 100'-0" SHEET 1 OF 8	41-H-722-014
WASTE HANDLING BUILDING 411 INSTRUMENT LOCATION PLAN @ ELEV. 100'-0" SHEET 2 OF 8	41-H-723-014
WASTE HANDLING BUILDING 411 INSTRUMENT LOCATION PLAN @ ELEV. 100'-0" SHEET 3 OF 8	41-H-724-014
WASTE HANDLING BUILDING 411 INSTRUMENT LOCATION PLAN @ ELEV. 100'-0" SHEET 4 OF 8	41-H-725-014
WASTE HANDLING BUILDING 411 INSTRUMENT LOCATION PLAN @ ELEV. 100'-0" SHEET 5 OF 8	41-H-726-014
WASTE HANDLING BUILDING 411 INSTRUMENT LOCATION PLAN @ ELEV. 100'-0" SHEET 6 OF 8	41-H-727-014
WASTE HANDLING BUILDING 411, CH AREA LOCAL CONTROL PANEL 411-CP-052-13	41-J-032-W1
WASTE HANDLING BUILDING 411, CH AREA HVAC LOCAL CONTROL PANEL ARRANGEMENT 411-CP-052-14	41-J-047-W1
WHB 411 CH AREA ROOM STATIC PRESSURE LOCAL CONTROL PANEL ARRANGEMENT 411-CP-059-20(FRONT PANEL)	41-J-050-W1
WHB 411 CH BAY LOCAL CONTROL PANEL 411-CP-059-021 ARRANGEMENT DIAGRAM	41-J-122-W1
~~WHB 411 CH BAY LOCAL CONTROL PANEL 411-IP-059-008~~ ARRANGEMENT DIAGRAM	41-J-123-W1
WHB 411 DIFFERENTIAL PRESSURE ALARM PANELS 41P-AP03/3 & 4 ARRANGEMENT & WIRING DIAGRAM	41-J-094-W
WASTE HANDLING BUILDING 411 SUSPECT WASTE COLLECTION SYSTEM P &ID	41-P-003-W
SEISMIC MONITORING SYSTEM (SURFACE) CABLE, LOOP; SCHEMATIC DIAGRAMS	105-J-004-W

INFORMATION ONLY

NOTES (THIS SHEET ONLY)

1. PRESSURES INDICATED IN THE ROOMS ARE WITH REFERENCE TO 0.0 INCH WG. OUTSIDE AMBIENT PRESSURE.
2. REMOVED
3. MANUAL VOLUME DAMPERS/BALANCING DAMPERS ARE SHOWN ON THE DUCT LAYOUT DRAWINGS, 41-H-722-W AND 41-H-724-W.

REV	ISSUE DESCRIPTION	DFTR / DATE	CHK / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
J	REVISED PER ECO	DM 5/04/05	RS 5/05/05	RE 5/05/05	BB 5/09/05	11096	0406862A
H	REVISED PER ECO/FD	TG 4/13/04	PA 6/7/04	RE 6/14/04	BB 6/14/04	9769	N/A

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 9769 PWR: 9906375J

DFTR: T.BLAND 10/09/01
CHKR: R.SEXTON 02/27/02
COG: R.ELMORE 02/27/02
CM: K.AVERSON 03/12/02
DM: B.BEEMAN 03/13/02

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions

Waste Isolation Pilot Plant — Carlsbad, New Mexico

CH AREA CONSTANT VOLUME CH AREA HVAC FLOW DIAGRAM SUPPLY AIR

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
HV01	41	00411	22	240

THIS DRAWING IS UP-TO-DATE AND LATEST REVISION VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

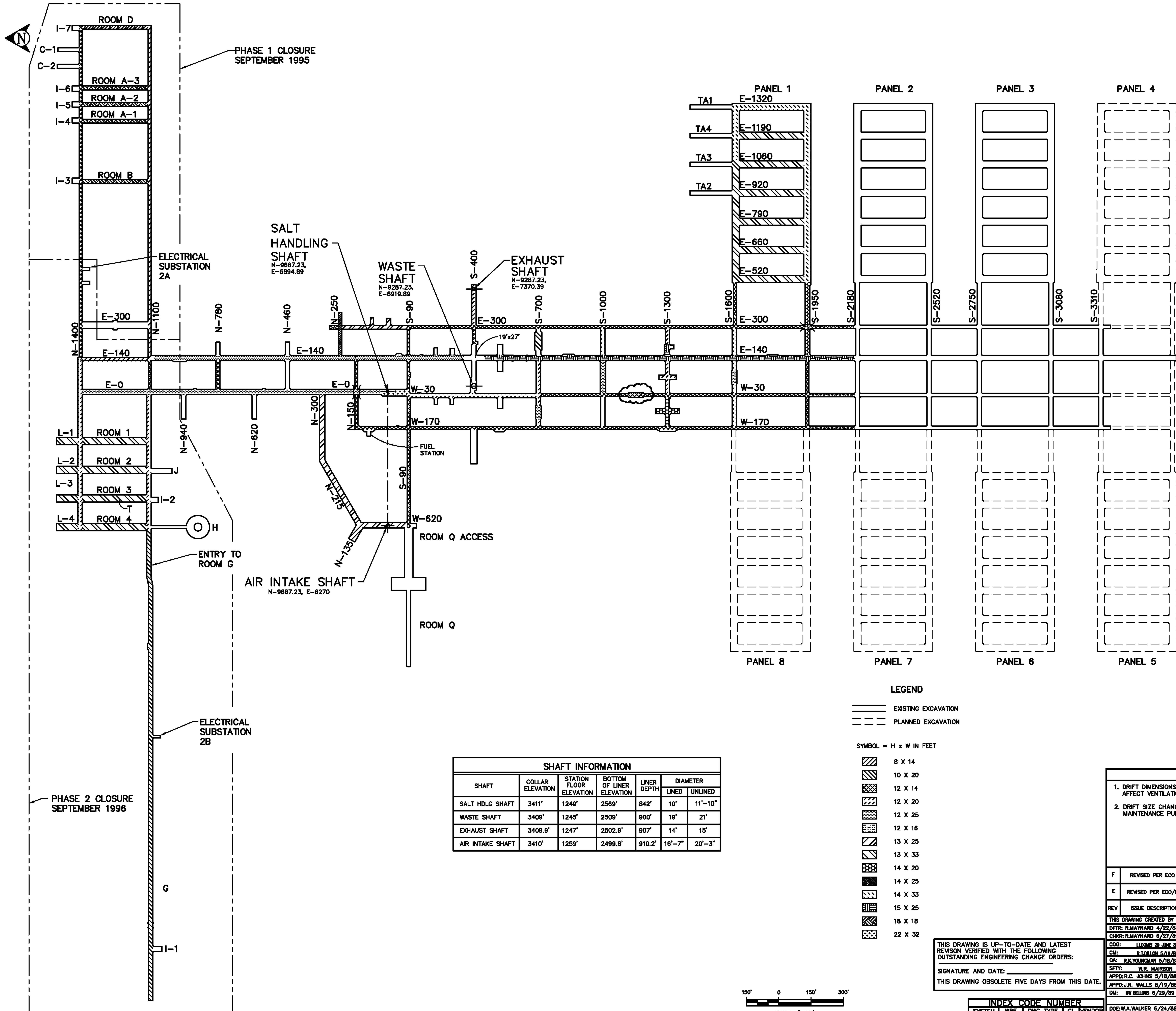
SIGNATURE AND DATE: ____________

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

SCALE: NONE
INTERPRET DWG PER ANSI Y14

SIZE	SYS	DWG NO	REV
E	HV01	41-B-010-W1	J

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A



SHAFT INFORMATION						
SHAFT	COLLAR ELEVATION	STATION FLOOR ELEVATION	BOTTOM OF LINER ELEVATION	LINER DEPTH	DIAMETER	
					LINED	UNLINED
SALT HDLG SHAFT	3411'	1249'	2569'	842'	10'	11'-10"
WASTE SHAFT	3409'	1245'	2509'	900'	19'	21'
EXHAUST SHAFT	3409.9'	1247'	2502.9'	907'	14'	15'
AIR INTAKE SHAFT	3410'	1259'	2499.8'	910.2'	16'-7"	20'-3"

LEGEND

EXISTING EXCAVATION
PLANNED EXCAVATION

SYMBOL = H x W IN FEET

8 X 14
10 X 20
12 X 14
12 X 20
12 X 25
12 X 16
13 X 25
13 X 33
14 X 20
14 X 25
14 X 33
15 X 25
18 X 18
22 X 32

NOTES

1. DRIFT DIMENSIONS MAY NOT BE DESIGNATED IN AREAS THAT DO NOT AFFECT VENTILATION.
2. DRIFT SIZE CHANGES DUE TO EXCAVATION FOR GROUND CONTROL MAINTENANCE PURPOSES AND MAY NOT BE REFLECTED ON THIS DRAWING.

REV	ISSUE DESCRIPTION	DFTR / DATE	CHKR / DATE	COG / DATE	DFTG MGR / DATE	ECO	PWR
F	REVISED PER ECO	DM 5/25/04	PA 6/07/04	TZ 6/09/04	BB 6/09/04	10836	0306660M 0306663M
E	REVISED PER ECO/FD	RS 05/28/98	PA 06/09/98	AER 06/09/98	GRC 06/09/98	8997	N/A

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): 2429 PWR: N/A

DFTR: R.MAYNARD 4/22/88
CHKR: R.MAYNARD 6/27/89
COG: I.LOOMIS 29 JUNE 89
CM: R.T.DILLON 5/19/88
QA: R.K.YOUNGMAN 5/18/88
SFTY: W.R. MAIRSON
APPD: R.C. JOHNS 5/18/88
APPD: J.R. WALLS 5/19/88
DM: HW BELLOWS 6/29/89
DOE: W.A.WALKER 5/24/88
SCALE: 1"=150'
INTERPRET DWG PER ANSI Y14

U.S. DEPARTMENT OF ENERGY

Washington TRU Solutions
Waste Isolation Pilot Plant Carlsbad, New Mexico

UNDERGROUND MINE PLAN
SHAFT AND DRIFT DIMENSIONS

SIZE: E SYS: AU00 DWG NO: 54-W-009-W REV: F

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

THIS DRAWING IS UP-TO-DATE AND LATEST REVISON VERIFIED WITH THE FOLLOWING OUTSTANDING ENGINEERING CHANGE ORDERS:

SIGNATURE AND DATE: ______

THIS DRAWING OBSOLETE FIVE DAYS FROM THIS DATE.

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
AU00	54	U0125	75	240

PUBLIC PARTICIPATION INFORMATION

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PUBLIC PARTICIPATION INFORMATION

TABLE OF CONTENTS

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Public Participation Information
In Accordance With
20 NMAC 4.1.901
(Incorporating §124.31 *Pre-application public meeting and notice*)

The applicant shall submit a summary of the meeting, along with the list of attendees and their addresses developed under paragraph (b) of this section, and copies of any written comments or materials submitted at the meeting, to the permitting agency as a part of the part B application, in accordance with 40 CFR 270.14(b)

Summary of February 10, 2009, Meeting in Carlsbad, NM

- Introductory comments were made by HL "Jody" Plum, DOE/CBFO
- A presentation (attached) was given on Draft 3 WIPP Hazardous Waste Facility Permit Renewal Application by HL "Jody" Plum, DOE/CBFO; William A. Most, Washington Regulatory & Environmental Services; Mike Gross, MG Enterprises
- Questions regarding the Renewal Application were solicited and answers provided
- The list of attendees is attached
- No written comments were provided to the Permittees (applicants) at the Pre-Application meeting. However, comments received subsequent to the meeting are attached

Summary of February 12, 2009, Meeting in Santa Fe, NM

- Introductory comments were made by HL "Jody" Plum, DOE/CBFO
- A presentation (attached) was given on Draft 3 WIPP Hazardous Waste Facility Permit Renewal Application by HL "Jody" Plum, DOE/CBFO; William A. Most, Washington Regulatory & Environmental Services; Mike Gross, MG Enterprises
- Questions regarding the Renewal Application were solicited and answers provided
- The list of attendees is attached
- No written comments were provided to the Permittees (applicants) at the Pre-Application meeting. However, comments received subsequent to the meeting are attached

Summary of May 5, 2009, Meeting in Carlsbad, NM

- Introductory comments were made by HL "Jody" Plum, DOE/CBFO
- A presentation (attached) was given on Draft 4 WIPP Hazardous Waste Facility Permit Renewal Application by William A. Most, Washington Regulatory & Environmental Services
- Questions regarding the Renewal Application were solicited and answers provided

- The list of attendees is attached
- No written comments were provided to the Permittees (applicants) at the Pre-Application meeting. However, comments received subsequent to the meeting are attached

Summary of May 7, 2009, Meeting in Santa Fe, NM

- Introductory comments were made by HL "Jody" Plum, DOE/CBFO
- A presentation (attached) was given on Draft 4 WIPP Hazardous Waste Facility Permit Renewal Application by William A. Most, Washington Regulatory & Environmental Services
- Questions regarding the Renewal Application were solicited and answers provided
- The list of attendees is attached
- No written comments were provided to the Permittees (applicants) at the Pre-Application meeting. However, comments received subsequent to the meeting are attached

List of Attendees
February 10, 2009, Pre-Application Meeting in Carlsbad, NM

Carlsbad, New Mexico February 10, 2009

U.S. Department of Energy
Waste Isolation Pilot Plant Renewal Application for the Hazardous Waste Facility Permit

*Names appearing on this list will become part of the administrative record

Name *Please Print All Information Clearly*	Mailing Address
Jerry V. Fox PECOS MANAGEMENT SER.	P.O BOX 13343 Albuquerque NM 87192
Johnelle Koriota PECOS Management Services	PO Box 13343 Albuquerque, NM 87192
FRED YARGER NM CENTER for ENERGY POLICY NM TECH	2632 N JADE AVE HOBBS, NM 88240

List of Attendees
February 12, 2009, Pre-Application Meeting in Santa Fe, NM

Santa Fe, New Mexico February 12, 2009

U.S. Department of Energy
Waste Isolation Pilot Plant Renewal Application for the Hazardous Waste Facility Permit

*Names appearing on this list will become part of the administrative record

Name *Please Print All Information Clearly*	Mailing Address
CHRISTOPHER TIMM	P.O. Box 13343 Albuquerque, NM 87192
Paul Pierce	P.O. Box 13343 Albuquerque, NM 87192
Kerry Rodgers	[illegible] 3570 39th St., NW, ~~#D-~~ 664 Washington, DC 20016
Scott Kovac	NWNM
Don Hancock	SRIC, PO B 4524, Alb 87196
Joni Arends	CCNS
Jerry Fox	P. O. Box 13343 Albuquerque, NM 87192

Written Comments from the February 10/12, 2009 Pre-Application Meetings

(copy retained)

1

January 19, 2009
135 Rincon Valverde
Ponderosa, NM
87044-9500

Mr. Bobby St. John
c/o United States Department of Energy
Carlsbad Field Office
P.O. Box 3090
Carlsbad, New Mexico
88221-3090

Dear Mr. St John,

Both February 10th and 12th, 2009 are days I deliver home-school instruction to my daughter. I regret that this renders me unable to attend either pre-application meetings that the U.S. Department of Energy Carlsbad Field Office and Washington TRU Solutions LLC are hosting.

I would very much like to be informed, nonetheless, of the proposed hazardous waste management activities and, after reasonable review of surface-mailed hardcopy of requested material, would like to compose questions to send to you.

(copy retained)

2

However, while I am waiting for my requests to be honored, I will, for-the-record, submit this non-technical written public comment on a renewal application being considered by NMED for defense-generated transuranic waste to be disposed of at the Waste Isolation Pilot Plant 30 miles east of Carlsbad, New Mexico before the expiration of the current permit on November 26, 2009, as follows;

-beginning-

"New Mexico Environment Department should not renew the Hazardous Waste Facility Permit for the Waste Isolation Pilot Plant 30 miles east of Carlsbad, New Mexico which would continue underground disposal of defense-generated transuranic waste in one more place in New Mexico. The disposal of byproducts of nuclear weapons research and production should be halted, forever, at the Carlsbad, New Mexico (actually, as already mentioned, 30 miles east of same)

(copy retained)

(3)

Waste Isolation Pilot Plant after November 26, 2009, Los Alamos National Laboratory and Sandia Laboratory should be receiving huge amounts of legacy waste clean-up money. Secretary of State Clinton recently criticized the Bush Administration for having downgraded the role of arms control. Simultaneously, Energy Secretary-designate Chu wants to push these same labs to turn the focus of their missions to the energy problem and he endorses nuclear power. When November 26, 2009 comes around, whatever defense-generated transuranic waste has not been disposed of at the Waste Isolation Pilot Plant in New Mexico will have to be recycled in Eunice, sealed at Los Alamos to wait for Yucca Mountain to open, or sealed in the massive taxpayer boondoggle construction project up at Los Alamos, permanently, or, if Mesa del Sol flops out on the flats between the Sunport

(copy retained)

4

and Isleta Pueblo. Most importantly, said Renewal Application should not be submitted to New Mexico Environment Department before May 30, 2009. This will give the incoming Obama Administration the time to close down this dangerous source of pollution in New Mexico. Until I receive requested evidence to the contrary, my unamended comment is as stated."

Please send all requested documentation to:

Rebecca G. Perry-Piper
135 Rincon Valverde
Ponderosa, New Mexico
87044-9500

Respectfully,

[signature]

Rebecca G. Perry-Piper

(copy retained)

FEB 2009

February 11, 2009
135 Rincon Valverde
Ponderosa, NM
87044-9500

Mr. Steve Zappe
New Mexico Environment Department
2905 Rodeo Park Drive
Building 1
Santa Fe, NM
87505

Dear Mr. Zappe,

I originally submitted my draft low-threshold non-technical written public comment on Draft 3 WIPP Hazardous Waste Facility Permit Renewal Application Volume I&II January 2009 United States Department Of Energy Washington TRU Solution LLC, with a January 19, 2009 date, to Mr. Bobby St. John c/o United States Department Of Energy, Carlsbad Field Office P.O. Box 3090 Carlsbad, New Mexico 88221-3090. I commend Mr. St. John for surface-mailing me requested draft so that I might review it and submit an amendment to my January 19, 2009 comment, upgrading it to one of high-threshold status. My amended for-the-record comment is as follows:

-beginning-

"New Mexico Environment Department should not renew the Hazardous Waste Facility Permit for the Waste Isolation Pilot Plant 30 miles east of Carlsbad, New Mexico, which would continue underground disposal of defense-generated transuranic waste in one more place in New Mexico. The disposal of byproducts of nuclear weapons should be halted, forever, at the Carlsbad WIPP after November 26, 2009. Most importantly, said renewal application should not be resubmitted to NMED before May 30, 2009 in order to give the new Obama Administration the time to close down and seal up this dangerous site.

In reviewing Draft 3, I, firstly, found the lack of depiction of predominant wind direction in "Wind Speed Report (Meter/Second) January 1, 2006 to December 31, 2006, Elevation 10.0 Meters (Will be updated prior to submittal)" to be inadequate for the correlation of other data depicted on groundwater surface elevation monit-

February 11, 2009

oring locations, cattle density, crop location, and inhabited ranches. I, secondly, was disappointed that "(Will be updated prior to submittal)" was a part of the caption of the aforenamed depiction in a draft submission subject to public review and comment, rendering the draft incomplete/invalid. I, thirdly, felt that "Figure L-18 Groundwater Surface Elevation Monitoring Locations Permit Chapter L Page L-70 of 70" gave no indication of the depth or proximity that the monitoring system functioned at, rendering the draft flawed. I, fourthly, found inconsistent the practice of letting cattle graze in areas where farmers avoided planting. I observed this when overlapping "2207 CY-Active Mines And Inhabited Ranches Within A 10-Mile Radius Of The WIPP Facility" and "2007 CY-Acres Planted In Edible Agriculture And Commercial Crops Within A 50-Mile Radius Of The WIPP Facility". Cattle should not be allowed to graze SSE/SE of WIPP for 50 miles.

All in the paragraph above reinforces my view expressed in my comment's first paragraph."

-ending-

Respectfully,

Rebecca G. Perry-Piper

Rebecca G. Perry-Piper
135 Rincon Valverde
Ponderosa, New Mexico
87044-9500

PECOS MANAGEMENT SERVICES, INC.

February 27, 2009

Mr. Vernon Daub, Deputy Manager
U.S. Department of Energy
Carlsbad Field Office
4021 National Parks Highway
Carlsbad, NM 88221

Subject: Contract No. DE-AC30-06EW03005 "Comments on Draft 3 of the Hazardous Waste Facility Permit Renewal Application"
PECOS Document #2009-C-0026

Dear Mr. Daub:

PECOS Management Services, Inc. (PECOS) is pleased to submit the enclosed comments on the Draft 3 of the Hazardous Waste Facility Permit (HWFP) Renewal Application for the Waste Isolation Pilot Plant (WIPP), which was provided for our review in January 2009. PECOS' review was based upon our belief that the intent of the HWFP should be to enable DOE to facilitate disposal of transuranic (TRU) waste in WIPP as efficiently and safely as possible as directed by the authorizing federal legislation. From that perspective, PECOS believes that the proposed HWFP renewal should be written to ensure maximum flexibility of operations for WIPP. Further, we believe that the overall health and safety of all of the facets of characterizing, treating, transporting, and disposing TRU waste in WIPP should be evaluated and changes proposed that reduce the overall risk associated with TRU waste disposal. This evaluation should focus on decreasing the risks associated with the storage, characterization, and treatment of TRU waste at the generator sites without increasing the risks during transportation and disposal. PECOS also suggests that DOE pursue the elimination of any permit requirements that have been proven to be not necessary based upon the almost ten years of operating data. Such actions will improve the efficiency and facilitate the safe disposal of TRU waste in WIPP.

One of our major concerns is that the proposed new HWFP does not address two of the key issues with respect to the disposal of remote handled (RH) TRU waste. The first issue is to ensure that the HWFP gives DOE the ability to be able to dispose of the maximum amount possible in horizontal boreholes in Panels 5 through 8. That issue can be at least partially addressed by including in this Renewal Application a request to increase the permitted capacity for RH TRU waste disposal in Panels 5 and 6 to that permitted for Panel 7. In fact, PECOS recommends that DOE submit a Permit Modification Request (PMR) for the current permit to increase the permitted capacity for RH TRU waste disposal in Panel 5 to be the same as Panel 7 in order to improve operational flexibility.

PO Box 13343 Albuquerque, NM 87192
Phone: 505-323-8355 Fax: 505-323-2028 www.pecosmanagement.com

The second issue is the ability to be able to continue to place RH TRU waste in rooms even after emplacement of contact handled (CH) TRU waste has started. The text in the current HWFP and in the Renewal Application basically state that once CH TRU waste begins to be emplaced in a room, the emplacement of RH TRU waste in boreholes in that room ceases, even if a substantial number of boreholes are unfilled. Rather than including that self-limiting requirement, we believe that it would add flexibility to WIPP operations if the text were changed in the new HWFP to indicate that DOE has the option to emplace RH TRU waste in the same room where CH TRU waste is being emplaced as long as all DOE health and safety requirements are met.

Another concern is with respect to the expected duration of the disposal phase. In several parts of the Renewal Application, the statement is made that the disposal phase is expected to last 25 years. Since only about 1/3 of the CH TRU waste and less than 3 percent of the RH TRU waste capacities will have been used in the first 10 years of operation, it is more likely that the disposal phase will more than 35 years. This is corroborated by the disposal phase timetable presented in Table I-1 on page I-25 of Chapter I, which indicates a disposal phase duration of over 31 years. Therefore, we suggest that DOE correct the Renewal Application and provide the best current estimate of the duration of the disposal phase throughout.

PECOS is also concerned about the inconsistency in the discussions regarding Panels 9 and 10 between various sections of the Renewal Application. Since the Part B Necessary Information Section and the changes to Appendix M2 that Panels 9 and 20 indicate that the approach to increasing the capacity of WIPP beyond the eight panels may or may not be Panels 9 and 10, it appears that this Renewal Application could be simplified by simply indicating that should there be a need to dispose of more TRU waste than authorized by the renewed permit, DOE would submit the appropriate PMR for more capacity – either by increasing the allowed capacity in the one or more of the panels as authorized by Section IV.A.1.b.ii of the current permit or by using the four access drifts or through mining more panels. Making this change would ensure maximum flexibility for DOE for future capacity expansions.

Since DOE is in the process of gaining approval to use shielded containers for disposal of TRU waste in WIPP and is also in the process of designing the Standard Waste Box 2 and the TRUPACT III to more safely accommodate disposal of larger TRU waste items, we believe that those containers should be included in the renewal application as planned future permit modification requests – a practice that is commonly called out in other sections of the current permit.

Another major concern is the number of errors and inconsistencies both within and between sections of the Renewal Application. While most of them do not impact the actual proposed operations of the WIPP, they give the impression to the readers that the quality assurance program for WIPP is not particularly effective. In addition, the formatting of the Appendices is inconsistent. Some have Tables of Contents and some don't (examples Appendices I2 and M2), some contain a list of acronyms and abbreviations and some don't (example Appendix I3). Also, there are numerous instances of references in the text not being included in the Reference list at the end of Chapters or Appendices and the converse, namely that references on the reference list are not referenced in the text.

Finally, we understand that additional permit changes are being drafted including changes related to the prohibition of liquids in TRU waste containers and the waste characterization process. We recommend that DOE consider the information presented in our reports entitled: *"An Evaluation of the Health and Safety Risks resulting from Repackaging TRU Waste for Disposal at WIPP"*, which was provided to DOE in September 2008, and *"Potential Health and Safety Impacts of Removal of Containers from the Waste Isolation Pilot Plant"*, which was provided to DOE in November 2008 during the formulation of those changes. We also recommend that DOE consider modifying the volatile organic compound (VOC) monitoring program. Since the monitoring results basically have shown very low levels of VOCs for the past ten years, it appears that a reduction in the sampling and analysis requirements is justified. This type of modification would essentially be comparable to the reduction in the headspace gas sampling requirements approved by NMED in 2006 that was justified by the low concentrations of VOCs found in over 70,000 payload containers up to that point in time.

We appreciate the opportunity to review the draft and look forward to the opportunity to review the fourth draft of the renewal application including all of the proposed changes to the HWFP text and attachments. Please call me or Christopher Timm at (505) 323-8355 should you have any questions.

Sincerely,

Jerry V. Fox, PhD
Project Director

cc: M. Long, EMCBC
L. Dumont, EMCBC
R. Nelson, DOE
B. St. John, Washington TRU Solutions
S. Keeney, PECOS
C. Timm, PECOS

Enc: As Stated

Comments on Draft 3 Hazardous Waste Facility Permit Application – February 2009

General Comments

DOE should take this opportunity to request the increase of the allowed disposal capacity for RH TRU waste in Panels 5 and 6 to 650 m^3 in order to give DOE the maximum operational flexibility.

Is the Renewal Application intended to be a 'stand alone' document or is it intended to be reviewed along with a copy of the existing permit? If it is 'stand alone' then all the references to Modules and Attachments should be changed to the appropriate Chapter or Appendix in the Application. (Ex. Chapter D, page D-5, line 3 refers to Module III of the permit. However the same description is provided in Appendix M1 of the Renewal Application.

If the Renewal Application is referring to the existing HWFP when specifying modules, then the text should read something like "Module XX of the current HWFP or Module XX of the 1999 Permit". For example, the sentence on page D-5, lines 2-3 should read "These containers are described in Module III of the current Permit".

There is extensive inconsistency in the definition and use of acronyms for the units at WIPP. For example, the hazardous waste management unit (HWMU) that consists of the Waste Handling Building is called either the Waste Handling Building (WHB) or the Waste Handling Building (WHB) Container Storage Area (WHB unit) depending on the Chapter and Appendix. Similarly, the acronyms for the other HWMU, the Parking Area Container Storage Unit, are the Parking Area Unit or PAU depending upon the Chapter and Appendix.

The Renewal Application should be reviewed to ensure that the acronyms NMED and WIPP versus the phrases "the NMED" and "the WIPP" are used properly.

The formatting of the Appendices is inconsistent. Some have Tables of Contents and some don't (examples Appendices I2 and M2), some contain a list of acronyms and abbreviations and some don't (example Appendix I3).

Unless the text refers to several different forms of each, words such as 'waste" and "sludge" should always be singular.

Specific Comments

Table of Contents – 1) Page numbers missing on even-numbered pages. 2) Chapter M erroneously called Appendix M

Abbreviations and Acronyms – 1) Many of the acronyms and abbreviations contained in the chapters and appendices to this application are not included in this list. It should either be all inclusive for the whole application or labeled to indicate what part of the application it covers. 2) There are two different acronyms given for radiation control – pick one or the other. 3) Rather than using the same term (AC) for acre and alternating current, suggest using Ac for acre and AC for alternating current. Also, the acronym HWDU, which is used in Part A of the application, is not on the acronym list.

Introduction – 1) The Introduction should clearly state that the mission of WIPP is for permanent disposal of radioactive waste as regulated by the EPA under 40CFR191 and 194 and that the permit is only required since some of the radioactive waste contains other waste forms regulated by RCRA. 2) On page 2, line 23, the wording after "TDSF" should be '*are incorporated*' instead of 'and incorporate'. Page 2, line 30, the last word should be singular.

Part A Certification – This section is still poorly organized and difficult to follow. 1) The RCRA Subtitle C Site Identification Form and Hazardous Waste Permit Information Form should be identified in the Table of Contents for the renewal application. 2) The Table of Contents for this section (Page A-i) is in the wrong location – it should be at the start of the section rather than after the Hazardous Waste Permit Information Form. Part 8 of the Hazardous Waste Permit Information Form should include a statement that the information for that part is continued on page A-1 of the section. Similarly, a statement should be inserted at the top of page A-1 such as "*The following information is a continuation of Part 8 of the Hazardous Waste Permit Information Form*". Also Part 14 of the Hazardous Waste Permit Information form and several other places in this section refer to Section XII, but there is no attachment identified as Section XII. Further, there are six figures or maps at the end of the section that are not page numbered for Part A. It appears they should be part of Appendix 2. Finally, there is an un-numbered table at the end of this section that appears should either be in the Regulatory Crosswalk section or in the Part B section.

Other comments on Part A:

1. **Necessary Information.** Page 5: For RH TRU mixed waste, the amount emplaced through Panel 7 should be "no more than 1,804 m^3" instead of 1,985 m^3 and the amount with Panel 8 should be changed from "2,635 m^3" to "2,454 m^3".

2. Page 5: In the paragraph beginning "During the ten year period....", change 'received' to 'receive' in the second line.

3. Page 5: Insert a space after 148,500 and change m3 to m^3 after 2,635.

4. Page A-1, line 18: The text indicates the acronym for hazardous waste management units is HWDU. However, the balance of the text on this page uses the acronym HWMU. It appears that the intent is to use the acronym HWMU for the above ground hazardous waste management units and the acronym HWDU (hazardous waste disposal units for the underground hazardous waste management (disposal) units. Revise the text accordingly. Also, in line 33 change 'bill' to 'will' after the acronym HWMU. Further, suggest deletion of the term S01 before HWMU on line 35 and changing S01 to HWMU after the second 'this' in that line. Also, in line 39, change the beginning of the sentence to read "The second HWMU in S01 is the parking area....".

5. Page A-2: It is suggested that the capacities cited for Panels 1 through 8 be changed to reflect the actual volumes disposed as discussed in the above comment. Basically, change "148,500" to "139,340" and "2,635" to "2,454".

Part B

Necessary Information

i. General: The possibility of using the 4 "disposal area access drifts" if waste cannot be accommodated in Panels 1 – 8 is mentioned in the Necessary Information. Additional information should be presented to account for this as a real possibility in light of the current disposal rate of approximately 2 years per panel and the fact that Table I-1 (Chapter I, Page I-25) shows an expected Operations start date of January 2017 for Panel 9.

ii. Pages 1 and 2: If filled to permitted capacity, Panels 1 through 8 would only hold approximately 151,135 m^3 of TRU waste. Therefore, the last sentence on page 1 should be changed to read: "Since wastes disposal volumes permitted to be disposed in the eight panels will be less than the stated design capacity, DOE may choose to either request a permit modification to increase the allowed CH TRU waste disposal capacity in panels as authorized by Section IV.A.1.b.ii of the Permit or use the four disposal access drifts for disposal or mine additional HDWUs or a combination of these alternatives. The permit modification request would describe the design of proposed capacity increases and the controls to be exercised for personnel safety and environmental protection while disposing of wastes in the new disposal areas.

iii. Page 2 lines 6-8:

1. 148,500 m^3 does not equal 4,605,700 ft^3, please correct. Also, insert a space between the "5" and the "m" in (2,635m^3).

2. The numbers presented for CH TRU waste volume should be revised to represent the amount actually emplaced in Panels 1 through 3, which is 1,609,019 ft^3 according to Table IV.A.1 in the current Permit. Since no more than 3,310,750 ft^3 is/will be permitted for Panels 4 thorough 8, no more than 4,919,769 ft^3 can be emplaced in Panels 1-8.

3. The numbers presented for RH TRU waste should also be revised to represent the actual amount emplaced in Panel 4. Our estimate is that no more than 175 m^3 will be emplaced in it. Therefore, since Panels 5 through 8 do/will have a permitted capacity of 2,279 m^3, the number presented in the application should be changed to 2,454 m^3).

4. RH TRU waste was never emplaced in Panels 1, 2 or 3. The text on line 8 should be revised to indicate that RH TRU waste will only be emplaced in Panels 4 through 8. Also the acronym for CH was identified, but RH was not. Please insert this acronym here *and* use it on page 18.

5. The text for lines 6-8 should be revised as follows: For the ten year term of this permit, DOE plans to dispose of up to 2,648,600 ft^3 (75,000 m^3) of contact-handled (CH) waste and 80,480 ft^3 (2,279 m^3) of remote-handled (RH) TRU mixed waste, in Panels 5 to 8. Therefore, the volume of CH TRU waste disposed in Panels 1 through 8 will be no more than 4,920,526 ft^3 (139,340 m^3) of CH waste, and Panels 4 through 8 will contain no more than 86,660 ft^3 (2,454 m^3) of RH TRU mixed waste.

iv. Page 5 line 9: Preparedness and Prevention should be italicized.

v. Page 5 line 28: A comma is needed between "County" and "New" in Eddy County New Mexico. The same error is on page 6, lines 9-10 and 27-28.

vi. Page 10 line 16: A period is needed at the end of the statement. Periods are also needed on lines 18, 20, 25, and 27.

vii. Pages 12-13: The term "ground water" is spelled three different ways (depending on its use as an adjective or noun) on these two pages: ground-water, groundwater and ground water. Select one way. Page 15 mentions that "A Class 3 permit modification request for No Further Action is pending before the NMED." Why can't the Class 2 PMR for training have the same wording on page 8? Also, this Class 3 permit modification request was formally approved by NMED on October 23, 2008. The wording needs to be changed to reflect this.

viii. Page 16 lines 34-35: all of the following text should be blue *and* have a period placed at the end: "and as described in Renewal Application Chapter F-4b, *Identification of Hazardous Materials,* and Renewal Application Appendix M1, *Container Storage*".

ix. Page 17 lines 7 & 15: Waste Analysis Plan should be italicized.

x. Page 17 line 34: A period is needed at the end of the sentence.

xi. Page 17 line 36: Change the verb "does not" to "do not".

xii. Page 18 lines 14-21: The text should be blue, not black.

xiii. Page 18 lines 7-10: Change the phrase "There is no change" in the first sentence to "There are no changes".

xiv. Page 18 line 9: Delete the phrase "TRU mixed waste for disposal".

xv. Page 18 line 10: Change contact-handled to "CH"

xvi. Page 18 lines 28-29: Change the period to a comma after "264.602" and change the comma to a period at the end of the sentence.

xvii. Page 19 lines 4-8: Change "There is no change to......" to "There are no changes". Also add a hyphen for the second occurrence of "land use". Further, the first sentence is not clear and should be re-written.

xviii. Page 19 line 18: Change "has" to "have".

xix. Page 19 lines 28-33: Change text color from black to blue.

xx. Page 19 line 4: Insert a space between "1" and "w" in "§264.601will".

Chapter A

1. Page A-1 line 32: New Mexico is spelled out on this line, but abbreviated on lines 16, 20, 29.
2. Page A-1 line 38: The phrase "32o 22' 30" N" should be "32° 22' 30" N".
3. Page A-2 line 9: Define DOE before using the acronym throughout the document.

4. Page A-2 lines 19-20: Suggest changing the designation of the Waste Handling Building (WHB) Container Storage Unit to just the Waste Handling Building unit (WHB unit) since there are more activities than just container storage conducted in that unit.

5. Page A-2 line 35: Define RCRA before using the acronym throughout the document.

6. Page A-3 line 24: Define NMAC.

7. Page A-4 line 10: Define NMED before using the acronym throughout the document.

8. Page A-4 line 28: Indent NMED so that it matches up with the rest of the text.

9. Page A-6 line 7: Remove the extra period after "Inc..".

Chapter B

i. General. Review document for failure to define or other inconsistent use of acronyms. For example, the acronym "AK" is defined on page B-2 but is re-defined on page B-5 and B-15. Additionally, the term "acceptable knowledge" is used instead of the acronym AK numerous times in the chapter starting on page B-9. Also, the acronyms VOC, SVOC, TCLP, are not defined when first used (page B-14).

ii. Page B-1 line 18: Replace "DOE" with "U.S. Department of Energy (DOE)".

iii. Page B-4 line 21: Since this is the first use of 'toxic characteristics" add the acronym (TC) after it and then change "toxic characteristic" to TC on the following pages.

iv. Page B-9 line 37: Add the acronym "SWB" after the term "standard waste box". Then delete the term "standard waste boxes" on page B-33.

v. Page B-14 line 14: The word "Atachment" is misspelled.

vi. Page B-20 line 31: Use "UCL_{90}" instead of "UCL90".

vii. Page B-21 line 11: The acronym DQO's should be DQOs (no apostrophe) as stated in line 8.

viii. Page B-25, line 7: Replace "U.S. Department of Energy" with "DOE".

ix. Page B-28 line 31: Change "a authorized" to "an authorized".

x. Page B-28 line 42: "Waste Stream Profile Form" was previously identified by its acronym "WSPF". Please continue to use WSPF here and in the rest of this section.

xi. Page B-30 line 6: The acronym SOPs was not previously defined.

xii. Page B-32 line 30: Add a period after the word "container(s)".

xiii. Page B-33 line 40: The acronym TDOPs was previously defined in this document. There is no need to do it again here.

xiv. Page B-47 and B-48 Table B-5: The phrase "statistical samplinga" needs to be changed to "statistical sampling" in two places.

Appendix B1 – Waste Characterization Sampling Methods

i. Page B1-1 lines 8-9: Define the acronyms TRU and WIPP. Then delete the definition of TRU on page B1-15.

ii. Page B1-1 line 15: Add the acronym HSG after "headspace gas" and substitute the acronym for that phrase throughout the Appendix. Or, if the acronym is not used, use either "headspace gas" or "headspace-gas" (see line 19) in the document.

iii. Page B1-2 line 5: Add a space after the period in the phrase "in Table B1-9.The DAC".

iv. Page B1-2 line 7: Use the same type of quotes for all footnotes.

v. Page B1-2 line 8: Adding the word "required" before the acronym DAC will make this sentence more understandable.

vi. Page B1-2 line 19: Use DAC instead of spelling it out.

vii. Page B1-2 line 36: Define WWIS before using it the first time.

viii. Page B1-3 line 22: Define BWXT before using it the first time.

ix. Page B1-3 lines 24 & 28: Remove the extra period at the end of each sentence.

x. Page B1-4 line 11: Define VOC before using it the first time.

xi. Page B1-6 line 1: Define PRQL before using it the first time and remove the extra space before the period at the end of the sentence.

xii. Page B1-6 line 11: Define ppm.

xiii. Page B1-6 line 24: Insert a comma after FTIRS.

xiv. Page B1-8 line 14: The degree symbol in "125 degrees C" does not show up correctly (it looks like a rectangle, instead). Please use the same "degree" symbol seen earlier in this document. Make the same correction on Page B1-14 line 32.

xv. Page B1-8 line 16: When then symbol ® is used it should be a superscript (here and elsewhere in the document).

xvi. Page B1-14 line 2: Define psig.

xvii. Page B1-15: The reference TO-14 (EPA 1988) is not included in the list of References on Page 29.

xviii. Page B1-16 lines 6-7: The phrase "may require no more sample than is required" might be better expressed as "may require no more samples than are required".

xix. Page B1-16 line 27: The phrase "light weight auger" should be "lightweight auger" (see also Figure B1-5 on page B1-51).

xx. Page B1-16 line 35: The word "teflon" should be "Teflon®".

xxi. Page B1-17 line 25: The word "coring tools leading edge" should be "coring tool's leading edge".

xxii. Page B1-17 line 30: The word "tools" should be "tool".

xxiii. Page 18 makes reference to "SW-846 Manual (1996)". Because this document is very large, it might be beneficial to reference a specific part of SW-846 (many parts have been revised since Update III in December 1996). Also change "(1996)" to "(EPA 1996)".

xxiv. Page B1-18 line 34: VOA stands for "volatile organic analysis", not "volatile organics analysis".

xxv. Page B1-24 line 39: Insert a comma after "In this way".

xxvi. Page B1-25 line 1: The phrase "with internal container of various sizes" should be "with internal containers of various sizes".

xxvii. Page B1-27 line 28: "Sample Coring equipment" should be "Sample coring equipment".

xxviii. Page B1-39: Table B1-7 has unequal row spacing which makes the middle rows difficult to read.

xxix. Page B1-42: Table B1-9 has a different font/font size for the entry at the bottom of the page. This entry's row height is also larger than the rest.

Appendix B2 – Statistical Methods Used In Sampling and Analysis

i. Page B2-1lines 8-9: Define the acronyms TRU and WIPP.

ii. Page B2-1 line 19: AK was previously defined in line 11, so use it here and everywhere else in the document.

iii. Page B2-1 line 35: D-numbers are defined, but F-numbers are not.

iv. Page B2-1 line 41: Change "these wastes streams" to "these waste streams".

v. Page B2-2 line 40: Equation variable $t_{a,n0-1}$ is not listed in the definition of variables. Instead, $t_{a,n-1}$ is defined on line 6 of page B2-3.

vi. Page B2-3 lines 7-8: Define TC and PRQL before using them for the first time.

vii. Page B2-3 line 37: Shouldn't the phrase "the validated samples results" be "the validated samples' results"?

viii. Page B2-4 line 4: Define WSPF.

ix. Page B2-4 line 23: Define UCL_{90}.

x. Page B2-4 line 42: define VOC.

xi. Page B2-7 line 36: Starting here, UCL_{90} is italicized in the remaining text of the document. This change in text format is seen with other variables, such as n*. Also, "the number of samples (n)" is mentioned in several places in the text. It was defined on page B2-2 and doesn't need to be redefined elsewhere.

xii. Page B2-8 line 15: Remove the box from around the variable *x*.

xiii. Page B2-8 line 16: The term $t_{(\alpha,n-1)}$ shows up in equations as $t_{\alpha,n-1}$. Consistency is warranted.

xiv. Page B2-9: Six references are listed, but only the last two are specifically called out in the text. Also, the reference to the DOE TRU Quality Assurance Program Plan (QAPP) is out of date. According to the current QA Program Document (QAPD rev 9), the QAPP was to become "inactive" with rev 3 of the QAPD.

xv. Page B2-13: Define the acronyms HSG and HWN in the text before using them in Figure B2-1.

Appendix B3 – Quality Assurance Objectives and Data Validation Techniques for Waste Characterization Sampling and Analytical Methods

i. General: Some citations are listed as (DOE, 2005), while others are listed as (EPA 1996). Choose one format (with or without a comma), not both.

ii. Page B3-3: The word "usability" is also spelled "useability" on this page. Use one form, not both.

iii. Page B3-4 line 11: Replace the period after the word "address"' with a comma.

iv. Page B3-5: Several references are made to SW-846 without citing the source (EPA 1996). Note that eventually the source is citied on page B3-14.

v. Page B3-5, lines 21 and 24: The word "coeluting" should be changed to "co-eluting"

vi. Page B3-5: line 28: Add the acronym HSG after "headspace gas" and substitute the acronym for that phrase in the rest of the document.

vii. Page B3-7: Headspace gas is not consistently hyphenated when used as an adjective on this page.

viii. Pages B3-8 and B3-31: Some bulleted items end with periods but others do not. Be consistent.

ix. Page B3-8 lines 21-22: Should the phrase "according to manufacturers specifications" be "according to manufacturers' specifications"?

x. Page B3-23 line 5: The word "involves" should be "involve".

xi. Page B3-29 line 31: Delete the extra space after "B6".

xii. References to the two Project Demonstration Plans are outdated. The PDP for headspace gas analysis was revised in 2007 (not 2003). The PDP for solids was revised in 2006 (not 2005).

xiii. Reference for the WIPP Waste Information System is also outdated. The current version was updated in 2008 and goes by a different title.

xiv. Page B3-35 line 36:Replace the comma after DOE with a period.

xv. Table B3-4: The term MDLb should be MDL[b].

xvi. Table B3-5 and Table B3-7: The acronym QAO's should be QAOs.

xvii. The following acronyms were not defined prior to first use:

Acronym	First Appears on Page	First Defined/Spelled Out on Page
TCLP	B3-5 line 11	B3-29 line 8
GC/MS	B3-5 line 12	
QC	B3-6 line 37	
PRQL	B3-7 line 7	B3-12 line 40
NIST	B3-8 line 20	
OVA	B3-8 line 21	
PRDLs	B3-9 line 41	B3-18 line 36
TSDF-WAC	B3-11 line 28	
WAP	B3-12 line 39	B3-18 line 41
ICP MS	B3-18 line 30	B3-50 line 7
TRU	B3-21 line 34	
WSPF	B3-23 line 28	B3-27 line 8
WWIS	B3-27 line 12	B3-32 line 4
UCL_{90}	B3-28 line 4	
RCRA	B3-29 line 5	
EPA	B3-30 line 26	
NMED	B3-30 line 27	
TRUCON	B3-30 line 37	
AK	B3-31 line 15	
TWIBR	B3-31 line 17	
GC/FID	B3-40 line 15	
RT	B3-46 (Tables B3-5 & B3-7)	
CCC	B3-46 (Tables B3-5 & B3-7)	
ICP AES	B3-50 line 7	
AA	B3-50 line 8	
CVAA	B3-51 (Table B3-9)	
GFAA	B3-51 (Table B3-9)	
HAA	B3-51 (Table B3-9)	
FLAA	B3-51 (Table B3-9)	
NCRs	B3-55 (Table B3-11)	B3-33
HSG	B3-56 (Table B3-12)	

Appendix B4 – TRU Mixed Waste Characterization Using Acceptable Knowledge

i. Page B4-1: Define the acronyms EPA and TRU. EPA is not defined until page B4-4, and transuranic is spelled out on page B4-6. Also, because AK is defined on this page, continue to use the acronym throughout the document.

ii. Page B4-1: There is no need to keep saying "Permit Attachment B" after WAP. It is already defined near the top of the first page.

iii. Page B4-1: An EPA document is called out as a reference (EPA, 1994), but there are no "References" listed at the end of the document.

iv. Page B4-2: Define WIPP.

v. Page B4-6: Define LANL, VOC, and NMMSS.

vi. Page B4-7: Define WSPF. Page B4-11 defines the acronym.

vii. Page B4-11: Define DQOs before using it the first time. It is spelled out on page B4-14.

viii. Page B4-12: Define TCLP.

ix. Page B4-13 line 39: The verb "can not" should be "cannot".

x. Page B4-16: Define CARs.

Appendix B5 – Quality Assurance Project Plan Requirements

i. Page B5-1lines 7-8: Define the acronyms TRU and WIPP. (On Page B5-1, Waste Isolation Pilot Plant is actually spelled out in line 12, while transuranic is on line 31.)

ii. Page B5-1 line 22. Add the acronym QA after the phrase "quality assurance" and substitute accordingly throughout the rest of the document.

iii. Page B5-1 line 39 and Page B5-2 line 35: Delete (Permit Attachment B) from both lines.

iv. Page B5-2 line 22: Define NMED.

v. Page B5-2 line 32: Define DOE.

vi. Page B5-2 line 35: Define QC.

Appendix B6 – Waste Isolation Pilot Plant Permittees' Audit and Surveillance Program

i. Page B6-1 line 16: Define NMED.

ii. Page B6-1 line 18: Add the acronym DOE after "Energy".

iii. Page B6-3 line 12: The acronym for Quality Assurance Objectives should be QAOs not QAO.

iv. Page B6-4 line 13: Define QAPjP.

v. Page B6-4 line 20: The word "laboratory" should be "laboratories".

vi. Page B6-6 line 10: Remove the carriage return at the end of this line.

Appendix B7 – Permittee Level TRU Waste Confirmation Processes

i. Page B7-1 line 17: Define TRU.

ii. Page B7-1 line 27: Define CH and RH.

iii. Page B7-1 line 33: Define TSDF-WAC.

iv. Page B7-3 line 12: define WSPF.

v. Page B7-7 lines 20-29: The font size is 11, but should be 12.

vi. Page B7-8 line 16: Either refer to WIPP as "WIPP" or "the WIPP", but not both.

vii. Page B7-8 line 26: Define QC.

viii. Page B7-9 line 2: Define CAR.

ix. Page B7-9 line 3: Define NMED.

x. Page B7-9 line 15: The spacing between words should be corrected on this line.

xi. Page B7-13: Define WWIS and HWFP before using them in the figure.

Chapter D.

i. General: Add a discussion indicating that a shielded container is being proposed for approval for use by WIPP and that DOE is developing the SWB-2 for use on WIPP.

ii. Page D-3, line 3: Where is the Operational Record maintained? Wouldn't the equipment logbook be better kept with the equipment?

iii. Page D-3, line 3: Define the acronym CH. In line 6, define the acronym RH.

iv. Page D-3, lines 19 and 20: Update the references to the DSA for WIPP to reflect the Combined CH-RH DSA issued in 2008.

v. Page D-4, line 5: Substitute the phrase "inspection procedures" for the word "inspection".

vi. Page D-6, lines 2, 15, 17, 19, and 20: Substitute CH for contact-handled and RH for remote-handled.

vii. Page D-7: Update reference to the most current DSA and TSR.

viii. Page D-19 & 20: The notes on page D-20 should be moved to page D-19 for convenience to the reader.

Chapter E.

i. General: Other than the first usage on page E5-1, line 6, change the phrases "the WIPP facility" and "WIPP facility" to "WIPP". Also, the use of hyphens is inconsistent – see page E-5, lines 5 and 6 for an example.
ii. Page E-2, line 24: Change "plantwide" to "plant-wide".
iii. Page E-2, line 30: Change "TRU mixed wastes are" to "TRU mixed waste is".
iv. Page E-2, line 32: Define the acronym "WHB".
v. Page E-4, line 2: Add a "The" at the beginning of the sentence. Also, remove the extra space after the first parenthesis.
vi. Page E-4, line 30: Delete the comma after the word "system".
vii. Pages E-4 and E-11: One page refers to domestic water and the other to potable water. They should be consistent.
viii. Page E-5, line 23: Change "contact-handled" to CH
ix. Page E-5, line 28: Change "10" to "ten".
x. Page E-6, line 17: Change "effected" to "affected".
xi. Page E-8, line 14: Change "allow" to "allows".
xii. Page E-9, line 9: Delete "DBE" since it is not used again in this chapter.
xiii. Page E-10, line 5: Hyphenate the word "nonliquid".
xiv. Page E-10, line 9: Change the word "discusses" to "discuss".
xv. Page E-10, line 39: Hyphenate the word "nonflood".
xvi. Page E-11, line 32: Change the word "provide" to "provides".
xvii. Page E-14, line 1: Transpose the words "are" and "criteria".
xviii. Page E-15, line 12: Change the word "are" to "is" at the end of the line.
xix.

Chapter F.

i. General: This section uses the terms 'shipping containers' (Page F-4, line 2), CH or RH Package shipping containers (Page F-5, line 21), Contact-Handled Package (Pages F-6,F-8, and F-9), and Remote-Handled Package (Pages F-7, F-8, and F-9). It is recommended that only the terms CH shipping containers and RH shipping containers be used.
ii. Page F-1, line 35: Are there still ten major TRU waste generator and/or storage sites now that Rocky Flats is closed?
iii. Page F-4, Section F1-a: A discussion about the receipt and disposal of RH TRU waste needs to be added to this section.
iv. Page F-6, Section F-1d: Add discussion of proposed addition of shielded containers and the development of the SWB-2 to the waste container list.

Chapter G.

i. General: There are a number of acronyms on Pages G-2 and G-3 that are not on the Abbreviations and Acronym List at the beginning of the Renewal Application package.
ii. Page G-2, lines 12 and 14: Change "Contact-Handled or Remote-Handled Packages" to "CH or RH shipping containers".
iii. Paragraph G-3, page G-3: This paragraph is inconsistent in that it includes the term Contact Handled (no hyphen) Packages and does not clearly indicate

that the shipping containers for CH TRU waste are either the TRUPACT II or the HalfPACT. Similarly, the description of how RH TRU waste gets to WIPP should include mention of the RH-72B and the CNS 10-160B shipping containers.

Chapter H. This chapter should be revised to read the same as what has been submitted in the most recent Class 2 Permit Modification request for the current permit.

Chapter I.

i. General: See Comment 18 from our review of Draft 2- it still applies.

ii. Page I-1, line 25: Insert the word "and" after WHB

iii. Page I-2, lines 12-13a: Use the same terminology for the WHB and PAU that are stated on Page I-1, line 15.

iv. Page I-3, Section I-1a(1): Suggest changing the title of the section to "WHB and Parking Area HWMUs" so as to be in conformance with the introductory discussion on Page I-1.

v. Page I-4, Section I-1a(2): This title is misleading since WIPP as a whole is defined under RCRA as a miscellaneous unit. Suggest changing the title of this section to "Waste Handling Disposal Units".

vi. Page I-4, lines 15-16a: The statement that post closure migration 'will not occur' is presumptuous. Suggest changing it to say that the Performance Assessment indicates that post closure migration will not occur.

vii. Page I-5, Section I-1a(3): This section needs to be edited to make it clear that the 30 year post-closure period is a RCRA requirement particularly when Section I-1(g) discusses the 100 year EPA requirement.

viii. Page I-6, Section I-1c: Add the following sentence to the end of the first paragraph: "The closure plan developed for the maximum waste inventory will be used for each of Panels 1 through 8 even if less than the maximum allowable volumes of TRU waste is disposed in any of the panels".

ix. Page I-6, Section I-1d and Page I-6, Section I-1d(2): The expected operational period should be changed to be more realistic given the fill-rate of WIPP. Also, the text in both these sections should be the same.

x. Page I-7, first paragraph: Revise to reflect that Panel 2 has been closed and the explosion-isolation wall installed. Second paragraph, revise to indicate that Panel 3 has been closed per the Appendix M2.

xi. Page I-7, line 25: Add the word 'The' at the start of this line. Also, disposal of TRU mixed waste did not start until November 1999. Thus, the end of the disposal phase should be 2024 or later and should match the times shown in Table I-1.

xii. Page I-8, line 8: The reference to the 1997 DSA has been deleted from the text, but the reference is still listed on page I-21

xiii. Page I-11, lines 7-8: The performance standard for air emissions is not provided in Renewal Application Appendix M2. Where is it?

xiv. Page I-16, line 25: Correct the reference to read (EPA, 1996) or correct the date on the reference on page I-21 to be 1986, whichever is correct.

xv. Page I-21: Should the reference be to the Final Supplemental EIS issued in 1997 rather than the 1980 EIS?

xvi. Page I-26 & I-33: The dates in Figure I-3 don't agree with the dates in Table I-2.

xvii. Appendix I-3, Page I3-3: First, update the SAR reference to the 2008 combined CH-RH DSA on lines 25 and 28. Second, on line 35-36, WIPP procedure WP-12-HP1100 is not included in the current Permit but rather is only available in the WIPP Operating Record. Also, the date for that procedure should be changed to 2008 – the date of the last revision.

Chapter J.

i. Page J-2, line 10: The acronym VOCMP is not on the master abbreviation and acronym list for the renewal application.

ii. Page J-2, line 22: Add EPA Compendium Method TO-15 to the reference list at the end of the chapter.

iii. Page J1-3, line 33: Correct the disposal phase time period to match the period shown in Table I-2.

iv. Page J1-4, top of page: Update this part of the text to reflect current status – 5 panels mined, 3 filled, one being filled.

v. Pages J1-6 and J1-7: Two different fonts used on those pages.

Chapter K – Missing?

Chapter L.

i. General: The title for Chapter L has ground water spelled two different ways (one at the top of the page, and the other at the bottom).

ii. General: Should all the WIPP procedures (WP 02-EMXXXX) discussed in the text be listed as references? Also, should the text indicate where they can be accessed?

iii. Many of the acronyms for this chapter are not on the master abbreviation and acronym list for the renewal application.

iv. Page L-2: Restrictions on drilling activities are described for the 16 sections of the Land Withdrawal Act with an exception for Section 31. Suggest describing the location and significance of Section 31.

v. Page L-15, line 29: The title of WP 13-1 should be added to the text and a footnote explaining the scope/purpose of the document added.

vi. Page L-15, footnotes. Where is footnote 1? Does not appear on any of the previous pages of this chapter.

vii. Page L-16, line 3: The FEIS is not referenced on the reference list at the end of the chapter nor is that acronym included on the master list. Also, shouldn't the reference be to the Final Supplemental EIS?

viii. Page L-17, line 21: The formula is typed incorrectly. Substitute the symbol for rho (ρ) for the second p in the formula.

ix. Page L-18, footnote 4: That procedure is already referenced by footnote 2 on page L-15, line 31.

Chapter M.

i. General:. Replace the term "first ten-year term of the HWFP" with the term "current Permit" or "Initial Permit"

ii. Page M-1, line 14: Suggest using the acronym "PAU", which is used in Chapter I, instead of "Parking Area Unit". Make the same change in the Appendices to Chapter M - see Page M1-1, M1-5,

iii. Page M-2, Line 43: The ventilation rate for active rooms is given as 35,000 ft^3 per minute. It should be shown as "35,000 scfm".

iv. Page M-9 of 47, Line 25: The sentence needs to be completed following the word "described".

v. Appendix M1: Add a discussion of the proposed shielded containers in anticipation of their approval for use. Also include the proposed SWB-2.

vi. Appendix M1: Replace **contact-handled** with CH and **remote-handled** with RH throughout this Appendix.

vii. Page M1-18, line 15: Update the reference to the 1997 SAR to the 2008 combined CH-RH DSA. Also update reference list on page M1-30 accordingly.

viii. Page M1-19, Section M1-1d(3): A discussion about contamination surveys and cleanup to be used for RH TRU waste shipments, comparable to the discussion for CH TRU waste shipments on pages M1-16-18 needs to be added to this section. Or alternately, a separate section should be created addressing receipt, inspection, survey, and decontamination of both CH and RH shipping containers.

ix. Page M1-35, Table M1-3: Since the weights are given in pounds, the capacities should also be given in pounds not tons (see Table M1-2).

x. Page M2-1, lines 31 and 32. The meaning of the phrase "and any currently active panel" is unclear. Suggest replacing it with "and Panel 4 should it still be active".

xi. Page M2-2, line 6: Change the phrase "in the first 10 year term of the HWFP" to "in the Initial Permit".

xii. Page M-2, line 15: Is the Salt Handling Shaft still the principal personnel transport shaft?

xiii. Page M-2, line 21: Change the cubic feet to be 5,244,000.

xiv. Page M-2, line 25: Change 2,635 to 2,460 to reflect the actual amount of RH TRU waste disposed in Panel 4. Also, this amount could be changed to 2,775 m^3 if DOE would request the RH TRU waste disposal capacity increase for Panels 5 and 6 discussed in the current HWFP.

xv. Page M2-6, line 43: Change this sentence to show there are **8** HWDUs (Panels 1-8) covered by this permit with active disposal expected to be in Panels 5 through 8.

xvi. Page M2-8, lines 42-43: Are the minimum ventilation rate units SCFM or ACFM?

xvii. Page M2-9, lines 25-31: Rearrange the text on those lines as shown below since it is more logical to discuss how the panel is closed after the discussion of how the rooms are "closed".

"Once a disposal room is filled ~~and~~[redacted] is ~~no longer needed for emplacement activities, it will be~~ barricaded against entry and isolated from the mine ventilation system by removing the air regulator bulkhead and constructing chain link/brattice cloth barricades at each end. There is no requirement for air for these rooms since personnel and/or equipment will not be in these areas. *After all rooms within a panel are filled, the panel will be closed using a closure system described Renewal Application Chapter I and Renewal Application Appendix I1".*

xviii. Page M2-13, lines 15 and 20: Substitute CH for contact-handled. Also change Packaging to Package on line 20.

xix. Page M2-13, line 16: Substitute WHB for 'waste handling building'.

xx. Page M2-17, line 10: Delete the first sentence. Revise the second sentence to read: "*Based upon the geomechanical instrumentation experience gained in the repository to date,* conditions are assessed....".

xxi. Page M2, lines 14-15: Suggest this discussion be updated to reflect the collection and analysis of the geomechanical monitoring data since 1999. If the reference to the Panel of Experts is still to be included, provide a reference to that presentation.

Chapter N.

i. Page N-1, line 21: The acronym RH is not included in the Acronym and Abbreviation list at the beginning of this chapter.

ii. Appendix N1: Should this appendix be updated to include Panel 8? Also, on the first page, the title of the Appendix should be changed to "Hydrogen and Methane Monitoring Plan".

Chapter P. Add the titles of each technical procedure to the appropriate summary sheet.

Chapter Q.

i. Page Q – 1 of 9 is mislabeled as Page Q – 9 of 9.

ii. Page Q – 1 of 9: The freezing point of water is listed as 460 °R. The freezing point of water is 492 °R or 32 °F. The Imperial standard state temperature is 0 °C equivalent to 32 °F rather than the listed 460 °R which is 0 °F. Also the summertime temperature is listed as 528 °R (100 °F). Five hundred twenty eight °R is 68 °F equivalent to 20 °C, which is also often taken as the standard state.

iii. This chapter should state what standard state temperature corresponds to the 35,000 scfm flow rate requirement and the temperature in question (summertime temperature in this case).

300 Year Performance Demonstration Re-Evaluation.

i. An introductory section should be added to this part of the renewal application package to explain the purpose for the performance demonstration – namely to respond to the requirement of 40CFR270.23 (see page 19 of the Necessary Information Section for Part). The introduction should also explain why the term of 300 years was selected since RCRA only requires 30 years and the federal regulations for WIPP only require 100 years of active post-closure control for WIPP.

ii. This section should also be referenced in the Closure Plan and Post-Closure Plan as further substantiation that those plans are more than adequate.

Materials Submitted at the Pre-Application Meetings

February 10th and 12th, 2009

WIPP Hazardous Waste Facility Permit Pre-Application Meetings

Carlsbad, NM, Feb 10, 2009

Santa Fe, NM, Feb 12, 2009

Purpose of Today's Meeting

- The Pre-Application meetings are required whenever the application proposes a significant change in facility operations in accordance with NMAC 20.4.1.901, *Permitting Procedures*

- At the Pre-Application meeting, the Permittees will
  - Notify the public of the hazardous waste management activities contained in the Renewal Application
  - Receive written comments from the public

Written Comments

- Comments received prior to May 15, 2009, will be included in the administrative record and be included in the Renewal Application
- Send Comments to:

  Bobby St. John

  Public Affairs

  P.O. Box 2078

  Carlsbad, New Mexico 88221

Purpose of Today's Meeting

- Introduce WIPP's Hazardous Waste Facility Permit (**Permit**) Renewal Application
  - Background
  - Proposed Changes in Facility Operations and Waste Characterization
  - Format
  - Public Participation
  - Required Renewal Application Submittal Date
- Presentation of the Re-Evaluation of the 300-Year Performance Demonstration

Second Pre-Application Meetings In April 2009

- Recently, additional scope has been identified that will be included in the Renewal Application

- Responding to NMED and stakeholder input

- Clarifying text

Background

- The WIPP Permit expires November 26, 2009
- Permittees must submit a new application at least 180 days before the expiration date of the effective permit
- The WIPP Renewal Application must be submitted on or before May 30, 2009
- So long as the Renewal Application is "timely and complete" the current Permit remains in effect until the new Permit is issued or denied

Proposed Changes in Facility Operations and Waste Characterization

- Authorization to dispose of TRU-mixed waste in Panel 8
  - Currently Permittees are authorized to construct and certify Panel 8
  - Authorization to dispose of TRU waste was not requested in 2005 modification to the Permit as the planning basis did not project the need for the disposal capacity during the Permit term

Proposed Changes in Facility Operations and Waste Characterization

- Inclusion of Attachment Q: *Mine Ventilation Rate Monitoring Plan*
  - Submittal of Plan required by Permit Condition IV.J.
  - Permittees submitted the Plan to NMED in 2000
  - Plan has not been formally incorporated into the Permit by NMED
  - Permittees work to all requirements of the Plan including reporting data

Changes Not Reflected in Draft 3

- Clarification of Visual Examination Requirements
- Clarification of the Liquid Prohibition
- Administrative change for notification of non-administrative non-conformances
- Distinguish between "generator" and "certified program" requirements to clearly identify who can perform characterization required by the Permit

Format

- Table of Contents
  - List of Tables
  - List of Figures
- Abbreviations/Acronyms
- Introduction
  - Narrative
  - Regulatory Crosswalk
- Part A Application
  - Necessary Information for Part A
  - Summary of Proposed Changes
  - Part A Application Form
  - Part A Application Certification
  - Other Environmental Permits
  - Facilities
  - Photographs
  - Maps

Format

- Part B Application
  - Required Regulatory Information
- Public Process Pre-Submittal Meeting Information
  - Name/address of participants (if offered)
  - Written Comments
  - Presentation
- Chapters and Appendices
  - Although not specifically required, the Permittees are choosing to provide proposed changed text in Redline/Strikeout text as a reviewer's aid.
- Supplement
  - Re-Evaluation of the 300-Year Performance Demonstration

Format

- Necessary Information
  - General and Specific Information Required by the Regulations
    - Part A § 40 CFR 270.13 Part A Information
    - Part B § 40 CFR 270.14 General
    - Part B § 40 CFR 270.15 Containers
    - Part B § 40 CFR 270.23 Miscellaneous Units
- Response to each information requirement in summary form
- Readers then directed to Renewal Application chapters and appendices for full information

Format

Changes are being requested

- Language authorizing disposal in Panel 8
- Formalization of Mine Ventilation Rate Monitoring Plan
- Clarification of
  - VE requirements
  - Liquid Prohibition
  - Definition of generator site/certified program
  - Reporting Non-administrative non-conformances

- Proposed verbiage for changes in Renewal Application Attachments A, B thru B7 (Waste Analysis Plan) I, M1, M2, N, N1, and Q

Public Participation

- Early Informational Meetings
  - Carlsbad 8/26/08
  - Santa Fe 8/28/08
  - Draft provided to stakeholders ahead of meetings
- Pre-Application Meetings
  - Carlsbad 2/10/09
  - Santa Fe 2/12/09
- Next Pre-Application Meetings (Plan Dates)
  - Carlsbad 4/28/09
  - Santa Fe 4/30/09

Upcoming Dates

- Next Pre-Application Meetings (Plan Dates)
  - Public Notice of Pre-Application Meeting: March 28, 2009
  - Copy of Draft 4 Changes to Stakeholders: April 15, 2009
  - April 28, 2009: Carlsbad
  - April 30, 2009: Santa Fe

- May 30, 2009: Renewal Application Due Date

Send Comments to:

Bobby St. John
Public Affairs
P.O. Box 2078
Carlsbad, New Mexico
88221

Re-Evaluation of the 300-Year Performance Demonstration

Mike Gross

List of Attendees

May 5, 2009, Pre-Application Meeting in Carlsbad, NM

Carlsbad, New Mexico May 5, 2009

U.S. Department of Energy
WIPP Hazardous Waste Facility Permit Renewal Application
To the Hazardous Waste Facility Permit
Waste Isolation Pilot Plant

Name *Please Print All Information Clearly*	**Mailing Address** *Would You Like to be on the Mailing List*	*Yes*	*/No*
Harry Samaniego			X
David Mattiano			X
N.T. Rempe			

List of Attendees

May 7, 2009, Pre-Application Meeting in Santa Fe, NM

Santa Fe, New Mexico May 7, 2009

U.S. Department of Energy
WIPP Hazardous Waste Facility Permit Renewal Application
To the Hazardous Waste Facility Permit
Waste Isolation Pilot Plant

Name *Please Print All Information Clearly*	Mailing Address *Would You Like to be on the Mailing List*	Yes	No
Jerry Fox	PECOS MGT Ser Co, 7901 Mountain Rd # 87110		✓
Janet Greenwald	202 Harvard SE Alb NM 87106	✓	
Dorie Bunting	202 Harvard SE 87106 06	✓	
Bob Press	901 adams Abq SE 87108	✓	
Floy Barrett	316 Washington N.E Albuquerque, N.M. 87108	✓	
SHERRY KEENEY	PECOS management Services PO BOX 13343, Albuq. NM 87192		✓
CHRISTOPHER M. TIMM	PECOS Management Services P.O. Box 13343, ALBQ. NM 87192	✓	

Santa Fe, New Mexico May 7, 2009

U.S. Department of Energy
WIPP Hazardous Waste Facility Permit Renewal Application
To the Hazardous Waste Facility Permit
Waste Isolation Pilot Plant

Name *Please Print All Information Clearly*	Mailing Address *Would You Like to be on the Mailing List*	Yes/No	
Bill Loeb	218 Camino Encantado Santa Fe, NM 87501	✓	
Don Hancock	PO Box 4524 Alb, NM 87196-4524	Already on	
MARINA DAY 223 N. Guadalupe Ste. 284 Santa Fe, NM 87501		✓	
Scott Kovac	NWNM	already	

Written Comments from the May 5/7, 2009 Pre-Application Meetings

Most, Wille

From: Plum, Jody - DOE
Sent: Thursday, May 14, 2009 7:04 AM
To: Most, Wille; St. John, Bobby
Subject: FW: Permit renewal application

IMPORTANT - a comment.

-----Original Message-----
From: Don Hancock [mailto:sricdon@earthlink.net]
Sent: Wednesday, May 13, 2009 3:34 PM
To: Plum, Jody - DOE
Subject: Permit renewal application

Jody,

I'm sending this to you, since the email address that I have for Bobby St. John doesn't seem to work.

This quick email is to try to emphasize one point I made at the May 7 pre-application meeting, but is not a finely crafted comment as SRIC normally does because of time constraints that I have.

I strongly encourage the permittees to NOT change "Generator/Storage Site" to "Certified Characterization Program/"

Such a change requires dozens (if not hundreds) of changes in the existing permit. I believe that the change is unnecessary, since the permittees have not identified the problem with the existing language, which has been in place for the last 10 years (and in the drafts of the original permit application). The existing generator/storage site language is well established in RCRA, so the new language also is confusing. ("Generator site" also is used hundreds of times in the CCA and is not being proposed to be changed in the RCA filed in March with EPA, so changing it in the RCRA permit is inconsistent and confusing.) I believe that there are likely to be unintended consequences with the proposed new language. One example is that it might require some discussion of CCP in the LANL permit renewal, which has been the subject of months long negotiations.

There are other concerns about the change, but I hope that the point -- and the importance of the issue -- has been made. Please return to the language in Draft 3, which retained the "generator/storage site"
language of the existing permit.

****
Don Hancock
Southwest Research and Information Center PO Box 4524 Albuquerque, NM 87196
505/262-1862

PECOS MANAGEMENT SERVICES, INC.

May 14, 2009

Mr. Vernon Daub
Deputy Manager
U.S. Department of Energy
Carlsbad Field Office
P.O. Box 3090
Carlsbad, NM 88221

Subject: Contract No. DE-AC30-06EW03005 "Comments on Draft No. 4 of the Hazardous Waste Facility Permit Renewal Application"
PECOS Document #2009-C-0029

Dear Mr. Daub:

PECOS Management Services, Inc. (PECOS) is pleased to submit the enclosed comments on the Preliminary Draft Hazardous Waste Facility Permit (HWFP) Renewal Application for the Waste Isolation Pilot Plant (WIPP), which was provided for our review on April 23, 2009. The PECOS review was based upon our belief that the intent of the HWFP should be to enable DOE to facilitate disposal of transuranic (TRU) waste in WIPP as efficiently and safely as possible as directed by the authorizing federal legislation. From that perspective, PECOS believes that the proposed HWFP renewal should be written to ensure maximum flexibility of operations for the WIPP while maintaining a high standard of health and safety for the workers and public. Further, we believe that the overall health and safety of all of the facets of characterizing, treating, transporting, and disposing TRU waste in WIPP should be evaluated and changes proposed to the permit that reduce the risk associated with characterization and treatment without increasing the risks during transportation and disposal. PECOS also suggests that DOE pursue the elimination of any permit requirements that have been proven to be not necessary based upon the over ten years of operating data. Such actions will improve the efficiency and facilitate the safe disposal of TRU waste in WIPP.

Based on the above concepts, PECOS first suggestion is to revise the proposed language in Chapter B and its appendices regarding prohibited items as shown on Attachment A. You will note that our proposed revisions address several issues. With respect to the liquid limits, we suggest that the permit language be changed to a limit of one percent of the volume of the acceptable waste containers. We have not found any literature documenting that there is a greater risk that eliminating the volumetric constraint on liquids in internal containers will cause a breach in any waste container, particularly since corrosive and reactive wastes are prohibited in general. This proposed change is further supported by the experience of WIPP with the transport and disposal of acceptable waste containers that were found to have liquids in excess of the current permit limits. The safe transport, placement, recovery, and return transport of acceptable waste containers with liquids over the current permit limits indicate that there is minimal risk with the transport and disposal of large volumes of liquids in acceptable waste containers in the first place.

PO Box 13343 Albuquerque, NM 87192
Phone: 505-323-8355 Fax: 505-323-2028 www.pecosmanagement.com

In contrast, efforts to re-package TRU waste to remove liquids has resulted in several workers being exposed to radiation despite the stringent health and safety practices being used for re-packaging or treatment to reduce the liquids in acceptable waste containers to below permit limits. One example is the accident that occurred at the Savannah River Site in 2006, where an operator received a puncture wound on his left thumb and clothing/skin contamination while repackaging TRU waste. Our reports entitled "*An Evaluation of the Health and Safety Risks resulting from Repackaging TRU Waste for Disposal at WIPP*", which was provided to DOE in September 2008, and "*Potential Health and Safety Impacts of Removal of Containers from the Waste Isolation Pilot Plant*", which was provided to DOE in November 2008 provides further discussion to support the revision of the liquid limits.

A second suggested change is to revise the restriction on compressed gas containers inside acceptable waste containers. As with liquids, it appears that the health and safety risks to the workers who have to remove any pressurized internal containers from the payload containers is greater than the potential risk of a deflagration of a pressurized internal container during transport or disposal.

A third suggested change is to delete all of the requirements for headspace gas (HSG) sampling. The gas monitoring tests specified in the CH-TRAMPAC in response to Department of Transportation and Nuclear Regulatory Commission requirements are sufficient to protect worker and public health and safety, which negate the need for HSG sampling. In addition, the data collected since the HSG monitoring requirements were changed in 2006 indicate that there are such low concentrations of volatile organic compounds (VOC) present that continued sampling and testing is not warranted. Our evaluation indicates that the earlier conclusion by the National Research Council report in 2000 that there is no utility in the information provided by HSG is still valid.

We also suggest that the VOC monitoring requirements be amended in the new permit. The current VOC monitoring requirements were predicated on protecting worker health and safety in the event of a roof fall or other accident that would cause an instantaneous release of high concentrations of VOCs from the disposed waste. However, the results of the HSG sampling over the past ten years indicate that the concentrations of VOCs in the waste containers is orders of magnitude less than originally projected and would not result in ambient concentrations in WIPP anywhere near the action levels specified in the current permit. Further, the current VOC monitoring program does not provide any instantaneous warning of ambient VOC concentrations that exceed the permit action levels so does not provide effective worker health and safety protection. It is suggested that DOE consider replacing the current VOC monitoring system with a system that is triggered by the shock wave that would be generated if there were a sizeable roof fall or if a stack of waste containers fell over.

In addition to the above suggested changes, the statement is made on page 2 of the necessary information Section of Part B, that "*The DOE plans to dispose of up to 4,919,769 ft ^{3} (139,312 m^3) of contact-handled (CH) waste and 93,050 ft^3 (2,635 m^3) of remote-handled (RH) TRU mixed waste in Panels 1 to 8.*" However, based upon how much RH TRU waste has actually been disposed in Panels 1 through 4 and assuming the current disposal plan of horizontal boreholes for RH TRU waste is continued for Panels 5 through 8, no more than 2,454 m^3 can be emplaced in Panels 1-8. Therefore, the renewal application should describe how DOE plans to emplace the additional 181 m^3. If the intent is to accomplish this through the use of shielded containers, then a discussion on shielded containers should be added to all the appropriate parts of the renewal application.

We also reiterate the concerns raised in our May 12, 2009 letter commenting on draft No. 3 of the renewal application. Specifically, we recommend that DOE includes in this renewal application:

- A request to increase the permitted capacity for RH TRU waste disposal in Panels 5 and 6 to that permitted for Panel 7,
- The option to emplace RH TRU waste in the same room where CH TRU waste is being emplaced as long as all DOE health and safety requirements are met,
- A description of shielded containers, the Standard Waste Box 2 and the TRUPACT III as planned future permit modification requests – a practice that is commonly called out in other sections of the current permit.

With respect to the substantial number of nomenclature changes and general clarification type revisions proposed by DOE in this renewal application, we believe that the application package should provide a clear justification of the reason for and benefit of those types of changes. For example, the while the discussions about the certified characterization program are intended to simplify the permit from DOE's perspective, they are confusing to much of the general public. Similarly, the deletion of entire sections or paragraphs without an explanation as to why they are being deleted (which could be accomplished by a parenthetical statement in the text) causes unnecessary confusion.

Finally, given the increased emphasis of this Administration on implementing 'green' practices and approaches, we suggest that DOE either provide paper copies as double-sided copies or delete the numerous pages annotated "This page intentionally left blank" in all single-sided copies.

Notwithstanding the above comments, we do want to commend the renewal application preparation team in that draft No. 4 is much better edited than the previous drafts. However, we still noted numerous grammatical errors; identifications of which are provided in Attachment B.

We appreciate the opportunity to review the draft and look forward to the opportunity to review the complete application including all of the proposed changes to the HWFP text and attachments. Please call me or Christopher Timm at (505) 323-8355 should you have any questions.

Sincerely,

Jerry V. Fox, PhD
Project Director

cc: M. Long, EMCBC
R. Nelson, DOE
J. Plum, DOE
B. St. John, WRES
S. Kilgore, PECOS
C. Timm, PECOS

ATTACHMENT A

PROPOSED REVISED LANGUAGE FOR THE HAZARDOUS WASTE FACILITY PERMIT – MODULE II.

II.C.3. Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (**TSDF-WAC**)

The Permittees shall not accept TRU mixed wastes at WIPP for storage, management, or disposal which fail to meet the treatment, storage, and disposal facility waste acceptance criteria as presented in Permit Conditions II.C.3.a through II.C.3.j of this Permit.

II.C.3.a. Liquids - the volume of liquid present in any acceptable waste container (See Condition III.C.1) may not exceed 1 percent volume of that container. If either the 85 gallon drum or ten drum overpack are used as overpacks to transport and dispose of other acceptable waste containers, the volume of liquid present in the overpack shall not exceed one percent of the volumes of the acceptable waste containers within the overpack container.

II.C.3.b. Pyrophoric materials - non-radionuclide pyrophoric materials, such as elemental potassium, are not acceptable at WIPP.

II.C.3.c. Non-mixed hazardous wastes - hazardous wastes not occurring as co-contaminants with TRU wastes (nonmixed hazardous wastes) are not acceptable at WIPP.

II.C.3.d. Chemical incompatibility - wastes incompatible with backfill, seal and panel closures materials, container and packaging materials, shipping container materials, or other wastes are not acceptable at WIPP.

II.C.3.e. Explosives and compressed gases - wastes containing explosives or more than one unvented internal container of compressed gases greater than one liter in volume are not acceptable at WIPP.

II.C.3.f. PCB waste - wastes with polychlorinated biphenyls (**PCBs**) not authorized under an EPA PCB waste disposal authorization are not acceptable at WIPP.

II.C.3.g. Ignitable, corrosive, and reactive wastes - wastes exhibiting the characteristic of ignitability, corrosivity, or reactivity (EPA Hazardous Waste Numbers of D001, D002, or D003) are not acceptable at WIPP.

II.C.3.h. Unvented waste containers. All acceptable waste containers must be vented as specified in Att. M1 including those used as overpacks.

PROPOSED CHANGE IN TEXT FOR THE HAZARDOUS WASTE FACILTY PERMIT RENEWAL APPLICATION, CHAPER B

B-1c Waste Prohibited at the WIPP Facility

The following TRU mixed waste are prohibited at the WIPP facility:

- Liquids in waste containers. None of the acceptable waste containers (Module III, Section III.C.1) shall contain liquids in excess of one percent of the volume of that container. This limit includes any liquids observed in internal containers (jars, cans, bags, tubing, etc.) located within the waste and any liquids that can be discerned as liquids either in the waste (a pocket of liquid) or between the waste and the sides of the waste container, including any liquids present between any inner liners and the sides of the waste container.
- Liquids in overpack containers. When one of the acceptable waste containers (restricted to the 85 gallon drum and the ten drum overpack) is used to overpack other waste containers, the total volume of liquids in the overpack container is limited to one percent of the volumes of the waste containers in the overpack container.
- Payload containers with U134 waste shall have no detectable liquid in either internal containers or in the waste container.
- Non-radionuclide pyrophoric materials, such as elemental potassium.
- Hazardous wastes not occurring as co-contaminants with TRU mixed wastes (non-mixed hazardous wastes).
- Wastes incompatible with backfill, seal and panel closures materials, container and packaging materials, shipping container materials, or other wastes.
- Wastes containing explosives or unvented internal containers of compressed gases greater than 1 liter in volume.
- Wastes with polychlorinated biphenyls (**PCBs**) not authorized under an EPA PCB waste disposal authorization.
- Wastes exhibiting the characteristic of ignitability, corrosivity, or reactivity (EPA Hazardous Waste Numbers of D001, D002, or D003).
- Any waste container (including overpacks) that has not been vented as specified in App M1.
- Any waste container from a waste stream (or waste stream lot) which has not undergone either radiographic or visual examination of a statistically representative subpopulation of the waste stream in each shipment, as described in Permit Attachment B7
- Any waste container from a waste stream which has not been preceded by an appropriate, certified WSPF (see Section B-1d).

Before accepting a container holding TRU mixed waste, the Permitees will perform waste confirmation activities on each waste stream shipment to confirm that the waste does not contain ignitable, corrosive, or reactive waste and the assigned EPA hazardous waste numbers are allowed for storage and disposal by this Permit. Waste confirmation activities will be performed on at least 7 percent of each waste stream shipped, equating to examination of at least one of fourteen containers in each waste stream shipment. If a waste stream shipment contains fewer than fourteen containers, one container will be examined to satisfy waste confirmation

requirements. Section B-4 and Permit Attachment B7 include descriptions of the waste confirmation processes that the Permittees will conduct prior to receiving a shipment at the WIPP facility.

To ensure the integrity of the WIPP facility, waste streams identified to contain incompatible materials or materials incompatible with waste containers cannot be shipped to WIPP unless they are treated to remove the incompatibility. Only those waste streams that are compatible or have been treated to remove incompatibilities will be shipped to WIPP.

ATTACHMENT B

General and Editorial Comments

The following comments are organized by renewal application part, chapter, appendix or addendum. Within each of those categories, they are presented as General comments first and then by page and line number.

Abbreviations and Acronyms:

General: Master list does not contain many of the acronyms and abbreviations used in Chapter L

List of Figures

General: Does not include the figures presented in Part A .

Page 4, Line beginning with I2-7: "Multid-deck" should be "Multi-deck"

Page 5, Line beginning with L1-11: "withGypsum" should be "with Gypsum"; line beginning with J1-4 "Fenceline" should be "Fence line"

Page 6, Line beginning with L1-19 "Drillholes" should be "Drill holes"

Introduction

Page 3, Line 27: should end with a close quotation mark

Necessary Information Part B

Page 2, Line 1: "Sections 17 to 22" should read "Sections 15-22"

Page 2, line 12: "CH" should be bolded.

Page 6, line 28: The second instance of "Eddy County" should be followed by a comma.

Page 7, line 14: The second instance of "Eddy County" should be followed by a comma.

Page 11, line 9: This sentence should end with a period.

Pages 12-13: The term "ground water" is being written inconsistently and should be revised after selecting one way of being written.

Page 18, line 24: This paragraph should end with a period.

Page 19, line 7: Waste Analysis Plan should be italicized.

Page 20, line 25: The period after "264.602" should be changed to a comma.

Page 20, line 26: "RCRA Part B Application" should be followed with a period.

Page 21, line 1: "There is no change" should read "There are no changes"

Page 21, line 4: "land use" should be changed to "land-use"

Chapter A

Page 2, lines 33 & 34: Since Panels 9 and 10, as currently planned and shown on various figures in this renewal application (Part A, Figure 3-2 for example), will not have seven rooms, the text on line 33 should be modified.

Chapter B

Page 8, line 17: The phrase "headspace gas" should be removed.

Page 9, line 11: TSDF-WAC does not need to be bolded.

Page 12, lines 34-37: This text should be moved to Appendix M1, Section M1-1b – it is more appropriate there.

Page 22, lines 2-3: The phrase "acceptable knowledge" should be removed.

Page 25, line 23: "TC" should replace "toxicity characteristic"

Page 25, line 31: "Transuranic" should replace "TRU"

Page 25, line 44: The phrase "drum age criteria" should be removed.

Page 36, line 7: The phrase "Carlsbad Field Office" should be removed.

Page 41, line 19: Replace "SWBs" with "standard waste boxes (**SWBs**)"

Page 41, lines 19-20: Replace "TDOPs" with "ten drum overpacks (**TDOPs**)"

Page 65, line 5: Replace "Contract" with "Contact"

Addendum B1

Page 1, line 9: The first instance of "RTL" should be bolded.

Page 1, line 11: "TC" should be bolded.

Page 1, line 13: "TCLP" should be bolded.

Page 1, line 17: "Pb" should be bolded.

Page 2, line 15: "EPA" should be bolded.

Addendum B2

Page 1, line 8: "CH", "RH", and "TRU" should be bolded.

Page 1, line 9: "WTWBIR" should be bolded.

Page 1, line 16: "EPA" should be bolded.

Appendix B1

Page 3, line 26: Insert "*the Determination of Drum Age Criteria and Prediction Factors Based on Packaging Configurations*" before the word "BWXT" and change BWXT (2000) to [BWXT (2000)]

Page 31, line 7: Insert (Lockheed) after "Company"

Appendix B2

Page 4, line 14: "WSPF" should be bolded.

Appendix B3

Page 30, Lines 8-10: Complete bullet should be removed since only toxicity characteristic organics are being reported.

Page 33, Line 14: Complete bullet should be removed since only toxicity characteristic organics are being reported.

Page 62 (Table B3-13): The TIC evaluation line needs to be removed since only toxicity characteristic organics are being reported.

Appendix B4

Page 2, line 38: Replace "AK Sufficiency Determination" with "AKSD"

Page 7, line 22: "WSPF" should be bolded.

Chapter D

Page 1, line 15: Replace "WIPP" with "Waste Isolation Pilot Plant (**WIPP**)"

Page 2, line 15: Include a definition for the term "CHAMPS"

Chapter E

Page 1, line 10: Replace "WIPP" with "Waste Isolation Pilot Plant (**WIPP**)"

Page 2, line 36: Replace "TRU mixed wastes are handled" with "TRU mixed waste is"

Page 5, line 39: Replace "10 55-gallon drums" with "ten 55-gallon drums"

Page 10, line 23: Replace "discusses" with "discuss".

Chapter F

Page 1, line 13-14: Replace "New Mexico Administrative Code" with "New Mexico Administrative Code (**NMAC**)"

Chapter G

Page 1, line 5: Replace "WIPP" with "Waste Isolation Pilot Plant (**WIPP**)"

Page 3, line 32: "SWB" should be bolded.

Appendix H1

Page 1: Provide a definition for the term "TRU"

Appendix H2

General: Many acronyms in this section are used without having been defined prior to their use.

Chapter I

Page 1, footnote 1: In the second sentence, the term "VOCs" should be bolded.

Page 25, page 8: Remove the number 4 from the first sentence.

Appendix I1

General: Some acronyms are defined and bolded twice within this part of the document.

Chapter L

General: The acronyms and abbreviations included in Chapter L are not always included in the Master Acronym and Abbreviation List for the renewal application.

Page 22, footnote 7: Replace "prior to the" with "prior to the"

Addendum L

General: Figures L-1 and L-2 are not indicated in the text.

Page 48, line 35 and page 49, line 22: Room Q, which is mentioned on both these pages, is not identified in any figure or otherwise described in the text.

Page 56, line 28: The text refers to Figure 2-36, which is not one of the figures listed for this addendum.

Chapter M

Page 1, Lines 18 and 24-25: The use of HWMU in line 18 is contradictory to the use of hazardous waste disposal units in lines 24-25 since line 18 refers to units in the repository as do lines 24-25. Suggest changing HWMU to HWDU in line 18.

nuclear watch new mexico

May 15, 2009

Bobby St. John
WTS Public Affairs
PO Box 2078
Carlsbad, NM, 88221

Sent via email to bobby.stjohn@wipp.ws

Dear Bobby,

Nuclear Watch New Mexico respectfully submits these comments on the April 21, 2009 revision of the WIPP HWFP renewal application. Quotes from the renewal application are in italics, followed by our comments. Thank you for your continuing efforts to involve the public.

Introduction

Pg. 2

- *Change "Generator/Storage Site" to "Certified Characterization Program" to identify responsibilities for characterizing waste to the WIPP Waste Analysis Plan (WAP).*
- *Delineate CCP and AMWTP as the only certified characterization programs*
- *Change "Site" to U. S. Department of Energy (DOE) TRU waste site or DOE contract TRU waste site (i.e., TRU waste site)*

This seems to be a major change. Please provide some more explanation. The existing language was working, so why change it? "Generator/Storage Site" is a clearly-defined, broadly used RCRA term. Is this just a change in terminology or does this indicatea change in proceedures as well? How will this impact possibly existing permits, such as the LANL RCRA permit? How will this impact past record-keeping?

- *Removed the distinction between newly generated waste characterization requirements and retrievably stored waste*

Why was this changed and what are the impacts?

Pg. 4

The version of the Permit used to create the Renewal Application is the version the NMED has posted on its web page as of May 29, 2009, and includes any approved permit modifications.

May should be March.

Nuclear Watch New Mexico • 551 W. Cordova Rd. Santa Fe, NM 87505 • 505.989.7342
info@nukewatch.org • www.nukewatch.org

Slide 16 of your publc presentation mentioned eliminating Permittee Management Representative review. This does not show up in your Introduction or Summary of Changes.

Summary of the proposed changes
Please also list the page and line number of the first instance of a specific change in the summary of proposed changes.
For instance, where can the "information to authorize the disposal of TRU waste in Panel 8" mentioned under the Chapter A paragraph be located?

Waste Analysis Plan Chapter B through B7
An actual list of the changes would be good here. Your Introduction is a much better summary and maybe should be re-titled "Introduction to Changes".

Necessary Information for the WIPP Ten Year Renewal Application, Part A
(a) The activities conducted by the applicant which require it to obtain a permit under RCRA.
No changes are being proposed to the activities conducted at the Waste Isolation Pilot Plant (WIPP) that entails receiving, unloading, and transferring radioactive-mixed waste from the surface of the site to the underground hazardous waste management units. Waste will be emplaced in an underground geologic repository horizon located in a deep-bedded salt formation approximately 2,150 feet beneath the surface.
Are there really no changes? How about emplacement of MgO on racks?

(i) A description of the processes to be used for treating, storing, and disposing of hazardous waste, and the design capacity of these items.
The Permittees propose no change in the manner in the in which they store or dispose of TRU mixed waste, except for requesting the authorization for the disposal of TRU-mixed waste in Panels 8. The Permittees do not treat TRU mixed waste.
Are there really no changes? How about emplacement of MgO on racks?

Chapter A
Pg. A-2
The WIPP underground area is designated as Panels 1 through 10, although only Panels 5 ~~1~~ through 8 ~~7~~ ~~and any current active panel~~ will be used to receive TRU waste for disposal under the terms of this Permit ~~permit~~. Each of the seven rooms is approximately 300 feet long, 33 feet wide and 13 feet high.
Please add a line that Panel 8 is being added to the permit instead of only just changing the number "7" to "8". Please explain why this Panel is being included in the permit.

Chapter B
Pg. B-1

Before the Permittees manage, store, or dispose transuranic (**TRU**) mixed waste from a *U.S. Department of Energy (**DOE**) TRU waste site or DOE contract TRU waste site (**TRU waste site**)* ~~*generator/storage site (**site**)*~~, *the Permittees shall require* ~~*that site*~~ *the Carlsbad Field Office (**CBFO**) certified waste characterization program (**certified characterization program**) established at the TRU waste site to implement the applicable requirements of this WAP. Certified characterization programs are limited to the Central Characterization Project characterizing TRU mixed waste (after receiving certification at that site) and the Advanced Mixed Waste Treatment Project characterizing TRU mixed waste at the Idaho National Laboratory.*
The TRU mixed waste that may be stored or disposed at WIPP is ~~*are*~~ *or was* ~~*were*~~ *generated at TRU waste* ~~*DOE generator/storage*~~ *sites by various specific processes and activities.*
Maybe some definitions are order for "U.S. Department of Energy (DOE) TRU waste site" and "DOE contract TRU waste site". And/or maybe you should list all the sites and state which is which.

Pg. B-2
~~Some TRU mixed waste is retrievably stored at the DOE generator/storage sites. Additional TRU mixed waste will be generated and packaged into containers at these generator/storage sites in the future. TRU mixed waste will be retrieved from storage areas at a DOE generator/storage site. Retrievably stored waste is defined as TRU mixed waste generated after 1970 and before the New Mexico Environment Department (**NMED**) notifies the Permittees, by approval of the final audit report, that the characterization requirements of the WAP at a generator/storage site have been implemented. Newly generated waste is defined as TRU mixed waste generated after NMED approves the final audit report for a generator/storage site. Acceptable knowledge (**AK**) information is assembled for both retrievably stored and newly generated waste. Waste characterization of retrievably stored TRU mixed waste will be performed on an ongoing basis, as the waste is retrieved. Waste characterization of newly generated TRU mixed waste is typically performed as it is generated, although some characterization occurs post-generation. Waste characterization requirements for newly generated and retrievably stored TRU mixed wastes differ, as discussed in Sections B-3d(1) and B-3d(2).~~
Why was this removed?

Pg. B-31
~~*B-4a(7) Records Management*~~
Where did this go?

Pg. B-65
~~Generator~~TRU Waste Site Name:
~~Generator~~TRU Waste Site EPA ID:
Does EPA issue ID numbers for "TRU Waste" sites or does it still use the term "generator site'?

App I

Figures I1-1 to I1-7 could not be read on my computer. (They would not show up.) I assume that there were no changes to these figures.

App M-1
Pg. 20
Off-normal events could interrupt normal operations in the waste management process line. These off normal events fall into the following categories:
Waste management system equipment malfunctions
Waste shipments with unacceptable levels of surface contamination
Hazardous Waste Manifest discrepancies that are not immediately resolved
A suspension of emplacement activities for regulatory reasons

Shipments of waste from the ~~generator~~ TRU waste sites will be stopped as appropriate for ~~in any~~ events which results in an interruption to normal waste handling operations ~~that exceeds three days~~.
Please remove "as appropriate" and add "any" back in, or define "as appropriate" and list events that will not stop shipments.

App M-2
Pg. 8
Typical emplacement configurations are shown in Figure M2-4~~s M2-5 and M2-5a~~. Backfill may also be emplaced on racks which allow for orderly stacking. Quality control ~~will be~~is provided within standard operating procedures to record that the correct number of sacks ~~are~~ is placed and that the condition of the sacks is acceptable.
&
Figure M2-5
RESERVED
Please be sure and include a picture of the rack emplacement.

Thank you for your consideration,
Scott

Scott Kovac
Operations and Research Director
Nuclear Watch New Mexico
551 Cordova Road #808
Santa Fe, NM, 87501
505.989.7342 office & fax
www.nukewatch.org

Scott, Susan

From: St. John, Bobby
Sent: Monday, May 18, 2009 11:15 AM
To: Scott, Susan
Subject: FW: Ten Year WIPP Renewal Process.

Comments 2 of 2

-----Original Message-----
From: Marina Day [mailto:marinaday123@yahoo.com]
Sent: Fri 5/15/2009 6:55 PM
To: St. John, Bobby
Subject: Ten Year WIPP Renewal Process.

May 15, 2009, Friday.

WIPP Worker Bobby St. John,

I am not going to comment on all aspects of the ten year WIPP renewal of the permit issued by the state of New Mexico Environment Department because it is too broad for me to want to deal with.

I do not like the proposed change of language on Chapter B, Section B-0d from confirmation prior to shipment to "prior to receipt" because prior to receipt could mean that trucks with shipment of nuclear waste could be confirmed right before they arrive at WIPP, and if there are errors, and the wrong waste is shipped then the trucks might have to go all the back to the generator site that is came from.
I would much rather catch errors at the generator sites before shipping the nuclear waste and not after shipping the nuclear waste and finding out errors on the way to WIPP.

Also, Bobby St. John, I am glad that I received your e-mail address of bobby.stjohn@wipp.ws partly because I did not use any paper to submit this e-mail to you, which is less demand to cut down trees, and it is more environmentally friendly.

I suggest that if you continue to be the contact person for WIPP related matters then not only included a mailing address in which people can mail letters to you using the U.S. postal service, but also include your telephone number and your e-mail address.

I am also sending a copy of this e-mail within a few minutes of the time I send you this e-mail to Steve Zappe who is a state of New Mexico Environment Department WIPP regulator.

Thank you for your time in these matters.

Sincerely,

Marina Day

WIPP Renewal Application Permit Comments

Some Areas of Concern

The Document
Though DOE's application, which is the size of two phone books, is well-formatted, it is a muddled document; in the permit application it is not always clear where the new language DOE wants to insert begins and what the older, accepted language is, so it is often necessary to ask DOE to clarify what they are intending to do and what the language is that they want to insert. The changes that DOE proposes are not properly referenced.

AKSD
Some waste that comes to WIPP is verified by Acceptable Knowledge Sufficiency Determination. The standards for this method of determination are necessarily high since no visual examination is done on the wastes before shipping to WIPP. DOE is changing the language concerning AKSD. Why are they doing this? What is the exact change? Will this change weaken the strict standards for using AKSD?

Liquid Prohibition
Liquids have always been prohibited at WIPP -- since the first discussions about the facility in the 1970s. Weapons plants have flammable and explosive liquids that substantially raise the risk of fires, explosions and other problems in shipment, storage, and disposal. Liquids are also susceptible to leaks and spills, which are dangerous. So they have been, and should be, prohibited at WIPP.

The new language that DOE is proposing seems to loosen the restriction of liquids at WIPP. LANL, especially, and other sites, have lots of sludges with liquids, so this is not an appropriate time to loosen requirements. We are playing with fire (and explosions) if we weaken the restrictions on liquids in WIPP drums.

Visual Examination
Pages of description of how VE is to be done have been crossed out in the Permit Renewal Application; in their place are a few short paragraphs. Because of the way this strike out and replacement wording has been done, it is difficult to understand what has been taken out and what has been left

in. It seems like the requirements for visual examination of drums have been diminished. CARD objects to diminishing the requirements for visual examination, the cornerstone of safe shipping and disposal at WIPP.

Confirmation
Confirmation means the use of visual examination or radiography on a representative subpopulation of each waste stream-at least seven percent- to confirm that the waste does not contain ignitable, corrosive or reactive waste. The DOE is required to do this examination and provide the state with the pertinent documents before waste leaves the generator site for WIPP. In the Permit Renewal Application, DOE would not be required to execute the confirmation or submit the relevant documents until after the waste has arrived at WIPP. CARD sees this change as a slippage in safety standards and objects to the change.

Why Drums are Vented
The permit, according to the Permit Renewal Application now reads: "Containers are vented through filters, allowing any gasses that are generated by radiolytic and microbial processes within a waste container to escape, thereby preventing over pressurization or development of conditions within the container that would lead to the development of ignitable, corrosive, reactive, or other characteristic wastes."(B-12, lines 34-37) The Permit Renewal Application would strike the words after 'over pressurization', giving an incomplete picture of why WIPP drums are vented.

300 Year Performance Demonstration Reevaluation and Water Monitoring
CARD will comment concerning these subjects after Rick Boheim's report and the results of DOE/NMED negotiations concerning water monitoring are made available to the public.

Respectfully Submitted,

Janet Greenwald
Co-coordinator Citizens for Alternatives to
Radioactive Dumping, CARD

I certify that these comments were mailed to Bobby St. John, PO Box 2078, Carlsbad, New Mexico 88221 on May 15, 2009.

Materials Submitted at the Pre-Application Meetings

May 5th, 2009

WIPP Hazardous Waste Facility Permit Renewal Application

Carlsbad, NM, May 5, 2009

Santa Fe, NM, May 7, 2009

Renewal Application

- Per Permit Condition I.B.2, *The Permittees may renew this Permit by submitting an application for a new Permit at least one hundred eighty (180) calendar days before the expiration date of this Permit*
- Renewal Application will be submitted to NMED no later than May 29, 2009

Public Participation

- Informal informational meeting with stakeholders in August 2008 to discuss the approach to the Renewal Application

- Informal informational meeting with stakeholders on April 24,2009, to present changes to Renewal Application since Draft 3 (Waste Analysis Plan changes)

Renewal Application

- First set of Pre-Application Meetings (required per 20.4.1.901C(1) NMAC incorporating 40 CFR 124.31)
  - February 10, 2009, Carlsbad, New Mexico
  - February 12, 2009, Santa Fe, New Mexico
  - Permittees introduced changes that would be in the draft Renewal Application and introduced the need to revise the Waste Analysis Plan chapter of the Renewal Application
  - Permittees requested public comment

Renewal Application

Second set of Pre-Application Meetings (required per 20.4.1.901C(1) NMAC incorporating 40 CFR 124.31)

- May 5, 2009, Carlsbad, New Mexico
- May 7, 2009, Santa Fe, New Mexico

- Posted Draft WIPP Hazardous Waste Facility Permit Renewal Application - April 2009 on WIPP Homepage (consistent with 20.4.1.901.E NMAC incorporating 40 CFR 124.33)
  - http:www.wipp.energy.gov/library/rcrapermit/ Draft_Renewal_Application_4_24_09.htm

Summary of Changes

- Revised information is provided to reflect TRU waste disposal in Panel 8

- Disposal unit waste disposal capacities were added to Appendix M2. Made a statement that backfill (MgO) may also be emplaced on racks.

Summary of Changes

- Clarified historical and descriptive text in Chapter L
  - Addendum L1 (Site Characterization) to Chapter L has been added to present updated information
- Added tables regarding storage capacities to Appendix M1
- Clarified in Appendix M1 container accountability practices upon receipt

Summary of Changes

- Added Tables in Chapter N and Appendix N1 identifying concentrations of concern, limits, and action levels for Volatile Organic Compound and Hydrogen/Methane Monitoring

- Included the WIPP Mine Ventilation Rate Monitoring Plan as Chapter Q

Summary of Changes

- Added information "addenda" to provide reviewers information on:
  - Totals vs. Toxicity Characteristic Leaching Procedure analytical methodology
  - Compatibility analysis
  - Dispute resolution
  - Site characterization information update
  - 300-year Performance Demonstration Re-evaluation

Summary of Changes

- Included documents used as references in electronic format as "Supplemental Information"
- Revised Waste Analysis Plan
- Included "reviewer's guide" for the Waste Analysis Plan to identify sections where corresponding changes have been made

Summary of Waste Analysis Plan Changes

- Deleted redundant text
- Re-ordered Chapter B, Section B-3 to correspond with the order in which characterization is typically performed
- Tech edits throughout
  - Typographical corrections
  - Editorial changes
  - Reference corrections

Summary of Waste Analysis Plan Changes

- Clarified text by:
  - Changing "Generator/Storage Site" to "Certified Characterization Program" or "TRU Waste Site" to identify responsibilities for characterizing waste to the WIPP Waste Analysis Plan
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Summary of Waste Analysis Plan Changes

- Clarified text by (cont.)
  - Clarifying the Liquid Waste Prohibition
    - How it applies to internal containers, payload containers, internal containers inside overpack containers and overpack payload containers

Summary of Waste Analysis Plan Changes

- Clarifying the Liquid Waste Prohibition (cont.)
  - The observable free-standing liquid and total residual liquid inside a payload container shall be no more than one percent of the payload container volume
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  - Deleting non-Toxicity Characteristic constituents from tables and deleted Tentatively Identified Compound evaluation requirements

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  - Revising Appendix B7 to focus confirmation on ignitable, corrosive, and reactive waste and hazardous waste numbers
  - Eliminated Permittee Management Representative review and revised training requirements

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- Clarified text by (cont.)
  - Revising the solids sampling Quality Assurance Objective to address completeness when either core or non-core sampling is being used
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- Clarified text by (cont.)
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Summary of Waste Analysis Plan Changes

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  - Revising requirement that a minimum of 5 samples is to be obtained from S3000/S4000 waste streams that consist of less than 5 containers
    - One sample of each container will be taken to achieve 100% representativeness

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Comments on Renewal Application
(to Permittees by May 15, 2009)

- **Send Comments to:**

Bobby St. John
WTS Public Affairs
P.O. Box 2078
Carlsbad, New Mexico 88221

Materials Submitted at the Pre-Application Meetings

May 7th, 2009

Pre-Application Meetings

Waste Isolation Pilot Plant

May 5, 2009	May 7, 2009
5 to 7 p.m.	2 to 4 p.m.
WIPP Information Center	6 to 8 p.m.
Skeen-Whitlock Building	Courtyard by Marriott
4021 National Parks Highway	3347 Cerrillos Road
Carlsbad, New Mexico	Santa Fe, New Mexico

The U.S. Department of Energy Carlsbad Field Office and Washington TRU Solutions (co-permittees) are hosting pre-application meetings regarding the Hazardous Waste Facility Permit (HWFP) renewal application for the Waste Isolation Pilot Plant (WIPP).

This notice is to inform the public of the pre-application meeting for the WIPP HWFP Renewal Application, as required by the New Mexico Hazardous Waste Management Regulations. The purpose of the pre-application meetings for the WIPP HWFP Renewal Application is to inform stakeholders of the proposed hazardous waste management activities and to solicit questions. The radioactive components of WIPP waste are regulated separately by the U.S. Environmental Protection Agency.

The effective term for the WIPP HWFP is ten years. At least 180-days before the expiration of the current permit (November 26, 2009), the Permittees must reapply for a permit. The Renewal Application must be submitted to NMED no later than May 30, 2009.

The WIPP facility, located 30 miles east of Carlsbad, New Mexico, is designed for permanent disposal of defense-generated transuranic waste, the byproduct of nuclear weapons research and production. WIPP is permitted to dispose only this type of waste. Project facilities include disposal rooms excavated 2,150 feet underground in a stable salt formation.

To obtain information regarding the reapplication or about WIPP operations, contact Mr. Bobby St. John at 1-800-336-9477. The draft renewal application submittal may also be viewed on the WIPP web site, http://www.wipp.energy.gov, and at the WIPP Information Center, Skeen-Whitlock Building, 4021 National Parks Highway, Carlsbad, New Mexico.

Persons requiring special assistance to participate in these meetings may also contact Mr. St. John at the telephone number noted above at least 72 hours prior to the meeting.

WIPP Hazardous Waste Facility Permit Renewal Application

Santa Fe, NM, May 7, 2009

Renewal Application

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Comments on Renewal Application
(to Permittees by May 15, 2009)

- **Send Comments to:**

  Bobby St. John
  WTS Public Affairs
  P.O. Box 2078
  Carlsbad, New Mexico 88221

CHAPTER A

GENERAL FACILITY DESCRIPTION AND PROCESS INFORMATION

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CHAPTER A

GENERAL FACILITY DESCRIPTION AND PROCESS INFORMATION

TABLE OF CONTENTS

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CHAPTER A

GENERAL FACILITY DESCRIPTION AND PROCESS INFORMATION

A-1 Facility Description

Abstract

NAME OF FACILITY:	Waste Isolation Pilot Plant
OWNER and CO-OPERATOR:	U.S. Department of Energy P.O. Box 3090 Carlsbad, NM 88221
CO-OPERATOR:	Washington TRU Solutions LLC P.O. Box 2078 Carlsbad, NM 88221
RESPONSIBLE OFFICIALS:	David. C. Moody, Manager DOE/Carlsbad Field Office Farok Sharif, General Manager Washington TRU Solutions LLC
FACILITY MAILING ADDRESS:	U.S. Department of Energy P.O. Box 3090 Carlsbad, NM 88221
FACILITY LOCATION:	30 miles east of Carlsbad on the Jal Highway, in Eddy County.
TELEPHONE NUMBER:	575/234-7300
U.S. EPA I.D. NUMBER:	NM4890139088
GEOGRAPHIC LOCATION:	32° 22′ 30″ N 103° 47′ 30″ W
DATE OPERATIONS BEGAN:	November 26, 1999

A-2 Description of Activities

The Waste Isolation Pilot Plant (**WIPP**) is a facility for the management, storage and disposal of transuranic (**TRU**) mixed waste. Both contact-handled (**CH**) and remote-handled (**RH**) TRU mixed wastes are permitted for storage or disposal at the WIPP facility.

A-3 Property Description

The WIPP facility has been divided into functional areas. The Property Protection Area (**PPA**), surrounded by a chain-link security fence, encompasses 34.16 acres and provides security and protection for all major surface structures. The DOE Off Limits Area encloses the PPA, and is approximately 1,454 acres. These areas define the DOE exclusion zone within which certain items and material are prohibited. The final zone is marked by the WIPP Site Boundary (WIPP land withdrawal area) a 16-section Federal land area under the jurisdiction of the DOE.

A-4 Facility Type

There are three basic groups of structures associated with the WIPP facility: surface structures, shafts and underground structures. The surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of TRU mixed waste from the surface to the underground. There are two surface locations where TRU mixed waste will be managed and stored. The first area is the Waste Handling Building (**WHB**) Container Storage Unit (WHB Unit) for TRU mixed waste management and storage. The WHB Unit consists of the WHB contact-handled (**CH**) Bay and the remote-handled (**RH**) Complex. The second area designated for managing and storing TRU mixed waste is the Parking Area Container Storage Unit (Parking Area Unit), an outside container storage area which extends south from the WHB to the rail siding. The Parking Area Unit provides storage space for up to 50 loaded Contact-Handled Packages and 14 loaded Remote-Handled Packages on an asphalt and concrete surface.

Four vertical shafts connect the surface facility to the underground. These are the Waste Shaft, the Salt Handling Shaft, the Exhaust Shaft and the Air Intake Shaft. The Waste Shaft is the only shaft used to transport TRU mixed waste to the underground. The WIPP underground structures are located in a mined salt bed 2,150 feet below the surface.

The underground structures include the underground Hazardous Waste Disposal Units (**HWDUs**), an area for future underground HWDUs, the shaft pillar area, interconnecting drifts and other areas unrelated to the RCRA Hazardous Waste Permit. The underground HWDUs are defined as waste panels, each consisting of seven rooms and two access drifts. The WIPP underground area is designated as Panels 1 through 10, although only Panels 1 through ~~7~~8 will be used under the terms of this permit. Each of the seven rooms is approximately 300 feet long, 33 feet wide and 13 feet high.

A-5 Waste Description

Wastes destined for WIPP are byproducts of nuclear weapons production and have been identified in terms of waste streams based on the processes that produced them. Each waste stream identified by generators is assigned to a Waste Summary Category to facilitate RCRA waste characterization, and reflect the final waste forms acceptable for WIPP disposal.

These Waste Summary Categories are:

S3000—Homogeneous Solids
Solid process residues defined as solid materials, excluding soil, that do not meet the applicable regulatory criteria for classification as debris [20.4.1.800 NMAC, (incorporating 40 CFR §268.2(g) and (h))]. Solid process residues include inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste. Other waste streams are included in this Waste Summary Category based on the specific waste stream types and final waste form. This category includes wastes that are at least 50 percent by volume solid process residues.

S4000—Soils/Gravel
This waste summary category includes waste streams that are at least 50 percent by volume soil. Soils are further categorized by the amount of debris included in the matrix.

S5000—Debris Wastes
This waste summary category includes waste that is at least 50 percent by volume materials that meet the NMAC criteria for classification as debris (20.4.1.800 NMAC (incorporating 40 CFR §268.2)). Debris means solid material exceeding a 2.36 inch (60 millimeter) particle size that is intended for disposal and that is: 1) a manufactured object, 2) plant or animal matter, or 3) natural geologic material.

The S5000 Waste Summary Category includes metal debris, metal debris containing lead, inorganic nonmetal debris, asbestos debris, combustible debris, graphite debris, heterogeneous debris, and composite filters, as well as other minor waste streams. Particles smaller than 2.36 inches in size may be considered debris if the debris is a manufactured object and if it is not a particle of S3000 or S4000 material.

If a waste does not include at least 50 percent of any given category by volume, characterization shall be performed using the waste characterization process required for the category constituting the greatest volume of waste for that waste stream.

Wastes may be generated at the WIPP facility as a direct result of managing the TRU and TRU mixed wastes received from the off-site generators. Such waste may be generated in either the WHB or the underground. This waste is referred to as “derived waste.” All such derived waste will be placed in the rooms in HWDUs along with the TRU mixed waste for disposal.

Non-mixed hazardous wastes generated at the WIPP, through activities where contact with TRU mixed waste does not occur, are characterized, placed in containers, and stored (for periods not exceeding the limits specified in 20.4.1.300 NMAC (incorporating 40 CFR §262.34)) until they are transported off site for treatment and/or disposal at a permitted facility. This waste generation and accumulation activity, when performed in compliance with 20.4.1.300 NMAC (incorporating 40 CFR §262), is not subject to RCRA permitting requirements and, as such, is not addressed in the permit.

A-6 Chronology of Events Relevant to Changes in Ownership or Operational Control

December 19, 1997	NMED received notification of a change of name/ownership from Westinghouse Electric Corporation to CBS Corporation. The WIPP Management and Operating Contractor (**MOC**), Westinghouse Waste Isolation Division (**WID**), became a division of Westinghouse Electric Company, which in turn was a division of CBS Corporation. Notification to NMED was made by the permit applicant in a letter dated December 18, 1997. The permit application was under review, but a draft permit was not yet issued.
September 22, 1998	NMED received notification of a pending transfer of ownership for the MOC, Westinghouse WID, from CBS Corporation to an as-yet-to-be-named limited liability company owned jointly by British Nuclear Fuels, plc and Morrison-Knudsen Corporation. The transfer of ownership was scheduled to occur on or about December 15, 1998. Notification to NMED was made by the permit applicant in a letter dated September 17, 1998. The draft permit had been issued for public comment, but the final permit was not yet issued.
March 9, 1999	NMED again received notification of the pending divestiture of the MOC, Westinghouse WID, by CBS Corporation to the limited liability company owned jointly by British Nuclear Fuels, plc and Morrison-Knudsen Corporation known as MK/BNFL GESCO LLC. The new MOC would be renamed to Westinghouse Government Environmental Services Company LLC. Notification to NMED was made by the permit applicant in a letter dated March 2, 1999. The public hearing on the permit was underway, but the final permit was not yet issued.
March 26, 1999	NMED received official notification of the divestiture of Westinghouse Electric Company by CBS Corporation to MK/BNFL GESCO LLC effective March 22, 1999. The MOC was renamed Westinghouse Government Environmental Services Company LLC (**WGES**), of which Westinghouse Waste Isolation Division was a division. This transaction constituted a change of operational control under 20.4.1.900 NMAC (incorporating 40 CFR §270.40). Notification to NMED was made by the

	permit applicant in a letter dated March 24, 1999. The public hearing on the permit was nearly concluded, but the final permit was not yet issued.
April 28, 1999	NMED received a revised Part A Permit Application in a letter dated April 21, 1999, reflecting that the Westinghouse Waste Isolation Division, co-operator of the WIPP hazardous waste facility, was now a part of WGES. However, the final permit, issued October 27, 1999, did not reflect the change in ownership.
July 25, 2000	NMED received a Class 1 permit modification in a letter dated July 21, 2000, changing the name in the Permit from Westinghouse Electric Corporation to Westinghouse Government Environmental Services Company LLC (**WGES**), Waste Isolation Division (**WID**). However, this notification did not constitute the required permit modification under 20.4.1.900 NMAC (incorporating 40 CFR §270.40) necessary to reflect the transfer of the permit to a new operator.
December 15, 2000	DOE announced that it had awarded a five-year contract for management and operation of WIPP to Westinghouse TRU Solutions LLC, a limited liability company owned jointly by WGES LLC and Roy F. Weston, Inc. The announcement further stated that, following a brief transition period, the new contractor would assume MOC responsibilities on February 1, 2001. This transaction constituted a change of operational control under 20.4.1.900 NMAC (incorporating 40 CFR §270.40) requiring a Class 1 permit modification with prior written approval of NMED.
February 5, 2001	NMED received a Class 1 permit modification in a letter dated February 2, 2001, which notified NMED of an organizational name change of the MOC from Westinghouse Government Environmental Services Company LLC Waste Isolation Division to Westinghouse TRU Solutions LLC. However, this notification did not constitute the required permit modification under 20.4.1.900 NMAC (incorporating 40 CFR §270.40) necessary to reflect the transfer of the permit to a new operator.
December 31, 2002	NMED received a Class 1 permit modification in a letter dated December 27, 2002, which changed the name of the MOC from Westinghouse TRU Solutions LLC to Washington TRU Solutions LLC. Again, this notification did not constitute the required permit modification under 20.4.1.900 NMAC (incorporating 40 CFR §270.40) necessary to reflect the transfer of the permit to a new operator.
February 28, 2003	NMED received a Class 1 permit modification requiring prior agency approval in a letter dated February 28, 2003, to satisfy the requirements specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.40) to reflect the transfer of the permit to a new operator.

September 16, 2004	NMED received a Class 1 permit modification requiring prior agency approval in a letter dated September 16, 2004, describing a change of ownership of Washington TRU Solutions LLC (**WTS**). WTS is owned jointly by WGES, managing member, and Weston Solutions, Inc. WGES had been owned jointly by Washington Group International, Inc. (**WGI**), and BNFL Nuclear Services, Inc. However, WGI has acquired BNFL's prior interest in the former Westinghouse government services businesses, which includes BNFL's prior interest in WGES.
August 6, 2007	NMED received notification in a letter dated August 2, 2007 of the pending acquisition of WGI by URS Corporation at an unknown future date. This acquisition would be related to operational control, because WGI is the sole owner of WGES, managing member of the joint venture, along with Weston Solutions, Inc., that owns WTS, the WIPP MOC. This notification was submitted to assure compliance with 20.4.1.900 NMAC (incorporating 40 CFR §270.40(b)).
November 26, 2007	NMED received a Class 1 permit modification requiring prior agency approval in a letter dated November 19, 2007, describing a change of ownership of WTS. On November 15, 2007, WGI was acquired by URS Corporation. WTS is owned jointly by WGES, managing member, and Weston Solutions, Inc. WGES, formerly owned by WGI, is now owned by URS Corporation

CHAPTER B

WASTE ANALYSIS PLAN

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CHAPTER B

WASTE ANALYSIS PLAN

TABLE OF CONTENTS

List of Tables

List of Figures

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CHAPTER B

WASTE ANALYSIS PLAN

B-0 Introduction and Attachment Highlights

This waste analysis plan (**WAP**) has been prepared for management, storage, or disposal activities to be conducted at the Waste Isolation Pilot Plant (**WIPP**) facility to meet requirements set forth in 20.4.1.500 NMAC (incorporating 40 CFR §264.13). Guidance in the most recent U.S. Environmental Protection Agency (**EPA**) manual on waste analysis has been incorporated into the preparation of this WAP (EPA, 1994). This WAP includes test methods, details of planned waste sampling and analysis for complying with the general waste analysis requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.13), a description of the waste shipment screening and verification process, and a description of the quality assurance (**QA**)/quality control (**QC**) program. Before the Permittees manage, store, or dispose transuranic (**TRU**) mixed waste from a generator/storage site (**site**), the Permittees shall require that site to implement the applicable requirements of this WAP.

TRU mixed waste that may be stored or disposed at WIPP are or were generated at DOE generator/storage sites by various specific processes and activities. Examples of the major types of operations that generate this waste include:

- Production of Nuclear Products—Production of nuclear products includes reactor operation, radionuclide separation/finishing, and weapons fabrication and manufacturing. The majority of the TRU mixed waste was generated by weapons fabrication and radionuclide separation/finishing processes. More specifically, wastes consist of residues from chemical processes, air and liquid filtration, casting, machining, cleaning, product quality sampling, analytical activities, and maintenance and refurbishment of equipment and facilities.

- Plutonium Recovery—Plutonium recovery wastes are residues from the recovery of plutonium-contaminated molds, metals, glass, plastics, rags, salts used in electrorefining, precipitates, firebrick, soot, and filters.

- Research and Development (**R&D**)—R&D projects include a variety of hot cell or glovebox activities that often simulate full-scale operations described above, producing similar TRU mixed wastes. Other types of R&D projects include metallurgical research, actinide separations, process demonstrations, and chemical and physical properties determinations.

- Decontamination and Decommissioning—Facilities and equipment that are no longer needed or usable are decontaminated and decommissioned, resulting in TRU mixed wastes consisting of scrap materials, cleaning agents, tools, piping, filters, Plexiglas™, gloveboxes, concrete rubble, asphalt, cinder blocks, and other building materials. These materials are expected to be the largest category by volume of TRU mixed waste to be generated in the future.

TRU mixed waste contains both TRU radioactive and hazardous components, as defined in 20.4.1.800 NMAC (incorporating 40 CFR, §268.35(d)), and in the Federal Facility Compliance Act, Public Law 102- 386, Title 1, §3021(d). It is designated and separately packaged as either contact-handled (**CH**) or remote-handled (**RH**), based on the radiological dose rate at the surface of the waste container.

The hazardous components of the TRU mixed waste to be managed at the WIPP facility are designated in Table B-9. Some of the waste may also be identified by unique state hazardous waste codes or numbers. These wastes are acceptable at WIPP as long as the Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (**TSDF-WAC**) in Module II are met. This WAP describes the measures that will be taken to ensure that the TRU mixed wastes received at the WIPP facility are within the scope of Table B-9 as established by 20.4.1.500 NMAC (incorporating 40 CFR §264), and that they comply with unit-specific requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.600), Miscellaneous Units.

Some TRU mixed waste is retrievably stored at the DOE generator/storage sites. Additional TRU mixed waste will be generated and packaged into containers at these generator/storage sites in the future. TRU mixed waste will be retrieved from storage areas at a DOE generator/storage site. Retrievably stored waste is defined as TRU mixed waste generated after 1970 and before the New Mexico Environment Department (**NMED**) notifies the Permittees, by approval of the final audit report, that the characterization requirements of the WAP at a generator/storage site have been implemented. Newly generated waste is defined as TRU mixed waste generated after NMED approves the final audit report for a generator/storage site. Acceptable knowledge (**AK**) information is assembled for both retrievably stored and newly generated waste. Waste characterization of retrievably stored TRU mixed waste will be performed on an ongoing basis, as the waste is retrieved. Waste characterization of newly generated TRU mixed waste is typically performed as it is generated, although some characterization occurs post-generation. Waste characterization requirements for newly generated and retrievably stored TRU mixed wastes differ, as discussed in Sections B-3d(1) and B-3d(2).

Waste characterization is defined in Module I as the activities performed by the waste generator to satisfy the general waste analysis requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.13(a)) before waste containers have been certified for disposal at WIPP. The characterization process for WIPP waste is presented in Figure B-2. Generator site waste characterization programs are first audited by the Permittees, with NMED approving the final audit report. After this, generator sites determine whether AK alone is sufficient for characterization, or whether a sampling and analysis program in conjunction with AK is necessary to adequately characterize wastes. If an AK Sufficiency Determination is sought, information is provided to the Permittees for their review and provisional approval; NMED determination of adequacy of the AK information is required before final approval by the Permittees. If the sampling and analysis route is chosen, sites proceed to sample and analyze waste in conjunction with AK and in accordance with this WAP. Once an AK Sufficiency

Determination is obtained, or when required sampling and analysis data are obtained, sites would then prepare and submit the Waste Stream Profile Form for the Permittees' approval. Once the WSPF is approved, a site may ship waste to WIPP. The Permittees will perform waste confirmation prior to shipment of the waste from the generator/storage site to WIPP as specified in Permit Attachment B7, by performing radiography or visual examination of a representative subpopulation of certified waste containers, to ensure that the wastes meet the applicable requirements of the TSDF-WAC.

B-0a Waste Characterization

Characterization requirements for individual containers of TRU mixed waste are specified on a waste stream basis. A waste stream is defined as waste material generated from a single process or from an activity that is similar in material, physical form, and hazardous constituents. Waste streams are grouped by Waste Matrix Code Groups related to the physical and chemical properties of the waste. Generator/storage sites shall use the characterization techniques described in this WAP to assign appropriate Waste Matrix Code Groups to waste streams for WIPP disposal. The Waste Matrix Code Groups are solidified inorganics, solidified organics, salt waste, soils, lead/cadmium metal, inorganic nonmetal waste, combustible waste, graphite, filters, heterogeneous debris waste, and uncategorized metal. Waste Matrix Code Groups can be grouped into three Summary Category groups: Homogeneous Solids (Summary Category S3000), Soil/Gravel (Summary Category S4000), and Debris Waste (Summary Category S5000).

TRU mixed wastes are initially categorized into the three broad Summary Category Groups that are related to the final physical form of the wastes. Waste characterization requirements for these groups are specified separately in Section B-2 of this WAP. Each of the three groups is described below.

S3000 - Homogeneous Solids
Homogeneous solids are defined as solid materials, excluding soil, that do not meet the NMED criteria for classification as debris (20.4.1.800 NMAC (incorporating 40 CFR §268.2[g] and [h])). Included in the series of homogeneous solids are inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste. Other waste streams are included in this Summary Category Group based on the specific waste stream types and final waste form. This Summary Category Group is expected to contain toxic metals and spent solvents. This category includes wastes that are at least 50 percent by volume homogeneous solids.

S4000 - Soils/Gravel
This Summary Category Group includes S4000 waste streams that are at least 50 percent by volume soil/gravel. This Summary Category Group is expected to contain toxic metals.

S5000 - Debris Wastes
This Summary Category Group includes heterogeneous waste that is at least 50 percent by volume materials that meet the criteria specified in 20.4.1.800 NMAC (incorporating

40 CFR §268.2 (g)). Debris means solid material exceeding a 2.36 inch (in.) (60 millimeter) particle size that is intended for disposal and that is:

1. a manufactured object, or
2. plant or animal matter, or
3. natural geologic material.

Particles smaller than 2.36 inches in size may be considered debris if the debris is a manufactured object and if it is not a particle of S3000 or S4000 material.

If a waste does not include at least 50 percent of any given Summary Category Group by volume, characterization shall be performed using the waste characterization process required for the category constituting the greatest volume of waste for that waste stream (see Section B-3d).

The most common hazardous constituents in the TRU mixed waste to be managed in the WIPP facility consist of the following:

<u>Metals</u>

Some of the TRU mixed waste to be emplaced in the WIPP facility contains metals for which 20.4.1.200 NMAC (incorporating 40 CFR §261.24), toxicity characteristics were established (EPA hazardous waste numbers D004 through D011). Cadmium, chromium, lead, mercury, selenium, and silver are present in discarded tools and equipment, solidified sludges, cemented laboratory liquids, and waste from decontamination and decommissioning activities. A large percentage of the waste consists of lead-lined gloveboxes, leaded rubber gloves and aprons, lead bricks and piping, lead tape, and other lead items. Lead, because of its radiation-shielding applications, is the most prevalent toxicity-characteristic metal present.

<u>Halogenated Volatile Organic Compounds</u>

Some of the TRU mixed waste to be emplaced in the WIPP facility contains spent halogenated volatile organic compound (**VOC**) solvents identified in 20.4.1.200 NMAC (incorporating 40 CFR, §261.31) (EPA hazardous waste numbers F001 through F005). Tetrachloroethylene; trichloroethylene; methylene chloride; carbon tetrachloride; 1,1,1-trichloroethane; and 1,1,2-trichloro-1,2,2-trifluoroethane (EPA hazardous waste numbers F001 and F002) are the most prevalent halogenated organic compounds identified in TRU mixed waste that may be managed at the WIPP facility during the Disposal Phase. These compounds are commonly used to clean metal surfaces prior to plating, polishing, or fabrication; to dissolve other compounds; or as coolants. Because they are highly volatile, only small amounts typically remain on equipment after cleaning or, in the case of treated wastewaters, in the sludges after clarification and flocculation. Radiolysis may also generate halogenated volatile organic compounds.

Nonhalogenated Volatile Organic Compounds

Xylene, methanol, and n-butanol are the most prevalent nonhalogenated VOCs in TRU mixed waste that may be managed at the WIPP facility during the Disposal Phase. Like the halogenated VOCs, they are used as degreasers and solvents and are similarly volatile. The same analytical methods that are used for halogenated VOCs are used to detect the presence of nonhalogenated VOCs. Radiolysis may also generate non-halogenated volatile organic compounds.

The generator/storage sites shall characterize their waste in accordance with this WAP and associated Permit Attachments, and ensure that waste proposed for storage and disposal at WIPP meets the applicable requirements of the TSDF-WAC in Module II. The generator/storage site shall assemble the Acceptable Knowledge (**AK**) information into an auditable record[1] for the waste stream as described in Permit Attachment B4. For those waste streams with an approved AK Sufficiency Determination (see below), sampling and analysis per the methods described in Permit Attachments B1 and B2 are not required.

All waste characterization activities specified in this WAP and associated Permit Attachments shall be carried out at generator/storage sites and Permittee approved laboratories in accordance with this WAP. The Permittees will audit generator/storage site waste characterization programs and activities as described in Section B-3. Waste characterization activities at the generator/storage sites include the following, although not all these techniques will be used on each container, as discussed in Section B-3:

- Radiography, which is an x-ray technique to determine physical contents of containers
- Visual examination of opened containers as an alternative way to determine their physical contents
- Headspace-gas sampling to determine VOC content of gases in the void volume of the containers
- Sampling and analysis of waste forms that are homogeneous and can be representatively sampled to determine concentrations of hazardous waste constituents and toxicity characteristic contaminants of waste in containers
- Compilation of AK documentation into an auditable record

[1] "Auditable records" mean those records which allow the Permittees to conduct a systematic assessment, analysis, and evaluation of the Permittees' compliance with the WAP and this Permit.

B-0b AK Sufficiency Determination

Generator/storage sites may submit a request to the Permittees for an AK Sufficiency Determination (**Determination Request**) to meet all or part of the waste characterization requirements. The contents of the Determination Request are specified in Permit Attachment B4, Section B4-3d. The Determination Request may take one of the following forms:

Scenario 1	Radiography or visual examination (**VE**) of the waste stream is not required, and chemical sampling and analysis is not required;
Scenario 2	Radiography or VE of the waste stream is not required, but chemical sampling and analysis of a representative sample of the waste stream is required; or
Scenario 3	Chemical sampling and analysis is not required, but radiography or VE of 100% of the containers in the waste stream is required.

The Permittees shall evaluate the Determination Request for completeness and technical adequacy. This evaluation shall include, but not be limited to whether the Determination Request is technically sufficient for the following:

- The Determination Request must include all information specified in Permit Attachment B4, Section B4-3d
- The AK Summary must identify relevant hazardous constituents, and must correctly identify all toxicity characteristic and listed hazardous waste numbers.
- All hazardous waste number assignments must be substantiated by supporting data and, if not, whether this lack of substantiation compromises the interpretation.
- Resolution of data discrepancies between different AK sources must be technically correct and documented.
- The AK Summary must include all the identification of waste material parameter weights by percentage of the material in the waste stream, and determinations must be technically correct.
- All prohibited items specified in the TSDF-WAC should be addressed, and conclusions drawn must be technically adequate and substantiated by supporting information.
- If the AK record includes process control information specified in Permit Attachment B4, Section B4-3b, the information should include procedures, waste manifests, or other documentation demonstrating that the controls were adequate and sufficient.
- The site must provide the supporting information necessary to substantiate technical conclusions within the Determination Request, and this information must be correctly interpreted.

The Permittees will review the Determination Request for technical adequacy and compliance with the requirements of the Permit, using trained and qualified individuals in accordance with standard operating procedures that shall, at a minimum, address all of the technical and procedural requirements listed above. The Permittees shall resolve comments with the generator/storage site, and the Permittees may change the scope of the Determination Request to one of the three scenarios. If the Permittees determine that the AK is sufficient, they will provisionally approve the Determination Request and forward it along with all relevant information submitted with the Determination Request to NMED for an evaluation that the provisional approval made by the Permittees is adequate. Within five (5) days of submitting a Determination Request to NMED, the Permittees will post a link to the transmittal letter to NMED on the WIPP Home Page and inform those on the e-mail notification list. Based on the results of NMED's evaluation, the Permittees will notify the generator/storage sites whether the AK information is sufficient and the Determination Request is approved. The Permittees will not approve a Determination Request that NMED has determined to be inadequate unless the generator/storage site resolves the inadequacies and provides the resolution to NMED for evaluation of adequacy. Should the inadequacies not be resolved to NMED's satisfaction, the Permittees shall not submit a Determination Request for the same waste stream at a later date.

In the event the Permittees disagree, in whole or in part, with an evaluation performed by NMED resulting in a determination by NMED that the Permittees' provisional approval for a particular waste stream is inadequate, the Permittees may seek dispute resolution. The dispute resolution process is specified in Module I.

If a generator/storage site does not submit a Determination Request, or if the Permittees do not approve a Determination Request, or if NMED finds that the Permittees' provisional approval of a Determination Request is inadequate, the generator/storage site shall perform radiography or VE on 100% of the containers in a waste stream and chemical sampling and analysis on a representative sample of the waste stream using headspace gas sampling and analysis (for debris waste) or solids sampling and analysis (for homogeneous solid or soil/gravel waste) as specified in Permit Attachments B1 and B2.

If a generator/storage site submits a Determination Request, the Permittees provisionally approve the Determination Request as Scenario 1, and NMED finds that the Permittees' provisional approval is adequate, neither radiography or VE nor chemical sampling and analysis of the waste stream is required.

If a generator/storage site submits a Determination Request, the Permittees provisionally approve the Determination Request as Scenario 2, and NMED finds that the Permittees' provisional approval is adequate, chemical sampling and analysis of a representative sample of the waste stream is required, but radiography or VE is not required.

If a generator/storage site submits a Determination Request, the Permittees provisionally approve the Determination Request as Scenario 3, and NMED finds that the Permittees' provisional approval is adequate, radiography or VE of 100% of the containers in the waste stream is required, but chemical sampling and analysis is not required.

B-0c Waste Stream Profile Form Completion

After a complete AK record has been compiled and either a Determination Request has been approved by the Permittees or the generator/storage site has completed the applicable representative sampling and analysis requirements specified in Permit Attachments B1 and B2, the generator/storage site will complete a Waste Stream Profile Form (**WSPF**) and Characterization Information Summary (**CIS**). The requirements for the completion of a WSPF and a CIS are specified in Permit Attachment B3, Sections B3-12b(1) and B3-12b(2) respectively.

The WSPF and the CIS for the waste stream resulting from waste characterization activities shall be transmitted to the Permittees, reviewed for completeness, and screened for acceptance prior to loading any TRU mixed waste into the Contact-Handled or Remote-Handled Packaging at the generator facility, as described in Section B-4. The review and approval process will ensure that the submitted waste analysis information is sufficient to meet the Data Quality Objectives (**DQOs**) for AK in Section B-4a(1) and allow the Permittees to demonstrate compliance with the requirements of this WAP. Only TRU mixed waste and TRU waste that has been characterized in accordance with this WAP and that meets the **TSDF-WAC** specified in this Permit will be accepted at the WIPP facility for disposal in a permitted Underground Hazardous Waste Disposal Unit (**HWDU**). The Permittees will provide NMED with copies of the approved WSPF and accompanying CIS prior to waste stream shipment. Upon notification of approval of the WSPF by the Permittees, the generator/storage site may be authorized to ship waste to WIPP.

In the event the Permittees request detailed information on a waste stream, the site will provide a Waste Stream Characterization Package (Section B3-12b(2)). For each waste stream, this package will include the WSPF, the CIS, and the complete AK summary. The Waste Stream Characterization Package will also include specific Batch Data Reports (**BDRs**) and raw analytical data associated with waste container characterization as requested by the Permittees.

B-0d Waste Confirmation

The Permittees will perform waste confirmation on a representative subpopulation of each waste stream shipment after certification and prior to shipment as described in Permit Attachment B7. The Permittees will use radiography, review of radiography audio/video recordings, **VE**, or review of VE records (e.g., VE data sheets or packaging logs) to examine at least 7 percent of each waste stream shipment to confirm that the waste does not contain ignitable, corrosive, or reactive waste. Waste confirmation will be performed by the Permittees prior to shipment of the waste from the generator/storage site to WIPP.

B-1 Identification of TRU Mixed Waste to be Managed at the WIPP Facility

B-1a Waste Stream Identification

TRU mixed waste destined for disposal at WIPP will be characterized on a waste stream basis. Generator/storage sites will delineate waste streams using acceptable knowledge. Required acceptable knowledge is specified in Section B-3b and Permit Attachment B4.

All of the waste within a waste stream may not be accessible for sampling and analysis at one time. Permit Attachment B2 addresses the requirements for selecting waste containers used for characterization of waste streams as they are generated or retrieved.

B-1b Waste Summary Category Groups and Hazardous Waste Accepted at the WIPP Facility

Once a waste stream has been delineated, generator/storage sites will assign a Waste Matrix Code to the waste stream based on the physical form of the waste. Waste streams are then assigned to one of three broad Summary Category Groups; S3000-Homogeneous Solids, S4000-Soils/Gravel, and S5000-Debris Wastes. These Summary Category Groups are used to determine further characterization requirements.

The Permittees will only allow generators to ship those TRU mixed waste streams with EPA hazardous waste numbers listed in Table B-9. Some of the waste may also be identified by unique state hazardous waste codes or numbers. These wastes are acceptable at WIPP as long as the TSDF-WAC are met. The Permittees will perform characterization of all waste streams as required by this WAP. If during the characterization process, new EPA hazardous waste numbers are identified, those wastes will be prohibited for disposal at the WIPP facility until a permit modification has been submitted to and approved by NMED for these new EPA hazardous waste numbers. Similar waste streams at other generator/storage sites will be examined by the Permittees to ensure that the newly identified EPA hazardous waste numbers do not apply to those similar waste streams. If the other waste streams also require new EPA hazardous waste numbers, shipment of these similar waste streams will also be prohibited for disposal until a permit modification has been submitted to and approved by NMED.

B-1c Waste Prohibited at the WIPP Facility

The following TRU mixed waste are prohibited at the WIPP facility:

- liquid waste (waste shall contain as little residual liquid as is reasonably achievable by pouring, pumping and/or aspirating, and internal containers shall contain less than 1 inch or 2.5 centimeters of liquid in the bottom of the container. Total residual liquid in any payload container (e.g., 55 gallon drum or standard waste box) may not exceed 1 percent volume of that container. Payload containers with U134 waste shall have no detectable liquid)
- non-radionuclide pyrophoric materials, such as elemental potassium
- hazardous wastes not occurring as co-contaminants with TRU mixed wastes (non-mixed hazardous wastes)
- wastes incompatible with backfill, seal and panel closures materials, container and packaging materials, shipping container materials, or other wastes
- wastes containing explosives or compressed gases

- wastes with polychlorinated biphenyls (**PCBs**) not authorized under an EPA PCB waste disposal authorization
- wastes exhibiting the characteristic of ignitability, corrosivity, or reactivity (EPA Hazardous Waste Numbers of D001, D002, or D003)
- waste that has ever been managed as high-level waste and waste from tanks specified in Table B-8, unless specifically approved through a Class 3 permit modification
- any waste container from a waste stream (or waste stream lot) which has not undergone either radiographic or visual examination of a statistically representative subpopulation of the waste stream in each shipment, as described in Permit Attachment B7
- any waste container from a waste stream which has not been preceded by an appropriate, certified WSPF (see Section B-1d)

Before accepting a container holding TRU mixed waste, the Permittees will perform waste confirmation activities on each waste stream shipment to confirm that the waste does not contain ignitable, corrosive, or reactive waste and the assigned EPA hazardous waste numbers are allowed for storage and disposal by this Permit. Waste confirmation activities will be performed on at least 7 percent of each waste stream shipped, equating to examination of at least one of fourteen containers in each waste stream shipment. If a waste stream shipment contains fewer than fourteen containers, one container will be examined to satisfy waste confirmation requirements. Section B-4 and Permit Attachment B7 include descriptions of the waste confirmation processes that the Permittees will conduct prior to receiving a shipment at the WIPP facility.

Containers are vented through filters, allowing any gases that are generated by radiolytic and microbial processes within a waste container to escape, thereby preventing over pressurization or development of conditions within the container that would lead to the development of ignitable, corrosive, reactive, or other characteristic wastes.

To ensure the integrity of the WIPP facility, waste streams identified to contain incompatible materials or materials incompatible with waste containers cannot be shipped to WIPP unless they are treated to remove the incompatibility. Only those waste streams that are compatible or have been treated to remove incompatibilities will be shipped to WIPP.

B-1d Control of Waste Acceptance

Every waste stream shipped to WIPP shall be preceded by a WSPF (Figure B-1) and a CIS. The required WSPF information and the CIS elements are found in Section B3-12b(1) and Section B3-12b(2).

Generator/storage sites will provide the WSPF to the Permittees for each waste stream prior to its acceptance for disposal at WIPP. The WSPF and the CIS will be transmitted to the Permittees for each waste stream from a generator/storage site. If continued waste characterization reveals discrepancies that identify different hazardous waste numbers or indicates that the waste belongs to a different waste stream, the waste will be redefined to a separate waste stream and a new WSPF submitted.

The Permittees are responsible for the review of WSPFs and CISs to verify compliance with the restrictions on TRU mixed wastes for WIPP disposal. The Permittees will submit completed WSPFs to NMED prior to waste stream shipment. The Permittees will also be responsible for the review of shipping records (Section B-5) to confirm that each waste container has been prepared and characterized in accordance with applicable provisions of this WAP. Waste characterization data shall ensure the absence of prohibited items specified in Section B-1c.

As stated in the Introduction of this WAP, any time the Permittees request additional information concerning a waste stream, the generator/storage site will provide a Waste Stream Characterization Package (Section B3-12b(2)). The option for the Permittees to request additional information ensures that the waste being offered for disposal is adequately characterized and accurately described on the WSPF.

B-1e Waste Generating Processes at the WIPP Facility

Waste generated as a result of the waste containers handling and processing activities at the WIPP facility is termed “derived” waste. Because derived wastes can contain only those RCRA-regulated materials present in the waste from which they were derived, no additional characterization of the derived waste is required for disposal purposes. In other words, the generator/storage site’s characterization data and knowledge of the processes at the WIPP facility will be used to identify and characterize hazardous waste and hazardous constituents in derived waste. The management of derived waste is addressed in Permit Attachment M1.

B-2 Waste Characterization Program Requirements and Waste Characterization Parameters

The Permittees shall require the sites to develop the procedure(s) which specify their programmatic waste characterization requirements. The Permittees will evaluate the procedures during audits conducted under the Permittees’ Audit and Surveillance Program (Section B-5a(3)) and may also evaluate the procedures as part of the review and approval of the WSPF. Sites must notify the Permittees and obtain approval prior to making data-affecting modifications to procedures (Permit Attachment B3, Section B3-15). Program procedures shall address the following minimum elements:

- Waste characterization and certification procedures for retrievably stored and newly generated wastes to be sent to the WIPP facility

- Methods used to ensure prohibited items are documented and managed. These will include procedures for performing radiography, VE, or treatment, if these methods are used to ensure prohibited items are not present in the waste prior to shipment of the waste to WIPP.

- Procedures used to verify packaging configurations to determine the correct drum age criteria (**DAC**) if headspace gas sampling and analysis is used to collect waste characterization information per Section B1-1a(1) of the WAP.

- Identify the organization(s) responsible for compliance with waste characterization and certification procedures.

- Identify the oversight procedures and frequency of actions to verify compliance with waste characterization and certification procedures.

- Develop training specific to waste characterization and certification procedures.

- Ensure that personnel may stop work if noncompliance with waste characterization or certification procedures is identified.

- Develop a nonconformance process that complies with the requirements in Permit Attachment B3 of the WAP to document and establish corrective actions.

- As part of the corrective action process, assess the potential time frame of the noncompliance, the potentially affected waste population(s), and the reassessment and recertification of those wastes.

- A listing of all approved hazardous waste numbers which are acceptable at WIPP are included in Table B-9.

For those waste streams or containers that are not amenable to radiography (e.g., RH TRU mixed waste, direct loaded ten-drum overpacks (**TDOPs**)) for waste confirmation by the Permittees as described in Permit Attachment B7, generator/storage site VE data may be used for waste acceptance. In those cases, the Permittees will review the generator/storage site VE procedures to ensure that data sufficient for the Permittees' waste acceptance activities as described in Permit Attachment B7 will be obtained and the procedures meet the minimum requirements for visual examination specified in Permit Attachment B1, Section B1-3.

The following waste characterization parameters shall be obtained from the generator/storage sites:

- Determination whether TRU mixed waste streams comply with the applicable provisions of the TSDF-WAC

- Determination whether TRU mixed wastes exhibit a hazardous characteristic (20.4.1.200 NMAC, incorporating 40 CFR §261 Subpart C)

- Determination whether TRU mixed wastes are listed (20.4.1.200 NMAC, incorporating 40 CFR §261 Subpart D)

- Estimation of waste material parameter weights

Tables B-1, B-2, B-3 and B-4 provide the parameters of interest for the various constituent groupings and analytical methodologies. The following sections provide a description of the acceptable methods to evaluate these parameters for each waste Summary Category Group.

B-3 Generator Waste Characterization Methods

The characterization techniques used by generator/storage sites includes acceptable knowledge and may also include, as necessary, headspace-gas sampling and analysis, radiography, visual examination, and homogeneous waste sampling and analysis. All characterization activities are performed in accordance with the WAP. Table B-5 provides a summary of the characterization requirements for TRU mixed waste.

B-3a Sampling and Analytical Methods

B-3a(1) Headspace Gas Sampling and Analysis

Representative headspace gas sampling and analysis shall be used by generator/storage sites to determine the types and concentrations of VOCs in the void volume of randomly selected waste containers in order to resolve the assignment of EPA hazardous waste numbers for those debris waste streams for which an AK Sufficiency Determination Request has not been approved by the Permittees. In addition, VOC constituents will be compared to those assigned by acceptable knowledge, which may include an analysis of radiolytically derived VOCs. The generator/storage sites may also consider radiolysis and packaging materials when assessing the presence of hazardous constituents in the headspace gas results, and whether radiolysis would generate wastes which exhibit the toxicity characteristic. Refer to Permit Attachment B4 for additional clarification regarding hazardous waste number assignment and headspace gas results. The methods for random selection of containers for headspace gas sampling and analysis are specified in Permit Attachment B2. Headspace gas sampling and analysis shall be subject to the Permittees' Audit and Surveillance Program (Permit Attachment B6).

In accordance with EPA convention, identification of hazardous constituents detected by gas chromatography/mass spectrometry methods that are not on the list of target analytes shall be reported. These compounds are reported as tentatively identified compounds (**TICs**) in the analytical BDR and shall be added to the target analyte list if detected in a given waste stream, if they appear in the 20.4.1.200 NMAC (incorporating 40 CFR §261) Appendix VIII, and if they are reported in 25% of the waste containers sampled from a given waste stream. The headspace gas analysis method Quality Assurance Objectives (**QAOs**) are specified in Permit Attachment B3.

B-3a(2) Homogeneous and Soil/Gravel Waste Sampling and Analysis

Representative homogeneous and soil/gravel waste sampling and analysis shall be used by generator/storage sites to resolve the assignment of EPA hazardous waste numbers for homogeneous and soil/gravel waste streams for which an AK Sufficiency Determination Request has not been approved by the Permittees. Sampling of homogeneous and soil/gravel wastes shall result in the collection of a sample that is used to resolve the assignment of hazardous waste numbers. Sampling is accomplished through coring or other EPA approved sampling, which is described in Permit Attachment B1.For those waste streams defined as Summary Category Groups S3000 or S4000 on page B-3, debris that may also be present within these wastes need not be sampled. The waste containers for sampling and analysis are to be selected randomly from the population of containers for the waste stream. The random selection methodology is specified in Permit Attachment B2. Homogeneous and soil/gravel sampling and analysis shall be subject to the Permittees' Audit and Surveillance Program (Permit Attachment B6).

Totals or TCLP analyses for VOCs, SVOCs, and RCRA-regulated metals are used to determine waste parameters in soils/gravels and solids that may be important to the performance within the disposal system (Tables B-3 and B-4). To determine if a waste exhibits a toxicity characteristic for compounds specified in 20.4.1.200 NMAC (incorporating 40 CFR §261, Subpart C), TCLP may be used instead of total analyses. The generator will use the results from these analyses to determine if a waste exhibits a toxicity characteristic. The mean concentration of toxicity characteristic contaminants are calculated for each waste stream such that it can be reported with an upper 90 percent confidence limit (**UCL_{90}**). The UCL_{90} values for the mean measured contaminant concentrations in a waste stream will be compared to the specified regulatory levels in 20.4.1.200 NMAC (incorporating 40 CFR §261 Subpart C), expressed as total/TCLP values, to determine if the waste stream exhibits a toxicity characteristic. A comparison of total analyses and TCLP analyses is presented in Appendix C3 of the WIPP RCRA Part B Permit Application (DOE, 1997), and a discussion of the UCL_{90} is included in Permit Attachment B2. If toxicity characteristic (**TC**) wastes are identified, these will be compared to those determined by acceptable knowledge and TC waste numbers will be revised, as warranted. Refer to Permit Attachment B4 for additional clarification regarding hazardous waste number assignment and homogeneous solid and soil/gravel analytical results.

B-3a(3) Laboratory Qualification

The Permittees will ensure that generator/storage sites conduct analyses using laboratories that are qualified through participation in the Performance Demonstration Program (**PDP**) (DOE, 2003, 2005). Required QAOs are specified in Permit Attachment B3. In addition, methods and supporting performance data demonstrating QAO compliance shall be ensured by the Permittees during the annual certification audit of the laboratories.

Analytical methods used by the laboratories shall: 1) satisfy all of the appropriate QAOs, and 2) be implemented through laboratory-documented standard operating procedures. These analytical QAOs are discussed in detail in Permit Attachment B3.

B-3b Acceptable Knowledge

Acceptable knowledge (**AK**) is used in TRU mixed waste characterization activities in five ways:

- To delineate TRU mixed waste streams
- To assess whether TRU mixed wastes comply with the TSDF-WAC
- To assess whether TRU mixed wastes exhibit a hazardous characteristic (20.4.1.200 NMAC, incorporating 40 CFR §261 Subpart C)
- To assess whether TRU mixed wastes are listed (20.4.1.200 NMAC, incorporating 40 CFR §261 Subpart D)
- To estimate waste material parameter weights

Acceptable knowledge is discussed in detail in Permit Attachment B4, which outlines the minimum set of requirements and DQOs which shall be met by the generator/storage sites in order to use acceptable knowledge. In addition, Section B-5a(3) of this permit attachment describes the assessment of acceptable knowledge through the Permittees' Audit and Surveillance Program.

B-3c Radiography and Visual Examination

Radiography is a nondestructive qualitative and quantitative technique that involves X-ray scanning of waste containers to identify and verify waste container contents. Visual examination (**VE**) constitutes opening a container and physically examining its contents. Generator/storage sites shall perform radiography or VE of 100 percent of CH TRU mixed waste containers in waste streams except for those waste streams for which the Permittees approve a Scenario 1 or Scenario 2 Determination Request. No RH TRU mixed waste will be shipped to WIPP for storage or disposal without documentation of radiography or VE of 100 percent of the containers as specified in Permit Attachment B1. Radiography and/or visual examination will be used, when necessary, to examine a waste container to verify its physical form. These techniques can detect liquid wastes and containerized gases, which are prohibited for WIPP disposal. The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes. Radiography and/or VE are also able to confirm that the physical form of the waste matches its waste stream description (i.e. Homogeneous Solids, Soil/Gravel, or Debris Waste [including uncategorized metals]). If the physical form does not match the waste stream description, the waste will be designated as another waste stream and assigned the preliminary hazardous waste numbers associated with that new waste stream assignment. That is, if radiography and/or VE indicates that the waste does not match the waste stream description arrived at by acceptable knowledge characterization, a non-conformance report will be completed and the inconsistency will be resolved as specified in Permit Attachment B4. The proper waste stream assignment will be determined (including preparation of a new WSPF), the correct hazardous waste codes will be assigned, and the resolution will be documented. Refer to Permit Attachment B4 for a discussion of acceptable knowledge and its verification process.

Generator/storage sites may conduct visual examination of waste containers in lieu of radiography. For generator/storage sites that choose to use visual examination in lieu of radiography, the detection of any liquid waste in non-transparent inner containers, detected from shaking the container, will be handled by assuming that the container is filled with liquid and adding this volume to the total liquid in the payload container (e.g., 55 gallon drum or SWB). The payload container would be rejected and/or repackaged to exclude the container if it is over the TSDF-WAC limits. When radiography is used, or visual examination of transparent containers is performed, if any liquid in inner containers is detected, the volume of liquid shall be added to the total for the payload container. Radiography, or the equivalent, will be used as necessary on the existing/stored waste containers to verify the physical characteristics of the TRU mixed waste correspond with its waste stream identification/waste stream Waste Matrix Code and to identify prohibited items. Radiographic examination protocols and QA/QC methods are provided in Permit Attachment B1. Radiography and VE shall be subject to the Permittees' Audit and Surveillance Program (Permit Attachment B6).

B-3d Characterization Techniques and Frequency for Newly Generated and Retrievably Stored Waste

Generator/storage sites will use acceptable knowledge to delineate all TRU mixed waste containers into waste streams for the purposes of grouping waste for further characterization. The analyses performed may differ based on the waste stream and the physical form of the waste (i.e., heterogeneous debris waste cannot be sampled for totals analyses). Both retrievably stored and newly generated wastes will be delineated in this fashion, though the types of acceptable knowledge used may differ. Section B-3b discusses the use of acceptable knowledge, sampling, and analysis in more detail. Acceptable knowledge is discussed more completely in Permit Attachment B4. Every TRU mixed waste stream will be assigned hazardous waste numbers based upon acceptable knowledge, and the generator/storage sites may resolve the assignment of hazardous waste numbers using headspace gas (Summary Category Group S5000 only) and solid sampling and analysis (Summary Category Groups S3000 and S4000 only).

In the CIS for each waste stream, the generator/storage site will be required to document their methods, and the findings from those methods, for determining the physical form of the waste and the presence or absence of prohibited items for both retrievably stored and newly generated waste. Radiography and/or VE may be used to verify the physical form of retrievably stored TRU mixed waste. For newly generated waste, physical form and prohibited items may either be documented during packaging (using the VE technique) or verified after packaging using radiography (or VE in lieu of radiography).

For debris waste streams that do not have an AK Sufficiency Determination approved by the Permittees, containers selected in accordance with Permit Attachment B2 from those waste streams must be sampled and analyzed for VOCs in the headspace gas. Likewise, a statistically selected portion of homogeneous solids and soil/gravel waste streams must be sampled and analyzed for RCRA-regulated total VOCs, SVOCs, and metals when those waste streams do not have an AK Sufficiency Determination approved by the Permittees. Sampling and analysis methods used for waste characterization are discussed in Section B-3a.

In the process of performing organic headspace and solid sample analyses, nontarget compounds may be identified. These compounds will be reported as TICs. TICs reported in 25% of the samples and listed in 20.4.1.200 NMAC (incorporating 40 CFR §261) Appendix VIII, will be compared with acceptable knowledge data to determine if the TIC is in a listed hazardous waste in the waste stream. TICs identified through headspace gas analyses that meet the Appendix VIII list criteria and the 25 percent reporting criteria for a waste stream will be added to the headspace gas waste stream target list, regardless of the hazardous waste listing associated with the waste stream. TICs subject to inclusion on the target analyte list that are toxicity characteristic parameters shall be added to the target analyte list regardless of origin because the hazardous waste designation for these numbers is not based on source. However, for toxicity characteristic and non-toxic F003 constituents, the site may take concentration into account when assessing whether to add a hazardous waste number. TICs reported from the Totals VOC or SVOC analyses may be excluded from the target analyte list for a waste stream if the TIC is a constituent in an F-listed waste whose presence is attributable to waste packaging materials or radiolytic degradation from acceptable knowledge documentation. If the TIC associated with a total VOC or SVOC analysis cannot be identified as a component of waste packaging materials or as a product of radiolysis, the generator/storage site will add these TICs to the list of hazardous constituents for the waste stream (and assign additional EPA listed hazardous waste numbers, if appropriate). A permit modification will be submitted to NMED for their approval to add these constituents (and waste numbers), if necessary. For toxicity characteristic compounds and non-toxic F003 constituents, the generator/storage site may consider waste concentration when determining whether to change a hazardous waste number. Refer to Permit Attachment B3 for additional information on TIC identification.

Waste characterization solid sampling and analysis activities may differ for retrievably stored waste and newly generated waste. The waste characterization processes used by the generator/storage sites for both retrievably stored and newly generated waste streams will be evaluated during the Permittees' audit of the site. The typical waste characterization data collection design used by the generator/storage sites for each type of waste is described in the following sections. Table B-1 provides a summary of hazardous waste characterization requirements for all TRU mixed waste by waste characterization parameters.

Table B-5 summarizes the parameters, methods, and rationales for stored and newly generated CH TRU mixed wastes according to their waste forms.

WIPP may accept TRU mixed waste that has been repackaged or treated. Treated waste shall retain the original waste stream's listed hazardous waste number designation.

B-3d(1) Newly Generated Waste

The RCRA-regulated constituents in newly generated wastes will typically be documented at the time of generation based on acceptable knowledge for the waste stream. Newly generated TRU mixed waste characterization typically begins with verification that processes generating the waste have operated within established written procedures. Waste containers are delineated into waste streams using acceptable knowledge. The Permittees will require that the generator/storage sites document the methods used to delineate waste streams in the acceptable knowledge record and Acceptable Knowledge Summary Report. Determination that the physical form of the waste (Summary Category Group) corresponds to the physical form of the assigned waste stream may be accomplished either during packaging or by performing radiography as specified in Permit Attachment B1, Section B1-3 for retrievably stored waste. Instead of using a video/audio tape as required with VE in lieu of radiography, the VE method for newly generated waste (or repackaged retrievably stored waste) uses a second operator, who is equally trained to the requirements stipulated in Permit Attachment B1, to provide additional verification by reviewing the contents of the waste container to ensure correct reporting. If the second operator cannot provide concurrence, corrective actions [2] will be taken as specified in Permit Attachment B3. The subsequent waste characterization activities depend on the assigned Summary Category Group, since waste within the Homogeneous Solids and Soils/Gravel Summary Category Groups may be characterized using different techniques than the waste in the Debris Waste Summary Category Group. The packaging configuration, type and number of filters, and rigid liner vent hole presence and diameter necessary to determine the appropriate drum age criteria (**DAC**) in accordance with Permit Attachment B1, Section B1-1, may be documented as part of the characterization information collected during the packaging of newly generated waste or repackaging of retrievably stored waste for those containers of debris waste that will undergo headspace gas sampling and analysis.

B-3d(1)(a) Sampling of Newly Generated Homogeneous Solids and Soil/Gravel

When a Determination Request has not been approved by the Permittees, sampling and analysis of newly generated homogeneous solid and soil/gravel waste streams shall be conducted in accordance with the requirements specified in Permit Attachment B1, Section B1-2. The number of newly generated homogeneous solid and soil/gravel waste containers to be sampled will be determined using the procedure specified in Section B2-1, wherein a statistically selected portion of the waste will be sampled.

B-3d(2) Retrievably Stored Waste

All retrievably stored waste containers will first be delineated into waste streams using acceptable knowledge. The Permittees will require that the generator/storage sites document the methods used to delineate waste streams in the acceptable knowledge record and Acceptable

[2] "Corrective action" as used in this WAP and its attachments does not mean corrective action as defined under HWA, RCRA, and their implementing regulations.

Knowledge Summary Report. Retrievably stored waste containers may be examined using radiography or VE to determine the physical waste form (Summary Category Group), the absence of prohibited items, and additional waste characterization techniques that may be used based on the Summary Category Groups (i.e., S3000, S4000, S5000).

The headspace gas sampling method provided in Permit Attachment B1 will be used, when necessary, to resolve the assignment of EPA hazardous waste numbers to debris waste streams, as specified in Permit Attachment B4.

A statistically selected portion of retrievably stored homogeneous solids and soil/gravel wastes will be sampled and analyzed for total VOCs, SVOCs, and metals, when necessary. The sample location selection method is described in Permit Attachment B2. The sampling methods for these wastes are provided in Permit Attachment B1.

The toxicity characteristic of retrievably stored homogeneous solids and soil/gravel wastes will be determined using total analysis of toxicity characteristic parameters or TCLP. To determine if a waste exhibits a toxicity characteristic for compounds specified in 20.4.1.200 NMAC (incorporating 40 CFR §261, Subpart C), TCLP may be used instead of total analyses. Appendix C3 of the WIPP RCRA Part B Permit Application (DOE, 1997) discusses comparability of totals analytical results to those of the TCLP method.

Representativeness of containers selected for headspace gas sampling and waste subjected to homogeneous solids and soil/gravel sampling and analysis will be validated by the generator/storage site and by the Permittees during an audit (Permit Attachment B6) via examination of documentation that shows that random samples were collected. (Because representativeness is a quality characteristic that expresses the degree to which a sample or group of samples represent the population being studied, the random sampling of waste streams ensures representativeness.)

B-4 Data Verification and Quality Assurance

The Permittees will ensure that applicable waste characterization processes performed by generator/storage sites sending TRU mixed waste to the WIPP for disposal meets WAP requirements through data validation, usability and reporting controls. Verification occurs at three levels: 1) the data generation level, 2) the project level, and 3) the Permittee level. The validation and verification process and requirements at each level are described in Permit Attachment B3, Section B3-10. The validation and verification process at the Permittee Level is also described in Section B-5.

B-4a Data Generation and Project Level Verification Requirements

B-4a(1) Data Quality Objectives

The waste characterization data obtained through WAP implementation will be used to ensure that the Permittees meet regulatory requirements with regard to both regulatory compliance and to ensure that all TRU mixed wastes are properly managed during the Disposal Phase. To satisfy the RCRA regulatory compliance requirements, the following DQOs are established by this WAP:

- Acceptable Knowledge
  - To delineate TRU mixed waste streams.
  - To assess whether TRU mixed wastes comply with the applicable requirements of the TSDF-WAC.
  - To assess whether TRU mixed wastes exhibit a hazardous characteristic (20.4.1.200 NMAC, incorporating 40 CFR §261 Subpart C).
  - To assess whether TRU mixed wastes are listed (20.4.1.200 NMAC, incorporating 40 CFR §261, Subpart D).
  - To estimate waste material parameter weights.
- Headspace-Gas Sampling and Analysis
  - To identify VOCs and quantify the concentrations of VOC constituents in waste containers to resolve the assignment of EPA hazardous waste numbers
- Homogeneous Waste Sampling and Analysis
  - To compare UCL_{90} values for the mean measured contaminant concentrations in a waste stream with specified toxicity characteristic levels in 20.4.1.200 NMAC (incorporating 40 CFR §261), to determine if the waste is hazardous, and to resolve the assignment of EPA hazardous waste numbers.
- Radiography
  - To determine the physical waste form, the absence of prohibited items, and additional waste characterization techniques that may be used based on the Summary Category Groups (i.e., S3000, S4000, S5000).
- Visual Examination
  - To determine the physical waste form, the absence of prohibited items, and additional waste characterization techniques that may be used based on the Summary Category Groups (i.e., S3000, S4000, S5000).

Reconciliation of these DQOs by the Generator/Storage Site Project Manager or the Permittee approved laboratories, as applicable, is addressed in Permit Attachment B3. Reconciliation requires determining whether sufficient type, quality, and quantity of data have been collected to ensure the DQO's cited above can be achieved.

B-4a(2) Quality Assurance Objectives

The generator/storage sites or the Permittee approved laboratories, as applicable, shall demonstrate compliance with each QAO associated with the various characterization methods as presented in Permit Attachment B3. Generator/Storage Site Project Managers or the Permittee approved laboratories, as applicable, are further required to perform a reconciliation of the data with the DQOs established in this WAP. The Generator/Storage Site Project Manager or the Permittee approved laboratories, as applicable, shall conclude that all of the DQOs have been met for the characterization of the waste stream prior to submitting a WSPF to the Permittees for approval (Permit Attachment B3). The following QAO elements shall be considered for each technique, as a minimum:

- Precision
  - Precision is a measure of the mutual agreement among multiple measurements.
- Accuracy
  - Accuracy is the degree of agreement between a measurement result and the true or known value.
- Completeness
  - Completeness is a measure of the amount of valid data obtained from a method compared to the total amount of data obtained that is expressed as a percentage.
- Comparability
  - Comparability is the degree to which one data set can be compared to another.
- Representativeness
  - Representativeness expresses the degree to which data represent characteristics of a population.

A more detailed discussion of the QAOs, including a mathematical representation, where appropriate, can be found in Permit Attachment B3, which describes the QAOs associated with each method of sampling and analysis.

B-4a(3) Sample Control

The generator/storage sites and Permittee approved laboratories, as applicable, will implement a sample handling and control program that will include the maintenance of field documentation records, proper labeling, and a chain of custody (**COC**) record. The generator/storage site and Permittee approved laboratories, as applicable, Quality Assurance Project Plan (**QAPjP**) or procedures referenced in the QAPjP will document this program and include COC forms to control the sample from the point of origin to the final analysis result reporting. The Permittees will review and approve the QAPjP, including their determination that the sample control program is adequate. The approved QAPjP will be provided to NMED prior to shipment of TRU mixed waste and before the generator/storage site audit, as specified in Permit Attachment B5. Details of this sample control program are provided in Permit Attachment B1 and are summarized below to include:

- Field Documentation of samples including: point of origin, date of sample, container ID, sample type, analysis requested, and COC number.
- Labeling and/or tagging including: sample numbering, sample ID, sample date, sampling conditions, and analysis requested.
- COC control including: name of sample relinquisher, sample receiver, and the date and time of the sample transfer.
- Proper sample handling and preservation.

B-4a(4) <u>Data Generation</u>

BDRs, in a format approved by the Permittees, will be used by each generator/storage site and Permittee approved laboratories, as applicable, for reporting waste characterization data. This format will be included in the generator/storage site and Permittee approved laboratories, as applicable, QAPjP, controlled electronic databases, or procedures referenced in the QAPjP (Permit Attachment B5) and will include all of the elements required by this WAP for BDR (Permit Attachment B3).

The Permittees shall perform audits of the generator/storage site waste characterization programs, as implemented by the generator/storage site QAPjP, to verify compliance with the WAP and the DQOs in this WAP (See Permit Attachment B6 for a discussion of the content of the audit program). The primary functions of these audits are to review generator/storage sites' adherence to the requirements of this WAP and ensure adherence to the WAP characterization program. The Permittees shall provide the results of each audit to NMED. If audit results indicate that a generator/storage site is not in compliance with the requirements of this WAP, the Permittees will take appropriate action as specified in Permit Attachment B6.

The Permittees shall perform audits of the Permittee approved laboratory's programs, as implemented by the laboratory's QAPjP (See Permit Attachment B6 for a discussion of the content of the audit program). The primary functions of these audits are to review the Permittee approved laboratory's adherence to the requirements of this WAP. The Permittees shall provide the results of each audit to NMED. If audit results indicate that a Permittee approved laboratory is not in compliance with the requirements of this WAP, the Permittees will take appropriate action as specified in Permit Attachment B6.

The Permittees shall further require all Permittee approved laboratories analyzing WIPP waste samples for the generator/storage sites to have established, documented QA/QC programs. The Permittees annually evaluate these laboratories and their QA/QC programs as part of their participation in the Permittees' PDP laboratory performance program. The Permittees' audits cover the requirements of the lab's QA/QC program, as well as compliance with this WAP. Continued compliance with these parameters will be verified by ongoing audits by the Permittees at the generator/storage sites and these laboratories as specified in Permit Attachment B6. The Permittees' audits of the generator/storage sites will verify that the laboratories analyzing the sites' waste have been properly audited by the generator/storage sites. The laboratory's QA/QC program shall include the following:

- Facility organization
- A list of equipment/instrumentation
- Operating procedures
- Laboratory QA/QC procedures
- Quality assurance review
- Laboratory records management

B-4a(5) Data Verification

BDRs will document the testing, sampling, and analytical results from the required characterization activities, and document required QA/QC activities. Data validation and verification at both the data-generation level and the project level will be performed as required by this Permit before the required data are transmitted to the Permittees (Permit Attachment B3). NMED may request, through the Permittees, copies of any BDR, and/or the raw data validated by the generator/storage sites, to check the Permittees' audit of the validation process.

B-4a(6) Data Transmittal

BDRs will include the information required by Section B3-10 and will be transmitted by hard copy or electronically (provided a hard copy is available on demand) from the data generation level to the project level.

The generator/storage site will transmit waste container information electronically via the WIPP Waste Information System (**WWIS**). Data will be entered into the WWIS in the exact format required by the database. Refer to Section B-5a(1) for WWIS reporting requirements and the

WIPP Waste Information System User's Manual for Use by Shippers/Generators (DOE, 2001) for the WWIS data fields and format requirements.

Once a waste stream is characterized, the Site Project Manager will also submit to the Permittees a WSPF (Figure B-1) accompanied by the CIS for that waste stream which includes reconciliation with DQOs (Sections B3-12b(1) and B3-12b(2)). The WSPF, the CIS, and information from the WWIS will be used as the basis for acceptance of waste characterization information on TRU mixed wastes to be disposed of at the WIPP.

B-4a(7) <u>Records Management</u>

Records related to waste characterization activities performed by the generator/storage sites will be maintained in the testing, sampling, or analytical facility files or generator/storage site project files, or at the WIPP Records Archive facility. Permittee approved laboratories will forward testing, sampling, and analytical records along with BDRs, to the generator/storage site project office for inclusion in the generator/storage site's project files and to the Permittees for inclusion in the WIPP facility operating record. Raw data obtained by testing, sampling, and analyzing TRU mixed waste in support of this WAP will be identifiable, legible, and provide documentary evidence of quality. TRU mixed waste characterization records submitted to the Permittees shall be maintained in the WIPP facility operating record and be available for inspection by NMED.

Records inventory and disposition schedule (**RIDS**) or an equivalent system shall be prepared and approved by generator/storage site personnel. All records relevant to an enforcement action under this Permit, regardless of disposition, shall be maintained at the generator/storage site until NMED determines they are no longer needed for enforcement action, and then dispositioned as specified in the approved RIDS. All waste characterization data and related QA/QC records for TRU mixed waste to be shipped to the WIPP facility are designated as either Lifetime Records or Non-Permanent Records.

Records that are designated as Lifetime Records shall be maintained for the life of the waste characterization program at a participating generator/storage site plus six years or transferred for permanent archival storage to the WIPP Records Archive facility.

Waste characterization records designated as Non-Permanent Records shall be maintained for ten years from the date of (record) generation at the participating generator/storage site or at the WIPP Records Archive facility and then dispositioned according to their approved RIDS. If a generator/storage site ceases to operate, all records shall be transferred before closeout to the Permittees for management at the WIPP Records Archive facility. Table B-6 is a listing of records designated as Lifetime Records and Non-Permanent Records. Classified information will not be transferred to WIPP. Notations will be provided to the Permittees indicating the absence of classified information. The approved generator/storage site RIDS will identify appropriate disposition of classified information. Nothing in this Permit is intended to, nor should it be interpreted to, require the disclosure of any U.S. Department of Energy classified information to persons without appropriate clearance to view such information.

B-5 Permittee Level Waste Screening and Verification of TRU Mixed Waste

Permittee waste screening is a two-phased process. Phase I will occur prior to configuring shipments of TRU mixed waste. Phase II will occur after configuration of shipments of TRU mixed waste but before it is disposed at the WIPP facility. Figure B-3 presents Phase I and a portion of Phase II of the TRU mixed waste screening process. Permit Attachment B7 presents the Permittees' TRU mixed waste confirmation portion of Phase II activities.

B-5a Phase I Waste Stream Screening and Verification

The first phase of the waste screening and verification process will occur before TRU mixed waste is shipped to the WIPP facility. Before the Permittees begin the process of accepting TRU mixed waste from a generator/storage site, an initial audit of that generator/storage site will be conducted as part of the Permittees' Audit and Surveillance Program (Permit Attachment B6). The RCRA portion of the generator/storage site audit program will provide on-site verification of characterization procedures; BDR preparation; and recordkeeping to ensure that all applicable provisions of the WAP requirements are met. Another portion of the Phase I verification is the WSPF approval process. At the WIPP facility, this process includes verification that all of the required elements of the WSPF and the CIS are present (Permit Attachment B3) and that the waste characterization information meet acceptance criteria required for compliance with the WAP (Section B3-12b(1)).

A generator/storage site must first prepare a QAPjP, which includes applicable WAP requirements, and submit it to the Permittees for review and approval (Permit Attachment B5). Once approved, a copy of the QAPjP is provided to NMED for examination. The generator/storage site will implement the specific parameters of the QAPjP after it is approved. An initial audit will be performed after QAPjP implementation and prior to the generator/storage site being certified for shipment of waste to WIPP. Additional audits, focusing on the results of waste characterization, will be performed at least annually. The Permittees have the right to conduct unannounced audits and to examine any records that are related to the scope of the audit. See Section B-5a(3) and Permit Attachment B6 for further information regarding audits.

When the required waste stream characterization data have been collected by a generator/storage site and the initial generator/storage site audit has been successfully completed, the generator/storage Site Project Manager will verify that waste stream characterization meets the applicable WAP requirements as a part of the project level verification (Section B3-10b). If the waste characterization does not meet the applicable requirements of the WAP, the mixed waste stream cannot be managed, stored, or disposed at WIPP until those requirements are met. The Site Project Manager will then complete a WSPF and submit it to the Permittees, along with the accompanying CIS for that waste stream (Section B3-12b(1)). All data necessary to check the accuracy of the WSPF will be transmitted to the Permittees for verification. This provides notification that the generator/storage site considers that the waste stream (identified by the waste stream identification number) has been adequately characterized for disposal prior to shipment to WIPP. The Permittees will compare headspace gas, radiographic, visual examination and solid sampling/analysis data obtained subsequent to submittal and approval of the WSPF (and prior to submittal) with characterization information presented on this form. If the Permittees determine (through the data comparison) that the characterization information is adequate, the WSPF will be approved. Prior to the first shipment of containers from the approved waste stream, the approved WSPF and accompanying CIS will be provided to NMED. If the data comparison indicates that analyzed containers have hazardous wastes not present on the WSPF, or a different Waste Matrix Code applies, the WSPF is in error and shall be resubmitted. Ongoing WSPF examination is discussed in detail in Section B-5a(2).

Audits of generator/storage sites will be conducted as part of the Permittees' Audit and Surveillance Program (Permit Attachment B6). The RCRA portion of the generator/storage site audit program will provide on-site verification of waste characterization procedures; BDR preparation; and record keeping to ensure that all applicable provisions of the WAP requirements are met. As part of the waste characterization data submittal, the generator/storage site will also transmit the data on a container basis via the WWIS. This data submittal can occur at any time as the data are being collected, but will be complete for each container prior to shipment of that container. The WWIS will conduct internal edit/limit checks as the data are entered, and the data will be available to the Permittees as supporting information for WSPF review. NMED will have read-only access to the WWIS as necessary to determine compliance with the WAP. The initial WSPF check performed by the Permittees will include WWIS data submitted by the generator/storage site for each waste container and the CIS. The Permittees will compare ongoing sampling/analysis characterization data obtained and submitted via the WWIS to the approved WSPF. If this comparison shows that containers have hazardous wastes not reported on the WSPF, or a different Waste Matrix Code applies, the data are rejected and the waste containers are not accepted for shipment until a new or revised WSPF is submitted to and approved by the Permittees.

If discrepancies regarding hazardous waste number assignment or Waste Matrix Code designation arise as a result of the Phase I review, the generator/storage sites will be contacted by the Permittees and required to provide the necessary additional information to resolve the discrepancy before that waste stream is approved for disposal at the WIPP facility. If the discrepancy is not resolved, the waste stream will not be approved. The Permittees will notify NMED in writing of any discrepancies identified during WSPF review and the resulting discrepancy resolution prior to waste shipment. The Permittees will not manage, store, or dispose the waste stream until this discrepancy is resolved in accordance with this WAP.

B-5a(1) WWIS Description

All generator/storage sites planning to ship TRU mixed waste to WIPP will supply the required data to the WWIS. The WWIS Data Dictionary includes all of the data fields, the field format and the limits associated with the data as established by this WAP. These data will be subjected to edit and limit checks that are performed automatically by the database, as defined in the *WIPP Waste Information System User's Manual for Use by Shippers/Generators* (DOE, 2001).

The Permittees will coordinate the data transmission with each generator/storage site. Actual data transmission will use appropriate technology to ensure the integrity of the data transmissions. The Permittees will require sites with large waste inventories and large databases to populate a data structure provided by the Permittees that contains the required data dictionary fields that are appropriate for the waste stream (or waste streams) at that site. For example, totals analysis data will not be requested from sites that do not have homogeneous solids or soil/gravel waste. The Permittees will access these data via the Internet to ensure an efficient transfer of this data. Small quantity sites will be given a similar data structure by the Permittees that is tailored to their types of waste. Sites with very small quantities of waste will be provided with the ability to assemble the data interactively to this data structure on the WWIS.

The Permittees will use the WWIS to verify that all of the supplied data meet the edit and limit checks prior to the shipment of any TRU mixed waste to WIPP. The WWIS automatically will notify the generator/storage site if any of the supplied data fails to meet the requirements of the edit and limit checks via an appropriate error message. The generator/storage site will be required to correct the discrepancy with the waste or the waste data and re-transmit the corrected data prior to acceptance of the data by the WWIS. The Permittees will review data reported for each container of each shipment prior to providing notification to the shipping generator/storage site that the shipment is acceptable. Read-only access to the WWIS will be provided to NMED. Table B-7 contains a listing of the data fields contained in the WWIS that are required as part of this Permit.

The WWIS will generate the following:

- Waste Emplacement Report

  This report will be added to the operating record to track the quantities of waste, date of emplacement, and location of authorized containers or container assemblies in the repository. The Permittees will document the specific panel room or drift that an individual waste container is placed in as well as the row/column/height coordinates location of the container or containers assembly. This report will be generated on a weekly basis. Locations of containers or container assemblies will also be placed on a map separate from the WWIS. Reports and maps that are included as part of the operating record will be retained at the WIPP site, for the life of the facility.

- Shipment Summary Report

  This report will contain the container identification numbers (**IDs**) of every container in the shipment, listed by Shipping Package number and by assembly number (for seven-packs, four-packs, and three-packs), for every assembly in the Shipping Package. This report is used by the Permittees to verify containers in a shipment and will be generated on a shipment basis.

- Waste Container Data Report

  This report will be generated on a waste stream basis and will be used by the Permittees during the WSPF review and approval process. This report will contain the data listed in the

Characterization Module on Table B-7. This report will be generated and attached to the WSPF for inclusion in the facility operating record and will be kept for the life of the facility.

- Reports of Change Log

This will consist of a short report that lists the user ID and the fields changed. The report will also include a reason for the change. A longer report will list the information provided on the short report and include a before and after image of the record for each change, a before-record for each deletion, and the new information for added records. These reports will provide an auditable trail for the data in the database.

Access to the WWIS will be controlled by the Permittees' Data Administrator (**DA**) who will control the WWIS users based on approval from management personnel.

The TRU mixed waste generator/storage sites will only have access to data that they have supplied, and only until the data have been formally accepted by the Permittees. After the data have been accepted, the data will be protected from indiscriminate change and can only be changed by a authorized DA.

The WWIS has a Change Log that requires a reason for the change from the DA prior to accepting the change. The data change information, the user ID of the authorized DA making the change, and the date of the change will be recorded in the data change log automatically. The data change log cannot be revised by any user, including the DA. The data change log will be subject to internal and external audits and will provide an auditable trail for all changes made to previously approved data.

B-5a(2) Examination of the Waste Stream Profile Form and Container Data Checks

The Permittees will be responsible for the verification of completeness and accuracy of the Waste Stream Profile Form (Section B3-12b(1)). Figure B-2 includes the waste characterization and Permittees' waste stream approval process. The assignment of the waste stream description, Waste Matrix Code Group, and Summary Category Groups; the results of waste analyses, as applicable; the acceptable knowledge summary documentation; the methods used for characterization; the Carlsbad Field Office (**CBFO**) certification, and appropriate designation of EPA hazardous waste number(s) will be examined. If the WSPF is inaccurate, efforts will be made to resolve discrepancies by contacting the generator/storage site in order for the waste stream to be eligible for shipment to the WIPP facility. If discrepancies in the waste stream are detected at the generator/storage site, the generator/storage site will implement a non-conformance program to identify, document, and report discrepancies (Permit Attachment B3).

The WSPF shall pass all verification checks by the Permittees in order for the waste stream to be approved for shipment to the WIPP facility. The WSPF check against waste container data will occur during the initial WSPF approval process (Section B-5a).

The EPA hazardous waste numbers for the wastes that appear on the Waste Stream Profile Form will be compared to those in Table B-9 to ensure that only approved wastes are accepted for management, storage, or disposal at WIPP. Some of the waste may also be identified by unique state hazardous waste codes or numbers. These wastes are acceptable at WIPP as long as the TSDF-WAC are met. The CIS will be reviewed by the Permittees to verify that the waste has been classified correctly with respect to the assigned EPA hazardous waste numbers. Any analytical method used will be compared to those listed in Tables B-2, B-3, and B-4 to ensure that only approved analytical methods were used for analysis of the waste. The Permittees will verify that the applicable requirements of the TSDF-WAC have been met by the generator/storage site.

Waste data transferred via the WWIS after WSPF approval will be compared with the approved WSPF. Any container from an approved hazardous waste stream with a description different from its WSPF will not be managed, stored, or disposed at WIPP.

The Permittees will also verify that three different types of data specified below are available for every container holding TRU mixed waste before that waste is managed, stored, or disposed at WIPP: 1) an assignment of the waste stream's waste description (by Waste Matrix Codes) and Waste Matrix Code Group; 2) a determination of ignitability, reactivity, and corrosivity; and 3) a determination of compatibility. The verification of waste stream description will be performed by reviewing the WWIS for consistency in the waste stream description and WSPF. The CIS will indicate if the waste has been checked for the characteristics of ignitability, corrosivity, and reactivity. The final verification of waste compatibility will be performed using Appendix C1 of the WIPP RCRA Part B Permit Application (DOE, 1997), the compatibility study.

Any container with unresolved discrepancies associated with hazardous waste characterization will not be managed, stored, or disposed at the WIPP facility until the discrepancies are resolved. If the discrepancies cannot be resolved, the Permittees will revoke the approval status of the waste stream, suspend shipments of the waste stream, and notify NMED. Waste stream approval will not be reinstated until the generator/storage site demonstrates all corrective actions have been implemented and the generator/storage site waste characterization program is reassessed by the Permittees.

B-5a(3) Permittees' Audit and Surveillance Program

An important part of the Permittees' verification process is the Permittees' Audit and Surveillance Program. The focus of this audit program is compliance with this WAP and the Permit. This audit program addresses all AK implementation and waste sampling and analysis activities, from waste stream classification assignment through waste container certification, and ensures compliance with SOPs and the WAP. Audits will ensure that containers and their associated documentation are adequately tracked throughout the waste handling process. Operator qualifications will be verified, and implementation of QA/QC procedures will be surveyed. A final report that includes generator/storage site or Permittee approved laboratory audit results and applicable WAP-related corrective action report (**CAR**) resolution will be provided to NMED for approval, and will be kept in the WIPP facility operating record until closure of the WIPP facility.

An initial audit will be performed at each generator/storage site performing waste characterization activities prior to the formal acceptance of the WSPFs and/or any waste characterization data supplied by the generator/storage sites. Audits will be performed at least annually thereafter, including the possibility of unannounced audits (i.e., not a regularly scheduled audit). These audits will allow NMED to verify that the Permittees have implemented the WAP and that generator/storage sites have implemented a QA program for the characterization of waste and meet applicable WAP requirements. The Permittees will also audit annually the Permittee approved laboratories performing waste sampling and/or analysis. The accuracy of physical waste description and waste stream assignment provided by the generator/storage site will be verified by review of the radiography results, and visual examination of data records and radiography images (as necessary) during audits conducted by the Permittees. More detail on this audit process is provided in Permit Attachment B6.

B-5b <u>Phase II Waste Shipment Screening and Verification</u>

As presented in Figure B-3, Phase II of the waste shipment screening and verification process begins with confirmation of the waste as required by Permit Attachment B7 after waste shipments are configured. After the waste shipment has arrived, the Permittees will screen the shipments to determine the completeness and accuracy of the EPA Hazardous Waste Manifest and the land disposal restriction notice completeness. The Permittees will verify there are no waste shipment irregularities and the waste containers are in good condition. Only those waste containers that are from shipments that have been confirmed as required by Permit Attachment B7 and that pass all Phase II waste screening and verification determinations will be emplaced at WIPP. For each container shipped, the Permittees shall ensure that the generator/storage sites provide the following information:

Hazardous Waste Manifest Information:

- Generator/storage site name and EPA ID
- Generator/storage site contact name and phone number
- Quantity of waste
- List of up to six state and/or federal hazardous waste numbers in each line item
- Listing of all shipping container IDs (Shipping Package serial number)
- Signature of authorized generator representative

Specific Waste Container information:

- Waste Stream Identification Number
- List of Hazardous Waste Numbers per Container
- Certification Data
- Shipping Data (Assembly numbers, ship date, shipping category, etc.)

This information shall also be supplied electronically to the WWIS. The container-specific information will be supplied electronically as described in Section B-5a(1), and shall be supplied prior to the Permittees' management, storage, or disposal of the waste.

The Permittees will verify each approved shipment upon receipt at WIPP against the data on the WWIS shipment summary report to ensure containers have the required information. A Waste Receipt Checklist will be used to document the verification.

B-5b(1) Examination of the EPA Uniform Hazardous Waste Manifest and Associated Waste Tracking Information

Upon receipt of a TRU mixed waste shipment, the Permittees will make a determination of EPA Uniform Hazardous Waste Manifest completeness and sign the manifest to allow the driver to depart. For CH TRU mixed waste, the Permittees will then make a determination of waste shipment completeness by checking the unique, bar-coded identification number found on each container holding TRU mixed waste against the WWIS database after opening the Shipping Package.

The WWIS links the bar-coded identification numbers of all containers in a specific waste shipment to the waste assembly (for 7-packs, 4-packs, 3-packs and 5-drum carriages) and to the shipment identification number, which is also written on the EPA Hazardous Waste Manifest.

For shipments in the RH-TRU 72B cask, the identification number of the single payload container is read during cask-to-cask transfer in the Transfer Cell and then checked against the WWIS database. For shipments in the CNS 10-160B cask, the Permittees will make a determination of waste shipment completeness by checking the unique identification number found on each container holding TRU mixed waste in the Hot Cell against the WWIS database after unloading the cask.

Generators electronically transmit the waste shipment information to the WWIS before the TRU mixed waste shipment is transported. Once a TRU mixed waste shipment arrives, the Permittees verify the identity of each cask or container (or one container in a bound 7-pack, 4-pack, or 3-pack) using the data already in the WWIS.

The WWIS will maintain waste container receipt and emplacement information provided by the Permittees. It will include, among other items, the following information associated with each container of TRU mixed waste:

- Package inner containment vessel or shipping cask closure date
- Package (container or canister) receipt date
- Overpack identification number (if appropriate)
- Package (container or canister) emplacement date
- Package (container or canister) emplacement location

Manifest discrepancies will be identified during manifest examination and container bar-code WWIS data comparison. A manifest discrepancy is a difference between the quantity or type of hazardous waste designated on the manifest and the quantity or type of hazardous waste the WIPP facility actually receives. The generator/storage site technical contact (as listed on the manifest) will be contacted to resolve the discrepancy. If the discrepancy is identified prior to the containers being removed from the package or shipping cask, the waste will be retained in the parking area. If the discrepancy is identified after the waste containers are removed from the package or cask, the waste will be retained in the Waste Handling Building (**WHB**) until the discrepancy is resolved. Errors on the manifest can be corrected by the WIPP facility with a verbal (followed by a mandatory written) concurrence by the generator/storage site technical contact. All discrepancies that are unresolved within fifteen (15) days of receiving the waste will be immediately reported to NMED in writing. Notifications to NMED will consist of a letter describing the discrepancies, discrepancy resolution, and a copy of the manifest. If the manifest discrepancies have not been resolved within thirty (30) days of waste receipt, the shipment will be returned to the generator/storage facility. If it becomes necessary to return waste containers to the generator/storage site, a new EPA Uniform Hazardous Waste Manifest may be prepared by the Permittees.

Documentation of the returned containers will be recorded in the WWIS. Changes will be made to the WWIS data to indicate the current status of the container(s) The reason for the WWIS data change and the record of the WWIS data change will be maintained in the change log of the WWIS, which will provide an auditable record of the returned shipment.

The Permittees will be responsible for the resolution of discrepancies, notification of NMED, as well as returning the original copy of the manifest to the generator/storage site.

B-5b(2) Examination of the Land Disposal Restriction (LDR) Notice

TRU mixed waste designated by the Secretary of Energy for disposal at WIPP is exempt from the LDRs by the WIPP Land Withdrawal Act Amendment (Public Law 104-201). This amendment states that WIPP “Waste is exempted from treatment standards promulgated pursuant to section 3004(m) of the Solid Waste Disposal Act (42 U.S. C. 6924(m)) and shall not be subjected to the Land Disposal prohibitions in section 3004(d), (e), (f), and (g) of the Solid Waste Disposal Act.” Therefore, with the initial shipment of a TRU mixed waste stream, the generator shall provide the Permittees with a one time written notice. The notice must include the information listed below:

Land Disposal Restriction Notice Information:

- EPA Hazardous Waste Number(s) and Manifest Numbers of first shipment of a mixed waste stream
- Statement: this waste is not prohibited from land disposal
- Date the waste is subject to prohibition

This information is the applicable information taken from column "268.7(a)(4)" of the "Generator Paperwork Requirements Table" in 20.4.1.800 NMAC (incorporating 40 CFR §268.7(a)(4)). Note that item "5" from the "Generator Paperwork Requirements Table" is not applicable since waste analysis data are provided electronically via the WWIS and item "7" is not applicable since waste designated by the Secretary of Energy for disposal at WIPP is exempted from the treatment standards.

The Permittees will review the LDR notice for accuracy and completeness. The generator will prepare this notice in accordance with the applicable requirements of 20.4.1.800 NMAC (incorporating 40 CFR §268.7(a)(4)).

B-5b(3) Verification

The Permittees will make a determination of TRU mixed waste shipment irregularities. The following items will be inspected for each TRU mixed waste shipment arriving at the WIPP facility:

- Whether the number and type of containers holding TRU mixed waste match the information in the WWIS
- Whether the containers are in good condition

The Permittees will verify that the containers (as identified by their container ID numbers) are the containers for which accepted data already exists in the WWIS. A check will be performed by the Permittees comparing the data on the WWIS Shipment Summary Report for the shipment to the actual shipping papers (including the EPA Hazardous Waste Manifest). This check also verifies that the containers included in the shipment are those for which approved shipping data already exist in the WWIS Transportation Data Module (Table B-7). For standard waste boxes (**SWBs**) and ten drum overpacks (**TDOPs**), this check will include comparing the barcode on the container with the container number on the shipping papers and the data on the WWIS Shipment Summary Report. For 7-pack assemblies, one of the seven container barcodes will be read by the barcode reader and compared to the assembly information for this container on the WWIS Shipment Summary Report. This will automatically identify the remaining six containers in the assembly. This process enables the Permittees to identify all of the containers in the assembly with minimum radiological exposure. If all of the container IDs and the information on the shipping papers agree with the WWIS Shipment Summary Report, and the shipment was subject to waste confirmation by the Permittees prior to shipment to WIPP as specified in Permit Attachment B7, the containers will be approved for storage and disposal at the WIPP facility.

B-6 Permittees' Waste Shipment Screening QA/QC

Waste shipment screening QA/QC ensures that TRU mixed waste received is that which has been approved for shipment during the Phase I and Phase II screening. This is accomplished by maintaining QA/QC control of the waste shipment screening process. The screening process will be controlled by administrative processes which will generate records documenting waste receipt that will become part of the waste receipt record. The waste receipt record documents that container identifications correspond to shipping information and approved TRU mixed waste streams. The Permittees will extend QA/QC practices to the management of all records associated with waste shipment screening determinations.

B-7 Records Management and Reporting

As part of the WIPP facility's operating record, data and documents associated with waste characterization and waste confirmation are managed in accordance with standard records management practices.

All waste characterization data for each TRU mixed waste container transmitted to WIPP shall be maintained by the Permittees for the active life of the WIPP facility plus two years. The active life of the WIPP facility is defined as the period from the initial receipt of TRU mixed waste at the facility until NMED receives certification of final closure of the facility. After their active life, the records shall be retired to the WIPP Records Archive facility and maintained for 30 years. These records will then be offered to the National Archives. However, this disposition requirement does not preclude the inclusion of these records in the permanent marker system or other requirements for institutional control.

The storage of the Permittees' copy of the manifest, LDR information, waste characterization data, WSPFs, waste confirmation activity records, and other related records will be identified on the appropriate records inventory and disposition schedule.

The following records will be maintained for waste characterization and waste confirmation purposes as part of the WIPP facility operating record:

- Completed WIPP WSPFs and accompanying CIS, including individual container data as transferred on the WWIS (or received as hard-copy) and any discrepancy-related documentation as specified in Section B-5a

- Radiography and visual examination records (data sheets, packaging logs, and video and audio recordings) of waste confirmation activities

- Completed Waste Receipt Checklists and discrepancy-related documentation as specified in Section B-5b

- WIPP WWIS Waste Emplacement Report as specified in Section B-5a(1)

- Audit reports and corrective action reports from the Permittees' Audit and Surveillance Program audits as specified in Section B-5a(3) and Permit Attachment B6

- CARs and closure information for corrective actions taken due to nonconforming waste being identified during waste confirmation by the Permittees

These records will be maintained for all TRU mixed waste managed at the WIPP facility.

Waste characterization and waste confirmation data and documents related to waste characterization that are part of the WIPP facility operating record are managed in accordance with the following guidelines:

B-7a General Requirements

- Records shall be legible
- Corrections shall be made with a single line through the incorrect information, and the date and initial of the person making the correction shall be added
- Black ink is encouraged, unless a copy test has been conducted to ensure the other color ink will copy
- Use of highlighters on records is discouraged
- Records shall be reviewed for completeness
- Records shall be validated by the cognizant manager or designee

B-7b Records Storage

- Active records shall be stored when not in use
- Quality records shall be kept in a one-hour (certified) fire-rated container or a copy of a record shall be stored separately (sufficiently remote from the original) in order to prevent destruction of both copies as a result of a single event such as fire or natural disaster
- Unauthorized access to the records is controlled by locking the storage container or controlling personnel access to the storage area

B-8 Reporting

The Permittees will provide a biennial report in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.75) to NMED that includes information on actual volume and waste descriptions received for disposal during the time period covered by the report.

B-9 List of References

U.S. Department of Energy (DOE), 2001, “WIPP Waste Information System User’s Manual for Use by Shippers/Generators”, DOE/CAO 97-2273, U.S. Department of Energy.

U.S. Department of Energy (DOE), 1997, Resource Conservation and Recovery Act Part B Permit Application for the Waste Isolation Pilot Plant”, Revision 6.5, U.S. Department of Energy.

U.S. Department of Energy (DOE), 2003, “Performance Demonstration Program Plan for the Analysis of Simulated Headspace Gases for the TRU Waste Characterization Program,” CAO-95-1076, Current Revision, Carlsbad, New Mexico, Carlsbad Field Office, U.S. Department of Energy.

U.S. Department of Energy (DOE), 2005, “Performance Demonstration Program Plans for Analysis of Solid Waste Forms,” CAO-95-1077, Current Revision, Carlsbad, New Mexico, Carlsbad Field Office, U.S. Department of Energy.

U.S. Environmental Protection Agency (EPA), April 1994, “Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste, a Guidance Manual,” OSWER 9938.4-03, Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency (EPA), April 1980. “A Method for Determining the Compatibility of Hazardous Wastes,” EPA-600/2-80-076, California Department of Health Services and the U.S. Environmental Protection Agency, Office of Research and Development.

U.S. Environmental Protection Agency (EPA), 1996. “Test Methods for Evaluating Solid Waste,” Laboratory Manual Physical/Chemical Methods, SW-846, 3rd ed., U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

TABLES

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TABLE B-1
SUMMARY OF HAZARDOUS WASTE CHARACTERIZATION REQUIREMENTS
FOR TRANSURANIC MIXED WASTE [a]

Parameter	Techniques and Procedure
Physical Waste Form Summary Category — Names S3000 — Homogeneous Solid S4000 — Soil/Gravel S5000 — Debris Wastes	**Waste Inspection Procedures** Radiography Visual Examination (Permit Attachment B1-3)
Headspace Gases **Volatile Organic Compounds** Benzene Bromoform Carbon tetrachloride Chlorobenzene Chloroform 1,1-Dichloroethane 1,2-Dichloroethane 1,1-Dichloroethylene (cis)-1,2-Dichloroethylene (trans)-1,2-Dichloroethylene Ethyl benzene Ethyl ether Methylene chloride 1,1,2,2-Tetrachloroethane Tetrachloroethylene Toluene 1,1,1-Trichloroethane Trichloroethylene 1,1,2-Trichloro-1,2,2-trifluoroethane Xylenes Alcohols and Ketones Acetone Butanol Methanol Methyl ethyl ketone Methyl isobutyl ketone	**Gas Analysis[f]** Gas Chromatography /Mass Spectroscopy (GC/MS), EPA TO-14A or TO-15, or modified SW-846 8260 (Permit Attachment B3) GC/Flame Ionization Detector (FID), for alcohols and ketones, SW-846 8015 (Permit Attachment B3) Fourier Transform Infrared Spectroscopy (FTIRS), SW-846
Total Volatile Organic Compounds Acetone Benzene Bromoform Butanol Carbon disulfide Carbon tetrachloride Chlorobenzene Chloroform 1,4-Dichlorobenzene[d] 1,2-Dichlorobenzene[d] 1,2-Dichloroethane 1,1-Dichloroethylene Ethyl benzene Ethyl ether Formaldehyde[b] Hydrazine[c] Isobutanol Methanol Methyl ethyl ketone Methylene chloride Pyridine[d] 1,1,2,2-Tetrachloroethane Tetrachloroethylene Toluene 1,1,2-Trichloro-1,2,2-trifluoroethane Trichlorofluoromethane 1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethylene Vinyl chloride Xylenes (trans)-1,2-Dichloroethylene	**Total Volatile Organic Compound Analysis [g]** TCLP, SW-846 1311 GC/MS, SW-846 8260 GC/FID, SW-846 8015 (Permit Attachment B3) HPLC, SW-846 8315A Acceptable Knowledge for Summary Category S5000 (Debris Wastes)

TABLE B-1
SUMMARY OF HAZARDOUS WASTE CHARACTERIZATION REQUIREMENTS FOR TRANSURANIC MIXED WASTE [a]

Parameter	Techniques and Procedure
Total Semivolatile Organic Compounds Cresols 1,4-Dichlorobenzene[e] 1,2-Dichlorobenzene[e] 2,4-Dinitrophenol 2,4-Dinitrotoluene Hexachlorobenzene Hexachloroethane Nitrobenzene Pentachlorophenol Pyridine[e]	**Total Semivolatile Organic Compound Analysis [g]** TCLP, SW-846 1311 GC/MS, SW-846 8270 (Permit Attachment B3) Acceptable Knowledge for Summary Category S5000 (Debris Wastes)
Total Metals Antimony, Mercury Arsenic, Nickel Barium, Selenium Beryllium, Silver Cadmium, Thallium Chromium, Vanadium Lead, Zinc	**Total Metals Analysis [g]** TCLP, SW-846 1311 ICP- MS, SW-846 6020 , ICP Emission Spectroscopy, SW-846 6010 Atomic Absorption Spectroscopy , SW-846 7000 (Permit Attachment B3) Acceptable Knowledge for Summary Category S5000 (Debris Wastes)

[a] Permit Attachment B
[b] Required only for homogeneous solids and soil/gravel waste from Savannah River Site to resolve the assignment of EPA hazardous waste numbers.
[c] Required only for homogeneous solids and soil/gravel waste from Oak Ridge National Laboratory and Savannah River Site to resolve the assignment of EPA hazardous waste numbers.
[d] Can also be analyzed as a semi-volatile organic compound.
[e] Can also be analyzed as a volatile organic compound.
[f] Required only to resolve the assignment of EPA hazardous waste numbers to debris waste streams.
[g] Required only to resolve the assignment of EPA hazardous waste numbers to homogeneous solid and soil/gravel waste streams.

TABLE B-2
HEADSPACE TARGET ANALYTE LIST AND METHODS [b]

Parameter	EPA Specified Analytical Method
Benzene Bromoform Carbon tetrachloride Chlorobenzene Chloroform 1,1-Dichloroethane 1,2-Dichloroethane 1,1-Dichloroethylene (cis)-1,2-Dichloroethylene (trans)-1,2-Dichloroethylene Ethyl benzene Ethyl ether Methylene chloride 1,1,2,2-Tetrachloroethane Tetrachloroethylene Toluene 1,1,1-Trichloroethane Trichloroethylene 1,1,2-Trichloro-1,2,2-trifluoroethane Xylenes	EPA: Modified TO-14A, TO-15[a]; Modified 8260 EPA – Approved FTIRS
Acetone Butanol Methanol Methyl ethyl ketone Methyl isobutyl ketone	EPA: Modified TO-14 A, TO-15[a]; Modified 8260 Method 8015 EPA – Approved FTIRS

[a] U.S. Environmental Protection Agency (EPA), 1999, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air – Second Edition (EPA/625/R-96/010b). The most current revision of the specified methods may be used.
[b] Required only for debris waste when required to resolve the assignment of EPA hazardous waste numbers.

TABLE B-3
REQUIRED ORGANIC ANALYSES AND TEST METHODS ORGANIZED BY ORGANIC ANALYTICAL GROUPS [e]

Organic Analytical Group	Required Organic Analyses	EPA Specified Analytical Method [a,d]
Nonhalogenated Volatile Organic Compounds (VOCs)	Acetone Benzene n-Butanol Carbon disulfide Ethyl benzene Ethyl ether Formaldehyde Hydrazine[b] Isobutanol Methanol Methyl ethyl ketone Toluene Xylenes	8015 8260 8315A
Halogenated VOCs	Bromoform Carbon tetrachloride Chlorobenzene Chloroform 1,2-Dichloroethane 1,1-Dichloroethylene (trans)-1,2-Dichloroethylene Methylene chloride 1,1,2,2-Tetrachloroethane Tetrachloroethylene 1,1,2-Trichloroethane 1,1,1-Trichloroethane Trichloroethylene Trichlorofluoromethane 1,1,2-Trichloro-1,2,2-trifluoroethane Vinyl Chloride	8015 8260
Semivolatile Organic Compounds (SVOCs)	Cresols (o, m, p) 1,2-Dichlorobenzene[c] 1,4-Dichlorobenzene[c] 2,4-Dinitrophenol 2,4-Dinitrotoluene Hexachlorobenzene Hexachloroethane Nitrobenzene Pentachlorophenol Pyridine[c]	8270

[a] U.S. Environmental Protection Agency (EPA), 1996, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition.
[b] Generator/Storage Sites will have to develop an analytical method for hydrazine. This method will be submitted to the Permittees for approval.
[c] These compounds may also be analyzed as VOCs by SW-846 Method 8260.
[d] TCLP (SW-846 1311) may be used to determine if compounds in 20.4.1.200 NMAC (incorporating 40 CFR §261, Subpart C) exhibit a toxicity characteristic.
[e] Required only to resolve the assignment of EPA hazardous waste numbers.

TABLE B-4
SUMMARY OF SAMPLE PREPARATION AND
ANALYTICAL METHODS FOR METALS

Parameters	EPA-Specified Analytical Methods[a,b,c]
Sample Preparation	3051, or equivalent, as appropriate for analytical method
Total Antimony	6010, 6020, 7000, 7010, 7062
Total Arsenic	6010, 6020, 7010, 7061, 7062
Total Barium	6010, 6020, 7000, 7010
Total Beryllium	6010, 6020, 7000, 7010
Total Cadmium	6010, 6020, 7000, 7010
Total Chromium	6010, 6020, 7000, 7010
Total Lead	6010, 6020, 7000, 7010
Total Mercury	7471
Total Nickel	6010, 6020, 7000, 7010
Total Selenium	6010, 7010, 7741, 7742
Total Silver	6010, 6020, 7000, 7010
Total Thallium	6010, 6020, 7000, 7010
Total Vanadium	6010, 7000, 7010
Total Zinc	6010, 6020, 7000, 7010

[a] U.S. Environmental Protection Agency (EPA), 1996. “Test Methods for Evaluating Solid Waste,” Laboratory Manual Physical/Chemical Methods, SW-846, 3rd ed., U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.
[b] TCLP (SW-846 1311) may be used to determine if compounds in 20.4.1.200 NMAC (incorporating 40 CFR §261, Subpart C) exhibit a toxicity characteristic.
[c] Required only for homogeneous solids and soil/gravel to resolve the assignment of EPA hazardous waste numbers.

TABLE B-5
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE
FOR TRANSURANIC MIXED WASTE (STORED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S3000- Homogeneous Solids	• Solidified inorganics • Salt waste • Solidified organics	Physical waste form	Acceptable knowledge, radiography, and/or visual examination	• Determine waste matrix • Demonstrate compliance with waste acceptance criteria (e.g., no free liquids, no incompatible wastes, no compressed gases)
S4000-Soil/Gravel	• Contaminated soil/debris	Hazardous constituents • Listed • Characteristic	Acceptable knowledge or statistical sampling[a] (see Tables B-3 and B-4)	• Determine characteristic metals and organics • Resolve the assignment of EPA hazardous waste numbers
S5000–Debris Waste	• Uncategorized metal (metal waste other than lead/cadmium) • Lead/cadmium waste • Inorganic nonmetal waste • Combustible waste • Graphite waste • Heterogeneous debris waste • Composite filter waste	Physical waste form	Acceptable knowledge, radiography, and/or visual examination	• Determine waste matrix • Demonstrate compliance with waste acceptance (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Hazardous constituents • Characteristic • Listed	Statistical gas sampling and analysis [a] (see Table B-2)	• Resolve the assignment of EPA hazardous waste numbers
		Hazardous constituents • Characteristic	Acceptable knowledge	• Determine characteristic metals and organics

TABLE B-5
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR TRANSURANIC MIXED WASTE (NEWLY GENERATED WASTE) (CONTINUED)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S3000-Homogeneous Solids S4000-Soil/Gravel	• Solidified inorganics • Salt waste • Solidified organics • Contaminated soil/debris	Physical waste form	Acceptable knowledge, radiography, and/or visual examination	• Determine waste matrix • Demonstrate compliance with waste acceptance criteria (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Hazardous constituents • Listed • Characteristic	Statistical sampling[a] (see Tables B-3 and B-4)	• Determine characteristic metals and organics • Resolve the assignment of EPA hazardous waste numbers
S5000–Debris Waste	• Uncategorized metal (metal waste other than lead/cadmium) • Lead/cadmium waste • Inorganic nonmetal waste • Combustible waste • Graphite waste • Heterogeneous debris waste • Composite filter waste	Physical waste form	Acceptable knowledge, radiography, and/or visual examination	• Determine waste matrix • Demonstrate compliance with waste acceptance (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Hazardous constituents • Characteristic • Listed	Statistical gas sampling and analysis [a] (see Table B-2)	• Resolve the assignment of EPA hazardous waste numbers
		Hazardous constituents • Characteristic	Acceptable knowledge	• Determine characteristic metals and organics

[a] Applies to waste streams that require sampling.

TABLE B-6
REQUIRED PROGRAM RECORDS MAINTAINED IN GENERATOR/STORAGE SITE PROJECT FILES

Lifetime Records • Field sampling data forms • Field and laboratory chain-of-custody forms • Test facility and laboratory batch data reports • Waste Stream Characterization Package • Sampling Plans • Data reduction, validation, and reporting documentation • Acceptable knowledge documentation • Waste Stream Profile Form and Characterization Information Summary
Non-Permanent Records • Nonconformance documentation • Variance documentation • Assessment documentation • Gas canister tags • Methods performance documentation • Performance Demonstration Program documentation • Sampling equipment certifications • Calculations and related software documentation • Training/qualification documentation • QAPjPs (generator/storage sites) documentation (all revisions) • Calibration documentation • Analytical raw data • Procurement documentation • QA procedures (all revisions) • Technical implementing procedures (all revisions) • Audio/video recording (radiography, visual, etc.)

TABLE B-7
WIPP WASTE INFORMATION SYSTEM DATA FIELDS[a]

Characterization Module Data Fields [b]	
Container ID [c] Generator EPA ID Generator Address Generator Name Generator Contact Hazardous Code Headspace Gas Sample Date Headspace Gas Analysis Date Layers of Packaging Liner Exists Liner Hole Size Filter Model Number of Filters Installed Headspace Gas Analyte [d] Headspace Gas Concentration [d] Headspace Gas Char. Method [d] Total VOC Char. Method [d] Total Metals Char. Method [d] Total Semi-VOC Char. Method [d] Item Description Code Haz. Manifest Number NDE Complete [e]	Total VOC Sample Date Total VOC Analysis Date Total VOC Analyte Name [d] Total VOC Analyte Concentration [d] Total Metal Sample Date Total Metal Analysis Date Total Metal Analyte Name [d] Total Metal Analyte Concentration [d] Semi-VOC Sample Date Semi-VOC Analysis Date Semi-VOC Analyte Name [d] Semi-VOC Concentration [d] Transporter EPA ID Transporter Name Visual Exam Container [e] Waste Material Parameter [d] Waste Material Weight [d] Waste Matrix Code Waste Matrix Code Group Waste Stream Profile Number
Certification Module Data Fields	
Container ID [c] Container type Container Weight Contact Dose Rate Container Certification date Container Closure Date	Handling Code
Transportation Data Module	
Contact Handled Package Number Assembly Number[f] Container IDs [c,d] ICV Closure Date	Ship Date Receive Date
Disposal Module Data	
Container ID [c] Disposal Date Disposal Location	

TABLE B-7
WIPP WASTE INFORMATION SYSTEM DATA FIELDS[a]

[a] This is not a complete list of the WWIS data fields.

[b] Some of the fields required for characterization are also required for certification and/or transportation.

[c] Container ID is the main relational field in the WWIS Database.

[d] This is a multiple occurring field for each analyte, nuclide, etc.

[e] These are logical fields requiring only a yes/no.

[f] Required for 7-packs of 55-gal drums, 4-packs of 85-gal drums, or 3-packs of 100-gal drums to tie all of the drums in that assembly together. This facilitates the identification of waste containers in a shipment without need to breakup the assembly.

TABLE B-8
WASTE TANKS SUBJECT TO EXCLUSION

Hanford Site - 177 Tanks	
A-101 through A-106	C-201 through C-204
AN-101 through AN-107	S-101 through S-112
AP-101 through AP-108	SX-101 through SX-115
AW-101 through AW-106	SY-101 through SY-103
AX-101 through AX-104	T-101 through T-112
AY-101 through AY-102	T-201 through T-204
B-101 through B-112	TX-101 through TX-118
B-201 through B-204	TY-101 through TY-106
BX-101 through BX-112	U-101 through U-112
BY-101 through BY-112	U-201 through U-204
C-101 through C-112	
Savannah River Site - 51 Tanks	
Tank 1 through 51	
Idaho National Engineering and Environmental Laboratory - 15 Tanks	
WM-103 through WM-106	WM-180 through 190

1 **TABLE B-9**
2 **LISTING OF PERMITTED HAZARDOUS WASTE NUMBERS**

EPA Hazardous Waste Numbers			
F001	D019	D043	U079
F002	D021	P015	U103
F003	D022	P030	U105
F004	D026	P098	U108
F005	D027	P099	U122
F006	D028	P106	U133*
F007	D029	P120	U134*
F009	D030	U002*	U151
D004	D032	U003*	U154*
D005	D033	U019*	U159*
D006	D034	U037	U196
D007	D035	U043	U209
D008	D036	U044	U210
D009	D037	U052	U220
D010	D038	U070	U226
D011	D039	U072	U228
D018	D040	U078	U239*

3 * Acceptance of U-numbered wastes listed for reactivity, ignitability, or corrosivity characteristics is contingent upon a
4 demonstration that the wastes no longer exhibit the characteristic of reactivity, ignitability, or corrosivity.

FIGURES

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WASTE STREAM PROFILE FORM

Waste Stream Profile Number: ____________________
Generator Site Name: ____________________ Technical Contract: ____________________
Generator Site EPA ID: ____________________ Technical Contact Phone Number: ____________
Date of audit report approval by NMED: ____________________
Title, version number and date of documents used for WAP Certification: ____________________

Did your facility generate this waste? ☐Yes ☐No
If no, provide the name and EPA ID of the original generator: ____________________

WIPP ID: ____________________ Summary Category Group: ____________________
Waste Stream Name: ____________________
Description from the WTWBIR: ____________________

Defense Waste: ☐Yes ☐No Check one: ☐CH ☐RH
Number of SWBs ____________ Number of Drums ____________ Number of Canisters ____________
Batch Data Report numbers supporting this waste stream characterization: ____________________
List applicable EPA Hazardous Waste Numbers [(2)] ____________________
Applicable TRUCON Content Numbers: ____________________

Acceptable Knowledge Information[(1)]
{For the following, enter supporting documentation used (i.e., references and dates)}

Required Program Information

- Map of site: ____________________
- Facility mission description: ____________________
- Description of operations that generate waste: ____________________
- Waste identification/categorization schemes: ____________________
- Types and quantities of waste generated: ____________________
- Correlation of waste streams generated from the same building and process, as applicable: ____________
- Waste certification procedures: ____________________

Required Waste Stream Information

- Area(s) and building(s) from which waste stream was generated: ____________________
- Waste stream volume and time period of generation: ____________________
- Waste generating process description for each building: ____________________
- Waste process flow diagrams: ____________________
- Material inputs or other information identifying chemical/radionuclide content and physical waste form: __
- Waste material parameter estimates per unit of waste: ____________________
- Which Defense Activity generated the waste: (check one)
  - ☐ Weapons activities including defense inertial confinement fusion
  - ☐ Naval reactors development
  - ☐ Verification and control technology
  - ☐ Defense research and development
  - ☐ Defense nuclear waste and material by products management
  - ☐ Defense nuclear material production
  - ☐ Defense nuclear waste and materials security and safeguards and security investigations

Figure B-1
WIPP Waste Stream Profile Form (Example Only)

WASTE STREAM PROFILE FORM

Supplemental Documentation
Process design documents: ____
Standard operating procedures: ____
Safety Analysis Reports: ____
Waste packaging logs: ____
Test plans/research project reports: ____
Site data bases: ____
Information from site personnel: ____
Standard industry documents: ____
Previous analytical data: ____
Material safety data sheets: ____
Sampling and analysis data from comparable/surrogate waste: ____
Laboratory notebooks: ____

Confirmation Information(2)
{For the following, when applicable, enter procedure title(s), number(s), and date(s)}

Radiography: ____

Visual Examination: ____

Waste Stream Profile Form Certification

I hereby certify that I have reviewed the information in this Waste Stream Profile Form, and it is complete and accurate to the best of my knowledge. I understand that this information will be made available to regulatory agencies and that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Signature of Site Project Manager	Printed Name and Title	Date

NOTE: (1) Use back of sheet or continuation sheets, if required.

(2) If, radiography, visual examination were used to confirm EPA Hazardous Waste Numbers, attach signed Characterization Information Summary documenting this determination.

Figure B-1
WIPP Waste Stream Profile Form (Example Only – Continued)

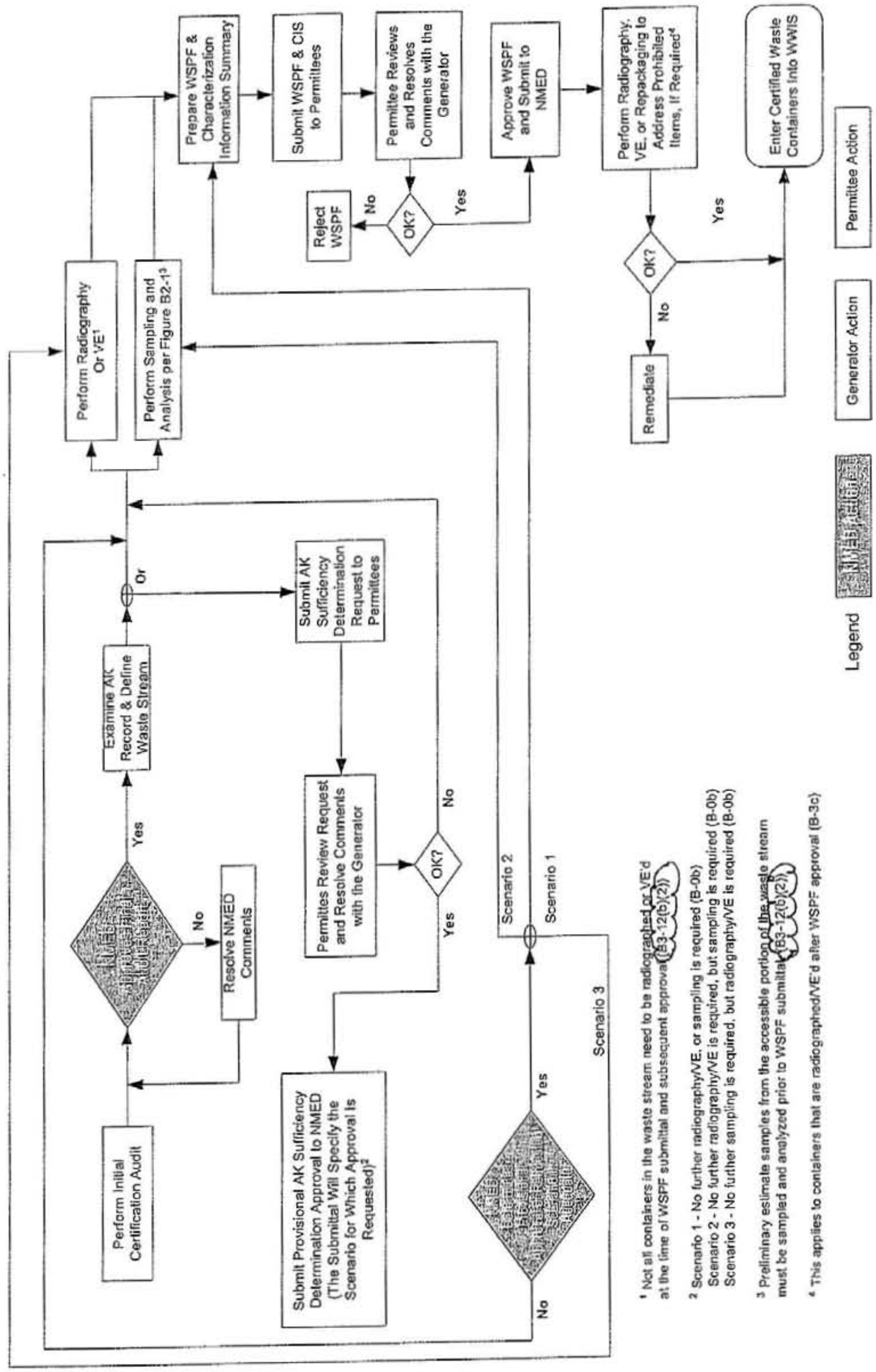


Figure B-2
Waste Characterization Process

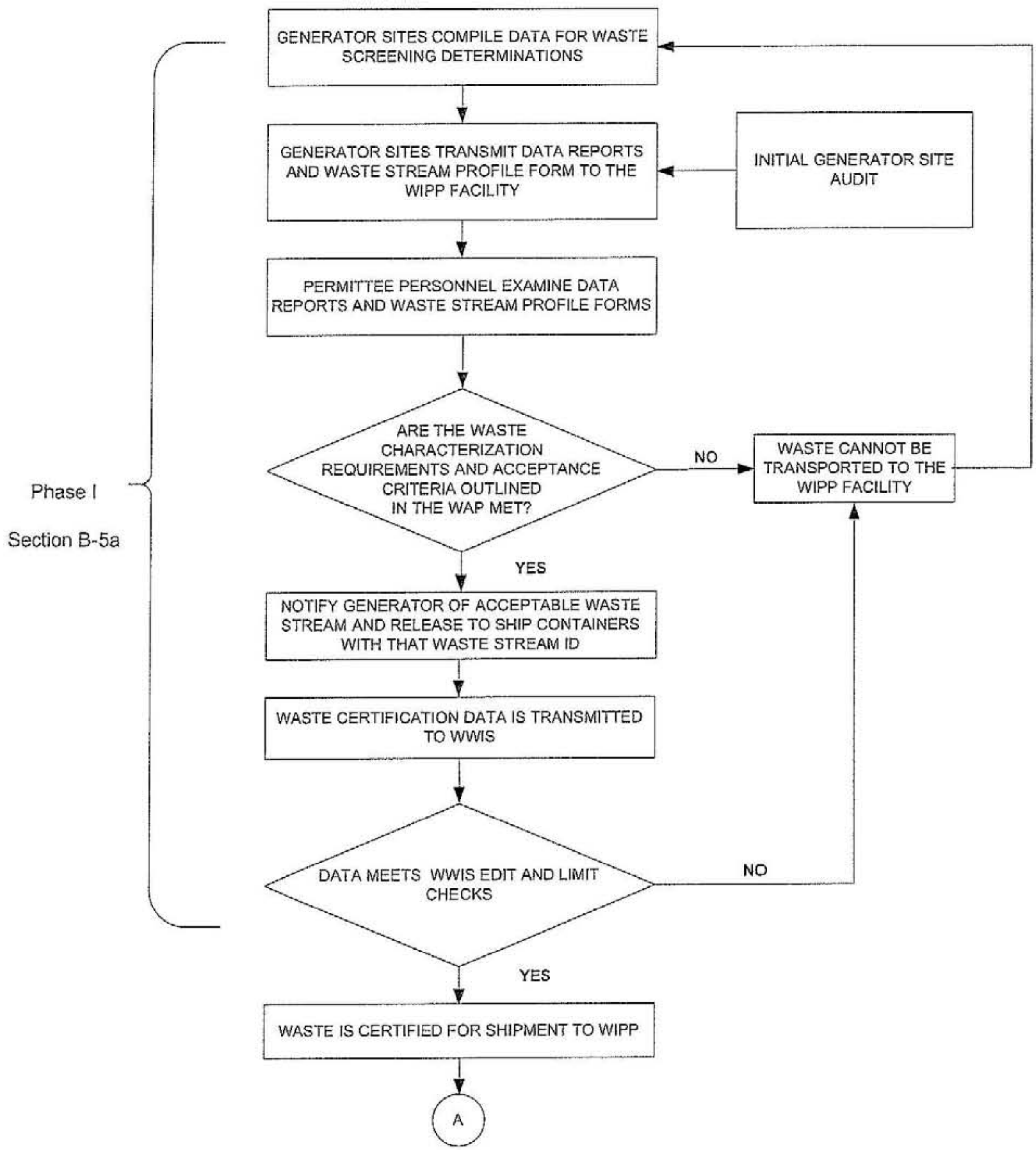
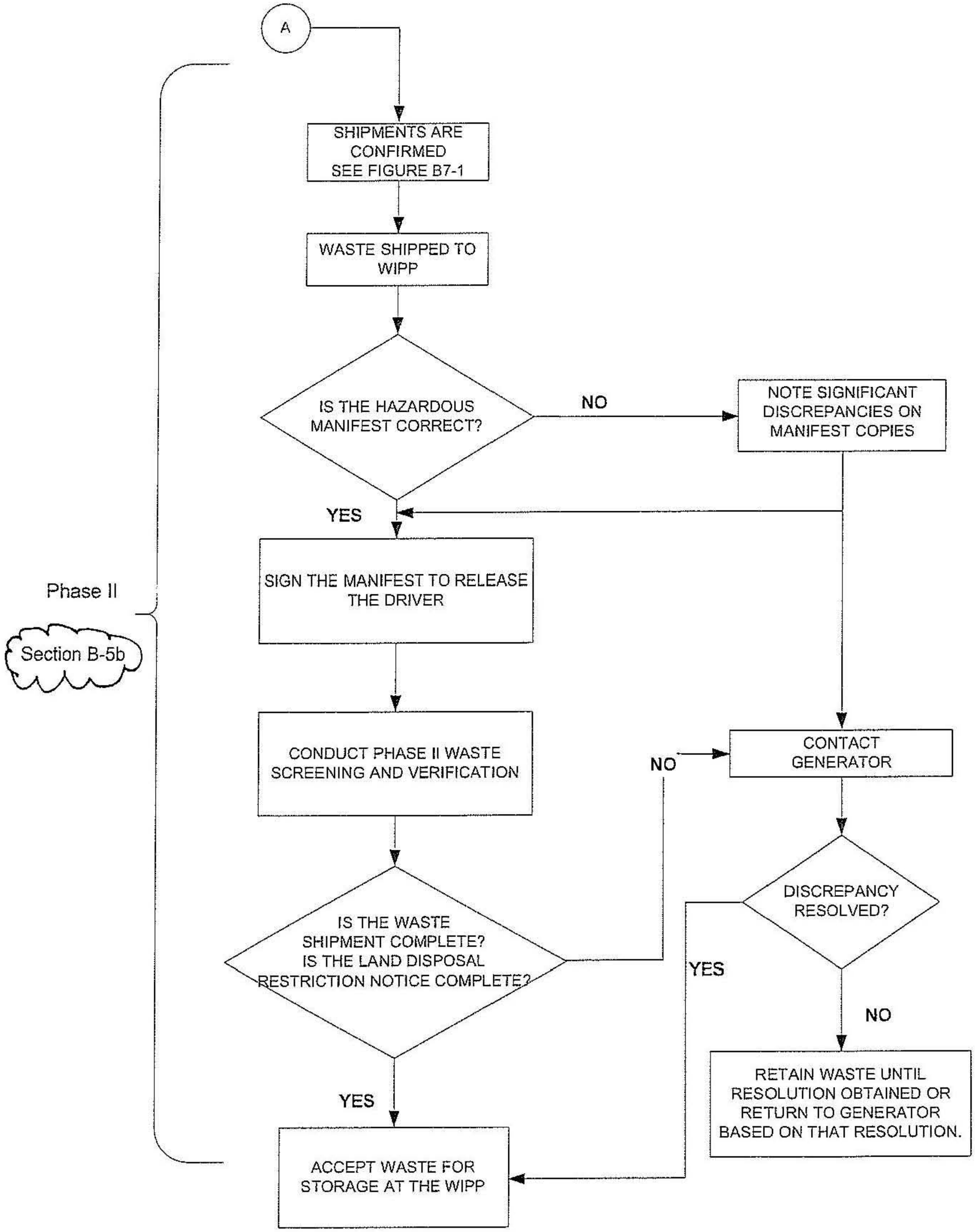


Figure B-3
TRU Mixed Waste Screening and Verification



1

2 Figure B-3
3 TRU Mixed Waste Screening and Verification (Continued)

APPENDIX B1

WASTE CHARACTERIZATION SAMPLING METHODS

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APPENDIX B1

WASTE CHARACTERIZATION SAMPLING METHODS

TABLE OF CONTENTS

List of Tables

List of Figures

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APPENDIX B1

WASTE CHARACTERIZATION SAMPLING METHODS

Introduction

The Permittees will require generator/storage sites (**sites**) to use the following methods, as applicable, for characterization of TRU mixed waste which is managed, stored, or disposed at WIPP. These methods include requirements for headspace-gas sampling, sampling of homogeneous solids and soil/gravel, and radiography or visual examination. Additionally, this Attachment provides quality control, sample custody, and sample packing and shipping requirements.

B1-1 Sampling of Debris Waste (Summary Category S5000)

Headspace gas sampling and analysis shall be used to resolve the assignment of Environmental Protection Agency (**EPA**) hazardous waste numbers to debris waste streams.

B1-1a Method Requirements

The Permittees shall require all headspace-gas sampling be performed in an appropriate radiation containment area on waste containers that are in compliance with the container equilibrium requirements (i.e., 72 hours at 18° C or higher).

For those waste streams without an acceptable knowledge (**AK**) Sufficiency Determination approved by the Permittees, containers shall be randomly selected from waste streams designated as summary category S5000 (Debris waste) and shall be categorized under one of the sampling scenarios shown in Table B1-5 and depicted in Figure B1-1. If the container is categorized under Scenario 1, the applicable drum age criteria (**DAC**) from Table B1-6 must be met prior to headspace gas sampling. If the container is categorized under Scenario 2, the applicable Scenario 1 DAC from Table B1-6 must be met prior to venting the container and then the applicable Scenario 2 DAC from Table B1-7 must be met after venting the container. The DAC for Scenario 2 containers that contain filters or rigid liner vent holes other than those listed in Table B1-7 shall be determined using footnotes "a" and "b" in Table B1-7. Containers that have not met the Scenario 1 DAC at the time of venting must be categorized under Scenario 3. Containers categorized under Scenario 3 must be placed into one of the Packaging Configuration Groups listed in Table B1-8. If a specific packaging configuration cannot be determined based on the data collected during packaging and/or repackaging (Attachment B, Section B-3d(1)), a conservative default Packaging Configuration Group of 3 for 55-gallon drums, 6 for Standard Waste Boxes (**SWBs**) and ten-drum overpacks (**TDOPs**), and 8 for 85-gallon and 100-gallon drums must be assigned, provided the drums do not contain pipe component packaging. If a container is designated as Packaging Configuration Group 4 (i.e., a pipe component), the headspace gas sample must be taken from the pipe component headspace. Drums, TDOPs, or SWBs that contain compacted 55-gallon drums containing a rigid liner may not be disposed of under any packaging configuration unless headspace gas sampling was performed before compaction in accordance with this waste analysis plan (**WAP**). The DAC for Scenario 3 containers that contain rigid liner vent holes that are undocumented during packaging, repackaging, and/or venting (Section B1-1a[4][ii]) shall be determined using the default conditions in footnote "b" in Table B1-9.The DAC for Scenario 3 containers that contain filters that are either undocumented or are other than those listed in Table B1-9 shall be determined using footnote 'a' in Table B1-9. Each of the Scenario 3 containers shall be sampled for headspace gas after waiting the DAC in Table B1-9 based on its packaging configuration (note: Packaging Configuration Groups 4, 5, 6, 7, and 8 are not summary category group dependent, and 85-gallon drum, 100-gallon drum, SWB, and TDOP requirements apply when the 85-gallon drum, 100-gallon drum, SWB, or TDOP is used for the direct loading of waste).

B1-1a(1) General Requirements

The determination of packaging configuration consists of identifying the number of confinement layers and the identification of rigid poly liners when present. Generator/storage sites shall use either the default conditions specified in Tables B1-7 through B1-9 for retrievably stored waste or the data documented during packaging, repackaging, and/or venting (Section B1-1a[4][ii]) for determining the appropriate DAC for each container from which a headspace gas sample is collected. These drum age criteria are to ensure that the container contents have reached 90 percent of steady state concentration within each layer of confinement (Lockheed, 1995; BWXT, 2000). The following information must be reported in the headspace gas sampling documents for each container from which a headspace gas sample is collected:

- sampling scenario from Table B1-5 and associated information from Tables B1-6 and/or Table B1-7;
- the packaging configuration from Table B1-8 and associated information from Table B1-9, including the diameter of the rigid liner vent hole, the number of inner bags, the number of liner bags, the presence/absence of drum liner, and the filter hydrogen diffusivity,
- the permit-required equilibrium time,
- the drum age,
- for supercompacted waste, both
    - the absence of rigid liners in the compacted 55-gallon drums which have not been headspace gas sampled in accordance with this permit prior to compaction, and
    - the absence of layers of confinement must be documented in the WWIS if Packaging Configuration Group 7 is used.

For all retrievably stored waste containers, the rigid liner vent hole diameter must be assumed to be 0.3 inches unless a different size is documented during drum venting or repackaging. For all retrievably stored waste containers, the filter hydrogen diffusivity must be assumed to be the most restrictive unless container-specific information clearly identifies a filter model and/or diffusivity characteristic that is less restrictive. For all retrievably stored waste containers that have not been repackaged, acceptable knowledge shall not be used to justify any packaging configuration less conservative than the default (i.e., Packaging Configuration Group 3 for 55-

gallon drums, 6 for SWBs and TDOPs, and 8 for 85-gallon and 100-gallon drums). For information reporting purposes listed above, sites may report the default packaging configuration for retrievably stored waste without further confirmation.

All waste containers with unvented rigid containers greater than 4 liters (exclusive of rigid poly liners) shall be subject to innermost layer of containment sampling or shall be vented prior to initiating drum age and equilibrium criteria. When sampling the rigid poly liner under Scenario 1, the sampling device must form an airtight seal with the rigid poly liner to ensure that a representative sample is collected (using a sampling needle connected to the sampling head to pierce the rigid poly liner, and that allows for the collection of a representative sample, satisfies this requirement). The configuration of the containment area and remote-handling equipment at each sampling facility are expected to differ. Headspace-gas samples will be analyzed for the analytes listed in Table B3-2 of Permit Attachment B3. If additional packaging configurations are identified, an appropriate Permit Modification will be submitted to incorporate the DAC using the methodology in BWXT (2000). Consistent with footnote “a” in Table B1-8, any waste container selected for headspace gas sampling that cannot be assigned a packaging configuration specified in Table B1-8 shall be assigned a conservative default packaging configuration..

Drum age criteria apply only to 55-gallon drums, 85-gallon drums, 100-gallon drums, standard waste boxes, and TDOPs. Drum age criteria for all other container types must be established through permit modification prior to performing headspace gas sampling..

The Permittees shall require site personnel to collect samples in SUMMA® or equivalent canisters using standard headspace-gas sampling methods that meet the general guidelines established by the EPA in the Compendium Method TO-14A or TO-15, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air (EPA, 1999) or by using on-line integrated sampling/analysis systems. Samples will be directed to an analytical instrument instead of being collected in SUMMA® or equivalent canisters if a single-sample on-line integrated sampling/analysis system is used. If a multi-sample on-line integrated sampling/analysis system is used, samples will be directed to an integrated holding area that meets the cleaning requirements of Section B1-1c(1). The leak proof and inert nature of the integrated holding area interior surface must be demonstrated and documented. Samples are not transported to another location when using on-line integrated sampling/analysis systems; therefore, the sample custody requirements of Section B1-4 and B1-5 do not apply. The same sampling manifold and sampling heads are used with on-line integrated sampling/analysis systems and all of the requirements associated with sampling manifolds and sampling heads must be met. However, when using an on-line integrated sampling/analysis system, the sampling batch and analytical batch quality control (**QC**) samples are combined as on-line batch QC samples as outlined in Section B1-1b.

B1-1a(2) Manifold Headspace Gas Sampling

This headspace-gas sampling protocol employs a multiport manifold capable of collecting multiple simultaneous headspace samples for analysis and QC purposes. The manifold can be used to collect samples in SUMMA® or equivalent canisters or as part of an on-line integrated sampling/analysis system. The sampling equipment will be leak checked and cleaned prior to first use and as needed thereafter. The manifold and sample canisters will be evacuated to 0.0039 inches (in.) (0.10 millimeters [mm]) mercury (**Hg**) prior to sample collection. Cleaned and evacuated sample canisters will be attached to the evacuated manifold before the manifold inlet valve is opened. The manifold inlet valve will be attached to a changeable filter connected to either a side port needle sampling head capable of forming an airtight seal (for penetrating a filter or rigid poly liner when necessary), a drum punch sampling head capable of forming an airtight seal (capable of punching through the metal lid of a drum for sampling through the drum lid), or a sampling head with an airtight fitting for sampling through a pipe overpack container filter vent hole. Refer to Section B1-1a(4) for descriptions of these sampling heads.

The manifold shall also be equipped with a purge assembly that allows applicable QC samples to be collected through all sampling components that may affect compliance with the quality assurance objectives (**QAOs**). The Permittees shall require the sites to demonstrate and document the effectiveness of the sampling equipment design in meeting the QAOs. Field blanks shall be samples of room air collected in the sampling area in the immediate vicinity of the waste container to be sampled. If using SUMMA® or equivalent canisters, field blanks shall be collected directly into the canister, without the use of the manifold.

The manifold, the associated sampling heads, and the headspace-gas sample volume requirements shall be designed to ensure that a representative sample is collected. The manifold internal volume must be calculated and documented in a field logbook dedicated to headspace-gas sample collection. The total volume of headspace gases collected during each sampling operation will be determined by adding the combined volume of the canisters attached to the manifold and the internal volume of the manifold. The sample volume should remain small in comparison to the volume of the waste container. When an estimate of the available headspace gas volume in the drum can be made, less than 10 percent of that volume should be withdrawn.

As illustrated in Figure B1-2, the sampling manifold must consist of a sample side and a standard side. The dotted line in Figure B1-2 indicates how the sample side shall be connected to the standard side for cleaning and collecting equipment blanks and field reference standards. The sample side of the sampling manifold shall consist of the following major components:

- An applicable sampling head that forms a leak-tight connection with the headspace sampling manifold.

- A flexible hose that allows movement of the sampling head from the purge assembly (standard side) to the waste container.

- A pressure sensor(s) that must be pneumatically connected to the manifold. This manifold pressure sensor(s) must be able to measure absolute pressure in the range from 0.002 in. (0.05 mm) Hg to 39.3 in. (1,000 mm) Hg. Resolution for the manifold pressure sensors must be ±0.0004 in. (0.01 mm) Hg at 0.002 in. (0.05 mm) of Hg. The manifold pressure sensor(s) must have an operating range from approximately 59°F (15°C) to 104°F (40°C).

- Available ports for attaching sample canisters. If using canister-based sampling methods, a sufficient number of ports shall be available to allow simultaneous collection of headspace-gas samples and duplicates for VOC analyses. If using an on-line integrated sampling/analysis system, only one port is necessary for the collection of comparison samples. Ports not occupied with sample canisters during cleaning or headspace-gas sampling activities require a plug to prevent ambient air from entering the system. In place of using plugs, sites may choose to install valves that can be closed to prevent intrusion of ambient air into the manifold. Ports shall have VCR® fittings for connection to the sample canister(s) to prevent degradation of the fittings on the canisters and manifold.

- Sample canisters, as illustrated in Figure B1-3, are leak-free, stainless steel pressure vessels, with a chromium-nickel oxide (**Cr-NiO**) SUMMA®-passivated interior surface, bellows valve, and a pressure/vacuum gauge. Equivalent designs, such as Silco Steel canisters, may be used so long as the leak proof and inert nature of the canister interior surface is demonstrated and documented. All sample canisters must have VCR® fittings for connection to sampling and analytical equipment. The pressure/vacuum gauge must be mounted on each manifold. The canister must be helium-leak tested to 1.5×10^{-7} standard cubic centimeters per second (cc/s), have all stainless steel construction, and be capable of tolerating temperatures to 125°C. The gauge range shall be capable of operating in the leak test range as well as the sample collection range.

- A dry vacuum pump with the ability to reduce the pressure in the manifold to 0.05 mm Hg. A vacuum pump that requires oil may be used, but precautions must be taken to prevent diffusion of oil vapors back to the manifold. Precautions may include the use of a molecular sieve and a cryogenic trap in series between the headspace sampling ports and the pump.

- A minimum distance, based upon the design of the manifold system, between the tip of the needle and the valve that isolates the pump from the manifold in order to minimize the dead volume in the manifold.

- If real-time equipment blanks are not available, the manifold must be equipped with an organic vapor analyzer (**OVA**) that is capable of detecting all analytes listed in Table B3-2 of Permit Attachment B3. The OVA shall be capable of measuring total VOC concentrations below the lowest headspace gas PRQL . Detection of 1,1,2-trichloro-1,2,2-trifluoroethane may not be possible if a photoionization detector is used. The OVA measurement shall be confirmed by the collection of equipment blanks at the frequency specified in Section B1-1 to check for manifold cleanliness.

The standard side must consist of the following major elements:

- A cylinder of compressed zero air, helium, argon, or nitrogen gas that is hydrocarbon and carbon dioxide (**CO_2**)-free (only hydrocarbon and CO_2-free gases required for Fourier

Transform Infrared System [**FTIRS**]) to clean the manifold between samples and to provide gas for the collection of equipment blanks or on-line blanks. These high-purity gases shall be certified by the manufacturer to contain less than one ppm total VOCs. The gases must be metered into the standard side of the manifold using devices that are corrosion proof and that do not allow for the introduction of manifold gas into the purge gas cylinders or generator. Alternatively, a zero air or nitrogen generator may be used, provided a sample of the zero air or nitrogen is collected and demonstrated to contain less than one ppm total VOCs. Zero air or nitrogen from a generator shall be humidified (except for use with FTIRS).

- Cylinders of field-reference standard gases or on-line control sample gases. These cylinders provide gases for evaluating the accuracy of the headspace-gas sampling process. Each cylinder of field-reference gas or on-line control sample gas shall have a flow-regulating device. The field-reference standard gases or on-line control sample gas shall be certified by the manufacturer to contain analytes from Table B3-2 of Permit Attachment B3 at known concentrations.

- If using an analytical method other than FTIRS a humidifier filled with American Society for Testing and Materials (**ASTM**) Type I or II water, connected, and opened to the standard side of the manifold between the compressed gas cylinders and the purge assembly shall be used. Dry gases flowing to the purge assembly will pick up moisture from the humidifier. Moisture is added to the dry gases to condition the equipment blanks and field-reference standards and to assist with system cleaning between headspace-gas sample collection. If using FTIRS for analysis, the sample and sampling system shall be kept dry.

  NOTE: Caution should be exercised to isolate the humidifier during the evacuation of the system to prevent flooding the manifold. In lieu of the humidifier, the compressed gas cylinders (e.g., zero air and field-reference standard gas) may contain water vapor in the concentration range of 1,000 to 10,000 parts per million by volume (**ppmv**).

- A purge assembly that allows the sampling head (sample side) to be connected to the standard side of the manifold. The ability to make this connection is required to transfer gases from the compressed gas cylinders to the canisters or on-line analytical instrument. This connection is also required for system cleaning.

- A flow-indicating device or a pressure regulator that is connected to the purge assembly to monitor the flow rate of gases through the purge assembly. The flow rate or pressure through the purge assembly shall be monitored to assure that excess flow exists during cleaning activities and during QC sample collection. Maintaining excess flow will prevent ambient air from contaminating the QC samples and allow samples of gas from the compressed gas cylinders to be collected near ambient pressure.

In addition to a manifold consisting of a sample side and a standard side, the area in which the manifold is operated shall contain sensors for measuring ambient pressure and ambient temperature, as follows:

- The ambient-pressure sensor must have a sufficient measurement range for the ambient barometric pressures expected at the sampling location. It must be kept in the sampling area during sampling operations. Its resolution shall be 0.039 in. (1.0 mm) Hg or less, and calibration performed by the manufacturer shall be based on National Institute of Standards and Technology (**NIST**), or equivalent, standards.

- The temperature sensor shall have a sufficient measurement range for the ambient temperatures expected at the sampling location. The measurement range of the temperature sensor must be from 18°C to 50°C. The temperature sensor calibration shall be traceable to NIST, or equivalent, standards.

B1-1a(3) Direct Canister Headspace Gas Sampling

This headspace-gas sampling protocol employs a canister-sampling system to collect headspace-gas samples for analysis and QC purposes without the use of the manifold described above. Rather than attaching sampling heads to a manifold, in this method the sampling heads are attached directly to an evacuated sample canister as shown in Figure B1-4.

Canisters shall be evacuated to 0.0039 in. (0.10 mm) Hg prior to use and attached to a changeable filter connected to the appropriate sampling head. The sampling head(s) must be capable of either punching through the metal lid of the drums (and/or the rigid poly liner when necessary) while maintaining an airtight seal when sampling through the drum lid, penetrating a filter or the septum in the orifice of the self-tapping screw, or maintaining an airtight seal for sampling through a pipe overpack container filter vent hole to obtain the drum headspace samples. Field duplicates must be collected at the same time, in the same manner, and using the same type of sampling apparatus as used for headspace-gas sample collection. Field blanks shall be samples of room air collected in the immediate vicinity of the waste-drum sampling area prior to removal of the drum lid. Equipment blanks and field-reference standards must be collected using a purge assembly equivalent to the standard side of the manifold described above. These samples shall be collected from the needle tip through the same components (e.g., needle and filter) that the headspace-gas samples pass through.

The sample canisters, associated sampling heads, and the headspace-sample volume requirements ensure that a representative sample is collected. When an estimate of the available headspace-gas volume of the waste container can be made, less than 10 percent of that volume should be withdrawn. A determination of the sampling head internal volume shall be made and documented. The total volume of headspace gases collected during each headspace gas sampling operation can be determined by adding the volume of the sample canister(s) attached to the sampling head to the internal volume of the sampling head. Every effort shall be made to minimize the internal volume of sampling heads.

Each sample canister used with the direct canister method shall have a pressure/vacuum gauge capable of indicating leaks and sample collection volumes. Canister gauges are intended to be gross leak-detection devices not vacuum-certification devices. If a canister pressure/vacuum gauge indicates an unexpected pressure change, determination of whether the change is a result of ambient temperature and pressure differences or a canister leak shall be made. This gauge shall be helium-leak tested to 1.5×10^{-7} standard cc/s, have all stainless steel construction, and be capable of tolerating temperatures to 125°C.

The SUMMA® or equivalent sample canisters as specified in EPA's Compendium Method TO-14A or TO-15 (EPA 1999) shall be used when sampling each drum. These heads shall form a leak-tight connection with the canister and allow sampling through the drum-lid filter, through the drum lid itself and/or rigid poly liner when necessary (by use of a punch or self-tapping screw), using an airtight fitting to collect the sample through the filter vent hole of a pipe overpack container, or using a hollow side port needle. Figure B1-4 illustrates the direct canister-sampling equipment.

B1-1a(4) Sampling Heads

A sample of the headspace gas directly under the container lid, pipe overpack filter vent hole, or rigid poly liner shall be collected. Several methods have been developed for collecting a representative sample: sampling through the filter, sampling through the drum lid by drum punching, sampling through a pipe overpack container filter vent hole, and sampling through the rigid poly liner. The chosen sampling method shall preserve the integrity of the drum to contain radionuclides (e.g., replace the damaged filter, replace set screw in filter housing, seal the punched drum lid).

B1-1a(4)(i) Sampling Through the Filter

To sample the drum-headspace gas through the drum's filter, a side-port needle (e.g., a hollow needle sealed at the tip with a small opening on its side close to the tip) shall be pressed through the filter and into the headspace beneath the drum lid. This permits the gas to be drawn into the manifold or directly into the canister(s). To assure that the sample collected is representative, all of the general method requirements, sampling apparatus requirements, and QC requirements described in this section shall be met in addition to the following requirements that are pertinent to drum headspace-gas sampling through the filter:

- The lid of the drum's 90-mil rigid poly liner shall contain a hole for venting to the drum headspace. A representative sample cannot be collected from the drum headspace until the 90-mil rigid poly liner has been vented. If the DAC for Scenario 1 is met, a sample may be collected from inside the 90-mil rigid poly liner. If the sample is collected by removing the drum lid, the sampling device shall form an airtight seal with the rigid poly liner to prevent the intrusion of outside air into the sample (using a sampling needle connected to the sampling head to pierce the rigid poly liner satisfies this requirement). If headspace-gas samples are collected from the drum headspace prior to venting the 90-mil rigid poly liner, the sample is not acceptable and a nonconformance report shall be prepared, submitted, and resolved. Nonconformance procedures are outlined in Permit Attachment B3.

- For sample collection, the drum's filter shall be sealed to prevent outside air from entering the drum and diluting and/or contaminating the sample.

The sampling head for collecting drum headspace by penetrating the filter shall consist of a side-port needle, a filter to prevent particles from contaminating the gas sample, and an adapter to connect the side-port needle to the filter. To prevent cross contamination, the sampling head shall be cleaned or replaced after sample collection, after field-reference standard collection, and after field-blank collection. The following requirements shall also be met:

- The housing of the filter shall allow insertion of the sampling needle through the filter element or a sampling port with septum that bypasses the filter element into the drum headspace.

- The side-port needle shall be used to reduce the potential for plugging.

- The purge assembly shall be modified for compatibility with the side-port needle.

B1-1a(4)(ii) Sampling Through the Drum Lid By Drum Lid Punching

Sampling through the drum lid at the time of drum punching or thereafter may be performed as an alternative to sampling through the drum's filter if an airtight seal can be maintained. To sample the drum headspace-gas through the drum lid at the time of drum punching or thereafter, the lid shall be breached using an appropriate punch. The punch shall form an airtight seal between the drum lid and the manifold or direct canister sampling equipment. To assure that the sample collected is representative, all of the general method requirements, sampling apparatus requirements, and QC requirements specified in EPA's Compendium Method TO-14A or TO-15 (EPA 1999) as appropriate, shall be met in addition to the following requirements:

- The seal between the drum lid and sampling head shall be designed to minimize intrusion of ambient air.

- All components of the sampling system that come into contact with sample gases shall be purged with humidified zero air, nitrogen, or helium prior to sample collection.

- Equipment blanks and field reference standards shall be collected through all the components of the punch that contact the headspace-gas sample.

- Pressure shall be applied to the punch until the drum lid has been breached.

- Provisions shall be made to relieve excessive drum pressure increases during drum-punch operations; potential pressure increases may occur during sealing of the drum punch to the drum lid.

- The lid of the drum's 90-mil rigid poly liner shall contain a hole for venting to the drum headspace. A representative sample cannot be collected from the drum headspace until the 90-mil rigid poly liner has been vented. If the DAC for Scenario 1 is met, a sample may be collected from inside the 90-mil rigid poly liner. If headspace-gas samples are collected from the drum headspace prior to venting the 90-mil rigid poly liner, the sample is not acceptable and a nonconformance report shall be prepared, submitted, and resolved. Nonconformance procedures are outlined in Permit Attachment B3.

- During sampling, the drum's filter, if present, shall be sealed to prevent outside air from entering the drum.

- While sampling through the drum lid using manifold sampling, a flow-indicating device or pressure regulator to verify flow of gases shall be pneumatically connected to the drum punch and operated in the same manner as the flow-indicating device described above in Section B1-1a(2).

- Equipment shall be used to adequately secure the drum-punch sampling system to the drum lid.

- If the headspace gas sample is not taken at the time of drum punching, the presence and diameter of the rigid liner vent hole shall be documented during the punching operation for use in determining an appropriate Scenario 2 DAC.

B1-1a(4)(iii) Sampling Through a Pipe Overpack Container Filter Vent Hole

Sampling through an existing filter vent hole in a pipe overpack container (**POC**) may be performed as an alternative to sampling through the POC's filter if an airtight seal can be maintained. To sample the container headspace-gas through a POC filter vent hole, an appropriate airtight seal shall be used. The sampling apparatus shall form an airtight seal between the POC surface and the manifold or direct canister sampling equipment. To assure that the sample collected is representative, all of the general method, sampling apparatus, and QC requirements specified in EPA's Compendium Method TO-14A or TO-15 (EPA 1999) as appropriate, shall be met in addition to the following requirements:

- The seal between the POC surface and sampling apparatus shall be designed to minimize intrusion of ambient air.

- The filter shall be replaced as quickly as is practicable with the airtight sampling apparatus to ensure that a representative sample can be taken. Sites must provide documentation demonstrating that the time between removing the filter and installing the airtight sampling device has been established by testing to assure a representative sample.

- All components of the sampling system that come into contact with sample gases shall be cleaned according to requirements for direct canister sampling or manifold sampling, whichever is appropriate, prior to sample collection.

- Equipment blanks and field reference standards shall be collected through all the components of the sampling system that contact the headspace-gas sample.

- During sampling, openings in the POC shall be sealed to prevent outside air from entering the container.

- A flow-indicating device shall be connected to sampling system and operated according to the direct canister or manifold sampling requirements, as appropriate.

B1-1b Quality Control

For manifold and direct canister sampling systems, field QC samples shall be collected on a per sampling batch basis. A sampling batch is a suite of samples collected consecutively using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding QC samples), all of which shall be collected within 14 days of the first sample in the batch. For on-line integrated sampling/analysis systems, QC samples shall be collected and analyzed on a per on-line batch basis. Holding temperatures and container requirements for gas sample containers are provided in Table B1-1. An on-line batch is the number of headspace-gas samples collected within a 12-hour period using the same on-line integrated analysis system. The analytical batch requirements are specified by the analytical method being used in the on-line system. Table B1-2 provides a summary of field QC sample collection requirements. Table B1-3 provides a summary of QC sample acceptance criteria.

For on-line integrated sampling analysis systems, the on-line batch QC samples serve as combined sampling batch/analytical batch QC samples as follows:

- The on-line blank replaces the equipment blank and laboratory blank

- The on-line control sample replaces the field reference standard and laboratory control sample

- The on-line duplicate replaces the field duplicate and laboratory duplicate

The acceptance criteria for on-line batch QC samples are the same as for the sampling batch and analytical batch QC samples they replace. Acceptance criteria are shown in Table B1-3. A separate field blank shall still be collected and analyzed for each on-line batch. However, if the results of a field blank collected through the sampling manifold meets the acceptance criterion, a separate on-line blank need not be collected and analyzed.

The Permittees shall require the site project manager to monitor and document field QC sample results and fill out a nonconformance report if acceptance or frequency criteria are not met. The Permittees shall require the site project manager to ensure appropriate corrective action is taken if acceptance criteria are not met.

B1-1b(1) Field Blanks

Field blanks shall be collected to evaluate background levels of program-required analytes. Field blanks shall be collected prior to sample collection, and at a frequency of one per sampling batch. The Permittees shall require the site project manager to use the field blank data to assess impacts of ambient contamination, if any, on the sample results. Field blank results determined by gas chromatography/mass spectrometry and gas chromatography/flame ionization detection shall be acceptable if the concentration of each VOC analyte is less than or equal to three times the method detection limit (**MDL**) listed in Table B3-2 in Permit Attachment B3. Field blank results determined by FTIRS shall be acceptable if the concentration of each VOC analyte is less than the program required quantitation limit listed in Table B3-2. A nonconformance report shall be initiated and resolved if the final reported QC sample results do not meet the acceptance criteria.

B1-1b(2) Equipment Blanks

Equipment blanks shall be collected to assess cleanliness prior to first use after cleaning of all sampling equipment. On-line blanks will be used to assess equipment cleanliness as well as analytical contamination. After the initial cleanliness check, equipment blanks collected through the manifold shall be collected at a frequency of one per sampling batch for VOC analysis or one per day, whichever is more frequent. If the direct canister method is used, field blanks may be used in lieu of equipment blanks. The Permittees shall require the site project manager to use the equipment blank data to assess impacts of potentially contaminated sampling equipment on the sample results. Equipment blank results determined by gas chromatography/mass spectrometry or gas chromatography/flame ionization detection shall be acceptable if the concentration of each VOC analyte is less than or equal to three times the MDL listed in Table B3-2 in Permit Attachment B3. Equipment blank results determined by FTIRS shall be acceptable if the concentration of each VOC analyte is less than the program required quantitation limit listed in Table B3-2.

B1-1b(3) Field Reference Standards

Field reference standards shall be used to assess the accuracy with which the sampling equipment collects VOC samples into SUMMA® or equivalent canisters prior to first use of the sampling equipment. The on-line control sample will be used to assess the accuracy with which the sampling equipment collects VOC samples as well as an indicator of analytical accuracy for the on-line sampling system. Field reference standards shall contain a minimum of six of the analytes listed in Table B3-2 in Permit Attachment B3 at concentrations within a range of 10 to 100 ppmv and greater than the MDL for each compound. Field reference standards shall have a known valid relationship to a nationally recognized standard (e.g., NIST), if available. If NIST traceable standards are not available and commercial gases are used, a Certificate of Analysis from the manufacturer documenting traceability is required. Commercial stock gases shall not be used beyond their manufacturer-specified shelf life. After the initial accuracy check, field reference standards collected through the manifold shall be collected at a frequency of one per sampling batch and submitted as blind samples to the analytical laboratory. For the direct canister method, field reference standard collection may be discontinued if the field reference standard results demonstrate the QAO for accuracy specified in Appendix B3. Field reference standard results shall be acceptable if the accuracy for each tested compound has a recovery of 70 to 130 percent .

B1-1b(4) Field Duplicates

Field duplicate samples shall be collected sequentially and in accordance with Table B1-1 to assess the precision with which the sampling procedure can collect samples into SUMMA® or equivalent canisters. Field duplicates will also serve as a measure of analytical precision for the on-line sampling system. Field duplicate results shall be acceptable if the relative percent difference is less than or equal to 25 for each tested compound found in concentrations greater than the PRQL in both duplicates.

B1-1c Equipment Testing, Inspection and Maintenance

All sampling equipment components that come into contact with headspace sample gases shall be constructed of relatively inert materials such as stainless steel or Teflon®. A passivated interior surface on the stainless steel components is recommended.

To minimize the potential for cross contamination of samples, the headspace sampling manifold and sample canisters shall be properly cleaned and leak-checked prior to each headspace-gas sampling event. Procedures used for cleaning and preparing the manifold and sample canisters shall be equivalent to those provided in EPA's Compendium Method TO-14A or TO-15 (EPA 1999). Cleaning requirements are presented below.

B1-1c(1) Headspace-Gas Sample Canister Cleaning

SUMMA® or equivalent canisters used in these methods shall be subjected to a rigorous cleaning and certification procedures prior to use in the collection of any samples. Guidance for the development of this procedure has been derived from Method TO-14A or TO-15 (EPA 1999). Specific detailed instructions shall be provided in laboratory standard operating procedures (**SOPs**) for the cleaning and certification of canisters.

Canisters shall be cleaned and certified on an equipment cleaning batch basis. An equipment cleaning batch is any number of canisters cleaned together at one time using the same cleaning method. A cleaning system, capable of processing multiple canisters at a time, composed of an oven (optional) and a vacuum manifold which uses a dry vacuum pump or a cryogenic trap backed by an oil sealed pump shall be used to clean SUMMA® or equivalent canisters. Prior to cleaning, a positive or negative pressure leak test shall be performed on all canisters. The duration of the leak test must be greater than or equal to the time it takes to collect a sample, but no greater than 24 hours. For a leak test, a canister passes if the pressure does not change by a rate greater than ±2 psig per 24 hours. Any canister that fails shall be checked for leaks, repaired, and reprocessed. One canister per equipment cleaning batch shall be filled with humid zero air or humid high purity nitrogen and analyzed for VOCs. The equipment cleaning batch of canisters shall be considered clean if there are no VOCs above three times the MDLs listed in Table B3-2 of Permit Attachment B3. After the canisters have been certified for leak-tightness and found to be free of background contamination, they shall be evacuated to 0.0039 in. (0.10 mm) Hg or less for storage prior to shipment. The Permittees shall require the laboratory responsible for canister cleaning and certification to maintain canister certification documentation and initiate the canister tags as described in Permit Attachment B3.

B1-1c(2) Sampling Equipment Initial Cleaning and Leak Check

The surfaces of all headspace-gas sampling equipment components that will come into contact with headspace gas shall be thoroughly inspected and cleaned prior to assembly. The manifold and associated sampling heads shall be purged with humidified zero air, nitrogen, or helium, and leak checked after assembly. This cleaning shall be repeated if the manifold and/or associated sampling heads are contaminated to the extent that the routine system cleaning is inadequate.

B1-1c(3) Sampling Equipment Routine Cleaning and Leak Check

The manifold and associated sampling heads which are reused shall be cleaned and checked for leaks in accordance with the cleaning and leak check procedures described in EPA's Compendium Method TO-14A or TO-15 (EPA 1999). The procedures shall be conducted after headspace gas and field duplicate collection; after field blank collection, after field blanks are collected through the manifold; and after the additional cleaning required for field reference standard collection has been completed. The protocol for routine manifold cleaning and leak check requires that sample canisters be attached to the canister ports, or that the ports be capped or closed by valves, and requires that the sampling head be attached to the purge assembly.

VOCs shall be removed from the internal surfaces of the headspace sampling manifold to levels that are less than or equal to three times the MDLs of the analytes listed in Table B3-2 of Permit Attachment B3, as determined by analysis of an equipment blank or through use of an OVA. It is recommended that the headspace sampling manifold be heated to 150° Centigrade and periodically evacuated and flushed with humidified zero air, nitrogen, or helium. When not in use, the manifold shall be demonstrated clean before storage with a positive pressure of high purity gas (i.e., zero air, nitrogen, or helium) in both the standard and sample sides.

Sampling shall be suspended and corrective actions shall be taken when the analysis of an equipment blank indicates that the VOC limits have been exceeded or if a leak test fails. The Permittees shall require the site project manager to ensure that corrective action has been taken prior to resumption of sampling.

B1-1c(4) Manifold Cleaning After Field Reference Standard Collection

The sampling system shall be specially cleaned after a field reference standard has been collected, because the field reference standard gases contaminate the standard side of the headspace sampling manifold when they are regulated through the purge assembly. This cleaning requires the installation of a gas-tight connector in place of the sampling head, between the flexible hose and the purge assembly. This configuration allows both the sample and standard sides of the sampling system to be flushed (evacuated and pressurized) with humidified zero air, nitrogen, or helium which, combined with heating the pneumatic lines, should sweep and adequately clean the system's internal surfaces. After this protocol has been completed and prior to collecting another sample, the routine system cleaning and leak check (see previous section) shall also be performed.

B1-1c(5) Sampling Head Cleaning

To prevent cross contamination, the needle, airtight fitting or airtight seal, adapters, and filter of the sampling heads shall be cleaned in accordance with the cleaning procedures described in EPA's Compendium Method TO-14A or TO-15 (EPA 1999). After sample collection, a sampling head shall be disposed of or cleaned in accordance with EPA's Compendium Method TO-14A or TO-15 (EPA1999), prior to reuse. As a further QC measure, the needle, airtight fitting or airtight seal, and filter, after cleaning, should be purged with zero air, nitrogen, or helium and capped for storage to prevent sample contamination by VOCs potentially present in ambient air.

B1-1d Equipment Calibration and Frequency

The manifold pressure sensor shall be certified prior to initial use, then annually, using NIST traceable, or equivalent, standards. If necessary, the pressure indicated by the pressure sensor(s) shall be temperature compensated. The ambient air temperature sensor, if present, shall be certified prior to initial use, then annually, to NIST traceable, or equivalent, temperature standards.

The OVA shall be calibrated once per day, prior to first use, or as necessary according to the manufacturer's specifications. Calibration gases shall be certified to contain known analytes from Table B3-2 of Permit Attachment B3 at known concentrations. The balance of the OVA calibration gas shall be consistent with the manifold purge gas when the OVA is used (i.e., zero air, nitrogen, or helium).

B1-2 Sampling of Homogeneous Solids and Soil/Gravel (Summary Categories S3000/S4000)

For those waste streams without an AK Sufficiency Determination approved by the Permittees, randomly selected containers of homogeneous solid and/or soil/gravel waste streams (S3000/S4000) shall be sampled and analyzed to resolve the assignment of EPA hazardous waste numbers. For example, analytical results may be useful to resolve uncertainty regarding hazardous constituents used in a process that generated the waste stream when the hazardous constituents are not documented in the acceptable knowledge information for the waste.

B1-2a Method Requirements

The methods used to collect samples of transuranic (**TRU**) mixed waste, classified as homogeneous solids and soil/gravel from waste containers, shall be such that the samples are representative of the waste from which they were taken. To minimize the quantity of investigation-derived waste, laboratories conducting the analytical work may require no more sample than is required for the analysis, based on the analytical methods. However, a sufficient number of samples shall be collected to adequately represent waste being sampled. For those waste streams defined as Summary Category Groups S3000 or S4000 in Attachment B, debris that may also be present within these wastes need not be sampled.

Samples of retrievably stored waste containers will be collected using appropriate coring equipment or other EPA approved methods to collect a representative sample. Newly generated wastes that are sampled from a process as it is generated may be sampled using EPA approved methods, including scoops and ladles, that are capable of collecting a representative sample. All sampling and core sampling will comply with the QC requirements specified in B1-2b.

B1-2a(1) Core Collection

Coring tools shall be used to collect cores of homogeneous solids and soil/gravel from waste containers, when possible, in a manner that minimizes disturbance to the core. A rotational coring tool (i.e., a tool that is rotated longitudinally), similar to a drill bit, to cut, lift the waste cuttings, and collect a core from the bore hole, shall be used to collect sample cores from waste containers. For homogeneous solids and soil/gravel that are relatively soft, non-rotational coring tools may be used in lieu of a rotational coring tool.

To provide a basis for describing the requirements for core collection, diagrams of a rotational coring tool (i.e., a light weight auger) and a non-rotational coring tool (i.e., a thin-walled sampler) are provided in Figures B1-5 and B1-6, respectively.

The following requirements apply to the use of coring tools:

- Each coring tool shall contain a removable tube (liner) that is constructed of fairly rigid material unlikely to affect the composition and/or concentrations of target analytes in the sample core. Materials that are acceptable for use for coring device sleeves are polycarbonate, teflon, or glass for most samples, and stainless steel or brass if samples are not to be analyzed for metals. The Permittees shall require site quality assurance project plans (**QAPjPs**) to document that analytes of concern are not present in liner material. The Permittees shall also require sites to document that the materials are unlikely to affect sample results through the collection and analysis of an equipment blank prior to first use as specified in the 'Equipment Blanks' section of this appendix. Liner outer diameter is recommended to be no more than 2 in. and no less than one in. Liner wall thickness is recommended to be no greater than 1/16 in. Before use, the liner shall be cleaned in accordance the requirements in Section B1-2b. The liner shall fit flush with the inner wall of the coring tool and shall be of sufficient length to hold a core that is representative of the waste along the entire depth of the waste. The depth of the waste is calculated as the distance from the top of the sludge to the bottom of the drum (based on the thickness of the liner and the rim at the bottom of the drum). The liner material shall have sufficient transparency to allow visual examination of the core after sampling. If sub-sampling is not conducted immediately after core collection and liner extrusion, then end caps constructed of material unlikely to affect the composition and/or concentrations of target analytes in the core (e.g., Teflon®) shall be placed over the ends of the liner. End caps shall fit tightly to the ends of the liner. The Permittees shall require site specific QAPjPs to indicate the acceptable materials for core liners and end caps.

- A spring retainer, similar to that illustrated in Figures B1-5 and B1-6, shall be used with each coring tool when the physical properties of the waste are such that the waste may fall out of the coring tool's liner during sampling activities. The spring retainer shall be constructed of relatively inert material (e.g., stainless steel or Teflon®) and its inner diameter shall not be less than the inner diameter of the liner. Before use, spring retainers shall be cleaned in accordance with the requirements in Section B1-2b.

- Coring tools may have an air-lock mechanism that opens to allow air inside the liners to escape as the tool is pressed into the waste (e.g., ball check valve). If used, this air-lock mechanism shall also close when the core is removed from the waste container.

- After disassembling the coring tool, a device (extruder) to forcefully extrude the liner from the coring tool shall be used if the liner does not slide freely. All surfaces of the extruder that may come into contact with the core shall be cleaned in accordance with the requirements in Section B1-2(b) prior to use.

- Coring tools shall be of sufficient length to hold the liner and shall be constructed to allow placement of the liner leading edge as close as possible to the coring tools leading edge.

- All surfaces of the coring tool that have the potential to contact the sample core or sample media shall be cleaned in accordance with the requirements in Section B1-2(b) prior to use.

- The leading edge of the coring tools may be sharpened and tapered to a diameter equivalent to, or slightly smaller than, the inner diameter of the liner to reduce the drag of the homogeneous solids and soil/gravel against the internal surfaces of the liner, thereby enhancing sample recovery.

- Rotational coring tools shall have a mechanism to minimize the rotation of the liner inside the coring tool during coring activities, thereby minimizing physical disturbance to the core.

- Rotational coring shall be conducted in a manner that minimizes transfer of frictional heat to the core, thereby minimizing potential loss of VOCs.

- Non-rotational coring tools shall be designed such that the tool's kerf width is minimized. Kerf width is defined as one-half of the difference between the outer diameter of the tool and the inner diameter of the tool's inlet.

B1-2a(2) Sample Collection

Sampling of cores shall be conducted in accordance with the following requirements:

- Sampling shall be conducted as soon as possible after core collection. If a substantial delay (i.e., more than 60 minutes) is expected between core collection and sampling, the core shall remain in the liner and the liner shall be capped at each end. If the liner containing the core is not extruded from the coring tool and capped, then two alternatives are permissible: 1) the liner shall be left in the coring tool and the coring tool shall be capped at each end, or 2) the coring tool shall remain in the waste container with the air-lock mechanism attached.

- Samples of homogeneous solids and soil/gravel for VOC analyses shall be collected prior to extruding the core from the liner. These samples may be collected by collecting a single sample from the representative subsection of the core, or three sub-samples may be collected from the vertical core to form a single 15-gram composite sample. Smaller sample sizes may be used if method PRQL requirements are met for all analytes. The sampling locations shall be randomly selected. If a single sample is used, the representative subsection is chosen by randomly selecting a location along the portion of the core (i.e. core length). If the three sub-sample method is used, the sampling locations shall be randomly selected within three equal-length subsections of the core along the long axis of the liner and access to the waste shall be gained by making a perpendicular cut through the liner and the core. The Permittees shall require sites to develop documented procedures to select, and record the selection, of random sampling locations. True random sampling involves the proper use of random numbers for identifying sampling locations. The procedures used to select the random sampling locations will be subject to review as part of annual audits by the Permittees. A sampling device such as the metal coring cylinder described in EPA's SW-846 Manual (1996), or equivalent, shall be immediately used to collect the sample once the core has been exposed to air. Immediately after sample collection, the sample shall be extruded into 40-ml volatile organics analysis (**VOA**) vials (or other containers specified in appropriate SW-846 methods), the top rim of the vial visually inspected and wiped clean of any waste residue, and the vial cap secured. Sample handling requirements are outlined in Table B1-4. Additional guidance for this type of sampling can be found in SW-846 (EPA 1996).

- Samples of the homogeneous solids and soil/gravel for semi-volatile organic compound and metals analyses shall be collected. These samples may be collected from the same sub-sample locations and in the same manner as the sample collected for VOC analysis, or they may be collected by splitting or compositing the representative subsection of the core. The representative subsection is chosen by randomly selecting a location along the portion of the core (i.e. core length). The Permittees shall require sites to develop documented procedures to select, and record the selection, of random sampling locations. True random sampling involves the proper use of random numbers for identifying sampling locations. The procedures used to select the random sampling locations will be subject to review as part of annual audits by the Permittees. Guidance for splitting and compositing solid materials can be found in SW-846 (EPA 1996). All surfaces of the sampling tools that have the potential to come into contact with the sample shall be constructed of materials unlikely to affect the composition or concentrations of target analytes in the waste (e.g., Teflon®). In addition, all surfaces that have the potential to come into contact with core sample media shall either be disposed or decontaminated according to the procedures found in Section B1-2(b). Sample sizes and handling requirements are outlined in Table B1-4.

Newly generated waste samples may be collected using methods other than coring, as discussed in Section B1-2a. Newly generated wastes samples will be collected as soon as possible after sampling, but the spatial and temporal homogeneity of the waste stream dictate whether a representative grab sample or composite sample shall be collected. As part of the site audit, the Permittees shall assess waste sampling to ensure collection of representative samples.

B1-2b Quality Control

QC requirements for sampling of homogeneous solids and soil/gravel include collecting co-located samples from cores or other sample types to determine precision; equipment blanks to verify cleanliness of the sampling and coring tools and sampling equipment; and analysis of reagent blanks to ensure reagents, such as deionized or high pressure liquid chromatography (**HPLC**) water, are of sufficient quality. Coring and sampling of homogeneous solids and soil/gravel shall comply, at minimum, with the following QC requirements.

B1-2b(1) Co-located Samples

In accordance with the requirement to collect field duplicates required by the EPA methods found in SW-846 (EPA 1996), samples shall be collected to determine the combined precision of the coring and sampling procedures. The co-located core methodology is a duplicate sample collection methodology intended to collect samples from a second core placed at approximately the same location within the drum when samples are collected by coring. Waste may not be amenable to coring in some instances. In this case, a co-located sample may be collected from a sample (e.g. scoop) collected from approximately the same location in the waste stream. A sample from each co-located core or waste sample collected by other means shall be collected side by side as close as feasible to one another, handled in the same manner, visually inspected through the transparent liner (if cored), and sampled in the same manner at the same randomly selected sample location(s). If the visual examination detects inconsistencies such as color, texture, or waste type in the waste at the sample location, another sampling location may be randomly selected, or the samples may be invalidated and co-located samples or cores may again be collected. Co-located samples, from either core or other sample type, shall be collected at a frequency of one per sampling batch or once per week, whichever is more frequent. A sampling batch is a suite of homogeneous solids and soil/gravel samples collected consecutively using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding field QC samples), all of which shall be collected within 14 days of the first sample in the batch.

B1-2b(2) Equipment Blanks

In accordance with SW-846 (EPA 1996), equipment blanks shall be collected from fully assembled sampling and coring tools (i.e., at least those portions of the sampling equipment that contact the sample) prior to first use after cleaning at a frequency of one per equipment cleaning batch. An equipment cleaning batch is the number of sampling equipment items cleaned together at one time using the same cleaning method. The equipment blank shall be collected from the fully assembled sampling or coring tool, in the area where the sampling or coring tools are cleaned, prior to covering with protective wrapping and storage. The equipment blank shall be collected by pouring clean water (e.g., deionized water, HPLC water) down the inside of the assembled sampling or coring tool. The water shall be collected in a clean sample container placed at the leading edge of the sampling or coring tool and analyzed for the analytes listed in Tables B3-4, B3-6, and B3-8 of Permit Attachment B3. The results of the equipment blank will be considered acceptable if the analysis indicates no analyte at a concentration greater than three times the MDLs listed in Tables B3-4 and B3-6 or in the Program Required Detection Limits (**PRDL**) in Table B3-8 of Permit Attachment B3. If analytes are detected at concentrations greater than three times the MDLs (or PRDLs for metals), then the associated equipment cleaning batch of sampling or coring tools shall be cleaned again and another equipment blank collected. Equipment from an equipment cleaning batch may not be used until analytical results have been received verifying an adequately low level of contamination in the equipment blank.

Equipment blanks for coring tools shall be collected from liners that are cleaned separately from the coring tools. These equipment blanks shall be collected at a frequency of one per equipment cleaning batch. The equipment blanks shall be collected by randomly selecting a liner from the equipment cleaning batch, pouring clean water (e.g., deionized water or HPLC water) across its internal surface, collecting the water in a clean sample container, and analyzing the water for the analytes listed in Tables B3-4, B3-6, and the PRDLs in Table B3-8 of Permit Attachment B3. The results of the equipment blank analysis will be considered acceptable if the results indicate no analyte at a concentration greater than three times the MDLs listed in Tables B3-4, B3-6, or B3-8 of Permit Attachment B3. If analytes are detected at concentrations greater than three times the MDLs (or PRDLs for metals), then the associated equipment cleaning batch of liners shall be cleaned again and another equipment blank collected. Equipment from an equipment cleaning batch may not be used until analytical results have been received verifying an adequately low level of contamination in the equipment blank.

Sampling equipment (e.g., bowls, spoons, chisel, VOC sub-sampler) shall also be cleaned. Equipment blanks shall be collected for the sampling equipment at a frequency of one per equipment cleaning batch. After the sampling equipment has been cleaned, one item from the equipment cleaning batch is randomly selected, water (e.g., deionized water, HPLC water) is passed over its surface, collected in a clean container, and analyzed for the analytes listed in Tables B3-4, B3-6, and B3-8 of Permit Attachment B3. The results of the equipment blank will be considered acceptable if the results indicate no analyte present at a concentration greater than three times the MDLs listed in Tables B3-4 and B3-6 and in the PRDLs in B3-8 of Permit Attachment B3. If analytes are detected at concentrations greater than three times the MDLs (or

PRDLs for metals), then the associated equipment cleaning batch of sampling equipment shall be cleaned again and another equipment blank collected. Equipment from an equipment cleaning batch may not be used until analytical results have been received verifying an adequately low level of contamination in the equipment blank. The above equipment blanks may be performed on a purchased batch basis for sampling equipment purchased sterile and sealed in protective packaging. Equipment blanks need not be performed for equipment purchased in sealed protective packaging accompanied by a certificate certifying cleanliness.

The results of equipment blanks shall be traceable to the items in the equipment cleaning batch that the equipment blank represents. All sampling items should be identified, and the associated equipment cleaning batch should be documented. The method of documenting the connection between equipment and equipment cleaning batches shall be documented. Equipment blank results for the coring tools, liners, and sampling equipment shall be reviewed prior to use. A sufficient quantity of these items should be maintained in storage to prevent disruption of sampling operations.

The Permittees may require a site to use certified clean disposable sampling equipment and discard liners and sampling tools after one use. In this instance, cleaning and equipment blank collection is not required.

B1-2b(3) <u>Coring Tool and Sampling Equipment Cleaning</u>

Coring tools and sampling equipment shall be cleaned in accordance with the following requirements:

- All surfaces of coring tools and sampling equipment that will come into contact with the samples shall be clean prior to use. All sampling equipment shall be cleaned in the same manner. Immediately following cleaning, coring tools and sampling equipment shall be assembled and sealed inside clean protective wrapping.

- Each reusable sampling or coring tool shall have a unique identification number. Each number shall be referenced to the waste container on which it was used. This information shall be recorded in the field records. One sampling or coring tool from each equipment cleaning batch shall be tested for cleanliness in accordance with the requirements specified above. The identification number of the sampling or coring tool from which the equipment blank was collected shall be recorded in the field records. The results of the equipment blank analysis for the equipment cleaning batch in which each sampling or coring tool was cleaned shall be submitted to the sampling facility with the identification numbers of all sampling or coring tools in the equipment cleaning batch. If analytes are detected at concentrations greater than three times the MDLs (or PRDLs for metals), then the associated equipment cleaning batch of sampling equipment shall be cleaned again and another equipment blank collected. Equipment from an equipment cleaning batch may not be used until analytical results have been received verifying an adequately low level of contamination in the equipment blank.

- Sample containers shall be cleaned in accordance with SW-846 (EPA 1996).

B1-2c Equipment Testing, Inspection and Maintenance

Prior to initiation of sampling or coring activities, sampling and coring tools shall be tested in accordance with manufacturer specifications to ensure operation within the manufacturer's tolerance limits. Other specifications specific to the sampling operations (e.g., operation of containment structure and safety systems) should also be tested and verified as operating properly prior to initiating coring activities. Coring tools shall be assembled, including liners, and tested. Air-lock mechanisms and rotation mechanisms shall be inspected for free movement of critical parts. Sampling and coring tools found to be malfunctioning shall be repaired or replaced prior to use.

Coring tools and sample collection equipment shall be maintained in accordance with manufacturer's specifications. Clean sampling and coring tools and sampling equipment shall be sealed inside clean protective wrapping and maintained in a clean storage area prior to use. Sampling equipment shall be properly maintained to avoid contamination. A sufficient supply of spare parts should be maintained to prevent delays in sampling activities due to equipment down time. Records of equipment maintenance and repair shall be maintained in the field records in accordance with site SOPs.

Inspection of sampling equipment and work areas shall include the following:

- Sample collection equipment in the immediate area of sample collection shall be inspected daily for cleanliness. Visible contamination on any equipment (e.g., waste on floor of sampling area, hydraulic fluid from hoses) that has the potential to contaminate a waste core or waste sample shall be thoroughly cleaned upon its discovery.

- The waste coring and sampling work areas shall be maintained in clean condition to minimize the potential for cross contamination between waste (including cores) and samples.

- Expendable equipment (e.g., plastic sheeting, plastic gloves) shall be visually inspected for cleanliness prior to use and properly discarded after each sample.

- Prior to removal of the protective wrapping from a coring tool designated for use, the condition of the protective wrapping shall be visually assessed. Coring tools with torn protective wrapping should be returned for cleaning. Coring tools visibly contaminated after the protective wrapping has been removed shall not be used and shall be returned for cleaning or properly discarded.

- Sampling equipment shall be visually inspected prior to use. All sampling equipment that comes into contact with waste samples shall be stored in protective wrapping until use. Prior to removal of the protective wrapping from sampling equipment, the condition of the protective wrapping shall be visually assessed. Sampling equipment with torn protective wrapping should be discarded or returned for cleaning. Sampling equipment visibly contaminated after the protective wrapping has been removed shall not be used and shall be returned for cleaning or properly discarded.

- Cleaned sampling and coring equipment will be physically segregated from all equipment that has been used for a sampling event and has not been decontaminated.

B1-2d Equipment Calibration and Frequency

The scale used for weighing sub-samples shall be calibrated as necessary to maintain its operation within manufacturer's specification, and after repairs and routine maintenance. Weights used for calibration shall be traceable to a nationally recognized standard. Calibration records shall be maintained in the field records.

B1-3 Radiography

Radiography has been developed by the Permittees specifically to aid in the examination and identification of containerized waste. The Permittees shall require that sites describe all activities required to achieve the radiography objectives in site QAPjPs and SOPs. These SOPs should include instructions specific to the radiography system(s) used at the site. For example, to detect liquids, some systems require the container to be rotated back and forth while other systems require the container to be tilted.

A radiography system (e.g., real time radiography, digital radiography/computed tomography) normally consists of an X-ray-producing device, an imaging system, an enclosure for radiation protection, a waste container handling system, an audio/video recording system, and an operator control and data acquisition station. Although these six components are required, it is expected there will be some variation within a given component between sites. The radiography system shall have controls or an equivalent process which allow the operator to control image quality. On some radiography systems, it should be possible to vary the voltage, typically between 150 to 400 kilovolts (**kV**), to provide an optimum degree of penetration through the waste. For example, high-density material should be examined with the X-ray device set on the maximum voltage. This ensures maximum penetration through the waste container. Low-density material should be examined at lower voltage settings to improve contrast and image definition. The imaging system typically utilizes either a fluorescent screen and a low-light television camera or x-ray detectors to generate the image.

To perform radiography, the waste container is scanned while the operator views the television screen. A video and audio recording is made of the waste container scan and is maintained as a non-permanent record. A radiography data form is also used to document the Waste Matrix Code to ensure that the waste container contains no ignitable, corrosive, or reactive waste by documenting the absence of liquids in excess of TSDF-WAC limits or compressed gases, and verify that the physical form of the waste is consistent with the waste stream description documented on the WSPF. Containers whose contents prevent full examination of the remaining contents shall be subject to visual examination unless the site certifies that visual examination would provide no additional relevant information for that container based on the acceptable knowledge information for the waste stream. Such certification shall be documented in the generator/storage site's record.

For containers which contain classified shapes and undergo radiography, the radiography video and audio recording will be considered classified. The radiography data forms will not be considered classified.

The radiography system involves qualitative and semiquantitative evaluations of visual displays. Operator training and experience are the most important considerations for ensuring quality controls in regard to the operation of the radiography system and for interpretation and disposition of radiography results. Only trained personnel shall be allowed to operate radiography equipment.

Standardized training requirements for radiography operators shall be based upon existing industry standard training requirements.

The Permittees shall require each site to develop a training program that provides radiography operators with both formal and on-the-job (**OJT**) training. Radiography operators shall be instructed in the specific waste generating practices, typical packaging configurations, and associated waste material parameters expected to be found in each Waste Matrix Code at the site. The OJT and apprenticeship shall be conducted by an experienced, qualified radiography operator prior to qualification of the training candidate. The training programs will be site-specific due to differences in equipment, waste configurations, and the level of waste characterization efforts. For example, certain sites use digital radiography equipment, which is more sensitive than real-time radiography equipment. In addition, the particular physical forms and packaging configurations at each site will vary; therefore, radiography operators shall be trained on the types of waste that are generated, stored, and/or characterized at that particular site.

Although the Permittees shall require each site to develop its own training program, all of the radiography QC requirements specified in this WAP shall be incorporated into the training programs and radiography operations. In this way data quality and comparability will not be affected.

Radiography training programs will be the subject of the Permittees' Audit and Surveillance Program (Permit Attachment B6).

A training drum with internal container of various sizes shall be scanned biannually by each operator. The audio and video media shall then be reviewed by a supervisor to ensure that operators' interpretations remain consistent and accurate. Imaging system characteristics shall be verified on a routine basis.

Independent replicate scans and replicate observations of the video output of the radiography process shall be performed under uniform conditions and procedures. Independent replicate scans shall be performed on one waste container per day or once per testing batch, whichever is less frequent. Independent observations of one scan (not the replicate scan) shall also be made once per day or once per testing batch, whichever is less frequent, by a qualified radiography operator other than the individual who performed the first examination. A testing batch is a suite of waste containers undergoing radiography using the same testing equipment. A testing batch can be up to 20 waste containers without regard to waste matrix.

Oversight functions include periodic audio/video tape reviews of accepted waste containers and shall be performed by qualified radiography personnel other than the operator who dispositioned the waste container. The results of this independent verification shall be available to the radiography operator. The Permittees shall require the site project manager to be responsible for monitoring the quality of the radiography data and calling for corrective action, when necessary.

B1-4 Visual Examination

In lieu of radiography, the waste container contents may be verified directly by visual examination of the waste container contents. Visual examination may be performed on waste containers to verify the Waste Matrix Code and to verify that the container is properly included in the appropriate waste stream. Visual examination shall be conducted to describe all contents of a waste container, clearly identifying all discernible waste items, residual materials, packaging materials, or waste material parameters. All visual examination activities shall be documented on video/audio media, or alternatively, by using a second operator to provide additional verification by reviewing the contents of the waste container to ensure correct reporting. The results of all visual examination shall be documented on visual examination data forms.

Visual examination recorded on video/audio media shall meet the following minimum requirements:

- The video/audio media shall record the waste packaging event for the container such that all waste items placed into the container are recorded in sufficient detail and shall contain an inventory of waste items in sufficient detail that another trained visual examination expert can identify the associated waste material parameters.

- The video/audio media shall capture the waste container identification number.

- The personnel loading the waste container shall be identified on the video/audio media or on packaging records traceable to the loading of the waste container.

- The date of loading of the waste container will be recorded on the video/audio media or on packaging records traceable to the loading of the waste container.

Visual examination performed using two generator site personnel shall meet the following minimum requirements:

- At least two generator site personnel shall approve the data forms or packaging logs attesting to the contents of the waste container.

- The data forms or packaging logs shall contain an inventory of waste items in sufficient detail that another trained visual examination expert can identify the associated waste material parameters.

- The waste container identification number shall be recorded on the data forms or packaging logs.

Visual examination video/audio media of containers which contain classified shapes shall be considered classified information. Visual examination data forms or packaging logs will not be considered classified information.

Visual examination records may be used for characterization of TRU mixed waste. The visual examination records must meet the minimum requirements listed above and shall be reviewed by operators trained and qualified to the requirements listed below. The operators will prepare data forms based on the visual examination records. Visual examination batch data reports will be prepared, reviewed, and approved as described in Permit Attachment B, Section B-4, and Permit Attachment B3.

Standardized training for visual inspection shall be developed. Visual inspectors shall be instructed in the specific waste generating processes, typical packaging configurations, and expected waste material parameters expected to be found in each Waste Matrix Code at the site. The training shall be site specific to include the various waste configurations generated/stored at the site. For example, the particular physical forms and packaging configurations at each site will vary so operators shall be trained on types of waste that are generated, stored, and/or characterized at that particular site. Visual examination personnel shall be requalified once every two years.

Each visual examination facility shall designate a visual examination expert. The visual examination expert shall be familiar with the waste generating processes that have taken place at that site and also be familiar with all of the types of waste being characterized at that site. The visual examination expert shall be responsible for the overall direction and implementation of the visual examination at that facility. The Permittees shall require site QAPjPs to specify the selection, qualification, and training requirements of the visual examination expert.

B1-5 Custody of Samples

Chain-of-Custody on field samples (including field QC samples) will be initiated immediately after sample collection or preparation. Sample custody will be maintained by ensuring that samples are custody sealed during shipment to the laboratory. After samples are accepted by the analytical laboratory, custody is maintained by assuring the samples are in the possession of an authorized individual, in that individual’s view, in a sealed or locked container controlled by that individual, or in a secure controlled access location. Sample custody will be maintained until the sample is released by the site project manager or until the sample is expended. The Permittees shall require that site QAPjPs or site-specific procedures include a copy of the sample chain-of-custody form and instructions for completing sample chain-of-custody forms in a legally defensible manner. This form will include provisions for each of the following:

- Signature of individual initiating custody control, along with the date and time.
- Documentation of sample numbers for each sample under custody. Sample numbers will be referenced to a specific sampling event description that will identify the sampler(s) through signature, the date and time of sample collection, type/number containers for each sample, sample matrix, preservatives (if applicable), requested methods of analysis, place/address of sample collection and the waste container number.
- For off-site shipping, method of shipping transfer, responsible shipping organization or corporation, and associated air bill or lading number.
- Signatures of custodians relinquishing and receiving custody, along with date and time of the transfer.
- Description of final sample container disposition, along with signature of individual removing sample container from custody.
- Comment section.
- Documentation of discrepancies, breakage or tampering.

All samples and sampling equipment will be identified with unique identification numbers. Sampling Coring tools and equipment will be identified with unique equipment numbers to ensure that all sampling equipment, coring tools, and sampling canisters are traceable to equipment cleaning batches.

All samples will be uniquely identified to ensure the integrity of the sample and can be used to identify the generator/storage site and date of collection. Sample tags or labels will be affixed to all samples and will identify at a minimum:

- Sample ID number
- Sampler initials and organization
- Ambient temperature and pressure (for gas samples only)
- Sample description
- Requested analyses
- Data and time of collection
- QC designation (if applicable)

B1-6 Sample Packing and Shipping

In the event that the analytical facilities are not at the generator/storage site, the samples shall be packaged and shipped to an off-site laboratory. Sample containers shall be packed to prevent any damage to the sampling container and maintain the preservation temperature, if necessary. Department of Transportation (**DOT**) regulations shall be adhered to for shipment of the package.

When preparing SUMMA® or equivalent canisters for shipment, special care shall be taken with the pressure gauge and the associated connections. Metal boxes which have separate compartments, or cardboard boxes with foam inserts are standard shipping containers. The chosen shipping container shall meet selected DOT regulations. If temperatures shall be maintained, an adequate number of cold packs necessary to maintain the preservation temperature shall be added to the package.

Glass jars are wrapped in bubble wrap or another type of protection. The wrapped jar should be placed in a plastic bag inside of the shipping container, so that if the jar breaks, the inside of the shipping container and the other samples will not be contaminated. The plastic bag will enable the receiving analytical lab to prevent contamination of their shipping and receiving area. Plastic jars do not present a problem for shipping purposes. All shipping containers will contain appropriate blank samples to detect any VOC cross-contamination. A DOT approved cooler, or similar package may be used as the shipping container. If temperatures must be maintained, an adequate number of cold packs necessary to maintain the preservation temperature shall be added to the package. If fill material is needed, compatibility between the samples and the fill should be evaluated prior to use.

All sample containers should be affixed with signed tamper-proof seals or devices so that it is apparent if the sample integrity has been compromised and that the identity of the seal or device is traceable to the individual who affixed the seal. A seal should also be placed on the outside of the shipping container for the same reason. Sample custody documentation shall be placed inside the sealed or locked shipping container, with the current custodian signing to release custody. Transfer of custody is completed when the receiving custodian opens the shipping container and signs the custody documentation. The shipping documentation will serve to track the physical transfer of samples between the two custodians.

A Uniform Hazardous Waste Manifest is not required, since samples are exempted from the definition of hazardous waste under RCRA. All other shipping documentation specified in the site specific SOP for sample shipment (i.e., bill of lading, site-specific shipping documentation) is required.

B1-7 List of References

Bechtel BWXT Idaho, LLC (BWXT), 2000, Determination of Drum Age Criteria and Prediction Factors Based on Packaging Configurations, INEEL/EXT-2000-01207, October 2000, Liekhus, K.J., S.M. Djordjevic, M. Devarakonda, and M.J. Connolly, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho.

Lockheed Idaho Technologies Company, 1995, Position for Determining Gas Phase Volatile Organic Compound Concentrations in Transuranic Waste Containers, INEL-95/0109/Revision 1, M.J. Connolly, et. al.

U.S. Environmental Protection Agency (EPA), 1999, Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air (EPA/625/R-96/10b, January 1999).

U.S. Environmental Protection Agency (EPA), 1996. Test Methods for Evaluating Solid Waste, “Laboratory Manual Physical/Chemical Methods, SW-846, 3rd ed., U.S. EPA, OSW and ER, Washington D.C.

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TABLES

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TABLE B1-1
GAS SAMPLE REQUIREMENTS

Parameter	Container[a]	Minimum Drum Headspace Sample Volume[b]	Holding Temperatures
VOCs	SUMMA® Canister	250 ml	0-40° C

[a] Alternately, canisters that meet QAOs may be used.
[b] Alternatively, if available headspace is limited, a single 100 ml sample may be collected for determination of VOCs.

TABLE B1-2
SUMMARY OF DRUM FIELD QC HEADSPACE SAMPLE FREQUENCIES

QC Samples	Manifold	Direct Canister	On-Line Systems
Field blanks[a]	1 per sampling batch[d]	1 per sampling batch[d]	1 per on-line batch[f]
Equipment blanks[b]	1 per sampling batch[d]	once[e]	1 per on-line batch[f]
Field reference standards[c]	1 per sampling batch[d]	once[e]	1 per on-line batch[f]
Field duplicates	1 per sampling batch[d]	1 per sampling batch[d]	1 per on-line batch[f]

[a] Analysis of field blanks for VOCs (Table B3-2 of Appendix B3), only, is required. For on-line integrated sampling/analysis systems, if field blank results meet the acceptance criterion, a separate on-line blank is not required.

[b] One equipment blank or on-line sample shall be collected, analyzed for VOCs (Table B3-2), and demonstrated clean prior to first use of the headspace gas sampling equipment with each of the sampling heads, then at the specified frequency, for VOCs only thereafter. Daily, prior to work, the sampling manifold, if in use, shall be verified clean using an OVA.

[c] One field reference standard or on-line control sample shall be collected, analyzed, and demonstrated to meet the QAOs specified in Permit Attachment B3 prior to first use, then at the specified frequency thereafter.

[d] A sampling batch is a suite of samples collected consecutively using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding field QC samples), all of which shall be collected within 14 days of the first sample in the batch.

[e] One equipment blank and field reference standard shall be collected after equipment purchase, cleaning, and assembly.

[f] An on-line batch is the number of samples collected within a 12-hour period using the same on-line integrated sampling/analysis system. The analytical batch requirements are specified by the analytical method being used in the on-line system.

TABLE B1-3
SUMMARY OF SAMPLING QUALITY CONTROL SAMPLE ACCEPTANCE CRITERIA

QC Sample	Acceptance Criteria	Corrective Action[a]
Field blanks	VOC amounts ≤ 3 × MDLs in Table B3-2 for GC/MS and GC/FID; < PRQLs in Table B3-2 for FTIRS	Nonconformance if any VOC amount > 3 × MDLs in Table B3-2 for GC/MS and GC/FID; ≥ PRQLs in Table B3-2 for FTIRS
Equipment blanks	VOC amounts ≤ 3 × MDLs in Table B3-2 of for GC/MS and GC/FID; < PRQLs in Table B3-2 for FTIRS	Nonconformance if any analyte amount > 3 × MDLs in Table B3-2 for GC/MS and GC/FID; ≥ PRQLs in Table B3-2 for FTIRS
Field reference standards or on-line control sample	70 - 130 %R	Nonconformance if %R < 70 or > 130
Field duplicates or on-line duplicate	RPD ≤ 25	Nonconformance if RPD > 25

[a] Corrective action is only required if the final reported QC sample results do not meet the acceptance criteria.
MDL = Method detection limit
%R = Percent recovery
RPD = Relative percent difference

TABLE B1-4
SAMPLE HANDLING REQUIREMENTS FOR HOMOGENEOUS SOLIDS AND SOIL/GRAVEL

Parameter	Suggested Quantity [a]	Required Preservative	Suggested Container	Maximum Holding Time [b]
VOCs	15 grams	Cool to 4°C	Glass Vial [c]	14 Days Prep/ 40 Days Analyze [d]
SVOCs	50 grams	Cool to 4°C	Glass Jar [e]	14 Days Prep/ 40 Days Analyze [d]
Metals	10 grams	Cool to 4°C	Plastic Jar [f]	180 Days [g]

[a] Quantity may be increased or decreased according to the requirements of the analytical laboratory, as long as the QAOs are met.
[b] Holding time begins at sample collection (holding times are consistent with SW-846 requirements).
[c] 40-ml VOA vial or other appropriate containers shall have an airtight cap.
[d] 40-day holding time allowable only for methanol extract - 14-day holding time for non-extracted VOCs.
[e] Appropriate containers should be used and should have Teflon® lined caps.
[f] Polyethylene or polypropylene preferred, glass jar is allowable.
[g] Holding time for mercury analysis is 28 days.

Note: Preservation requirements in the most recent version of SW-846 may be used if appropriate.

TABLE B1-5
HEADSPACE GAS DRUM AGE CRITERIA SAMPLING SCENARIOS

Scenario	Description
1	A. Unvented 55-gallon drums without rigid poly liners are sampled through the drum lid at the time of venting. B1. Unvented 55-gallon drums with unvented rigid poly liners are sampled through the rigid poly liner at the time of venting or prior to venting. B2. Vented 55-gallon drums with unvented rigid poly liners are sampled through the rigid poly liner at the time of venting or prior to venting. C. Unvented 55-gallon drums with vented rigid poly liners are sampled through the drum lid at the time of venting.
2	55-gallon drums that have met the criteria for Scenario 1 and then are vented, but not sampled at the time of venting. [a]
3	Containers (i.e., 55-gallon drums, 85-gallon drums, 100-gallon drums, SWBs, TDOPs, and pipe components) that are initially packaged in a vented condition and sampled in the container headspace and containers that are not sampled under Scenario 1 or 2.

[a] Containers that have not met the Scenario 1 DAC at the time of venting must be categorized under Scenario 3. This requires the additional information required of each container in Scenario 3 (i.e., determination of packaging configuration), and such containers can only be sampled after meeting the appropriate Scenario 3 DAC.

TABLE B1-6
SCENARIO 1 DRUM AGE CRITERIA (IN DAYS) MATRIX

Summary Category Group	DAC (Days)
S5000	53

Note: Containers that are sampled using the Scenario 1 DAC do not require information on the packaging configuration because the Scenario 1 DAC are based on a bounding packaging configuration. In addition, information on the rigid liner vent hole presence and diameter do not apply to containers that are sampled using the Scenario 1 DAC because they are unvented prior to sampling.

TABLE B1-7
SCENARIO 2 DRUM AGE CRITERIA (IN DAYS) MATRIX

	Summary Category Group S5000			
Filter H_2 Diffusivity [a]	**Rigid Liner Vent Hole Diameter (in)** [b]			
(mol/s/mod fraction)	0.30	0.375	0.75	1.0
1.9×10^{-6}	29	22	13	12
3.7×10^{-6}	25	20	12	11
3.7×10^{-5}	7	6	6	4

[a] The documented filter H_2 diffusivity must be greater than or equal to the listed value to use the DAC for the listed filter H_2 diffusivity (e.g., a container with a filter H_2 diffusivity of 4.2×10^{-6} must use a DAC for a filter with a 3.7×10^{-6} filter H_2 diffusivity). If a filter H_2 diffusivity for a container is undocumented or unknown or is less than 1.9×10^{-6} filter H_2 diffusivity, a filter of known H_2 diffusivity that is greater than or equal to 1.9×10^{-6} filter H_2 diffusivity must be installed prior to initiation of the relevant DAC period.

[b] The documented rigid liner vent hole diameter must be greater than or equal to the listed value to use the DAC for the listed rigid liner vent hole diameter (e.g., a container with a rigid liner vent hole of 0.5 in. must use a DAC for a rigid liner vent hole of 0.375 in.). If the rigid liner vent hole diameter for a container is undocumented during packaging (Attachment B, Section B-3d(1)), repackaging (Attachment B, Section B-3d(1)), and/or venting (Section B1-1a[4][ii]), that container must use a DAC for a rigid liner vent hole diameter of 0.30 in.

Note: Containers that are sampled using the Scenario 2 DAC do not require information on the packaging configuration because the Scenario 2 DAC are based on a bounding packaging configuration.

TABLE B1-8
SCENARIO 3 PACKAGING CONFIGURATION GROUPS

Packaging Configuration Group	Covered S5000 Packaging Configuration Groups
Packaging Configuration Group 1, 55-gal drums [a]	• No layers of confinement, filtered inner lid [b] • No inner bags, no liner bags (bounding case)
Packaging Configuration Group 2, 55-gal drums [a]	• 1 inner bag • 1 filtered inner bag • 1 liner bag • 1 filtered liner bag • 1 inner bag, 1 liner bag • 1 filtered inner bag, 1 filtered liner bag • 2 inner bags • 2 filtered inner bags • 2 inner bags, 1 liner bag • 2 filtered inner bags, 1 filtered liner bag • 3 inner bags • 3 filtered inner bags • 3 filtered inner bags, 1 filtered liner bag • 3 inner bags, 1 liner bag (bounding case)
Packaging Configuration Group 3, 55-gal drums [a]	• 2 liner bags • 2 filtered liner bags • 1 inner bag, 2 liner bags • 1 filtered inner bag, 2 filtered liner bags • 2 inner bags, 2 liner bags • 2 filtered inner bags, 2 filtered liner bags • 3 filtered inner bags, 2 filtered liner bags • 4 inner bags • 3 inner bags, 2 liner bags • 4 inner bags, 2 liner bags (bounding case)
Packaging Configuration Group 4, pipe components	• No layers of confinement inside a pipe component • 1 filtered inner bag, 1 filtered metal can inside a pipe component • 2 inner bags inside a pipe component • 2 filtered inner bags inside a pipe component • 2 filtered inner bags, 1 filtered metal can inside a pipe component • 2 inner bags, 1 filtered metal can inside a pipe component (bounding case)
Packaging Configuration Group 5, Standard Waste Box or Ten-Drum Overpack [a]	• No layers of confinement • 1 SWB liner bag (bounding case)
Packaging Configuration Group 6, Standard Waste Box or Ten-Drum Overpack [a]	• any combination of inner and/or liner bags that is less than or equal to 6 • 5 inner bags, 1 SWB liner bag (bounding case)

Packaging Configuration Group 7, 85-gal. drums and 100-gal. drums [a]	• No inner bags, no liner bags, no rigid liner, filtered inner lid (bounding case) [b] • No inner bags, no liner bags, no rigid liner
Packaging Configuration Group 8, 85-gal. drums and 100-gal. drums [a]	• 4 inner bags and 2 liner bags, no rigid liner, filtered inner lid (bounding case) [b]

[a] If a specific Packaging Configuration Groups cannot be determined based on the data collected during packaging and/or repackaging, a conservative default Packaging Configuration Group of 3 for 55-gallon drums, 6 for SWBs and TDOPs, and 8 for 85-gallon and 100-gallon drums must be assigned provided the drums do not contain pipe component packaging. If pipe components are present as packaging in the drums, the pipe components must be sampled following the requirements for Packaging Configuration Group 4.

[b] A "filtered inner lid" is the inner lid on a double lid drum that contains a filter.

Definitions:

Liner Bags: One or more optional plastic bags that are used to control radiological contamination. Liner bags for drums have a thickness of approximately 11 mils. Liner bags are typically similar in size to the container. SWB liner bags have a thickness of approximately 14 mils. TDOPs use SWB liner bags.

Inner Bags: One or more optional plastic bags that are used to control radiological contamination. Inner bags have a thickness of approximately 5 mils and are typically smaller than liner bags.

TABLE B1-9
SCENARIO 3 DRUM AGE CRITERIA (IN DAYS) MATRIX FOR S5000 WASTE BY PACKAGING CONFIGURATION GROUP

Packaging Configuration Group 1

Filter H_2 Diffusivity [a] (mol/s/mol fraction)	Rigid Liner Vent Hole Diameter [b]				No Liner Lid	No Liner
	0.3-inch Diameter Hole	0.375-inch Diameter Hole	0.75-inch Diameter Hole	1-inch Diameter Hole		
1.9×10^{-6}	131	95	37	24	4	4
3.7×10^{-6}	111	85	36	24	4	4
3.7×10^{-5}	28	28	23	19	4	4

Packaging Configuration Group 2

Filter H_2 Diffusivity [a] (mol/s/mol fraction)	Rigid Liner Vent Hole Diameter [b]				No Liner Lid	No Liner
	0.3-inch Diameter Hole	0.375-inch Diameter Hole	0.75-inch Diameter Hole	1-inch Diameter Hole		
1.9×10^{-6}	175	138	75	60	30	11
3.7×10^{-6}	152	126	73	59	30	11
3.7×10^{-5}	58	57	52	47	28	8

Packaging Configuration Group 3

Filter H_2 Diffusivity [a] (mol/s/mol fraction)	Rigid Liner Vent Hole Diameter [b]				No Liner Lid	No Liner
	0.3-inch Diameter Hole	0.375-inch Diameter Hole	0.75-inch Diameter Hole	1-inch Diameter Hole		
1.9×10^{-6}	199	161	96	80	46	16
3.7×10^{-6}	175	148	93	79	46	16
3.7×10^{-5}	72	72	67	62	42	10

Packaging Configuration Group 4

Filter H_2 Diffusivity [a] (mol/s/mol fraction)	Headspace Sample Taken Inside Pipe Component
$> 1.9 \times 10^{-6}$	152

Packaging Configuration Group 5	
Filter H_2 Diffusivity [a, c] (mol/s/mol fraction)	**Headspace Sample Taken Inside SWB/TDOP**
> 7.4×10^{-6} (SWB)	15
3.33×10^{-5} (TDOP)	15

Packaging Configuration Group 6	
Filter H_2 Diffusivity [a, c] (mol/s/mol fraction)	**Headspace Sample Taken Inside SWB/TDOP**
> 7.4×10^{-6} (SWB)	56
3.33×10^{-5} (TDOP)	56

Packaging Configuration Group 7 [d]			
Filter H_2 Diffusivity [a] (mol/s/mol fraction)	**Inner Lid Filter Vent Minimum H_2 Diffusivity (mol/s/mol fraction) [a]**		
	7.4×10^{-6}	**1.85×10^{-5}**	**9.25×10^{-5} [e]**
3.7×10^{-6}	13	7	2
7.4×10^{-6}	10	6	2
1.85×10^{-5}	6	4	2

Packaging Configuration Group 8	
Filter H_2 Diffusivity [a] (mol/s/mol fraction)	**Inner Lid Filter Vent Minimum H_2 Diffusivity (mol/s/mol fraction)**
	7.4×10^{-6}
3.7×10^{-6}	21

[a] The documented filter H_2 diffusivity must be greater than or equal to the listed value to use the DAC for the listed filter H_2 diffusivity (e.g., a container with a filter H_2 diffusivity of 4.2×10^{-6} must use a DAC for a filter with a 3.7×10^{-6} filter H_2 diffusivity). If a filter H_2 diffusivity for a container is undocumented or unknown or is less than 1.9×10^{-6} filter H_2 diffusivity, a filter of known H_2 diffusivity that is greater than or equal to 1.9×10^{-6} filter H_2 diffusivity must be installed prior to initiation of the relevant DAC period.

[b] The documented rigid liner vent hole diameter must be greater than or equal to the listed value to use the DAC for the listed rigid liner vent hole diameter (e.g., a container with a rigid liner vent hole of 0.5 in. must use a DAC for a rigid liner vent hole of 0.375 in.). If the rigid liner vent hole diameter for a container is undocumented during packaging, repackaging, and/or venting (Section B1-1a[64][ii]), that container must use a DAC for a rigid liner vent hole diameter of 0.30 in.

[c] The filter H_2 diffusivity for SWBs or TDOPs is the sum of the diffusivities for all of the filters on the container because SWBs and TDOPs have more than 1 filter.

[d] Headspace sample taken between inner and outer drum lids. If headspace sample is taken inside the filtered inner drum lid prior to placement of the outer drum lid, then a DAC value of 2 days may be used. Footnote e is also applicable. Packaging Configuration Group 7 DAC values apply to drums with up to two lids.

[e] While a DAC value of 2 days may be determined, containers must comply with the equilibrium requirements specified in Section B1-1a (i.e., 72 hours at 18°C or higher). The equilibrium requirement for headspace gas sampling shall be met separately.

FIGURES

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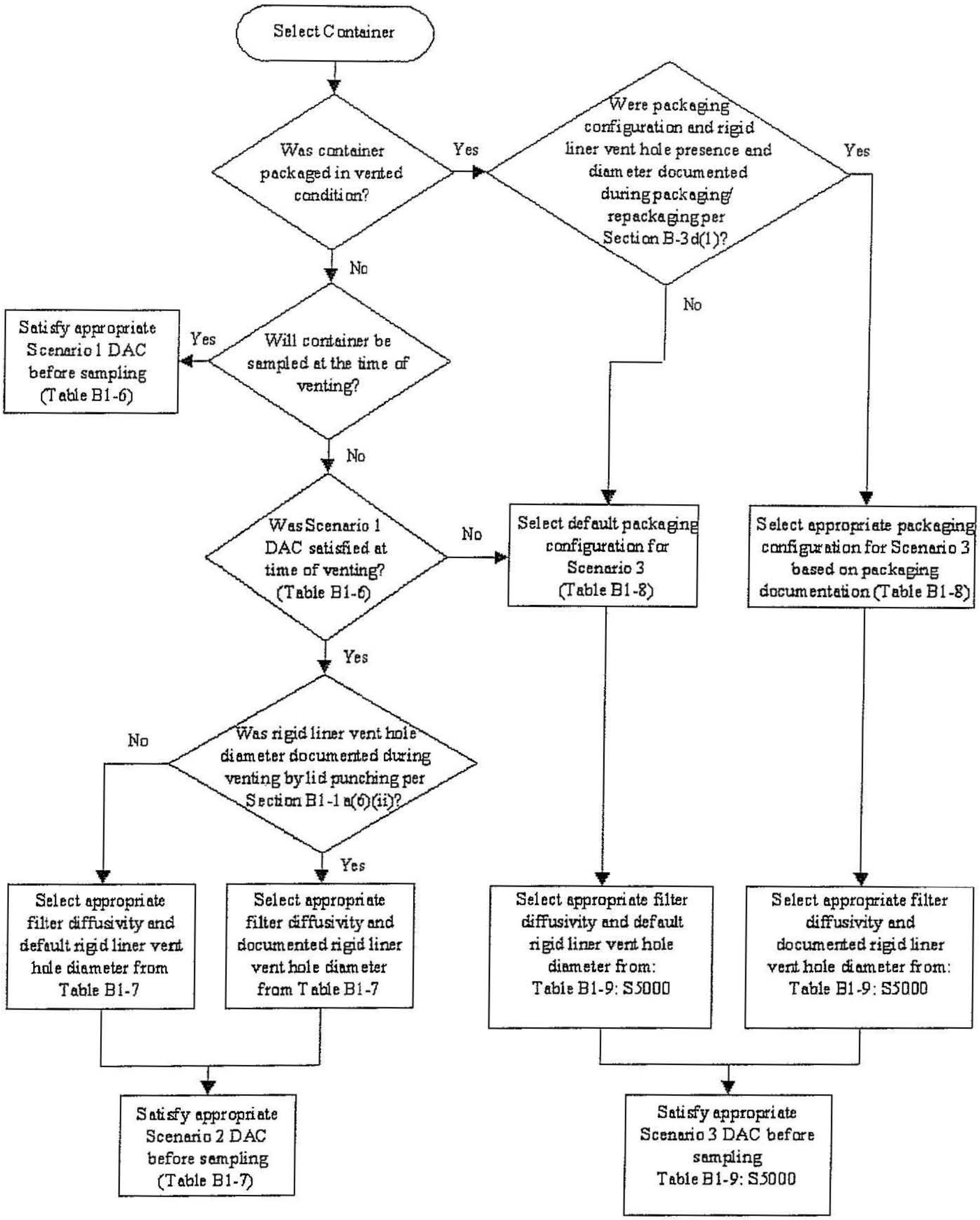


Figure B1-1
Headspace Gas Drum Age Criteria Sampling Scenario Selection Process

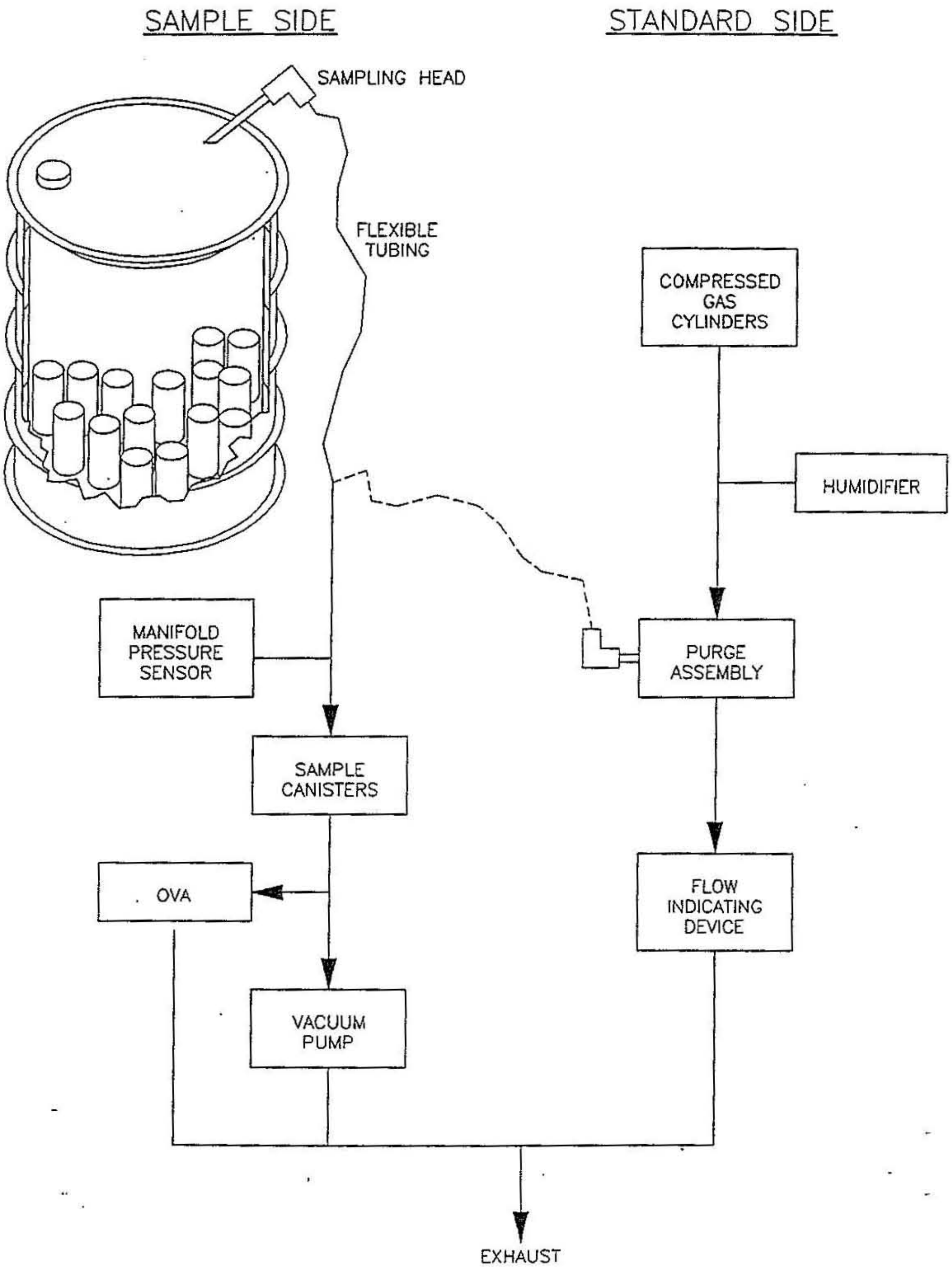


Figure B1-2
Headspace Sampling Manifold

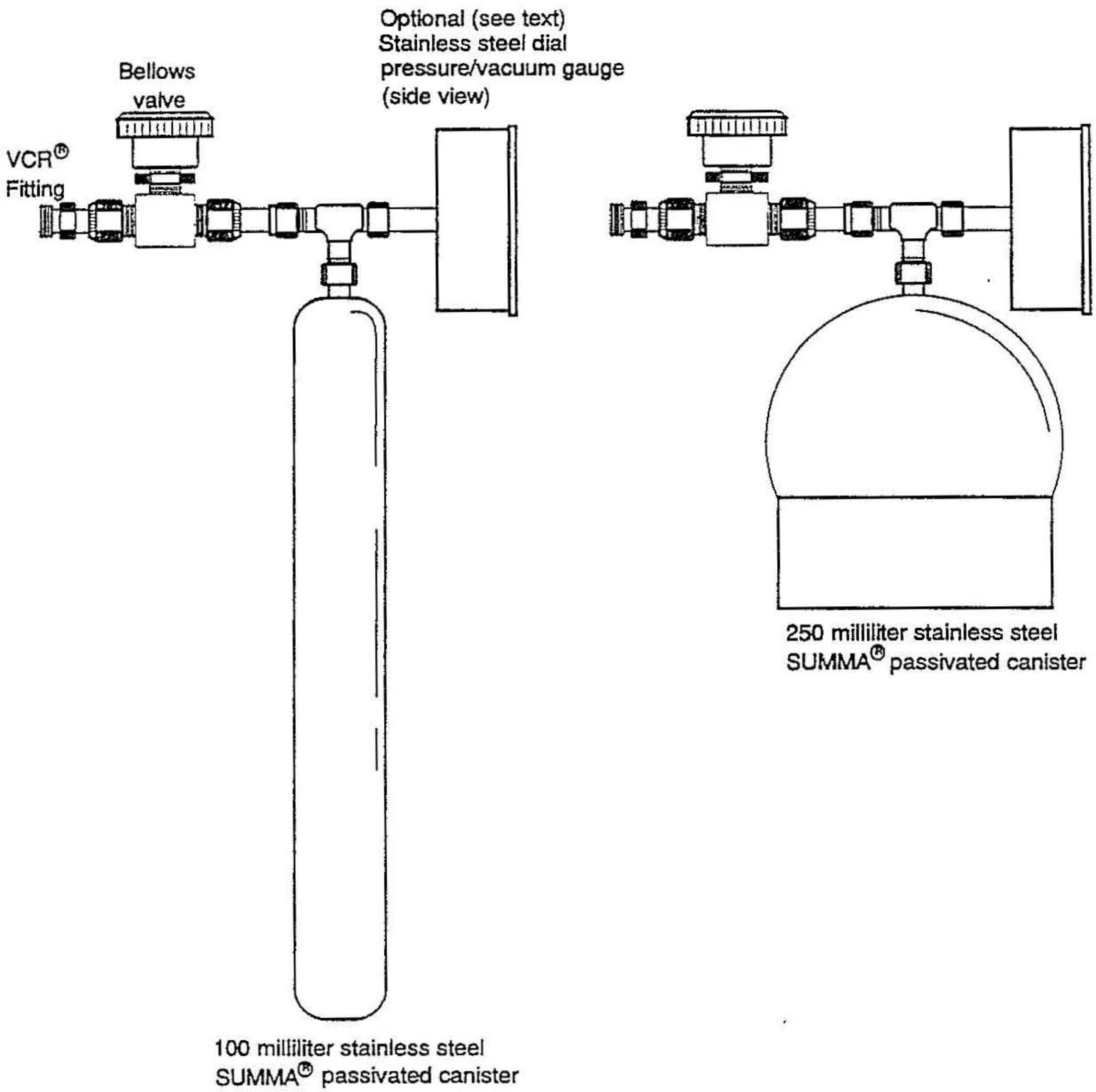


Figure B1-3
SUMMA® Canister Components Configuration (Not to Scale)

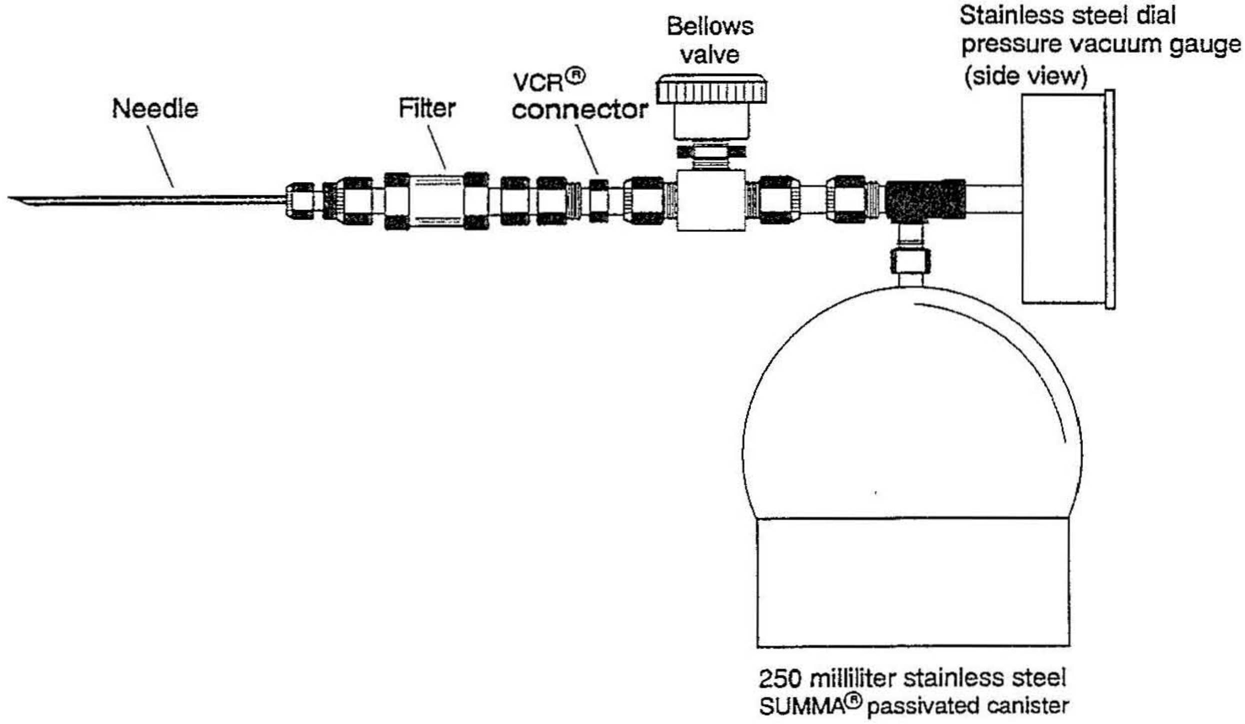
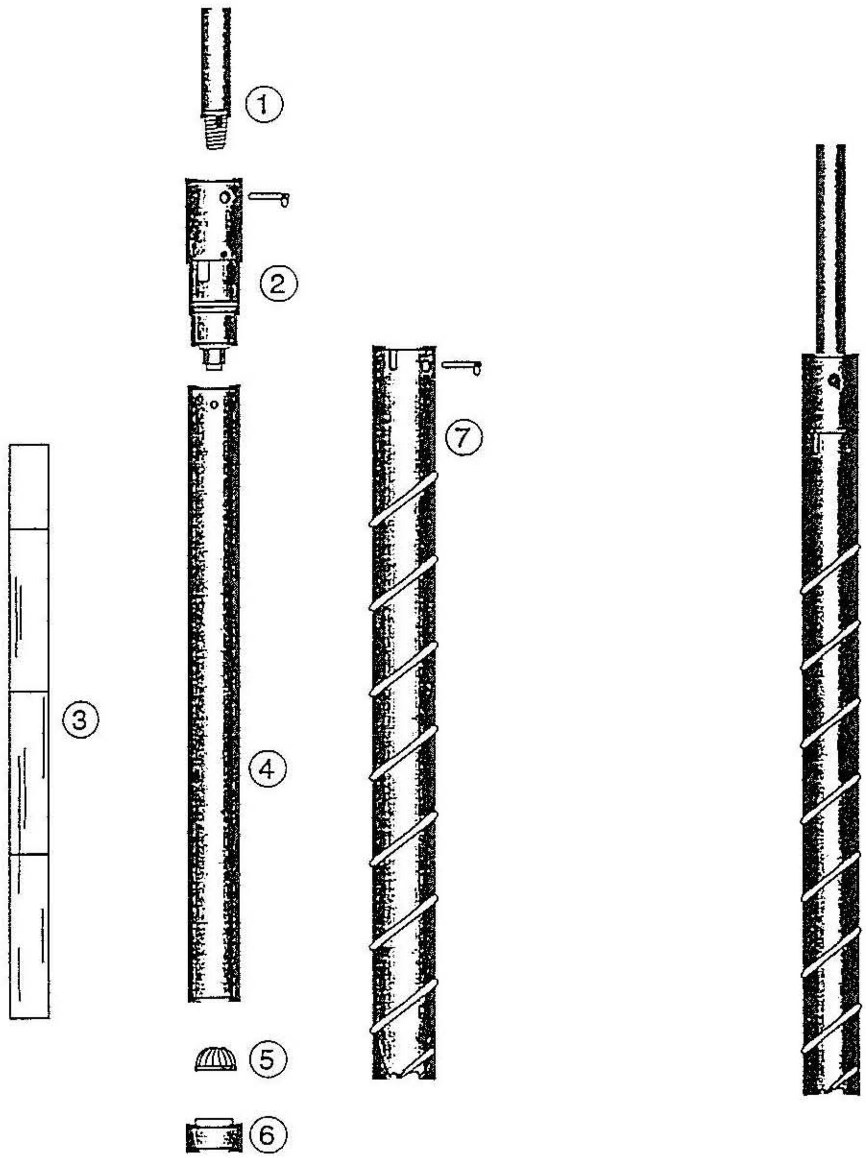


Figure B1-4
Schematic Diagram of Direct Canister with the Poly Bag Sampling Head



1 Drill Rod
2 Thrust Bearing Ball Check Valve
3 Clear Teflon® Liners
4 Core Barrel
5 Spring Retainer (optional)
6 Core barrel tip
7 Auger and Pin

Figure B1-5
Rotational Coring Tool (Light Weight Auger)

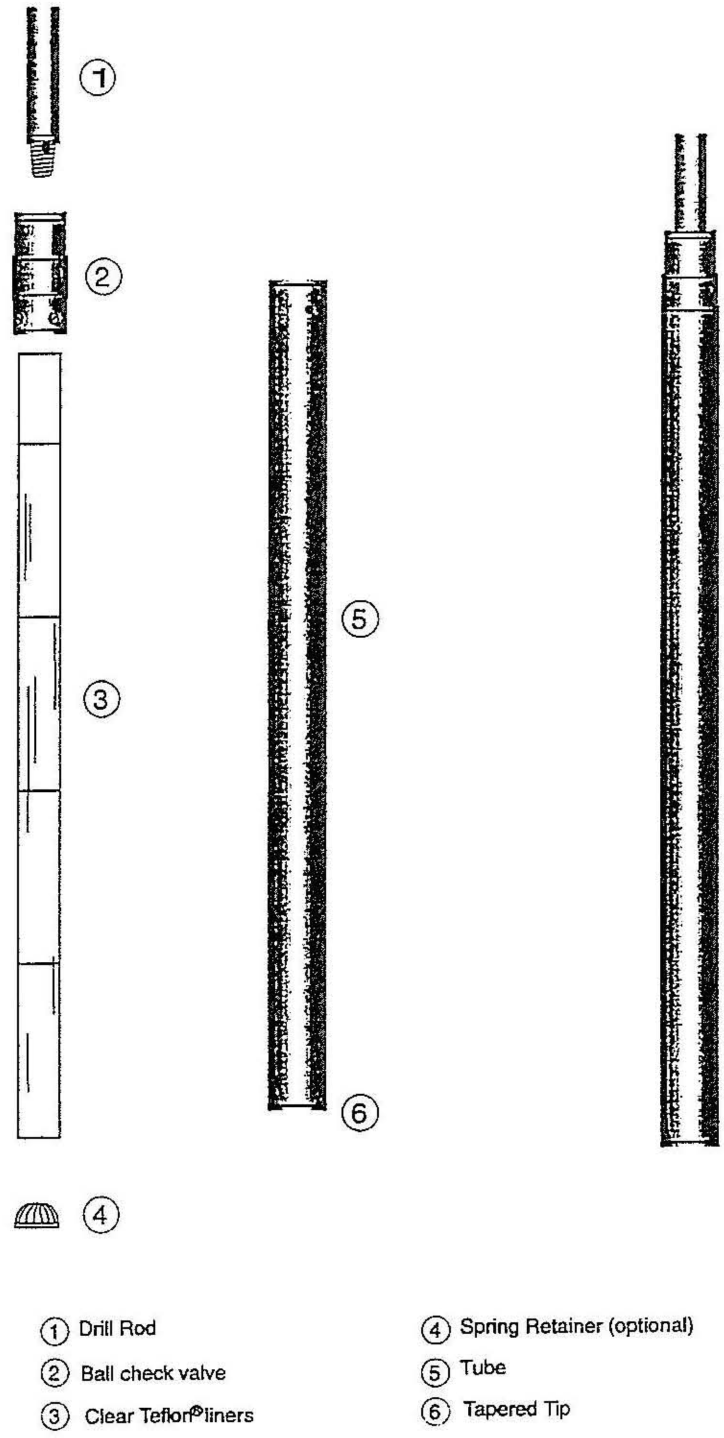


Figure B1-6
Non-Rotational Coring Tool (Thin Walled Sampler)

APPENDIX B2

STATISTICAL METHODS USED IN SAMPLING AND ANALYSIS

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APPENDIX B2

STATISTICAL METHODS USED IN SAMPLING AND ANALYSIS

TABLE OF CONTENTS

List of Figures

APPENDIX B2

STATISTICAL METHODS USED IN SAMPLING AND ANALYSIS

Introduction

The Permittees shall require generator/storage sites (**sites**) to use the following statistical methods for sampling and analysis of TRU mixed waste which is managed, stored, or disposed at WIPP, unless determined unnecessary by the Permittees as a result of an Acceptable Knowledge (AK) Sufficiency Determination. These statistical methods include methods for selecting waste containers for totals analysis, selecting waste containers for headspace gas sampling and analysis, and setting the upper confidence limit.

B2-1 Approach for Selecting Waste Containers for Statistical Sampling

B2-1a Statistical Selection of Containers for Totals Analysis

The statistical approach for characterizing retrievably stored and newly generated homogeneous solids (S3000) and soil/gravel (S4000) waste and repackaged or treated S3000 waste relies on using acceptable knowledge to segregate waste containers into relatively homogeneous waste streams. Using acceptable knowledge, generator/storage sites will classify the entire waste stream as hazardous or nonhazardous rather than individual waste containers. Individual waste containers serve as convenient units for characterizing the combined mass of waste from the waste stream of interest. Once segregated by waste stream, random selection and sampling of the waste containers followed by analysis of the waste samples shall be performed to ensure that the resulting mean contaminant concentration provides an unbiased representation of the true mean contaminant concentration for each waste stream. The Permittees shall require each site project manager to verify that the samples collected from within a waste stream were selected randomly.

An end use of analytical results for retrievably stored homogeneous solids and soil/gravel is for assigning the Environmental Protection Agency (**EPA**) hazardous waste numbers associated with toxicity characteristic waste (D-numbers) that apply to each mixed waste stream. The toxicity characteristic D-numbers are indicators that the waste exhibits the toxicity characteristic for specific contaminants under the Resource Conservation and Recovery Act (**RCRA**). The RCRA-toxicity determination is made on the basis of sampling and analysis of waste streams and on whether or not the waste stream includes F-number wastes. If a waste stream includes one or more RCRA F-numbers identified via acceptable knowledge, toxicity characteristic contaminants associated with the F-number waste(s) are not included in the RCRA-toxicity characteristic determination. That is, the F-numbers take precedence over RCRA-toxicity D-number, and the waste stream is assumed hazardous regardless of the concentration. Therefore, toxicity characteristics contaminants associated with F-numbers for a waste stream shall be omitted from all calculations for determining the number of containers to sample because these wastes streams are assumed to be hazardous. In addition, each toxicity characteristic contaminant associated with the F-number(s) shall be excluded from evaluation of analytical results to determine D-numbers. Contaminants of interest for the sampling, analysis, and RCRA-toxicity determination of a waste stream, then, excludes contaminants associated with F-numbers that have been assigned to the waste stream.

The sampling and analysis strategy is illustrated in Figure B2-1. Preliminary estimates of the mean concentration and variance of each RCRA regulated contaminant in the waste will be used to determine the number of waste containers to select for sampling and analysis. Preliminary estimates will be based on a minimum of five samples selected randomly from the waste stream. If the entire waste stream is not accessible for sampling then a minimum of five preliminary samples will be selected randomly from the accessible population. As the rest of the waste stream is retrieved or generated, additional selected containers will be sampled as provided below and the analytical results will be reported to the Permittees. Samples collected to establish preliminary estimates that are selected, sampled, and analyzed using a Permittee approved laboratory in accordance with applicable provisions of the WAP may be used as part of the required number of samples to be collected. The applicability of the preliminary estimates to the waste stream to be sampled shall be justified and documented. The preliminary estimates will be determined in accordance with the following equations:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad \text{(B2-1)}$$

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2 \qquad \text{(B2-2)}$$

Where:

$\bar{x}$ = the calculated mean.
s^2 = the calculated concentration variance.
n = the number of samples analyzed.
x_i = the concentration determined in the *ith* sample.
i = an index from 1 to n.

Based upon the preliminary estimates of $\bar{x}$ and s^2 for each chemical contaminant of concern, estimate the appropriate minimum number of samples (*n*) to be collected for each contaminant using the following formula from SW-846 (EPA 1996):

$$n = \frac{t^2_{a,n_O-1} s^2}{\left(RT - \bar{x}\right)^2} \qquad \text{(B2-3)}$$

Where:

n_0 = the initial number of samples used to calculate the preliminary estimates.
n = the calculated minimum number of samples to be collected.
$t_{\alpha,n-1}$ = the 90th percentile for the t distribution with n_0-1 degrees of freedom.
RT = the Regulatory Threshold of the contaminant (TC limit for toxicity characteristic wastes, PRQL for listed wastes)

The number of samples to be collected will be based upon the largest n calculated for each of the contaminants of concern. The actual number of samples collected shall be adjusted as necessary to ensure that an adequate number of samples are collected to allow for acceptable levels of completeness.

Non-integer results of calculations for the required sample size should be rounded up to the next integer. A minimum of five containers shall be sampled and analyzed in each waste stream. If there are fewer containers than the minimum or required number of samples in a waste stream, one or more randomly selected containers shall be sampled more than once to obtain the number of needed samples of the waste. Otherwise any one container may be selected for sampling only once.

The calculated total number of required waste containers will then be randomly sampled and analyzed using a Permittee approved laboratory. Waste container samples from the preliminary mean and variance estimates may be counted as part of the total number of calculated required samples if and only if:

- There is documented evidence that the waste containers for the preliminary estimate samples were selected in the same random manner as is chosen for the required samples.

- There is documented evidence that the method of sample collection in the preliminary estimate samples were identical to the methodology to be employed for the required samples.

- There is documented evidence that the method of sample analysis in the preliminary estimate samples were identical to the analytical methodology employed for the required samples.

- There is documented evidence that the validation of the sample analyses in the preliminary estimate samples were comparable to the validation employed for the required samples. In addition, the validated samples results shall indicate that all sample results were valid according to the analytical methodology.

If only a portion of a waste stream is accessible for sampling (e.g., the remainder of the waste stream will be recovered from storage at the generator/storage site, or only a portion of the waste stream has been repackaged, treated, or generated), the calculated number of samples will be randomly selected from the accessible portion of the waste stream. A minimum of five randomly selected samples will be obtained and analyzed from the accessible portion of the waste stream. The Permittees may approve the WSPF and authorize the generator/storage site to begin shipping the waste stream to WIPP once the analytical data for the randomly selected samples from the accessible portion of the waste stream have been obtained.

The generator/storage site will also randomly select the calculated number of sample locations from the waste stream as a whole. A minimum of five randomly selected sample locations will be selected from the waste stream as a whole. As those randomly selected locations (e.g., buried or newly generated waste containers) become accessible for sampling, samples will be obtained and analyzed.

For those waste streams where the population of the waste stream as a whole is indeterminate (e.g., continually generated waste streams from ongoing processes) or to facilitate waste processing, the generator/storage site may divide the waste stream into lots. In this case, a minimum of five randomly selected sample locations will be selected from within each subsequent lot. As those randomly selected locations (e.g., buried or newly generated waste containers) become accessible, samples will be obtained and analyzed. As with sampling from the waste stream as a whole, the generator/storage site may ship waste from the lot being generated or retrieved prior to completing sampling and analysis of the lot.

The generator/storage site will use the data to update the UCL_{90} values for the waste stream as described in Section B2-2a and assign EPA hazardous waste numbers as appropriate. The generator/storage sites will submit the analytical data from subsequent sampling to the Permittees for inclusion in the WIPP facility operating record upon completion of project level data validation in Permit Attachment B3, Section B3-10b. If changes to EPA hazardous waste numbers are required as a result of subsequent sampling, the generator/storage site will notify the Permittees and shipments of the affected waste stream shall be suspended until the Permittees approve a revised WSPF for the affected waste stream.

Upon collection and analysis of the preliminary samples, or at any time after the preliminary samples have been analyzed, the generator/storage site may presumptively assign hazardous waste numbers to a waste stream even if the calculated number of required samples is greater than the preliminary number of samples collected. For waste streams with calculated upper confidence limits below the regulatory threshold, the site shall collect the required number of samples if the site intends to establish that the constituent is below the regulatory threshold.

B2-1b Statistical Selection of Containers for Headspace Gas Analysis

Headspace gas sampling of a waste stream may be done on a randomly selected portion of containers in the waste stream. The minimum number of containers, n, that must be sampled is determined by taking an initial VOC sample from ten randomly selected containers. These samples are analyzed for all the target analytes analytes using a Permittee approved laboratory. The standard deviation, s, is calculated for each of the nine VOCs in Module IV, Table IV.D.1. The value of n is determined as the largest number of samples (not to exceed the number of containers in the waste stream or waste stream lot) calculated using the following equation:

$$n_{voc_i} = \frac{t^2_{\alpha,n-1} s^2 e_{voc_i}}{E^2_{voc_i}} \tag{B2-4}$$

Where:

n_{voci} = the number of samples needed to representatively sample the waste stream for the VOC $_i$ from Table IV.D.1
$t_{\alpha,n-1}$ = the 90th percentile of the *t* distribution with *n*-1 degrees of freedom
s_{evoci} = the estimated standard deviation, based on the initial *n* samples, for VOC $_i$ from Table IV.D.1
E_{voci} = the allowable error determined as 1 percent of the limiting concentration for VOC $_i$ from Table IV.D.1

Non-integer results of calculations for the required sample size should be rounded up to the next integer. A minimum of ten containers shall be sampled and analyzed in each waste stream. If there are fewer containers than the minimum or required number of samples in a waste stream, then each container should be sampled once.

The calculated total number of required waste containers will then be randomly sampled and analyzed. Waste container samples from the preliminary mean and variance estimates may be counted as part of the total number of calculated required samples if and only if:

- There is documented evidence that the waste containers for the preliminary estimate samples were selected in the same random manner as is chosen for the required samples.
- There is documented evidence that the method of sample collection in the preliminary estimate samples were identical to the methodology to be employed for the required samples.
- There is documented evidence that the method of sample analysis in the preliminary estimate samples were identical to the analytical methodology employed for the required samples.
- There is documented evidence that the validation of the sample analyses in the preliminary estimate samples were comparable to the validation employed for the required samples. In addition, the validated samples results shall indicate that all sample results were valid according to the analytical methodology.

The mean and standard deviation calculated after sampling *n* containers can be used to calculate a UCL_{90} for each of the headspace gas VOCs using the methodology presented in Section B2-2b.

If only a portion of a waste stream is accessible for sampling (e.g., the remainder of the waste stream will be recovered from storage at the generator/storage site or only a portion of the waste stream has been repackaged or treated), the calculated number of samples will be randomly selected from the accessible portion of the waste stream. A minimum of ten randomly selected samples will be obtained and analyzed from the accessible portion of the waste stream. The Permittees may approve the WSPF and authorize the generator/storage site to begin shipping the waste stream to WIPP once the analytical data for the randomly selected samples from the accessible portion of the waste stream has been obtained.

The generator/storage site will also randomly select the calculated number of sample locations from the waste stream as a whole. A minimum of ten randomly selected sample locations will be selected from the waste stream as a whole. As those randomly selected locations (e.g., buried or newly generated waste containers) become accessible for sampling, samples will be obtained and analyzed.

For those waste streams where the population of the waste stream as a whole is indeterminate (e.g., continually generated waste streams from ongoing processes) or to facilitate waste processing, the generator/storage site may divide the waste stream into lots. In this case, a minimum of ten randomly selected containers will be selected from within each subsequent lot. As those randomly selected containers (e.g., buried or newly generated waste containers) become accessible, samples will be obtained and analyzed. As with sampling from the waste stream as a whole, the generator/storage site may ship waste from the lot being generated or retrieved prior to completing sampling and analysis of the lot.

The generator/storage site will use the data to update the UCL_{90} values for the waste stream as described in Section B2-2b and assign EPA hazardous waste numbers as appropriate. The generator/storage sites will submit the analytical data from subsequent sampling to the Permittees for inclusion in the WIPP facility operating record upon completion of project level data validation in Permit Attachment B3, Section B3-10b. If changes to EPA hazardous waste numbers are required as a result of subsequent sampling, the generator/storage site will notify the Permittees, and shipments of the affected waste stream shall be suspended until the Permittees approve a revised WSPF for the affected waste stream.

Upon collection and analysis of the preliminary samples, or at any time after the preliminary samples have been analyzed, the generator/storage site may presumptively assign hazardous waste numbers to a waste stream even if the calculated number of required samples is greater than the preliminary number of samples collected. For waste streams with calculated upper confidence limits below the regulatory threshold, the site shall collect the required number of samples if the site intends to establish that the constituent is below the regulatory threshold.

B2-2 Upper Confidence Limits for Statistical Sampling

B2-2a Upper Confidence Limit for Statistical Solid Sampling

Upon completion of the required sampling, final mean and variance estimates and the UCL_{90} for the mean concentration for each contaminant shall be determined. The observed sample n^* shall be checked against the preliminary estimate for the number of samples (n) to be collected before proceeding, where n* is:

$$n^* = \frac{t^2{}_{a,n-1} s^2}{\left(RT - \bar{x}\right)^2} \qquad \text{(B2-5)}$$

and the right-side terms in the equation are as defined in Section B2-1a.

If the observed sample *n** estimate results in greater than 20 percent or more required samples than were originally calculated, then the additional samples required to fulfill the revised sample estimate shall be collected and analyzed. The determination of *n** is an iterative process that follows the collection and analysis of any additional samples and continues until the difference between *n** and the previous sample size determination is less than 20 percent.

Once sufficient sampling and analysis has occurred, the waste characterization will proceed. The assessment will be made at the 90 percent confidence level. The UCL_{90} for the mean concentration of each contaminant will be calculated using the following equation from OSWER 9285.6-10 (EPA 2002):

$$UCL_{90} = \bar{x} + \frac{t_{a,n-1} s}{\sqrt{n}} \qquad \text{(B2-6)}$$

If the UCL_{90} for the mean concentration is less than the regulatory threshold limit, the waste stream is not required to be assigned the hazardous waste number for the associated contaminant. If the UCL_{90} is greater than or equal to the regulatory threshold limit, the waste stream will be assigned the hazardous waste number for the associated contaminant.

B2-2b Upper Confidence Limit for Statistical Headspace Gas Sampling

A UCL_{90} concentration for each of the headspace gas VOCs must be calculated from the sample data collected. The observed sample *n** shall be checked against the estimate for the number of samples (n) to be collected before proceeding, where n* is:

$$n^* = \frac{t^2{}_{a,n-1} s^2}{E^2} \qquad \text{(B2-7)}$$

where *E* is as defined in Section B2-1b and the remaining right-side terms in the equation are defined in Section B2-1a. When composite headspace gas sample results are used, the mean, standard deviation, and t-statistic are based on the number of composite samples analyzed, rather than the number of containers sampled.

If the observed sample *n** estimate results in greater than 20 percent or more required samples than were originally calculated, then the additional samples required to fulfill the revised sample estimate shall be collected and analyzed. The determination of *n** is an iterative process that follows the collection and analysis of any additional samples and continues until the difference between *n** and the previous sample size determination is less than 20 percent. The UCL_{90} is then calculated using equation B2-6. In this case, UCL_{90} is the 90 percent upper confidence limit for the mean VOC concentration, $\bar{x}$ is the calculated sample mean VOC concentration and s is the calculated sample standard deviation. The value of $t_{(\alpha,n-1)}$ is found in Table 9-2 of Chapter 9 of SW-846 (EPA, 1996).

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FIGURES

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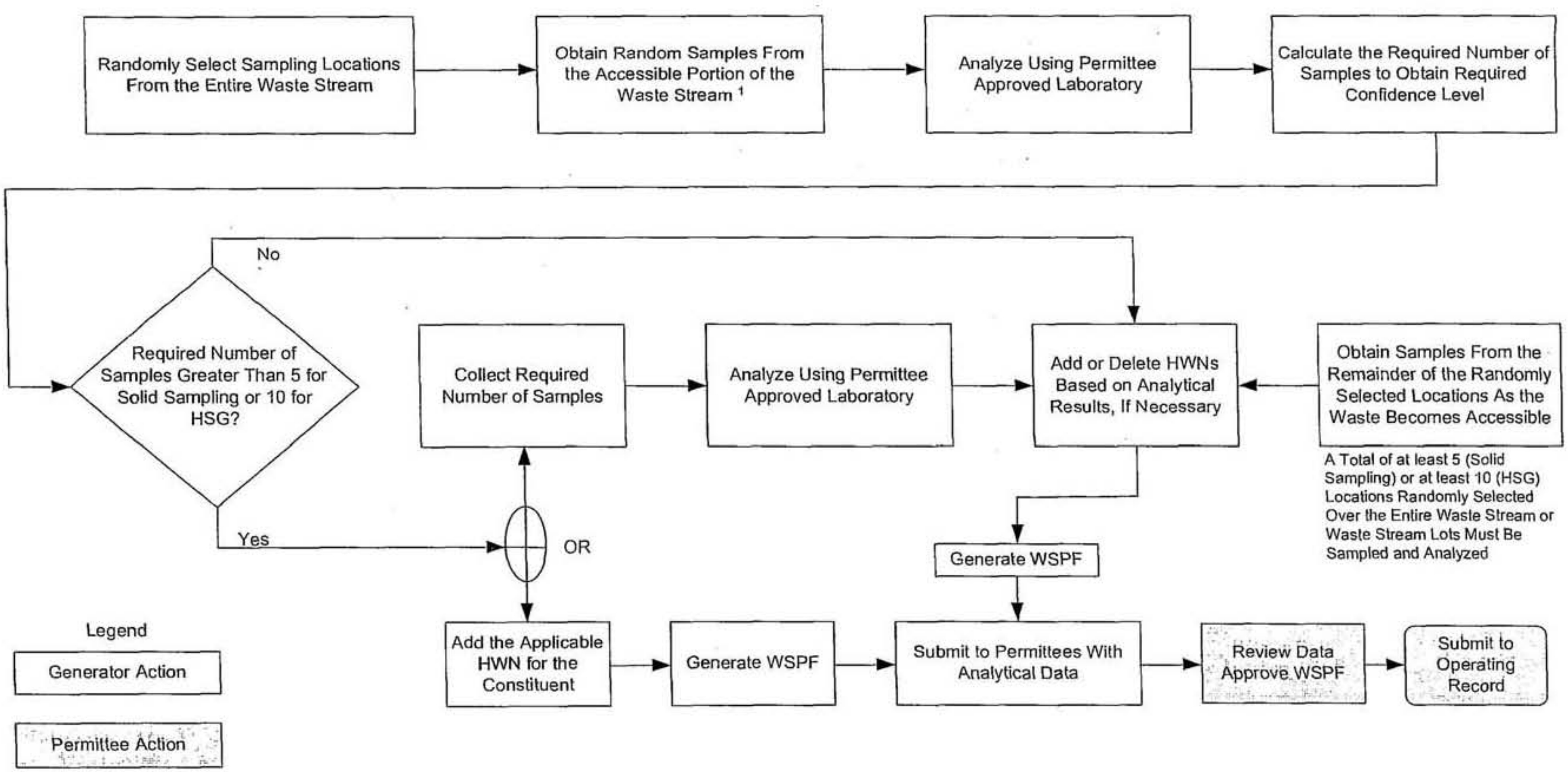

[1] Samples Are Obtained From the First Five Accessible Random Locations for Solid Sampling and the First Ten Accessible Random Locations for Headspace Gas Sampling

Figure B2-1
Approach for Solid and Headspace Gas Sampling and Analysis to Obtain Additional Waste Characterization Information

APPENDIX B3

QUALITY ASSURANCE OBJECTIVES AND DATA VALIDATION TECHNIQUES FOR WASTE CHARACTERIZATION SAMPLING AND ANALYTICAL METHODS

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APPENDIX B3

QUALITY ASSURANCE OBJECTIVES AND DATA VALIDATION TECHNIQUES FOR WASTE CHARACTERIZATION SAMPLING AND ANALYTICAL METHODS

TABLE OF CONTENTS

List of Tables

List of Figures

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APPENDIX B3

QUALITY ASSURANCE OBJECTIVES AND DATA VALIDATION TECHNIQUES FOR WASTE CHARACTERIZATION SAMPLING AND ANALYTICAL METHODS

B3-1 Validation Methods

The Permittees shall require the generator/storage sites (**sites**) to perform validation of all data (qualitative as well as quantitative) so that data used for Waste Isolation Pilot Plant (**WIPP**) compliance programs will be of known and acceptable quality. Validation includes a quantitative determination of precision, accuracy, completeness, and method detection limits (as appropriate) for analytical data (headspace Volatile Organics Compounds (**VOC**), total VOCs, Semivolatile Organic Compounds (**SVOC**), and metals data). Quantitative data validations shall be performed according to the conventional methods outlined below (equations B3-1 through B3-8). These quantitative determinations will be compared to the Quality Assurance Objectives (**QAOs**) specified in Sections B3-2 through B3-9. A qualitative determination of comparability and representativeness will also be performed.

The qualitative data or descriptive information generated by radiography and visual examination is not amenable to statistical data quality analysis. However, radiography and visual examination are complementary techniques yielding similar data for determining the waste matrix code. The waste matrix code is determined to ensure that the container is properly included in the appropriate waste stream.

Data validation will be used to assess the quality of waste characterization data collected based upon project precision, accuracy, completeness, comparability, and representativeness objectives. These objectives are described below:

Precision

Precision is a measure of the mutual agreement among multiple measurements of a single analyte, either by the same method or by different methods. Precision is either expressed as the relative percent difference (**RPD**) for duplicate measurements or as the percent relative standard deviation **(%RSD**) for three or more replicate measurements. For duplicate measurements, the precision expressed as the RPD is calculated as follows:

$$RPD = \frac{C_1 - C_2}{\frac{(C_1 + C_2)}{2}} \times 100 \qquad \text{(B3-1)}$$

where C_1 and C_2 are the two values obtained by analyzing the duplicate samples. C_1 is the larger of the two observed values.

For three or more replicate measurements, the precision expressed as the %RSD is calculated as follows:

$$\%RSD = \frac{s}{y_{mean}} \times 100 \qquad \text{(B3-2)}$$

where s is the standard deviation and y_{mean} is the mean of the replicate sample analyses.

The standard deviation, s, is calculated as follows:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(y_i - y_{mean})^2}{n - 1}} \qquad \text{(B3-3)}$$

where y_i is the measured value of the *i*th replicate sample analysis measurement, and n equals the number of replicate analyses.

Another aspect of precision is associated with analytical equipment calibration. In these instances, the percent difference (**%D**) between multiple measurements of an equipment calibration standard shall be calculated as follows:

$$\%D = \frac{|C_1 - C_2|}{C_1} \times 100 \qquad \text{(B3-4)}$$

where C_1 is the initial measurement and C_2 is the second or other additional measurement.

<u>Accuracy</u>

Accuracy is the degree of agreement between a measured analyte concentration (or the average of replicate measurements of a single analyte concentration) and the true or known concentration. Accuracy is determined as the percent recovery (**%R**).

For situations where a standard reference material is used, the %R is calculated as follows:

$$\%R = \frac{C_m}{C_{srm}} \times 100 \qquad \text{(B3-5)}$$

where C_m is the measured concentration value obtained by analyzing the sample and C_{srm} is the "true" or certified concentration of the analyte in the sample.

For measurements where matrix spikes are used, the %R is calculated as follows:

$$\%R = \frac{S - U}{C_{SC}} \times 100 \qquad \text{(B3-6)}$$

where S is the measured concentration in the spiked aliquot, U is the measured concentration in the unspiked aliquot, and C_{sc} is the actual concentration of the spike added.

<u>Method Detection Limit</u>

The method detection limit (**MDL**) is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The MDL for all quantitative measurements (except for those using Fourier Transform Infrared Spectroscopy [**FTIRS**]) is defined as follows:

$$MDL = t_{(n-1,1-\alpha=.99)} \times s \qquad \text{(B3-7)}$$

where $t_{(n-1,1-\alpha=.99)}$ is the t-distribution value corresponding to a 99 percent confidence level with n-1 degrees of freedom, n is the number of observations, and s is the standard deviation of replicate measurements.

For headspace-gas analysis using FTIRS, MDL is defined as follows:

$$\text{MDL} = 3\text{s} \qquad \text{(B3-8)}$$

where s is the standard deviation. Initially, a minimum of seven samples spiked at a level of three to five times the estimated MDL and analyzed on non-consecutive days must be used to establish the MDLs. MDLs should be updated using the results of the laboratory control sample or on-line control samples.

<u>Completeness</u>

Completeness is a measure of the amount of valid data obtained from the overall measurement system compared to the amount of data collected and submitted for analysis. Completeness must be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. Completeness, expressed as the percent complete (**%C**), is calculated as follows:

$$\%C = \frac{V}{n} \times 100 \qquad \text{(B3-9)}$$

where V is the number of valid sampling or analytical results obtained and n is the number of samples submitted for analysis.

Comparability

Comparability is the degree to which one data set can be compared to another. Comparability of data generated at different sites will be ensured through the use of standardized, approved testing, sampling, preservation, and analytical techniques and by meeting the QAOs specified in Sections B3-2 through B3-9.

The comparability of waste characterization data shall be ensured through the use of generator/storage site data usability criteria. The Permittees shall ensure that data usability criteria are consistently established and used by the generator/storage sites to assess the usability of analytical and testing data. The criteria shall address. as appropriate, the following:

- Definition or reference of criteria used to define and assign data qualifier flags based on Quality Assurance Objective results,
- Criteria for assessing the useability of data impacted by matrix interferences,
- Criteria for assessing the useability of data based upon positive and negative bias as indicated by quality control data, of data qualifiers, and qualifier flags,
- Criteria for assessing the useability of data due to
    - Severe matrix effects,
    - Misidentification of compounds,
    - Gross exceedance of holding times,
    - Failure to meet calibration or tune criteria
- Criteria for assessing the useability of data that does not meet minimum detection limit requirements.

The Permittees shall be responsible for evaluating generator/storage site data useability and shall assess implementation through the generator/storage site audit.

Representativeness

Representativeness is the degree to which sample data represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that concerns the proper design of the sampling program.

Representativeness of waste containers from waste streams subjected to headspace gas, homogeneous solids, and soil/gravel sampling and analysis will be validated, through documentation, that a true random sample with an adequate population was identified and collected consistent with Permit Attachment B2, Section B2-1. Since representativeness is a quality characteristic that expresses the degree to which a sample or group of samples represents the population being studied, the random selection of waste containers ensures representativeness on a Program level. The Permittees shall require the Site Project Manager to document that the selected waste containers from within a waste stream were randomly selected. Sampling personnel shall verify that proper procedures are followed to ensure that samples are representative of the waste contained in a particular waste container or a waste stream.

Identification of Tentatively Identified Compounds

In accordance with SW-846 convention, identification of compounds detected by gas chromatography/mass spectrometry methods that are not on the list of target analytes shall be reported. Both composited and individual container headspace gas, volatile analysis (TCLP/Totals), and semi-volatile (TCLP/Totals) shall be subject to tentatively identified compound (**TIC**) reporting. These TICs for GC/MS Methods are identified in accordance with the following SW-846 criteria:

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within ± 20 percent.
- Molecular ions present in the reference spectrum should be present in the sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.
- Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks.
- The reference spectra used for identifying TICs shall include, at minimum, all of the available spectra for compounds that appear in the 20.4.1.200 NMAC (incorporating 40 CFR Part 261) Appendix VIII list. The reference spectra may be limited to VOCs when analyzing headspace gas samples.
- TICs for headspace gas analyses that are performed through FTIR analyses shall be identified in accordance with the specifications of SW-846 Method 8410.

TICs shall be reported as part of the analytical batch data reports for GC/MS Methods in accordance with the following minimum criteria:

- a TIC in an individual container headspace gas or solids sample shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 10% of the area of the nearest internal standard.

- a TIC in a composited headspace gas sample that contains 2 to 5 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 2% of the area of the nearest internal standard.

- a TIC in a composited headspace gas sample that contains 6 to 10 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 1% of the area of the nearest internal standard.

- a TIC in a composited headspace gas sample that contains 11 to 20 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 0.5% of the area of the nearest internal standard.

TICs that meet the SW-846 identification criteria, are reported in 25 percent of all waste containers sampled from a given waste stream, and that appear in the 20.4.1.200 NMAC (incorporating 40 CFR §261) Appendix VIII list, will be compared to acceptable knowledge data to determine if the TIC is a listed waste in the waste stream. TICs identified through headspace gas analyses that meet the Appendix VIII list criteria and the 25 percent reporting criteria for a waste stream will be added to the headspace gas waste stream target list regardless of the hazardous waste listing associated with the waste stream. TICs reported from the Totals VOC or SVOC analyses may be excluded from the target analyte list for a waste stream if the TIC is a constituent in an F-listed waste whose presence is attributable to waste packaging materials or radiolytic degradation from acceptable knowledge documentation. If a listed waste constituent TIC cannot be attributed to waste packaging materials, radiolysis, or other origins, the constituent will be added to the target analyte list and new hazardous waste numbers will be assigned, if appropriate. TICs subject to inclusion on the target analyte list that are toxicity characteristic parameters shall be added to the target analyte list regardless of origin because the hazardous waste designation for these numbers is not based on source. However, for toxicity characteristic and non-toxic F003 constituents, the site may take concentration into account when assessing whether to add a hazardous waste number. If a target analyte list for a waste stream is expanded due to the presence of TICs, all subsequent samples collected from that waste stream will be analyzed for constituents on the expanded list.

B3-2 Headspace-Gas Sampling

Quality Assurance Objectives

The precision and accuracy of the container headspace-gas sampling operations must be assessed by analyzing field QC headspace-gas samples. These samples must include equipment blanks, field reference standards, field blanks, and field duplicates. If the QAOs described below are not met, a nonconformance report must be prepared, submitted, and resolved (Section B3-13).

Precision

The precision of the headspace-gas sampling and analysis operation must be assessed by sequential collection of field duplicates for manifold sampling operations or simultaneous collection of field duplicates for direct canister sampling operations for VOCs determination. Corrective actions must be taken if the RPD exceeds 25 percent for any analyte found greater than the PRQL in both of the duplicate samples.

Accuracy

A field reference standard must be collected using headspace-gas sampling equipment to assess the accuracy of the headspace-gas sampling operation at a frequency of one field reference standard for every 20 containers sampled or per sampling batch. Corrective action must be taken if the %R of the field-reference standard is less than 70 or greater than 130.

Field blanks must also be collected at a frequency of 1 field blank for every 20 containers or sampling batch sampled to assess possible contamination in the headspace gas sampling method. Equipment blanks must also be collected at a frequency of 1 equipment blank for each equipment cleaning batch to assess possible contamination in the equipment cleaning method. Corrective actions must be taken if the blank exceeds three times the MDLs listed for any of the compounds listed in Table B3-2.

Completeness

Sampling completeness shall be expressed as the number of valid samples collected as a percent of the total number of samples collected for each waste stream A valid sample is defined as a sample collected in accordance with approved sampling methods and the container was properly prepared for sampling (e.g., the polyliner was vented to the container headspace). The Permittees shall require participating sampling facilities to achieve a minimum 90 percent completeness. The amount and type of data that may be lost during the headspace-gas sampling operation cannot be predicted in advance. The Permittees shall require the Site Project Manager to evaluate the importance of any lost or contaminated headspace-gas samples and take corrective action as appropriate.

Comparability

Consistent use and application of uniform procedures and equipment, as specified in Permit Attachment B1 and application of data useability criteria, should ensure that headspace gas sampling operations are comparable when sampling headspace at the different sampling facilities. The Permittees shall require each site to take corrective actions if uniform procedures, equipment, or operations are not followed without approved and justified deviations. In addition, laboratories analyzing samples must successfully participate in the Performance Demonstration Program (**PDP**) (DOE, 2003).

Representativeness

Specific headspace-gas sampling steps to ensure samples are representative include:

- Selection of the correct Drum Age Criteria (**DAC**) Scenario and waste packaging configuration and meeting DAC equilibrium times.
- A sample canister cleaning and leak check after assembly
- Sampling equipment cleaning or disposal after use
- Sampling equipment leak check after sample collection
- Use of sample canisters with passivated internal surfaces
- Use of low-internal-volume sampling equipment
- Collection of samples with a low-sample volume to available headspace volume ratio (less than 10 percent of the headspace when the headspace can be determined)
- Careful and documented pressure regulation of all activities specified in Attachment B1, Section B1-1
- Performance audits
- Collection of equipment blanks, field reference standard, field blanks, and field duplicates at the specified frequencies.
- Manifold pressure sensors and temperature sensors calibrated before initial use and annually using NIST, or equivalent standards.
- OVA calibrated daily, prior to first use, or as necessary according to manufacturers specifications.

Failure to perform the checks at the prescribed frequencies would result in corrective actions.

B3-3 Sampling of Homogeneous Solids and Soils/Gravel

Quality Assurance Objectives

To ensure that sampling is conducted in a representative manner on a waste-stream basis for waste containers containing homogeneous solids and soil/gravel, samples must be collected randomly in both the horizontal and vertical planes of each container's waste. For waste containers that contain homogeneous solids and soil/gravel in smaller containers (e.g., 1 gal [4.0 L] poly bottles) within the waste container, one randomly chosen smaller container must be sampled from each container.

Precision

Sampling precision must be determined by collecting and sampling field duplicates (e.g., co-located cores or co-located samples as described in Permit Attachment B1-2b(1)) once per sampling batch or once per week during sampling operations, whichever is more frequent. A sampling batch is a suite of homogeneous solids and soil/gravel samples collected consecutively using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding field QC samples), all of which must be collected within 14 days of the first sample in the batch. The Permittees shall require the Site Project Manager to calculate and report the RPD between co-located core/samples.

The recommended method for establishing acceptance criteria for co-located cores and co-located samples is the F-test method because the F-Test: 1) does not require potentially arbitrary groupings into batches, 2) is based on exact distributions, and 3) is more likely to detect a change in the process. When a sufficient number of samples are collected (25 to 30 pairs of co-located cores or samples), control charts of the RPD will be developed for each constituent and for each waste matrix or waste type (e.g., pyrochemical salts or organic sludges). The limits for the control chart will be three standard deviations above or below the average RPD. Once constructed, RPDs for additional co-located pairs will be compared with the control chart to determine whether or not the co-located cores are acceptable. Periodically, the control charts will be updated using all available data.

The statistical test will involve calculating the variance for co-located cores and samples by pooling the variances computed for each pair of duplicate results. The variance for the waste stream will be computed excluding any data from containers with co-located cores, because the test requires the variance estimates to be independent. All data must be transformed to normality prior to computing variances and performing the test. The test hypothesis is evaluated using the F distribution and the method for testing the difference in variances.

Accuracy

Sampling accuracy through the use of standard reference materials shall not be measured. Because waste containers containing homogeneous solids and soil/gravel with known quantities of analytes are not available, sampling accuracy cannot be determined. However, sampling methods and requirements described are designed to minimize sample degradation and hence maximize sampling accuracy.

Sampling accuracy as a function of sampling cross-contamination will be measured. Equipment blanks will be collected at a frequency of once per equipment cleaning batch. Corrective actions must be taken if the blank exceeds three times the MDLs (PRDLs for metals) listed for any of the compounds or analytes listed in Tables B3-4, B3-6, and B3-8. Equipment blanks will be collected from the following equipment types:

- Fully assembled coring tools
- Liners cleaned separately from coring tools
- Miscellaneous sampling equipment that is reused (bowls, spoons, chisels)

Completeness

Sampling completeness shall be expressed as the number of valid samples collected as a percent of the total number of samples collected for each waste stream. A valid sample is any sample that is collected from a randomly selected container using randomly selected horizontal and vertical planes in accordance with approved sampling methods. The Permittees shall require participating sampling facilities to achieve a minimum 90 percent completeness.

Comparability

Consistent use and application of uniform procedures, sampling equipment, and measurement units must ensure that sampling operations are comparable. Consistent application of data useability criteria will also ensure comparability. In addition, the Permittees shall require laboratories analyzing samples to successfully participate in the PDP (DOE, 2005).

Representativeness

Specific steps to ensure the representativeness of samples include the following for both waste containers and smaller containers:

- Coring tools and sampling equipment must be clean prior to sampling.
- The entire depth of the waste minus a site defined approved safety factor must be cored, and the core collected must have a length greater than or equal to 50 percent of the depth of the waste. This is called the core recovery and is calculated as follows:

$$\textit{Core recovery (percent)} = \frac{y}{x} \times 100 \qquad \text{(B3-10)}$$

where

x = the depth of the waste in the container
y = the length of the core collected from the waste.

- Coring operations and tool selection should be designed to minimize alteration of the in-place waste characteristics. Minimal waste disturbance must be verified by visually examining the core and describing the observation (e.g., undisturbed, cracked, or pulverized) in the field logbook.

  If core recovery is less than 50 percent of the depth of the waste, a second coring location shall be randomly selected. The core with the best core recovery shall be used for sample collection.

One randomly selected container within a container will be chosen if the container contains individual waste containers.

B3-4 Non Destructive Examination Methods

Quality Assurance Objectives

The QAOs for non destructive examination (**NDE**) are detailed in this section. NDE can be either radiography or visual examination (**VE**). If the QAOs described below are not met, then corrective action shall be taken. It should be noted that NDE does not have a specific MDL because it is primarily a qualitative determination. The objective of NDE for the program is to determine the physical waste form, the absence of prohibited items, and additional waste characterization techniques that may be used based on the Summary Category Groups (i.e., S3000, S4000, S5000). The Permittees shall require each site to describe all activities required to achieve these objectives in the site quality assurance project plan (**QAPjP**) and standard operating procedures (**SOP**).

B3-4a Radiography

Data to meet these objectives must be obtained from a video and audio recorded scan provided by trained radiography operators at the sites. Results must also be recorded on a radiography data form. The precision, accuracy, completeness, and comparability objectives for radiography data are presented below.

Precision

Precision is maintained by reconciling any discrepancies between two radiography operators with regard to identification of the waste matrix code, liquids in excess of TSDF-WAC limits, and compressed gases through independent replicate scans and independent observations. Additionally, the precision of radiography is verified prior to use by tuning precisely enough to demonstrate compliance with QAOs through viewing an image test pattern.

Accuracy

Accuracy is obtained by using a target to tune the image for maximum sharpness and by requiring operators to successfully identify 100 percent of the required items in a training container during their initial qualification and subsequent requalification.

Completeness

A video and audio media recording of the radiography examination and a validated radiography data form will be obtained for 100 percent of the waste containers subject to radiography. All video and audio media recordings and radiography data forms will be subject to validation as indicated in Section B3-10.

Comparability

The comparability of radiography data from different operators shall be enhanced by using standardized radiography procedures and operator qualifications.

B3-4b Visual Examination

Results must be recorded on a VE data form. The precision, accuracy, completeness, and comparability objectives for VE data are presented below.

Precision

Precision is maintained by reconciling any discrepancies between the operator and the independent technical reviewer with regard to identification of waste matrix code, liquids in excess of TSDF-WAC limits, and compressed gases.

Accuracy

Accuracy is maintained by requiring operators to pass a comprehensive examination and demonstrate satisfactory performance in the presence of the VE expert during their initial qualification and subsequent requalification.

Completeness

A validated VE data form will be obtained for 100 percent of the waste containers subject to VE.

Comparability

The comparability of VE data from different operators shall be enhanced by using standardized VE procedures and operator qualifications.

B3-5 Gas Volatile Organic Compound Analysis

Quality Assurance Objectives

The development of data quality objective (**DQOs**) specifically for this program has resulted in the QAOs listed in Table B3-2. The specified QAOs represent the required quality of data necessary to draw valid conclusions regarding program objectives. WAP-required limits, such as the program required quantitation limits (**PRQL**) associated with VOC analysis, are specified to ensure that the analytical data collected satisfy the requirements of all data users. A summary of the Quality Control Samples and the associated acceptance criteria is included in Table B3-3. Key data-quality indicators for laboratory measurements are defined below.

Precision

Precision shall be assessed by analyzing laboratory duplicates and replicate analyses of laboratory-control samples and PDP blind-audit samples. Results from measurements on these samples must be compared to the criteria listed in Table B3-2. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Accuracy

Accuracy as %R shall be assessed for the laboratory operations by analyzing PDP blind-audit samples and laboratory-control samples. Results from these measurements must be compared to the criteria listed in Table B3-2. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Calibration

GC/MS Tunes, Initial Calibrations, and Continuing Calibration will be performed and evaluated using the procedures and criteria specified in Table B3-3. These criteria will be used to demonstrate acceptable calibration and to trigger corrective action when control limits are exceeded.

Method Detection Limit

MDLs shall be expressed in nanograms for VOCs and must be less than or equal to those listed in Table B3-2. MDLs shall be determined based on the method described in Section B3-1. The detailed procedures for MDL determination shall be included in site SOPs.

Program Required Quantitation Limit

Laboratories must demonstrate the capability to quantitate analytes at or below the PRQLs given in Table B3-2. Laboratories shall set the concentration of at least one calibration standard below the PRQL. The detailed procedures for PRQL demonstration shall be included in laboratory SOPs.

Completeness

Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. A composited sample is treated as one sample for the purposes of completeness, because only one sample is run through the analytical instrument. Valid results are defined as results that meet the data useability criteria based on application of the Quality Control Criteria specified in Tables B3-2 and B3-3; and meet the detection limit, calibration representativeness, and comparability criteria within this section. The Permittees shall require that participating laboratories meet the completeness criteria specified in Table B3-2.

Comparability

For VOC analysis, data generated through analysis of samples from different sites shall be comparable. The Permittees shall require each site to achieve comparability by using standardized methods and traceable standards and by requiring all sites to successfully participate in the PDP (DOE, 2003).

Representativeness

Representativeness for VOC analysis shall be achieved by collecting sufficient numbers of samples using clean sampling equipment that does not introduce sample bias. Samples must be collected as described in Permit Attachment B1.

B3-6 Total Volatile Organic Compound Analysis

Quality Assurance Objectives

The development of DQOs specifically for this program has resulted in the QAOs listed in Table B3-4. The specified QAOs represent the required quality of data necessary to draw valid conclusions regarding program objectives. WAP-required limits, such as the PRQL associated with VOC analysis, are specified to ensure that the analytical data collected satisfy the requirements of all data users. Key data-quality indicators for laboratory measurements are defined below.

Precision

Precision shall be assessed by analyzing laboratory duplicates or matrix spike duplicates, replicate analyses of laboratory control samples, and PDP blind-audit samples. Results from measurements on these samples must be compared to the criteria listed in Table B3-4. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Accuracy

Accuracy as %R shall be assessed for the laboratory operations by analyzing laboratory control samples, matrix spikes, surrogate compounds, and PDP blind-audit samples. Results from these measurements for matrix spikes samples must be compared to the %R criteria listed in Table B3-4. Results for surrogates and internal standards are evaluated as specified in the SW-846 method (EPA 1996) or Table B3-5. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Laboratory blanks shall be assessed to determine possible laboratory contamination and are evaluated as specified in Table B3-5. These QC measurements will be used to demonstrate acceptable levels of laboratory contamination and to trigger corrective action when control limits are exceeded.

Calibration

GC/MS Tunes, Initial Calibrations, and Continuing Calibration will be performed and evaluated using the procedures and criteria specified in Table B3-5 and the SW-846 method (EPA 1996). These criteria will be used to demonstrate acceptable calibration and to trigger corrective action when control limits are exceeded.

Method Detection Limit

MDLs shall be expressed in milligrams per kilogram (mg/kg) for VOCs and must be less than or equal to those listed in Table B3-4. The detailed procedures for MDL determination shall be included in site SOPs.

Program Required Quantitation Limit

Laboratories must demonstrate the capability to quantitate analytes in samples at or below the PRQLs given in Table B3-4. Laboratories shall set the concentration of at least one calibration standard below the PRQL. The detailed procedures for PRQL demonstration shall be included in laboratory SOPs.

Completeness

Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. Valid results are defined as results that meet the data useability criteria based upon application of the Quality Control Criteria specified in Tables B3-4 and B3-5 and meet the calibration, detection limit, representativeness, and comparability criteria within this section. Participating laboratories must meet the completeness criteria specified in Table B3-4.

Comparability

For VOC analysis, data generated through analysis of samples from different sites shall be comparable. The Permittees shall require sites to achieve comparability by using standardized SW-846 sample preparation and methods that meet the QAO requirements in Tables B3-4 and B3-5, traceable standards, and by requiring all sites to successfully participate in the PDP (DOE, 2005). Generator/storage sites may use the most recent version of SW-846. Any changes to SW-846 methodology that results in the elimination of sample preparation or analytical methods in use at generator/storage sites must be addressed as a corrective action to address the comparability of data before and after the SW-846 modification.

Representativeness

Representativeness for VOC analysis shall be achieved by collecting unbiased samples. Samples must be collected as described in Permit Attachment B1.

B3-7 Total Semivolatile Organic Compound Analysis

Quality Assurance Objectives

The development of DQOs specifically for this program has resulted in the QAOs listed in Table B3-6. The specified QAOs represent the required quality of data necessary to draw valid conclusions regarding program objectives. WAP-required limits, such as the PRQLs, are specified to ensure that the analytical data collected satisfy the requirements of all data users. A summary of Quality Control Samples and associated acceptance criteria for this analysis is included in Table B3-7. Key data-quality indicators for laboratory measurements are defined below.

Precision

Precision shall be assessed by analyzing laboratory duplicates or matrix spike duplicates, replicate analyses of laboratory control samples, and PDP blind-audit samples. Results from measurements on these samples must be compared to the criteria listed in Table B3-6. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Accuracy

Accuracy as %R shall be assessed for the laboratory operations by analyzing laboratory control samples, matrix spikes, surrogate compounds, and PDP blind-audit samples. Results from these measurements for matrix spikes samples must be compared to the %R criteria listed in Table B3-6. Results for surrogates and internal standards are evaluated as specified in the SW-846 method (EPA 1996) or Table B3-7. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Laboratory blanks shall be assessed to determine possible laboratory contamination and are evaluated as specified in Table B3-7. These QC measurements will be used to demonstrate acceptable levels of laboratory contamination and to trigger corrective action when control limits are exceeded.

Calibration

GC/MS Tunes, Initial Calibrations, and Continuing Calibration will be performed and evaluated using the procedures and criteria specified in Table B3-7 and the SW-846 method (EPA 1996). These criteria will be used to demonstrate acceptable calibration and to trigger corrective action when control limits are exceeded.

Method Detection Limit

MDLs shall be expressed in mg/kg for SVOCs and must be less than or equal to those listed in Table B3-6. The detailed procedures for MDL determination shall be included in site SOPs.

Program Required Quantitation Limit

Laboratories must demonstrate the capability to quantitate analytes in samples at or below the PRQLs given in Table B3-6. Laboratories shall set the concentration of at least one calibration standard below the PRQL. The detailed procedures for PRQL demonstration shall be included in laboratory SOPs.

Completeness

Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. Valid results are defined as results that meet the data useability criteria based on application of the Quality Control Criteria specified in Tables B3-6 and B3-7 and meet the detection limit, calibration, representativeness, and comparability criteria within this section. The Permittees shall require participating laboratories to meet the level of completeness specified in Table B3-6.

Comparability

For SVOC analysis, data generated through analysis of samples from different sites shall be comparable. The Permittees shall require sites to achieve comparability by using standardized SW-846 sample preparation and methods that meet the QAO requirements in Tables B3-6 and B3-7, traceable standards, and by requiring all sites to successfully participate in the PDP (DOE, 2005). Generator/storage sites may use the most current version of SW-846 if the methods are consistent with QAO requirements. Any changes to SW-846 methodology that results in the elimination of sample preparation or analytical methods in use at generator/storage sites must be addressed as a corrective action to address the comparability of data before and after the SW-846 modification.

Representativeness

Representativeness for SVOC analysis shall be achieved by collecting unbiased samples. Samples must be collected as described in Permit Attachment B1.

B3-8 Total Metal Analysis

Quality Assurance Objectives

The development of DQOs for the program has resulted in the QAOs listed in Table B3-8. The specified QAOs represent the required quality of data necessary to draw valid conclusions regarding program objectives. WAP-required limits, such as the PRQLs associated with metal analysis, are specified to ensure that the analytical data collected satisfy the requirements of all data users. A summary of Quality Control Samples and the associated acceptance criteria for this analysis is provided in Table B3-9. Key data-quality indicators for laboratory measurements are defined below.

Precision

Precision shall be assessed by analyzing laboratory sample duplicates or laboratory matrix spike duplicates, replicate analyses of laboratory-control samples, and PDP blind-audit samples. Results from measurements on these samples must be compared to the criteria listed in Table B3-8. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Accuracy

Accuracy shall be assessed through the analysis of laboratory matrix spikes, PDP blind-audit samples, serial dilutions, interference check samples, and laboratory-control samples. Results from these measurements must be compared to the criterion listed in Table B3-8 and B3-9. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Laboratory blanks and calibration blanks shall be assessed to determine possible laboratory contamination and are evaluated as specified in Table B3-9. These QC measurements will be used to demonstrate acceptable levels of laboratory contamination and to trigger corrective action when control limits are exceeded.

Calibration

Mass Tunes (for ICP MS only), Standards Calibration, Initial Calibration verifications, and Continuing Calibrations will be performed and evaluated using the procedures and criteria specified in Table B3-9 and the SW-846 method (EPA 1996). These criteria will be used to demonstrate acceptable calibration and to trigger corrective action when control limits are exceeded.

Program Required Detection Limits

PRDLs, expressed in units of micrograms per L (µg/L), are the maximum values for instrument detection limits (**IDL**) permissible for program support under the WAP. IDLs must be less than or equal to the PRDL for the method used to quantitate a specific analyte. Any method listed in Table B-5 of the Waste Analysis Plan (Permit Attachment B) may be used if the IDL meets this criteria. For high concentration samples, an exception to the above requirements may be made in cases where the sample concentration exceeds five times the IDL of the instrument being used. In this case, the analyte concentration may be reported even though the IDL may exceed the PRDL. IDLs shall be determined semiannually (i.e., every six months). Detailed procedures for IDL determination shall be included in laboratory SOPs.

Program Required Quantitation Limit

The Permittees shall require participating laboratories to demonstrate the capability of analyte quantitation at or below the PRQLs in units of mg/kg wet weight (given in Table B3-8). The

PRDLs are set an order of magnitude less than the PRQLs (assuming 100 percent solid sample diluted by a factor of 100 during preparation). The Permittees shall require participating laboratories to set the concentration of at least one QC or calibration standard at or below the solution concentration equivalent of the PRQL. Detailed calibration procedures shall be included in site SOPs.

Completeness

Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. Valid results are defined as results that meet the data useability criteria based upon application of the Quality Control Criteria specified in Tables B3-8 and B3-9 and meet the detection limit, calibration, representativeness, and comparability criteria within this section. The Permittees shall require participating laboratories to meet the completeness specified in Table B3-8.

Comparability

For metals analysis, data generated through analysis of samples from different sites shall be comparable. Comparability will be achieved by using standardized SW-846 sample preparation and methods that meet QAO requirements in Tables B3-8 and B3-9, demonstrating successful participation in the PDP (DOE, 2005), and use of traceable standards. Generator/storage sites may use the most recent SW-846 update. Any changes to SW-846 methodology that results in the elimination of sample preparation or analytical methods in use at generator/storage sites must be addressed as a corrective action to address the comparability of data before and after the SW-846 modification.

Representativeness

Representativeness for metals analysis shall be achieved by the collection of unbiased samples and the preparation of samples in the laboratory using representative and unbiased methods. Samples must be collected as described in Permit Attachment B1.

B3-9 Acceptable Knowledge

Acceptable knowledge documentation provides primarily qualitative information that cannot be assessed according to specific data quality goals that are used for analytical techniques. QAOs for analytical results are described in terms of precision, accuracy, completeness, comparability, and representativeness. Appropriate analytical and testing results may be used to augment the characterization of wastes based on acceptable knowledge. To ensure that the acceptable knowledge process is consistently applied, the Permittees shall require sites to comply with the following data quality requirements for acceptable knowledge documentation:

- Precision - Precision is the agreement among a set of replicate measurements without assumption of the knowledge of a true value. The qualitative determinations, such as compiling and assessing acceptable knowledge documentation, do not lend themselves to statistical evaluations of precision. However, the acceptable knowledge information will be addressed by the independent review of acceptable knowledge information during internal and external audits.

- Accuracy - Accuracy is the degree of agreement between an observed sample result and the true value. The percentage of waste containers which require reassignment to a new waste matrix code and/or designation of different hazardous waste numbers based on sampling and analysis data and discrepancies identified by the Permittees during waste confirmation will be reported as a measure of acceptable knowledge accuracy.

- Completeness - Completeness is an assessment of the number of waste streams or number of samples collected to the number of samples determined to be useable through the data validation process. The acceptable knowledge record must contain 100 percent of the required information (Permit Attachment B4-3). The useability of the acceptable knowledge information will be assessed for completeness during audits.

- Comparability - Data are considered comparable when one set of data can be compared to another set of data. Comparability is ensured through sites meeting the training requirements and complying with the minimum standards outlined for procedures that are used to implement the acceptable knowledge process. All sites must assign hazardous waste numbers in accordance with Permit Attachment B4-3b and provide this information regarding its waste to other sites who store or generate a similar waste stream.

- Representativeness - Representativeness expresses the degree to which sample data accurately and precisely represent characteristics of a population. Representativeness is a qualitative parameter that will be satisfied by ensuring that the process of obtaining, evaluating, and documenting acceptable knowledge information is performed in accordance with the minimum standards established in Permit Attachment B4. Sites also must assess and document the limitations of the acceptable knowledge information used to assign hazardous waste numbers (e.g., purpose and scope of information, date of publication, type and extent to which waste parameters are addressed).

The Permittees shall require each generator/storage site to comply with the nonconformance notification and reporting requirements of Section B3-13 if the results of sampling and analysis specified in Permit Attachment B are inconsistent with acceptable knowledge documentation.

The Permittees shall require each site to address quality control by tracking its performance with regard to the use of acceptable knowledge by: 1) assessing the frequency of inconsistencies among information, and 2) documenting acceptable knowledge inconsistencies identified through radiography, visual examination, headspace-gas analyses, and solidified waste analyses. In addition, the acceptable knowledge process and waste stream documentation must be evaluated through internal assessments by generator/storage site quality assurance organizations and assessments by auditors external to the organization (i.e., the Permittees).

B3-10 Data Review, Validation, and Verification Requirements

Procedures shall be developed for the review, validation, and verification of data at the data generation level; the validation and verification of data at the project level; and the verification of data at the Permittee level. Data review determines if raw data have been properly collected and ensures raw data are properly reduced. Data validation verifies that the data reported satisfy the requirements of this WAP and is accompanied by signature release. Data verification authenticates that data as presented represent the sampling and analysis activities as performed and have been subject to the appropriate levels of data review. The requirements presented in this section ensure that WAP records furnish documentary evidence of quality.

The Permittees shall require the sites to generate the following Batch Data Reports for data validation, verification, and quality assurance activities:

- A Testing Batch Data Report or equivalent includes all data pertaining to radiography or visual examination for up to 20 waste containers without regard to waste matrix. Table B3-11 lists all of the information required in Testing Batch Data Reports (identified with an “X”) and other information that is necessary for data validation, but is optional in Testing Batch Data Reports (identified with an “O”).

- A Sampling Batch Data Report or equivalent includes all sample collection data pertaining to a group of no more than 20 headspace gas or homogeneous waste samples that were collected for chemical analysis. Table B3-12 lists all of the information required in Sampling Batch Data Reports (identified with an “X”) and other information that is necessary for data validation, but is optional in Sampling Batch Data Reports (identified with an “O”).

- An Analytical Batch Data Report or equivalent includes analytical data from the analysis of TRU-mixed waste for up to 20 headspace gas or homogeneous waste samples. Analytical Batch Data Reports or equivalent that contain results for composited headspace gas samples must contain sufficient information to identify the containers that were composited for each composite sample and the sample volume that was taken from each waste container. Because Analytical Batch Data Reports are generated based on the number of samples analyzed, an Analytical Batch Data Report may contain results that are applicable to more than 20 containers depending on how many composite samples are part of the report, but may not exceed a total of 20 samples analyzed. Table B3-13 lists all of the information required in Analytical Batch Data Reports (identified with an “X”) and other information that is necessary for data validation, but is optional in Analytical Batch Data Reports (identified with an “O”).

  Raw analytical data need not be included in Analytical Batch Data Reports, but must be maintained in the site project files and be readily available for review upon request. Raw data may include all analytical bench sheet and instrumentation readouts for all calibration standard results, sample data, QC samples, sample preparation conditions and logs, sample run logs, and all re-extraction, re-analysis, or dilution information pertaining to the individual samples. Raw data may also include calculation records and any qualitative or semi-quantitative data collected for a sample and that has been recorded on a bench sheet or in a log book.

- An On-line Batch Data Report or equivalent contains the combined information from the Sampling Batch Data Report and Analytical Batch Data Report that is relevant to the on-line method used.

B3-10a <u>Data Generation Level</u>

The following are minimum requirements for raw data collection and management which the Permittees shall require for each site:

- All raw data shall be signed and dated in reproducible ink by the person generating it. Alternately, unalterable electronic signatures may be used.

- All data must be recorded clearly, legibly, and accurately in field and laboratory records (bench sheets, logbooks), and include applicable sample identification numbers (for sampling and analytical labs).

- All changes to original data must be lined out, initialed, and dated by the individual making the change. A justification for changing the original data may also be included. Original data must not be obliterated or otherwise disfigured so as not to be readable. Data changes shall only be made by the individual who originally collected the data or an individual authorized to change the data.

- All data must be transferred and reduced from field and laboratory records completely and accurately.

- All field and laboratory records must be maintained as specified in Table B-6 of Attachment B.

- Data must be organized into a standard format for reporting purposes Batch Data Report), as outlined in specific sampling and analytical procedures.

- All electronic and video data must be stored appropriately to ensure that waste container, sample, and associated QC data are readily retrievable. In the case of classified information, additional security provisions may apply that could restrict retrievability. The additional security provisions will be documented in generator/storage site procedures as outlined in the QAPjP in accordance with prevailing classified information security standards.

Data review, validation, and verification at this level involves scrutiny and signature release from qualified independent technical reviewer(s)[1] as specified below. Individuals conducting this data review, validation, and verification must use checklists that address all of the items included in this section. Checklists must contain or reference tables showing the results of sampling, analytical or on-line batch QC samples, if applicable. Checklists must reflect review of all QC samples and quality assurance objective categories in accordance with criteria established in Tables B3-2 through B3-9 (as applicable to the methods validated). Completed checklists must be forwarded with Batch Data Reports to the project level. Analytical raw data must be available and reviewed by the data generation level reviewer.

B3-10a(1) Independent Technical Review

The independent technical review ensures by review of raw data that data generation and reduction are technically correct; calculations are verified correct; deviations are documented; and QA/QC results are complete, documented correctly, and compared against WAP criteria. This review validates and verifies all of the work documented by the originator.

One hundred percent of the Batch Data Reports must receive an independent technical review. This review shall be performed by an individual other than the data generator who is qualified to have performed the initial work. The independent technical review must be performed as soon as practicably possible in order to determine and correct negative quality trends in the sampling or analytical process. However at a minimum, the independent technical review must be performed before any waste associated with the data reviewed is managed, stored, or disposed at WIPP, unless the data are being obtained from waste sampling and analysis as containers are being retrieved or generated after initial WSPF approval as described in Attachment B2, Section B2-1. The reviewer(s) must release the data as evidenced by signature, and as a consequence ensure the following:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used (procedure with revision). Data were reported in the proper units and correct number of significant figures.
- Calculations have been verified by a valid calculation program, a spot check of verified calculation programs, and/or 100 percent check of all hand calculations. Values that are not verifiable to within rounding or significant difference discrepancies must be rectified prior to completion of independent technical review.
- The data have been reviewed for transcription errors.
- The testing, sampling, or analytical data QA documentation for Batch Data Reports is complete and includes, as applicable, raw data, DAC and equilibrium calculations and

[1] Independent technical review is performed by a competent individual who is not directly responsible for performing the work.

times, calculation records, chain-of-custody (**COC**) forms, calibration records (or references to an available calibration package), QC sample results, and copies or originals of gas canister sample tags. Corrective action will be taken to ensure that all Batch Data Reports are complete and include all necessary raw data prior to completion of the independent technical review.

- QC sample results are within established control limits, and if not, the data have been appropriately qualified in accordance with data useability criteria. Data outside of established control limits will be qualified as appropriate, assigned an appropriate qualifier flag, discussed in the case narrative, and included as appropriate in calculations for completeness. QC criteria that were not met are documented.

- Reporting flags (Table B3-14) were assigned correctly.

- Sample holding time and preservation requirements were met, or exceptions documented.

- Radiography tapes have been reviewed (independent observation) on a waste container basis at a minimum of once per testing batch or once per day of operation, whichever is less frequent (Attachment B1, Section B1-3). The radiography tape will be reviewed against the data reported on the radiography form to ensure that the data are correct and complete.

- Field sampling records are complete. Incomplete or incorrect field sampling records will be subject to resubmittal prior to completion of the independent technical review.

- QAOs have been met according to the methods outlined in Sections B3-2 through B3-9.

B3-10b Project Level

Data validation and verification at this level involves scrutiny and signature release from the Site Project Manager (or designee). The Permittees shall require each site to meet the following minimum requirements for each waste container. Any nonconformance identified during this process shall be documented on a nonconformance report (Section B3-13).

The Site Project Manager shall ensure that a repeat of the data generation level review, validation, and verification is performed on the data for a minimum of one randomly chosen waste container quarterly (every three months). This exercise will document that the data generation level review, validation, and verification is being performed according to implementing procedures.

B3-10b(1) Site Project Manager Review

The Site Project Manager Review is the final validation that all of the data contained in Batch Data Reports from the data generation level are complete and have been properly reviewed as evidenced by signature release and completed checklists.

One hundred percent of the Batch Data Reports must have Site Project Manager signature release. At a minimum, the Site Project Manager signature release must be performed before any waste associated with the data reviewed is managed, stored, or disposed at WIPP, unless the data are being obtained from waste sampling and analysis as containers are being retrieved or generated as described in Permit Attachment B2, Section B2-1. This signature release must ensure the following:

- The validity of the DAC assignment made at the data generation level based upon an assessment of the data collection and evaluation necessary to make the assignment.
- Testing batch QC checks (e.g., replicate scans, measurement system checks) were properly performed. Radiography data are complete and acceptable based on evidence of videotape review of one waste container per day or once per testing batch, whichever is less frequent, as specified in B1-3.
- Sampling batch QC checks (e.g., equipment blanks, field duplicates, field reference standards) were properly performed, and meet the established QAOs and are within established data useability criteria.
- Analytical batch QC checks (e.g., laboratory duplicates, laboratory blanks, matrix spikes, matrix spike duplicates, laboratory control samples) were properly performed and meet the established QAOs and are within established data useability criteria.
- On-line batch QC checks (e.g., field blanks, on-line blanks, on-line duplicates, on-line control samples) were properly performed and meet the established QAOs and are within established data useability criteria.
- Proper procedures were followed to ensure representative samples of headspace gas and homogeneous solids and soil/gravel were taken.
- Data generation level independent technical review, validation, and verification have been performed as evidenced by the completed review checklists and appropriate signature releases.
- Batch data review checklists are complete.
- Batch Data Reports are complete and data are properly reported (e.g., data are reported in the correct units, with the correct number of significant figures, and with qualifying flags).
- Verify that data are within established data assessment criteria and meet all applicable QAOs (Sections B3-2 through B3-9).

B3-10b(2) Prepare Site Project Manager Summary and Data Validation Summary

To document the project-level validation and verification described above, the Permittees shall require each Site Project Manager (or designee) to prepare a Site Project Manager Summary and a Data Validation Summary. These reports may be combined to eliminate redundancy. The Site Project Manager Summary includes a validation checklist for each Batch Data Report. Checklists for the Site Project Manager Summary must be sufficiently detailed to validate all aspects of a Batch Data Report that affect data quality. The Data Validation Summary provides verification that, on a per waste container or sample basis as evidenced by Batch Data Report reviews, all data have been validated in accordance with the site QAPjP. The Data Validation Summary must identify each Batch Data Report reviewed (including all waste container numbers), describe how the validation was performed and whether or not problems were detected (e.g., nonconformance reports), and include a statement indicating that all data are acceptable. Summaries must include release signatures.

Once the data have received project-level validation and verification or when the Site Project Manager decides the sample no longer needs to be retained, the Site Project Manager must ensure that the laboratory is notified. Samples must be retained by the laboratory until this notification is received. Gas sample canisters may then be released from storage for cleaning, recertification, and subsequent reuse. Sample tags must be removed and retained in the project files before recycling the canisters. If the Site Project Manager requests that samples or canisters be retained for future use (e.g., an experimental holding time study), the same sample identification and COC forms shall be used and cross-referenced to a document which specifies the purpose for sample or canister retention.

B3-10b(3) Prepare Waste Stream Characterization Package

In the event the Permittees request detailed information on a waste stream, the Site Project Manager will provide a Waste Stream Characterization Package. The Site Project Manager must ensure that the Waste Stream Characterization Package (Section B3-12b(3)) will support waste characterization determinations.

B3-10c Permittee Level

The final level of data verification occurs at the Permittee level and must, at a minimum, consist of reviewing a sample of the Batch Data Reports during audits of generator/storage sites and Permittee approved laboratories to verify completeness. During such audits, the Permittees are responsible for the verification that Batch Data Reports include the following:

- Project-level signature releases
- Listing of all waste containers being presented in the report
- Listing of all testing, sampling, and analytical batch numbers associated with each waste container being reported in the package

- Analytical Batch Data Report case narratives
- Site Project Manager Summary
- Data Validation Summary
- Complete summarized qualitative and quantitative data for all waste containers with data flags and qualifiers.

For each Waste Stream Profile Form (**WSPF**) submitted for approval, the Permittees must verify that each submittal (i.e., WSPF and Characterization Information Summary) is complete and notify the originating site in writing of the WSPF approval. The Permittees will maintain the data as appropriate for use in the regulatory compliance programs. For subsequent shipments made after the initial WSPF approval, the verification will also include WWIS internal limit checks (Attachment B, Section B-5a(1)).

B3-11 Reconciliation with Data Quality Objectives

Reconciling the results of waste testing and analysis with the DQOs provides a way to ensure that data will be of adequate quality to support the regulatory compliance programs. Reconciliation with the DQOs will take place at both the project level and the Permittees' level. At the project level, reconciliation will be performed by the Site Project Manager, while at the Permittees' level, reconciliation will be performed as described below.

B3-11a Reconciliation at the Project Level

The Permittees shall require each Site Project Manager to ensure that all data generated and used in decision making meet the DQOs provided in Section B-4a(1) of Permit Attachment B. To do so, the Site Project Manager must assess whether data of sufficient type, quality, and quantity have been collected. The Site Project Manager must determine if the variability of the data set is small enough to provide the required confidence in the results. The Site Project Manager must also determine if, based on the desired error rates and confidence levels, a sufficient number of valid data points have been determined (as established by the associated completeness rate for each sampling and analytical process). In addition, the Site Project Manager must document that random sampling of containers was performed for the purposes of waste stream characterization.

For each waste stream characterized, the Permittees shall require each Site Project Manager to determine if sufficient data have been collected to determine the following WAP-required waste parameters, as applicable:

- Waste matrix code
- Waste material parameter weights
- If each waste container of waste contains TRU radioactive waste

- Mean concentrations, UCL_{90} for the mean concentrations, standard deviations, and the number of samples collected for each VOC in the headspace gas of waste containers in the waste stream

- Mean concentrations, UCL_{90} for the mean concentrations, standard deviations, and number of samples collected for VOCs, SVOCs, and metals in the waste stream

- Whether the waste stream exhibits a toxicity characteristic (**TC**) under 40 CFR Part 261, Subpart C

- Whether the waste stream contains listed waste found in 20.4.1.200 NMAC incorporating 40 CFR Part 261, Subpart D

- Whether the waste stream can be classified as hazardous or nonhazardous at the 90-percent confidence level

- Whether an appropriate packaging configuration and DAC were applied and documented in the headspace gas sampling documentation, and whether the drum age was met prior to sampling.

- Whether all TICs were appropriately identified and reported in accordance with the requirements of Section B3-1 prior to submittal of a WSPF for a waste stream or waste stream lot.

- Whether the overall completeness, comparability, and representativeness QAOs were met for each of the analytical and testing procedures as specified in Sections B3-2 through B3-9 prior to submittal of a WSPF for a waste stream or waste stream lot.

- Whether the PRQLs for all analyses were met prior to submittal of a WSPF for a waste stream or waste stream lot.

If the Site Project Manager determines that insufficient data have been collected to make the determinations listed above, additional data collection efforts must be undertaken. The reconciliation of a waste stream shall be performed, as described in Permit Attachment B4, prior to submittal of WSPF and Characterization Information Summary to the Permittees for that waste stream. The Permittees shall not manage, store, or dispose a TRU mixed waste stream at WIPP unless the Site Project Manager determines that the WAP-required waste parameters listed above have been met for that waste stream.

The statistical procedure presented in Permit Attachment B2 shall be used by participating Site Project Managers to evaluate and report waste characterization data from the analysis of homogeneous solids and soil/gravel. The procedure, which calculates UCL_{90} values, shall be used to assess compliance with the DQOs in Attachment B, Section B-4a(1) as well as with RCRA regulations. The procedure must be applied to all laboratory analytical data for total VOCs, total SVOCs, and total metals. For RCRA regulatory compliance (40 CFR § 261.24), data from the analysis of the appropriate metals and organic compounds shall be expressed as toxicity characteristic leaching procedure (**TCLP**) values or results may also be compared to the TC levels expressed as total values. These total values will be considered the regulatory threshold limit (**RTL**) values for the WAP. RTL values are obtained by calculating the weight/weight concentration (in the solid) of a TC analyte that would give the regulatory weight/volume concentration (in the TCLP extract), assuming 100-percent analyte dissolution.

B3-11b Reconciliation at the Permittee Level

The Permittees must also ensure that data of sufficient type, quality, and quantity are collected to meet WAP DQOs. The Permittees will ensure sufficient data have been collected to determine if the waste characterization information is adequate to demonstrate the Permittees' compliance with Attachment B, Section B-4a(1). This is performed during Permittees' review of the WSPF and Characterization Information Summary.

B3-12 Data Reporting Requirements

Data reporting requirements define the type of information and the method of transmittal for data transfer from the data generation level to the project level and from the project level to the Permittees.

B3-12a Data Generation Level

Data shall be transmitted by hard copy or electronically (provided a hard copy is available on demand) from the data generation level to the project level. Transmitted data shall include all Batch Data Reports and data review checklists. The Batch Data Reports and checklists used must contain all of the information required by the testing, sampling, and analytical techniques described in Permit Attachments B1 through B6 , as well as the signature releases to document the review, validation, and verification as described in Section B3-10. All Batch Data Reports and checklists shall be in approved formats, as provided in site-specific documentation.

Batch Data Reports shall be forwarded to the Site Project Manager. All Batch Data Reports shall be assigned serial numbers, and each page shall be numbered. The serial number used for Batch Data Reports can be the same as the testing, sampling, or analytical batch number.

QA documentation, including raw data, shall be maintained in either testing, sampling, and analytical facility files, or site project files for those facilities located on site in accordance with the document storage requirements of site approved site QAPjPs. Permittee approved laboratories shall forward testing, sampling, and analytical QA documentation along with Batch Data Reports to the site project office for inclusion in site project files.

B3-12b Project Level

The site project office shall prepare a WSPF for each waste stream certified for shipment to WIPP based on information obtained from acceptable knowledge and Batch Data Reports, if applicable. In addition, the site project office must ensure that the Characterization Information Summary and the Waste Stream Characterization Package (when requested by the Permittees) are prepared as appropriate. The Site Project Manager must also verify these reports are consistent with information found in analytical batch reports. Summarized testing, sampling, and analytical data are included in the Characterization Information Summary. The contents of the WSPF, Characterization Information Summary, and Waste Stream Characterization Package are discussed in the following sections.

After approval of a WSPF and the associated Characterization Information Summary by the Permittees, the generator/storage site are required to maintain a cross reference of container identification numbers to each Batch Data Report.

A Waste Stream Characterization Package shall be transmitted by hard copy or electronically from the Site Project Manager to the Permittees when requested.

B3-12b(1) Waste Stream Profile Form

The Waste Stream Profile Form (WSPF, Figure B-1) shall include the following information:

- Generator/storage site name
- Generator/storage site EPA ID
- Date of audit report approval by NMED (if obtained)
- Original generator of waste stream
- Whether waste is Contact-Handled or Remote-Handled
- The Waste Stream WIPP Identification Number
- Summary Category Group
- Waste Matrix Code Group
- Waste Material Parameter Weight Estimates per unit of waste
- Waste stream name
- A description of the waste stream
- Applicable EPA hazardous waste numbers
- Applicable TRUCON codes
- A listing of acceptable knowledge documentation used to identify the waste stream

- The waste characterization procedures used and the reference and date of the procedure
- Certification signature of Site Project Manager, name, title, and date signed

B3-12b(2) Characterization Information Summary

The Characterization Information Summary shall include the following elements, if applicable:

- Data reconciliation with DQOs
- Headspace gas summary data listing the identification numbers of samples used in the statistical reduction, the maximum, mean, standard deviation, UCL_{90}, RTL, and associated EPA hazardous waste numbers that must be applied to the waste stream.
- Total metal, VOC, and SVOC analytical results for homogeneous solids and soil/gravel (if applicable).
- TIC listing and evaluation.
- Radiography and visual examination summary to document that all prohibited items are absent in the waste (if applicable).
- A complete listing of all container identification numbers used to generate the WSPF, cross-referenced to each Batch Data Report
- Complete AK summary, including stream name and number, point of generation, waste stream volume (current and projected), generation dates, TRUCON codes, Summary Category Group, Waste Matrix Code(s) and Waste Matrix Code Group, other TWBIR information, waste stream description, areas of operation, generating processes, RCRA determinations, radionuclide information, all references used to generate the AK summary, and any other information required by Permit Attachment B4, Section B4-2b.
- Method for determining Waste Material Parameter Weights per unit of waste.
- List of any AK Sufficiency Determinations requested for the waste stream.
- Certification through acceptable knowledge or testing and/or analysis that any waste assigned the hazardous waste number of U134 (hydrofluoric acid) no longer exhibits the characteristic of corrosivity. This is verified by ensuring that no liquid is present in U134 waste.

B3-12b(3) Waste Stream Characterization Package

The Waste Stream Characterization Package includes the following information:

- Waste Stream Profile Form (WSPF, Section B3-12b(1))
- Accompanying Characterization Information Summary (Section B3-12b(2))
- Complete AK summary (Section B3-12b(2))
- Batch Data Reports supporting the characterization of the waste stream and any others requested by the Permittees
- Raw analytical data requested by the Permittees

B3-12b(4) WIPP Waste Information System (**WWIS**) Data Reporting

The WWIS Data Dictionary includes all of the data fields, the field format and the limits associated with the data as established by this WAP. These data will be subjected to edit and limit checks that are performed automatically by the database, as defined in the *WIPP Waste Information System User's Manual for Use by Shippers/Generators* (DOE, 2001). If a container was part of a composite headspace gas sample, the analytical results from the composite sample must be assigned as the container headspace gas data results, including associated TICs, for every waste container associated with the composite sample.

B3-13 Nonconformances

The Permittees shall require the status of work and the WAP activities at participating generator/storage sites to be monitored and controlled by the Site Project Manager. This monitoring and control shall include nonconformance identification, documentation, and reporting.

The nonconformances and corrective action processes specified in this section describe procedures between the Permittees and the generator/storage sites.

Nonconformances

Nonconformances are uncontrolled and unapproved deviations from an approved plan or procedure. Nonconforming items and activities are those that do not meet the WAP requirements, procurement document criteria, or approved work procedures. Nonconforming items shall be identified by marking, tagging, or segregating, and the affected generator/storage site(s) notified. The Permittees shall require participating sites reconcile and correct nonconforming items as appropriate in accordance with the Permittees' Quality Assurance Program Description (**QAPD**). Disposition of nonconforming items shall be identified and documented. The QAPjPs shall identify the person(s) responsible for evaluating and dispositioning nonconforming items and shall include referenced procedures for handling them.

Management at all levels shall foster a “no-fault” attitude to encourage the identification of nonconforming items and processes. Nonconformances may be detected and identified by anyone performing WAP activities, including

- Project staff - during field operations, supervision of subcontractors, data validation and verification, and self-assessment

- Laboratory staff - during the preparation for and performance of laboratory testing; calibration of equipment; QC activities; laboratory data review, validation, and verification; and self-assessment

- QA personnel - during oversight activities or audits

A nonconformance report shall be prepared for each nonconformance identified. Each nonconformance report shall be initiated by the individual(s) identifying the nonconformance. The nonconformance report shall then be processed by knowledgeable and appropriate personnel. For this purpose, a nonconformance report including, or referencing as appropriate, results of laboratory analysis, QC tests, audit reports, internal memoranda, or letters shall be prepared. The nonconformance report must provide the following information:

- Identification of the individual(s) identifying or originating the nonconformance

- Description of the nonconformance

- Method(s) or suggestions for correcting the nonconformance (corrective action)

- Schedule for completing the corrective action

- An indication of the potential ramifications and overall useability the data, if applicable

- Any approval signatures specified in the site nonconformance procedures

The Permittees shall require the Site Project Manager to oversee the nonconformance report process and be responsible for developing a plan to identify and track all nonconformances and report this information to the Permittees. The Site Project Manager is also responsible for notifying project personnel of the nonconformance and verifying completion of the corrective action for nonconformances.

Nonconformance to DQOs

For any non-administrative nonconformance related to applicable requirements specified in this WAP which are first identified at the Site Project Manager signature release level (i.e., a failure to meet a data quality objective DQO), the Permittees shall receive written notification within five (5) calendar days of identification and shall also receive a nonconformance report within thirty (30) calendar days of identification of the incident. The Permittees shall require the generator/storage site to implement a corrective action which remedies the nonconformance prior to management, storage, or disposal of the waste at WIPP. The Permittees shall send NMED a monthly summary of nonconformances identified during the previous month, indicating the number of nonconformances received and the generator/storage sites responsible.

Permittees' Corrective Action Process

The Permittees shall initiate a corrective action process when internal nonconformances and nonconformances at the generator/storage sites are identified. Activities and processes that do not meet requirements are documented as deficiencies.

When a deficiency is identified by the Permittees, the following process action steps are required:

- The condition is documented on a Corrective Action Report (**CAR**) by the individual identifying the problem.
- The Permittees have designated the CAR Initiator and Assessment Team Leader to review the CAR, determine validity of the finding (determine that a requirement has been violated), classify the significance of the condition, assign a response due date, and issue the CAR to the responsible party.
- The responsible organization reviews the CAR, evaluates the extent and cause of the deficiency and provides a response to the Permittees, indicating remedial actions and actions to preclude recurrence that will be taken.
- The Permittees review the response from the responsible organization and, if acceptable, communicate the acceptance to the responsible organization.
- The responsible organization completes remedial actions and actions to preclude recurrence of the condition.
- After all corrective actions have been completed, the Permittees schedule and perform a verification to ensure that corrective actions have been completed and are effective. When all actions have been completed and verified as being effective, the CAR is closed by the CAR Initiator and Assessment Team Leader on behalf of the Permittees.
- As part of the planning process for subsequent audits and surveillances, past deficiencies are reviewed and the previous deficient activity or process is subject to reassessment.

B3-14 Special Training Requirements and Certifications

Before performing activities that affect WAP quality, all personnel are required to receive indoctrination into the applicable scope, purpose, and objectives of the WAP and the specific QAOs of the assigned task. Personnel assigned to perform activities for the WAP shall have the education, experience, and training applicable to the functions associated with the work. Evidence of personnel proficiency and demonstration of competence in the task(s) assigned must be demonstrated and documented. All personnel designated to work on specific aspects of the WAP shall maintain qualification (i.e., training and certification) throughout the duration of the work as specified in this WAP and applicable QAPjPs/procedures. Job performance shall be evaluated and documented at periodic intervals, as specified in the implementing procedures.

Personnel involved in WAP activities shall receive continuing training to ensure that job proficiency is maintained. Training includes both education in principles and enhancement of skills. Each participating site shall include in its QAPjP a description of the procedures for implementing personnel qualification and training. All training records that specify the scope of the training, the date of completion, and documentation of job proficiency shall be maintained as QA Records in the site project file.

Analytical laboratory line management must ensure that analytical personnel are qualified to perform the analytical method(s) for which they are responsible. The minimum qualifications for certain specified positions for the WAP are summarized in Table B3-10. QAPjPs, or their implementing SOPs, shall specify the site-specific titles and minimum training and qualification requirements for personnel performing WAP activities. QAPjPs/procedures shall also contain the requirements for maintaining records of the qualification, training, and demonstrations of proficiency by these personnel.

An evaluation of personnel qualifications shall include comparing and evaluating the requirements specified in the job/position description and the skills, training, and experience included in the current resume of the person. This evaluation also must be performed for personnel who change positions because of a transfer or promotion as well as personnel assigned to short-term or temporary work assignments that may affect the quality of the WAP. QAPjPs/procedures shall identify the responsible person(s) for ensuring that all personnel maintain proficiency in the work performed and identify any additional training that may be required.

B3-15 Changes to WAP-Related Plans or Procedures

Controlled changes to WAP-related plans or procedures shall be managed through the document control process described in the QAPD. The Site Project Manager shall review all non-administrative changes and evaluate whether those changes could impact DQOs specified in the Permit. After site certification, any changes to WAP-related plans or procedures that could positively or negatively impact DQOs (i.e., those changes that require prior approval of the Permittees as defined in Attachment B5, Section B5-2) shall be reported to the Permittees within five (5) days of identification by the project level review. The Permittees shall send NMED a monthly summary briefly describing the changes to plans and procedures identified pursuant to this section during the previous month.

B3-16 List of References

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DOE. 2005. Performance Demonstration Program Plan for RCRA Constituent Analysis of Solidified Wastes. DOE/CBFO-95-1077, Current Revision, Carlsbad, New Mexico, Carlsbad Area Office, U.S. Department of Energy.

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Pasternack B. S. and N. H. Harley. 1971. "Detection Limits for Radionuclides in the Analysis of Multi-Component Gamma-Spectrometric Data." *Nucl. Instr. and Meth,* No. 91: pp. 533-40.

TABLES

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TABLE B3-1
WASTE MATERIAL PARAMETERS AND DESCRIPTIONS

Waste Material Parameter	Description
Iron-based Metals/Alloys	Iron and steel alloys in the waste; does not include the waste container materials
Aluminum-based Metals/Alloys	Aluminum or aluminum-based alloys in the waste materials
Other Metals	All other metals found in the waste materials
Other Inorganic Materials	Nonmetallic inorganic waste including concrete, glass, firebrick, ceramics, sand, and inorganic sorbents
Cellulosics	Materials generally derived from high-polymer plant carbohydrates; (e.g., paper, cardboard, wood, and cloth)
Rubber	Natural or man-made elastic latex materials; (e.g., surgeons' gloves, and leaded rubber gloves)
Plastics (waste materials)	Generally man-made materials, often derived from petroleum feedstock; (e.g., polyethylene and polyvinylchloride)
Organic Matrix	Cemented organic resins, solidified organic liquids and sludges
Inorganic Matrix	Any homogeneous materials consisting of sludge or aqueous-based liquids that are solidified with cement, calcium silicate, or other solidification agents; (e.g., wastewater treatment sludge, cemented aqueous liquids, and inorganic particulates)
Soils/gravel	Generally consists of naturally occurring soils that have been contaminated with inorganic waste materials
Steel (packaging materials)	55-gal (208-L) drums
Plastics (packaging materials)	90-mil polyethylene drum liner and plastic bags

TABLE B3-2
GAS VOLATILE ORGANIC COMPOUNDS TARGET ANALYTE LIST AND QUALITY ASSURANCE OBJECTIVES

Compound	CAS Number	Precision[a] (%RSD or RPD)	Accuracy[a] (%R)	MDL[b,d] (ng)	FTIRS MDL[b] (ppmv)	PRQL (ppmv)	Completeness (%)
Benzene	71-43-2	≤25	70-130	10	5	10	90
Bromoform	75-25-2	≤25	70-130	10	5	10	90
Carbon tetrachloride	56-23-5	≤25	70-130	10	5	10	90
Chlorobenzene	108-90-7	≤25	70-130	10	5	10	90
Chloroform	67-66-3	≤25	70-130	10	5	10	90
1,1-Dichloroethane	75-34-3	≤25	70-130	10	5	10	90
1,2-Dichloroethane	107-06-2	≤25	70-130	10	5	10	90
1,1-Dichloroethylene	75-35-4	≤25	70-130	10	5	10	90
cis-1,2-Dichloroethylene	156-59-2	≤25	70-130	10	5	10	90
trans-1,2-Dichloroethylene	156-60-5	≤25	70-130	10	5	10	90
Ethyl benzene [d]	100-41-4	≤25	70-130	10	10	10	90
Ethyl ether	60-29-7	≤25	70-130	10	5	10	90
Methylene chloride	75-09-2	≤25	70-130	10	5	10	90
1,1,2,2-Tetrachloroethane	79-34-5	≤25	70-130	10	5	10	90
Tetrachloroethylene	127-18-4	≤25	70-130	10	5	10	90
Toluene	108-88-3	≤25	70-130	10	5	10	90
1,1,1-Trichloroethane	71-55-6	≤25	70-130	10	5	10	90
Trichloroethylene	79-01-6	≤25	70-130	10	5	10	90
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	≤25	70-130	10	5	10	90
m-Xylene[c]	108-38-3	≤25	70-130	10	5	10	90
o-Xylene	95-47-6	≤25	70-130	10	5	10	90
p-Xylene[c]	106-42-3	≤25	70-130	10	5	10	90
Acetone	67-64-1	≤25	70-130	150	50	100	90
Butanol	71-36-3	≤25	70-130	150	50	100	90
Methanol	67-56-1	≤25	70-130	150	50	100	90
Methyl ethyl ketone	78-93-3	≤25	70-130	150	50	100	90
Methyl isobutyl ketone	108-10-1	≤25	70-130	150	50	100	90

[a] Criteria apply to PRQL concentrations.
[b] Values based on delivering 10 mL to the analytical system.
[c] These xylene isomers cannot be resolved by GC/MS.
[d] The ethyl benzene PRQL for FTIRS is 20 ppm

CAS = Chemical Abstract Service
%RSD = Percent relative standard deviation
RPD = Relative percent difference
%R = Percent recovery
MDL = Method detection limit (maximum permissible value), for GC/MS and GC/FID; total number of nanograms delivered to the analytical system per sample (nanograms); for FTIRS based on 1 m sample cell
PRQL = Program required quantitation limit (parts per million/volume basis)

TABLE B3-3
SUMMARY OF LABORATORY QUALITY CONTROL SAMPLES AND FREQUENCIES FOR GAS VOLATILE ORGANIC COMPOUND ANALYSIS

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Method performance samples	Seven (7) samples initially and four (4) semiannually	Meet method QAOs	Repeat until acceptable
Laboratory duplicates or on-line duplicates	One (1) per analytical batch or on-line batch	RPD ≤ 25[b]	Nonconformance if RPD >25
Laboratory blanks or on-line blanks	Daily prior to sample analysis for GC/MS and GC/FID. Otherwise, daily prior to sample analysis and one (1) per analytical batch or on-line	Analyte amounts ≤ 3 × MDLs for GC/MS and GC/FID; ≤ PRQL for FTIRS	Flag Data if analyte amounts > 3 × MDLs for GC/MS and GC/FID; > PRQL for FTIRS
Laboratory control samples or on-line control samples	One (1) per analytical batch or on-line batch	70-130 %R	Nonconformance if %R <70 or >130
GC/MS comparison sample (for FTIRS only)	One (1) per analytical or on-line batch	RPD ≤ 25[b]	Nonconformance if RPD > 25
Blind audit samples	Samples and frequency controlled by the Gas PDP Plan	Specified in the Gas PDP Plan	Specified in the Gas PDP Plan
GC/MS	BFB Tune Every 12 hours	Abundance criteria for key ions are met	Repeat Until Acceptable
GC/MS	Minimum 5-point initial calibration (minimum of 5 standards) Initially and as needed	%RSD of response factor for each target analyte <35	Repeat Until Acceptable
GC/MS	Continuing calibration Every 12 hours	%D for all target analytes ≤ 30 of initial calibration	Repeat Until Acceptable

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
GC/FID	Minimum 3-point initial calibration (minimum 3 standards) Initially and as needed	Correlation coefficient ≥ 0.99 or %RSD <20 for each target analyte and the retention time of each target analyte within an acceptance criteria defined in the method	Repeat Until Acceptable
GC/FID	Continuing calibration Every 12 hours	%RSD ≤ 15%	Repeat Until Acceptable

[a] Corrective action per Section B3-13 when final reported QC samples do not meet the acceptance criteria.
[b] Applies only to concentrations greater than the PRQLs listed in Table B3-2.

MDL = Method Detection Limit
QAO = Quality Assurance Objective
PDP = Performance Demonstration Program
PRQL = Program Required Quantitation Limit
%R = Percent Recovery
RPD = Relative Percent Difference
BFB = 4-Bromofluorobenzene
%D = Percent difference
%RSD = Percent relative standard deviation

TABLE B3-4
VOLATILE ORGANIC COMPOUNDS TARGET ANALYTE LIST AND QUALITY ASSURANCE OBJECTIVES

Compound	CAS Number	Precision[a] (%RSD or RPD)	Accuracy[a] (%R)	MDL[b] (mg/kg)	PRQL[b] (mg/kg)	Completeness (%)
Benzene	71-43-2	≤45	37-151	1	10	90
Bromoform	75-25-2	≤47	45-169	1	10	90
Carbon disulfide	75-15-0	≤50	60-150	1	10	90
Carbon tetrachloride	56-23-5	≤30	70-140	1	10	90
Chlorobenzene	108-90-7	≤38	37-160	1	10	90
Chloroform	67-66-3	≤44	51-138	1	10	90
1,4-Dichlorobenzene[c]	106-46-7	≤60	18-190	1	10	90
ortho-Dichlorobenzene[c]	95-50-1	≤60	18-190	1	10	90
1,2-Dichloroethane	107-06-2	≤42	49-155	1	10	90
1,1-Dichloroethylene	75-35-4	≤250	D-234[d]	1	10	90
trans-1,2-Dichloroethylene	156-60-5	≤50	60-150	1	10	90
Ethyl benzene	100-41-4	≤43	37-162	1	10	90
Methylene chloride	75-09-2	≤50	D-221[d]	1	10	90
1,1,2,2-Tetrachloroethane	79-34-5	≤55	46-157	1	10	90
Tetrachloroethylene	127-18-4	≤29	64-148	1	10	90
Toluene	108-88-3	≤29	47-150	1	10	90
1,1,1-Trichloroethane	71-55-6	≤33	52-162	1	10	90
1,1,2-Trichloroethane	79-00-5	≤38	52-150	1	10	90
Trichloroethylene	79-01-6	≤36	71-157	1	10	90
Trichlorofluoromethane	75-69-4	≤110	17-181	1	10	90
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	≤50	60-150	1	10	90
Vinyl chloride	75-01-4	≤200	D-251[d]	1	4	90
m-xylene	108-38-3	≤50	60-150	1	10	90
o-xylene	95-47-6	≤50	60-150	1	10	90
p-xylene	106-42-3	≤50	60-150	1	10	90
Acetone	67-64-1	≤50	60-150	10[e]	100	90
Butanol	71-36-3	≤50	60-150	10[e]	100	90
Ethyl ether	60-29-7	≤50	60-150	10[e]	100	90
Formaldehyde[f]	50-00-0	≤50	60-150	10[e]	100	90
Hydrazine[g]	302-01-2	≤50	60-150	10[e]	100	90
Isobutanol	78-83-1	≤50	60-150	10[e]	100	90
Methanol	67-56-1	≤50	60-150	10[e]	100	90
Methyl ethyl ketone	78-93-3	≤50	60-150	10[e]	100	90
Pyridine[c]	110-86-1	≤50	60-150	10[e]	100	90

[a] Applies to laboratory control samples and laboratory matrix spikes. If a solid laboratory control sample material which has established statistical control limits is used, then the established control limits for that material should be used for accuracy requirements.
[b] TCLP MDL and PRQL values are reported in units of mg/l and limits are reduced by a factor of 20.
[c] Can also be analyzed as a semi-volatile organic compound. If analyzed as a semi-volatile compound, the QAOs of Table B3-6 apply.
[d] Detected; result must be greater than zero.
[e] Estimate, to be determined.
[f] Required only for homogeneous solids and soil/gravel waste from Savannah River Site, if analysis is required to resolve assignment of EPA hazardous waste numbers.
[g] Required only for homogeneous solids and soil/gravel waste from Oak Ridge National Laboratory and Savannah River Site, if analysis is required to resolve assignment of EPA hazardous waste numbers.

CAS = Chemical Abstract Service
%RSD = Percent relative standard deviation
RPD = Relative percent difference
%R = Percent recovery
MDL = Method detection limit (maximum permissible value) (milligrams per kilogram)
PRQL = Program required quantitation limit; calculated from the toxicity characteristic level for benzene assuming a 0.9 oz (25-gram [g]) sample, 0.1 gal (0.5 liter [L]) of extraction fluid, and 100 percent analyte extraction (milligrams per kilogram)

TABLE B3-5
SUMMARY OF LABORATORY QUALITY CONTROL SAMPLES AND FREQUENCIES FOR VOLATILE ORGANIC COMPOUND ANALYSIS

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Method performance samples	Seven (7) samples initially and four (4) semiannually	Meet Table B3-4 QAOs	Repeat until acceptable
Laboratory duplicates[b]	One (1) per analytical batch	Meet Table B3-4 precision QAOs	Nonconformance if RPDs > values in Table B3-4
Laboratory blanks	One (1) per analytical batch	Analyte concentrations ≤ 3 × MDLs	Nonconformance if analyte concentrations > 3 × MDLs
Matrix spikes[b]	One (1) per analytical batch	Meet Table B3-4 accuracy QAOs	Nonconformance if %Rs are outside the range specified in Table B3-4
Matrix spike duplicates	One (1) per analytical batch	Meet Table B3-4 accuracy and precision QAOs	Nonconformance if RPDs > values and %Rs outside range specified in Table B3-4
Laboratory control samples	One (1) per analytical batch	Meet Table B3-4 accuracy QAO's	Nonconformance if %R < 80 or > 120
GC/MS Calibration	BFB Tune every 12 hours 5-pt. Initial Calibration initially, and as needed	Abundance criteria met as per method Calibrate according to SW-846 Method requirements: %RSD for CCC ≤ 30, %RSD for all other compounds ≤ 15% Average response factor (RRF) used if %RSD ≤ 15, use linear regression if %RSD >15; R or R^2 ≥ 0.990 if using alternative curve System Performance Check Compound (SPCC) minimum RRF as per SW-846 Method; RRF for all other compounds ≥ 0.01	Repeat until acceptable

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
GC/MS Calibration (continued)	Continuing Calibration every 12 hours	%D ≤ 20 for CCC; SPCC minimum RRF as per SW-846 Method; RRF for all other compounds ≥ 0.01 RT for internal standard must be ± 30 seconds from last daily calibration, internal standard area count must be >50% and <200% of last daily calibration	Repeat until acceptable
GC/FID Calibration	3-pt. Initial Calibration initially and as needed Continuing Calibration every 12 hours	Correlation Coefficient ≥ 0.990 or %RSD ≤ 20 for all analytes %D or %Drift for all analytes ≤ 15 of expected values, RT ± 3 standard deviations from initial RT calibration per applicable SW-846 Method	Repeat until acceptable.
Surrogate compounds	Each analytical sample	Average %R from minimum of 30 samples for a given matrix ±3 standard deviations	Nonconformance if %R < (average %R - 3 standard deviation) or > (average %R + 3 standard deviation)
Blind audit samples	Samples and frequency controlled by the Solid PDP Plan	Specified in the Solid PDP Plan	Specified in the Solid PDP Plan

[a] Corrective Action per Section B3-13 when final reported QC samples do not meet the acceptance criteria. Nonconformances do not apply to matrix related exceedances.
[b] May be satisfied using matrix spike duplicate; acceptance criteria applies only to concentrations greater than the PRQLs listed in Table B3-4.

MDL = Method detection limit
QAO = Quality assurance objective
PDP = Performance Demonstration Program
%R = Percent recovery
RPD = Relative percent difference

TABLE B3-6
SEMI-VOLATILE ORGANIC COMPOUND TARGET ANALYTE LIST AND QUALITY ASSURANCE OBJECTIVES

Compound	CAS Number	Precision[a] (%RSD or RPD)	Accuracy [a] (%R)	MDL[b] (mg/kg)	PRQL[b] (mg/kg)	Completeness (%)
Cresols	1319-77-3	≤50	25-115	5	40	90
1,4-Dichlorobenzene[bc]	106-46-7	≤86	20-124	5	40	90
ortho-Dichlorobenzene[c]	95-50-1	≤64	32-129	5	40	90
2,4-Dinitrophenol	51-28-5	≤119	D-172[d]	5	40	90
2,4-Dinitrotoluene	121-14-2	≤46	39-139	0.3	2.6	90
Hexachlorobenzene	118-74-1	≤319	D-152[d]	0.3	2.6	90
Hexachloroethane	67-72-1	≤44	40-113	5	40	90
Nitrobenzene	98-95-3	≤72	35-180	5	40	90
Pentachlorophenol	87-86-5	≤128	14-176	5	40	90
Pyridine[c]	110-86-1	≤50	25-115	5	40	90

CAS = Chemical Abstract Service
%RSD = Percent relative standard deviation
RPD = Relative percent difference
%R = Percent recovery
MDL = Method detection limit (maximum permissible value) (milligrams per kilogram)
PRQL = Program required quantitation limit; calculated from the toxicity characteristic level for nitrobenzene assuming a 100-gram (g) sample, 0.5 gal (2 liter [L]) of extraction fluid, and 100 percent analyte extraction (milligrams per kilograms)

[a] Applies to laboratory control samples and laboratory matrix spikes. If a solid laboratory control sample material which has established statistical control limits is used, then the established control limits for that material should be used for accuracy requirements.
[b] TCLP MDL and PRQL values are reported in units of mg/l and limits are reduced by a factor of 20.
[c] Can also be analyzed as a volatile organic compound
[d] Detected; result must be greater than zero

TABLE B3-7
SUMMARY OF LABORATORY QUALITY CONTROL SAMPLES AND FREQUENCIES FOR SEMI-VOLATILE ORGANIC COMPOUNDS ANALYSIS

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Method performance samples	Seven (7) samples initially and four (4) semiannually	Meet Table B3-6 QAOs	Repeat until acceptable
Laboratory duplicates[b]	One (1) per analytical batch	Meet Table B3-6 precision QAOs	Nonconformance if RPDs > values in Table B3-6
Laboratory blanks	One (1) per analytical batch	Analyte concentrations ≤ 3 × MDLs	Nonconformance if analyte concentrations > 3 × MDLs
Matrix spikes	One (1) per analytical batch	Meet Table B3-6 accuracy QAOs	Nonconformance if RPDs > values and %Rs outside range in Table B3-6
GC/MS Calibration	DFTPP Tune every 12 hours	Abundance criteria met as per method	Repeat until acceptable
	5-pt. Initial Calibration initially, and as needed	Calibrate according to SW-846 Method requirements: %RSD for CCC ≤ 30, %RSD for all other compounds ≤ 15% Average response factor (RRF) used if %RSD ≤ 15, use linear regression if >15; R or R^2 ≥0.990 if using alternative curve System Performance Check Compound (SPCC) minimum RRF as per SW-846 Method; RRF for all other compounds ≥ 0.01	
	Continuing Calibration every 12 hours	%D≤ 20 for CCC, SPCC minimum RRF as per SW-846 Method; RRF for all other compounds ≥ 0.01 RT for internal standard must be ± 30 seconds from last daily calibration, internal standard area count must be >50% and <200% of last daily calibration	

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
GC/ECD Calibration	5-pt. Calibration initially and as needed Continuing Calibration every 12 hours	Correlation Coefficient ≥ 0.990 or %RSD < 20 for all analytes %D or %Drift for all analytes ≤ 15 of expected values, RT ± 3 standard deviations of initial RT calibration per applicable SW-846 Method	Repeat until acceptable
Matrix spike duplicates	One (1) per analytical batch	Meet Table B3-6 accuracy and precision QAOs	Nonconformance if RPDs > values and %Rs outside range specified in Table B3-6
Laboratory control samples	One (1) per analytical batch	Meet Table B3-6 accuracy QAO's	Nonconformance if %R < 80 or > 120
Surrogate compounds	Each analytical sample	Average %R from minimum of 30 samples from a given matrix ±3 standard deviations	Nonconformance if %R < (average %R - 3 standard deviations) or > (average %R + 3 standard deviations)
Blind audit samples	Samples and frequency controlled by the Solid PDP Plan	Specified in the Solid PDP Plan	Specified in the Solid PDP Plan

[a] Corrective action per Section B3-13 when final reported QC samples do not meet the acceptance criteria. Nonconformances do not apply to matrix related exceedances.
[b] May be satisfied by using matrix spike duplicate; acceptance criteria applies only to concentrations greater than the PRQLs listed in Table B3-6.

MDL = Method Detection Limit
QAO = Quality Assurance Objective
PDP = Performance Demonstration Program
%R = Percent Recovery
RPD = Relative Percent Difference

TABLE B3-8
METALS TARGET ANALYTE LIST
AND QUALITY ASSURANCE OBJECTIVES

Analyte	CAS Number	Precision (%RSD or RPD)[a]	Accuracy (%R)[b]	PRDL[d] (µg/L)	PRQL[c] (mg/kg)	Completeness (%)
Antimony	7440-36-0	≤30	80-120	100	100	90
Arsenic	7440-38-2	≤30	80-120	100	100	90
Barium	7440-39-3	≤30	80-120	2000	2000	90
Beryllium	7440-41-7	≤30	80-120	100	100	90
Cadmium	7440-43-9	≤30	80-120	20	20	90
Chromium	7440-47-3	≤30	80-120	100	100	90
Lead	7439-92-1	≤30	80-120	100	100	90
Mercury	7439-97-6	≤30	80-120	4.0	4.0	90
Nickel	7440-02-0	≤30	80-120	100	100	90
Selenium	7782-49-2	≤30	80-120	20	20	90
Silver	7440-22-4	≤30	80-120	100	100	90
Thallium	7440-28-0	≤30	80-120	100	100	90
Vanadium	7440-62-2	≤30	80-120	100	100	90
Zinc	7440-66-6	≤30	80-120	100	100	90

[a] ≤ 30 percent control limits apply when sample and duplicate concentrations are ≥ 10 x IDL for ICP-AES and AA techniques, and ≥ 100 x IDL for Inductively Coupled Plasma—Mass Spectrometry (ICP-MS) techniques. If less than these limits, the absolute difference between the two values shall be less than or equal to the PRQL.
[b] Applies to laboratory control samples and laboratory matrix spikes. If a solid laboratory control sample material which has established statistical control limits is used, then the established control limits for that material should be used for accuracy requirements.
[c] TCLP PRQL values are reported in units of mg/l and limits are reduced by a factor of 20.
[d] PRDL set such that it is a factor of 10 below the PRQL for 100 percent solid samples, assuming a 100x dilution during digestion.

CAS = Chemical Abstract Service
%RSD = Percent relative standard deviation
RPD = Relative percent difference
%R = Percent recovery
PRDL = Program required detection limit (i.e., maximum permissible value for IDL) (micrograms per liter)
PRQL = Program required quantitation limit (milligrams per kilogram)

TABLE B3-9
SUMMARY OF LABORATORY QUALITY CONTROL SAMPLES AND FREQUENCIES FOR METALS ANALYSIS

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Method performance samples	Seven (7) samples initially and four (4) semiannually	Meet Table B3-8 QAOs	Repeat until acceptable
Laboratory blanks	One (1) per analytical batch	≤ 3 × IDL (≤ 5 × IDL for ICP-MS)[b]	Redigest and reanalyze any samples with analyte concentrations which are ≤10 × blank value and ≥ 0.5 × PRQL
Matrix spikes	One (1) per analytical batch	Meet Table B3-8 accuracy QAOs	Nonconformance if %R outside the range specified in Table B3-8
Matrix spike duplicates	One (1) per analytical batch	Meet Table B3-8 accuracy and precision QAOs	Nonconformance if RPDs > values and %Rs outside range specified in Table B3-8
ICP-MS Tune (ICP-MS Only)	Daily	4 Replicate %RSD ≤ 5; mass calibration within 0.9 amu; resolution < 1.0 amu full width at 10% peak height	Nonconformance if %RSD > 5; mass calibration > 0.9 amu; resolution > 1.0 amu
Initial Calibration 1 blank, 1 standard (ICP, ICP-MS) 3 standard, 1 blank (GFAA, FLAA) 5 standard, 1 blank (CVAA, HAA)	Daily	90-110 %R (80-120% for CVAA, GFAA, HAA, FLAA) for initial calibration verification solution. Regression coefficient ≥ 0.995 for FLAA, CVA, GFAA, MAA	Correct problem and recalibrate; repeat initial calibration
Continuing Calibration	Every 10 samples and beginning and end of run	90-110% for continuing calibration verification solution. (80-120% for CVAA, GFAA, HAA, FLAA)	Correct problem and recalibrate; rerun last 10 samples
Internal Standard Area Verification (ICP-MS)	Every Sample	Meet SW-846 Method 6020 criteria	Nonconformance if not reanalyzed at 5 × dilution until criteria are met
Serial Dilution (ICP, ICP-MS)	One (1) per analytical batch	5 × dilution must be ≤10% D of initial value for sample > 50xIDL	Flag Data if >10% and > 50×IDL

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Interference Correction Verification (ICP, ICP-MS)	Beginning and end of run or every 12 hours (8 for ICP) whichever is more frequent	80-120% recovery for analytes Note: Acceptance Criteria and Corrective Action apply only if interferents found in samples at levels greater than ICS A Solution	Correct problem and recalibrate, nonconformance if not corrected
Laboratory Control Samples	One (1) per analytical batch	Table B3-8 accuracy QAOs	Redigest and reanalyze for affected analytes; non conformance if not reanalyzed
Blind audit samples	Samples and frequency controlled by the Solid PDP Plan	Specified in the Solid PDP Plan	Specified in the Solid PDP Plan

[a] Corrective action per Section B3-13 when final reported QC samples do not meet the acceptance criteria. Nonconformances do not apply to matrix related exceedances.
[b] Applies only to concentrations greater than the PRQLs listed in Table B3-8.

IDL = Instrument Detection Limit
PDP = Performance Demonstration Program
PRQL = Program Required Quantitation Limit
%R = Percent Recovery
RPD = Relative Percent Difference

TABLE B3-10
MINIMUM TRAINING AND QUALIFICATIONS REQUIREMENTS [a]

Personnel	Requirements[a]
Radiography Operators[c]	Site-specific training based on waste matrix codes and waste material parameters; requalification every 2 years
FTIRS Technical Supervisors[b] FTIRS Operators[c]	Site-specific and on-the-job training based on the site-specific FTIRS system; requalification every 2 years
Gas Chromatography Technical Supervisors[b] Gas Chromatography Operators[c]	B.S. or equivalent experience and 6 months previous applicable experience
Gas Chromatography/Mass Spectrometry Operators[c] Mass Spectrometry Operators[c]	B.S. or equivalent experience and 1 year independent spectral interpretation or demonstrated expertise
Gas Chromatography/Mass Spectrometry Technical Supervisors[b] Mass Spectrometry Technical Supervisors[b] Atomic Absorption Spectroscopy Technical Supervisors[b] Atomic Absorption Spectroscopy Operators[c] Atomic Mass Spectrometry Operators[c] Atomic Emission Spectroscopy Operators[c]	B.S. or equivalent experience and 1 year applicable experience
Atomic Mass Spectrometry Technical Supervisors[b]	B.S. and specialized training in Atomic Mass Spectrometry and 2 years applicable experience
Atomic Emission Spectroscopy Technical Supervisors[b]	B.S. and specialized training in Atomic Emission Spectroscopy and 2 years applicable experience.

[a] Based on requirements contained in *USEPA Contract Laboratory Program Statement of Work for Organics Analysis* (Document Number OLM 01.0) and *Statement of Work for Inorganics Analysis* (Document Number ILM 03.0).
[b] Technical Supervisors are those persons responsible for the overall technical operation and development of a specific laboratory technique. QAPjPs shall include the site-specific title for this position.
[c] Operators are those persons responsible for the actual operation of analytical equipment. QAPjPs shall include the site-specific title for this position.

TABLE B3-11
TESTING BATCH DATA REPORT CONTENTS

Required Information	Radiography	Visual Examination	Comment
Batch Data Report Date	X	X	
Batch number	X	X	
Waste container number	X	X	
Waste stream name and/or number	O	O	
Waste Matrix Code	X	X	Summary Category Group included in waste matrix code
Implementing procedure (specific version used)	X	X	If procedure cited contains more than one method, the method used must also be cited. Can use revision number, date, or other means to track specific version used.
Container type	O	O	Drums, Standard Waste Box, Ten Drum Overpack, etc.
Video media reference	X	X	Reference to Video media applicable to each container. For visual examination of newly generated waste, video media not required if two trained operators review the contents of the waste container to ensure correct reporting.
Imaging check	O		
Camera check		O	
Audio check	O	O	
QC documentation	X	X	
Verification that the physical form matches the waste stream description and Waste Matrix Code.	X	X	Summary Category Group included in waste matrix code
Comments	X	X	
Reference to or copy of associated NCRs, if any	X	X	Copies of associated NCRs must be available.

Required Information	Radiography	Visual Examination	Comment
Verify absence of prohibited items	X	X	
Operator signature and date of test	X	X	Signatures of both operators required for Visual Verification of Acceptable Knowledge
Data review checklists	X	X	All data review checklists will be identified

LEGEND:

X - Required in batch data report.
O - Information must be documented and traceable; inclusion in batch data report is optional.

TABLE B3-12
SAMPLING BATCH DATA REPORT CONTENTS

Required Information	Headspace Gas	Solid Sampling	Comment
Batch Data Report Date	X	X	
Batch number	X	X	
Waste stream name and/or number	O	O	
Waste Matrix Code		X	Summary Category Group included in Waste Matrix Code
Procedure (specific version used)	X	X	If procedure cited contains more than one method, the method used must also be cited. Can use revision number, date, or other means to track specific version used.
Container number	X	X	
Container type	O	O	Drums, Standard Waste Box, Ten Drum Overpack, etc.
Sample matrix and type	X	X	
Analyses requested and laboratory	X	X	
Point of origin for sampling	X	X	Location where sample was taken (e.g., building number, room)
Sample number	X	X	
Sample size	X	X	
Sample location	X	X	Location within container where sample is taken. (For HSG, specify what layer of confinement was sampled. For solids, physical location within container.)
Sample preservation	X	X	
Person collecting sample	X	X	
Person attaching custody seal	O	O	May or may not be the same as the person collecting the sample
Chain of custody record	X	X	Original or copy is allowed
Sampling equipment numbers	X	X	For disposable equipment, a reference to the lot

Required Information	Headspace Gas	Solid Sampling	Comment
Drum age	X		Must include all supporting determinative information, including but not limited to packaging date, equilibrium start time, storage temperature, and sampling date/time. If Scenario 3 is used, the packaging configuration, filter diffusivity, liner presence/absence, and rigid liner vent hole diameter used in determining the DAC must be documented. If Scenario 1 and 2 are used together, the filter diffusivity and rigid liner vent hole diameter used in determining the DAC must be documented. If default values are used for retrievably stored waste, these values must clearly be identified as such.
Cross-reference of sampling equipment numbers with associated cleaning batch numbers	O	X	As applicable to the equipment used for the sampling. For disposable equipment, a reference to the lot and procurement records to support cleanliness is sufficient
Drum age	X		
Equilibration time	X		
Verification of rigid liner venting	X		Only applicable to containers with rigid liners
Verification that sample volume taken is small in comparison to the available volume	X		Must include headspace gas volume when it can be estimated
Scale Calibration		O	
Depth of waste		X	For newly generated waste, if a sampling method other than coring is used, this is replaced by documentation that a representative sample has been taken.
Calculation of core recovery		X	For newly generated waste, if a sampling method other than coring is used, this is replaced by documentation that a representative sample has been taken.
Co-located core description		X	For newly generated waste, if a sampling method other than coring is used, this is replaced by documentation that a QC sample has been taken.
Time between coring and subsampling		X	Only applicable to coring.
OVA calibration and reading	O		Only applicable to manifold systems. Must be done in accordance with manufacturer’s specifications

Required Information	Headspace Gas	Solid Sampling	Comment
Field Records	X	X	Must contain the following as applicable to the sampling method used: Collection problems, Sequence of sampling collection, Inspection of the solids sampling area, Inspection of the solids sampling equipment, Coring tool test, random location of sub-sample, canister pressure, and ambient temperature and pressure.
Reference to or copy of associated NCRs, if any	X	X	Copies of associated NCRs must be available.
Operator Signature and date and time of sampling	X	X	
Data review checklists	X	X	All data review checklists will be identified

LEGEND:

X - Required in batch data report.
O - Information must be documented and traceable; inclusion in batch data report is optional.

TABLE B3-13
ANALYTICAL BATCH DATA REPORT CONTENTS

Required Information	Headspace Gas	Solid Sampling	Comment
Batch Data Report Date	X	X	
Batch number	X	X	
Sample numbers	X	X	
QC designation for sample	X	X	
Implementing procedure (specific version used)	X	X	If procedure cited contains more than one method, the method used must also be cited. Can use revision number, date, or other means to track specific version used.
QC sample results	X	X	
Sample data forms	X	X	Form should contain reduced data for target analytes and TICs
Chain of custody	X	X	Original or copy
Gas canister tags	X		Original or copy
Sample preservation	X	X	
Holding time		X	
Cross-reference of field numbers to laboratory sample numbers	X	X	
Date and time analyzed	X	X	
Verification of spectra used for results	O	O	Analyst must qualitatively evaluate the validity of the results based on the spectra, can be implemented as a check box for each sample
TIC evaluation	X	X	
Reporting flags, if any	X	X	Table B3-14 lists applicable flags
Case narrative	X	X	
Reference to or copy of associated NCRs, if any	X	X	Copies of associated NCRs must be available.
Operator signature and analysis date	X	X	
Data review checklists	X	X	All data review checklists will be identified

LEGEND:

X - Required in batch data report.
O - Information must be documented and traceable; inclusion in batch data report is optional.

TABLE B3-14
DATA REPORTING FLAGS

DATA FLAG	INDICATOR
B	Analyte detected in blank (Organics/ Headspace gases)
B	Analyte blank concentration greater than or equal to 20 percent of sample concentration prior to dilution corrections (Metals)
E	Analyte exceeds calibration curve (Organics/ Headspace gases)
J	Analyte less than PRQL but greater than or equal to MDL (Organics/ Headspace gases)
J	Analyte greater than or equal to IDL but less than 5 times the IDL before dilution correction (Metals)
U	Analyte was not detected and value is reported as the MDL (IDL for Metals)
D	Analyte was quantitated from a secondary dilution, or reduced sample aliquot (Organics/ Headspace gases)
Z	One or more QC samples do not meet acceptance criteria
H	Holding time exceeded

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FIGURES

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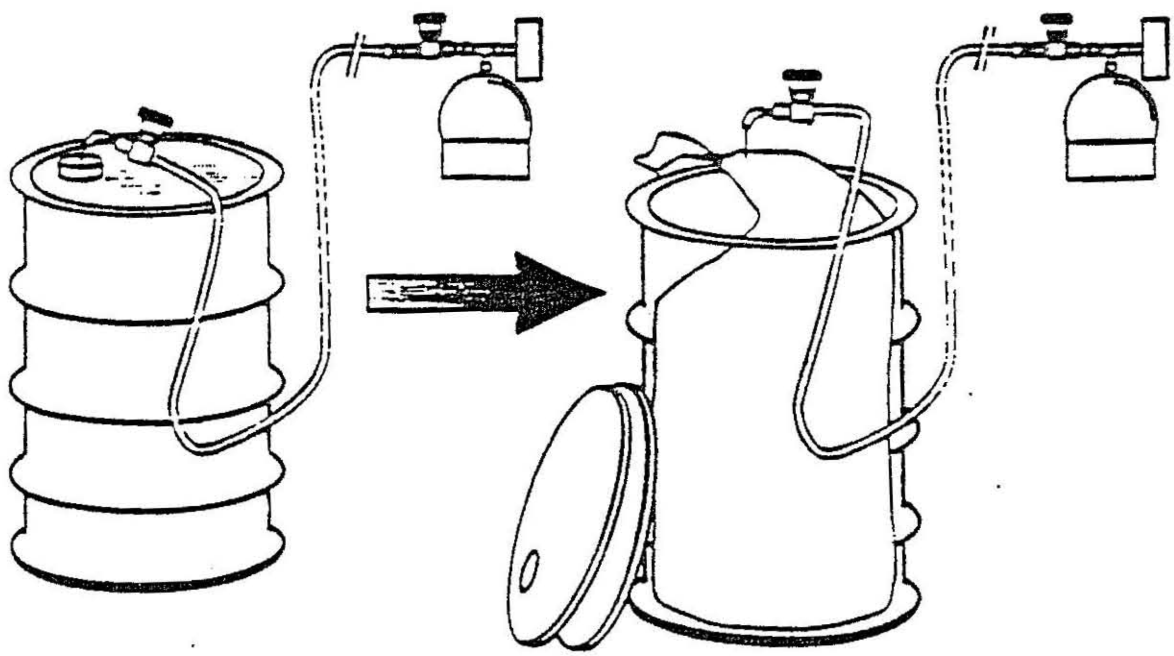

Figure B3-1
Overall Headspace-Gas Sampling Scheme Illustrating Manifold Sampling

APPENDIX B4

TRU MIXED WASTE CHARACTERIZATION USING ACCEPTABLE KNOWLEDGE

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APPENDIX B4

TRU MIXED WASTE CHARACTERIZATION USING ACCEPTABLE KNOWLEDGE

TABLE OF CONTENTS

List of Figures

APPENDIX B4

TRU MIXED WASTE CHARACTERIZATION USING ACCEPTABLE KNOWLEDGE

B4-1 Introduction

The Resource Conservation and Recovery Act (**RCRA**) regulations codified in 40 CFR Parts 260 through 265, 268, and 270, and the New Mexico Hazardous Waste Management Regulations in Title 20 New Mexico Administrative Code, Chapter 4, Part 1, (20.4.1 NMAC) Subparts I through VI, Subpart VIII, and Subpart IX, authorize the use of acceptable knowledge (**AK**) in appropriate circumstances by waste generators, or treatment, storage, or disposal facilities to characterize hazardous waste. Acceptable knowledge is described in *Waste Analysis: EPA Guidance Manual for Facilities That Generate, Treat, Store and Dispose of Hazardous Waste* (EPA, 1994). Acceptable knowledge, as an alternative to sampling and analysis, can be used to meet all or part of the waste characterization requirements under the RCRA (EPA, 1994).

EPA's 1994 Waste Analysis Guidance Manual broadly defines the term "acceptable knowledge" to include process knowledge, whereby detailed information on the wastes is obtained from existing published or documented waste analysis data or studies conducted on hazardous waste generated by processes similar to that which generated the waste; facility records of analysis performed before the effective date of RCRA; and waste analysis data obtained from generators of similar wastes that send their wastes off-site for treatment, storage, or disposal (EPA, 1994). If a generator/storage site determines that AK alone is insufficient to accurately characterize a waste, the site may use radiography and/or visual examination, headspace gas sampling and analysis, and homogeneous waste sampling and analysis (specified in Permit Attachment B1) to complete the waste characterization process and satisfy the requirements of the Waste Analysis Plan (**WAP**) specified in Permit Attachment B. Acceptable knowledge is used in TRU mixed waste characterization activities in five ways:

- To delineate TRU mixed waste streams
- To assess whether TRU mixed wastes comply with the applicable requirements of the Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (**TSDF-WAC**)
- To assess whether TRU mixed wastes exhibit a hazardous characteristic (20.4.1.200 NMAC, incorporating 40 CFR §261 Subpart C)
- To assess whether TRU mixed wastes are listed (20.4.1.200 NMAC, incorporating 40 CFR §261 Subpart D)
- To estimate waste material parameter weights

Sampling and analysis may be performed to augment the characterization of wastes based on acceptable knowledge when an AK Sufficiency Determination has not been requested by the generator/storage site or, if requested, has not been granted by the Permittees (see Section B4-3d). Sampling and analysis consists of radiography, visual examination, headspace gas, and homogeneous waste sampling and analysis. TRU mixed waste streams shall undergo applicable provisions of the acceptable knowledge process prior to management, storage, or disposal by the Permittees at WIPP.

B4-2 Acceptable Knowledge Documentation

The Permittees shall obtain from each Department of Energy (**DOE**) TRU mixed waste generator/storage site (**site**) a logical sequence of acceptable knowledge information that progresses from general facility information (TRU Mixed Waste Management Program Information) to more detailed waste-specific information (TRU Mixed Waste Stream Information). Traceability of acceptable knowledge information for a selected container in the audited Waste Summary Category Group(s) will be examined during the Permittees' audit of a site (Section B4-3g). The consistent presentation of acceptable knowledge documentation among sites in auditable records[1] will allow the Permittees to verify the completeness and adequacy of acceptable knowledge for TRU mixed waste characterization during the audit process. The Permittees shall implement the acceptable knowledge process as specified in this Permit to characterize TRU mixed wastes and obtain sufficient waste characterization data to demonstrate compliance with the Permit. The New Mexico Environment Department (**NMED**) may independently validate the implementation of and compliance with applicable provisions of the WAP at each generator/storage site by participation in the Permittees' Audit and Surveillance Program (Permit Attachment B6). The Permittees shall provide NMED with current audit schedules and notify NMED in writing no later than thirty (30) calendar days prior to each audit. NMED may choose to accompany the Permittees on any audit of the WAP implementation.

The following sections include the information the Permittees will require for each site to characterize TRU mixed waste using acceptable knowledge. Because waste generating processes are site-specific, sites shall, as necessary, augment the required acceptable knowledge records with additional supporting information (see Section B4-2c, Supporting Acceptable Knowledge Information). If the required information is not available for a particular waste stream, the waste stream will not be eligible for an AK Sufficiency Determination as specified in Section B4-3d.

B4-2a Required TRU Mixed Waste Management Program Information

TRU mixed waste management program information shall clearly define waste categorization schemes and terminology, provide a breakdown of the types and quantities of TRU mixed waste that are generated and stored at the site, and describe how waste is tracked and managed at the site, including historical and current operations. Information related to TRU mixed waste

[1] "Auditable records" mean those records which allow the Permittees to conduct a systematic assessment, analysis, and evaluation of the Permittees compliance with the WAP and this Permit.

certification procedures and the types of documentation (e.g., waste profile forms) used to summarize acceptable knowledge shall also be provided. The following information shall be included as part of the acceptable knowledge written record:

- Map of the site with the areas and facilities involved in TRU mixed waste generation, treatment, and storage identified
- Facility mission description as related to TRU mixed waste generation and management (e.g., nuclear weapons research may involve metallurgy, radiochemistry, and nuclear physics operations that result in specific waste streams)
- Description of the operations that generate TRU mixed waste at the site (e.g., plutonium recovery, weapons design, or weapons fabrication)
- Waste identification or categorization schemes used at the facility (e.g., item description codes, content codes)
- Types and quantities of TRU mixed waste generated, including historical generation through future projections
- Correlation of waste streams generated from the same building and process, as appropriate (e.g., sludge, combustibles, metals, and glass)
- Waste certification procedures for retrievably stored and newly generated wastes to be sent to the WIPP facility

B4-2b Required TRU Mixed Waste Stream Information

The Permittees may use acceptable knowledge to delineate site-specific waste streams. For each TRU mixed waste stream, the Permittees shall require sites to compile all process information and data that support the acceptable knowledge used to characterize that waste stream. The type and quantity of supporting documentation will vary by waste stream, depending on the process generating the waste and site-specific requirements imposed by the Permittees. At a minimum, the waste process information shall include the following written information:

- Area(s) and/or building(s) from which the waste stream was or is generated
- Waste stream volume and time period of generation (e.g., 100 standard waste boxes of retrievable stored waste generated from June 1977 through December 1977)
- Waste generating process described for each building (e.g., batch waste stream generated during decommissioning operations of glove boxes), including processes associated with U134 waste generation, if applicable.

- Process flow diagrams (e.g., a diagram illustrating glove boxes from a specific building to a size reduction facility to a container storage area). In the case of research/development, analytical laboratory waste, or other similar processes where process flow diagrams cannot be created, a description of the waste generating processes, rather than a formal process flow diagram, may be included if this modification is justified and the justification is placed in the auditable record

- Material inputs or other information that identifies the chemical content of the waste stream and the physical waste form (e.g., glove box materials and chemicals handled during glove box operations; events or processes that may have modified the chemical or physical properties of the waste stream after generation; data obtained through visual examination of newly generated waste that later undergoes radiography; information demonstrating neutralization of U134 [hydrofluoric acid] and waste compatibility)

The acceptable knowledge written record shall include a summary that identifies all sources of waste characterization information used to delineate the waste stream. The basis and rationale for delineating each waste stream, based on the parameters of interest, shall be clearly summarized and traceable to referenced documents. Assumptions made in delineating each waste stream also shall be identified and justified. If discrepancies exist between required information, then sites shall apply all hazardous waste numbers indicated by the information to the subject waste stream unless the sites choose to justify an alternative assignment and document the justification in the auditable record. The Permittees shall obtain from each site, at a minimum, procedures that comply with the following acceptable knowledge requirements:

- Procedures for identifying and assigning the physical waste form of the waste

- Procedures for delineating waste streams and assigning Waste Matrix Codes

- Procedures for resolving inconsistencies in acceptable knowledge documentation

- Procedures for headspace gas sampling and analysis, visual examination and/or radiography, and homogeneous waste sampling and analysis, if applicable

- For newly generated waste, procedures describing process controls used to ensure prohibited items (specified in the WAP, Permit Attachment B) are documented and managed

- Procedures to ensure radiography and visual examination include a list of prohibited items that the operator shall verify are not present in each container of waste (e.g., liquids exceeding TSDF-WAC limits, corrosives, ignitables, reactives, and incompatible wastes)

- Procedures to document how changes to Waste Matrix Codes, waste stream assignment, and associated Environmental Protection Agency (**EPA**) hazardous waste numbers based on material composition are documented for any waste

- Procedures for assigning EPA hazardous waste numbers to TRU mixed waste streams
- Procedures for estimating waste material parameter weights

B4-2c Supporting Acceptable Knowledge Information

The generator/storage sites shall obtain supporting acceptable knowledge information. The amount and type of supporting information is site-specific and cannot be mandated, but sites shall collect information as appropriate to augment required information. Adequacy of supporting information shall be assessed by the Permittees during audits (Section B4-3g). Sites will use this information to compile the acceptable knowledge written record. Supporting acceptable knowledge documentation that may be used (if available) in addition to the required information specified above include, but are not limited to, the following information:

- Process design documents (e.g., Title II Design)

- Standard operating procedures that may include a list of raw materials or reagents, a description of the process or experiment generating the waste, and a description of wastes generated and how the wastes are managed at the point of generation

- Preliminary and final safety analysis reports and technical safety requirements

- Waste packaging logs

- Test plans or research project reports that describe reagents and other raw materials used in experiments

- Site databases (e.g., chemical inventory database for Superfund Amendments and Reauthorization Act Title III requirements)

- Information from site personnel (e.g., documented interviews)

- Standard industry documents (e.g., vendor information)

- Analytical data relevant to the waste stream, including results from fingerprint analyses, spot checks, or routine verification sampling. This may also include new information which augments required information (e.g., visual examination not performed in compliance with the WAP)

- Material Safety Data Sheets, product labels, or other product package information

- Sampling and analysis data from comparable or surrogate waste streams (e.g., equivalent nonradioactive materials)

- Laboratory notebooks that detail the research processes and raw materials used in an experiment

For waste containers that belong to LANL sealed sources waste streams, these containers do not require headspace gas sampling and analysis if the following information is part of the AK documentation:

- Documentation that the waste container contents meet the definition of sealed sources per 10 CFR §30.4 and 10 CFR §835.2 (effective January 1, 2004).

- Documentation of the certification of the sealed sources as U.S. Department of Transportation Special Form Class 7 (Radioactive) Material per 49 CFR §173.403 (effective October 1, 2003).

- Documentation of contamination survey results that validate the integrity of each sealed source per 10 CFR §34.27 (effective January 1, 2004).

- AK documentation does not indicate the use of VOCs or VOC-bearing materials as constituents of the sealed sources.

- The outer casing of each sealed source must be of a non-VOC bearing material, which must be verified at the time of packaging.

- AK Documentation shall also include but shall not be limited to, as available and as necessary to determine the hazardous constituents associated with sealed sources, the following: source manufacturer's sales catalogues, original purchase records, source manufacturer's fabrication documents, source manufacturer's drawings, source manufacturer's fuel capture assembly reports, source manufacturer's operational procedures for cleanliness requirements, source manufacturer's shipping documents, source manufacturer's welding records, transuranic batch material records, and information from national databases (e.g., NMMSS). All of this information may not and need not be available for each source, but sufficient information must be included in the auditable record to derive an adequate understanding of source construction and history to ensure that no VOCs are present in association with the sealed source itself that would render the source hazardous. If AK data indicate that assignment of a hazardous waste number related to organic materials is required in association with a source, this specific source will be assigned to a separate waste stream and that waste stream will be subject to representative headspace gas sampling unless a separate AK Sufficiency Determination is approved by the Permittees for the waste stream.

All specific, relevant supporting acceptable knowledge documentation assembled and used in the acceptable knowledge process, whether it supports or contradicts any required acceptable knowledge documentation, shall be identified and an explanation provided for its use (e.g., identification of a toxicity characteristic). Supporting documentation may be used to further document the rationale for the hazardous characterization results. The collection and use of supporting information shall be assessed by the Permittees during site audits to ensure that hazardous waste characterization is supported, as necessary, by supporting information. Similar to required information, if discrepancies exist between supporting information and the required information, then sites shall apply all hazardous waste numbers indicated by the supporting information to the subject waste stream unless the sites choose to justify an alternative assignment and document the justification in the auditable record.

B4-3 Acceptable Knowledge Training, Procedures and Other Requirements

The Permittees shall require consistency among sites in using acceptable knowledge information to characterize TRU mixed waste by the use of the following: 1) compiling the required and supporting acceptable knowledge documentation in an auditable record, 2) auditing acceptable knowledge records, and 3) WSPF approval and waste confirmation. This section specifies qualification and training requirements, describes each phase of the process, specifies the procedures that the Permittees shall require all sites to develop to implement the requirements for using acceptable knowledge, and specifies data quality requirements for acceptable knowledge.

B4-3a Qualifications and Training Requirements

Site personnel responsible for compiling acceptable knowledge, assessing acceptable knowledge, and resolving discrepancies associated with acceptable knowledge shall be qualified and trained in the following areas at a minimum:

- WIPP WAP in Permit Attachment B and the TSDF-WAC specified in this permit
- State and Federal RCRA regulations associated with solid and hazardous waste characterization
- Discrepancy resolution and reporting processes
- Site-specific procedures associated with waste characterization using acceptable knowledge

B4-3b Acceptable Knowledge Assembly and Compilation

The Permittees shall obtain from sites acceptable knowledge procedures which require consistent application of the acceptable knowledge process and requirements. Site-specific acceptable knowledge procedures shall address the following:

- Sites shall prepare and implement a written procedure outlining the specific methodology used to assemble acceptable knowledge records, including the origin of the documentation, how it will be used, and any limitations associated with the information (e.g., identify the purpose and scope of a study that included limited sampling and analysis data).
- Sites shall develop and implement a written procedure to compile the required acceptable knowledge record.

- Sites shall develop and implement a written procedure that ensures unacceptable wastes (e.g., reactive, ignitable, corrosive) are identified and segregated from TRU mixed waste populations sent to WIPP.

- Sites shall prepare and implement a written procedure to evaluate acceptable knowledge and resolve discrepancies. If different sources of information indicate different hazardous wastes are present, then sites shall include all sources of information in its records and conservatively assign all potential hazardous waste numbers unless the sites choose to justify an alternative assignment and document the justification in the auditable record. The assignment of hazardous waste numbers shall be tracked in the auditable record to all required documentation.

- Sites shall prepare and implement a written procedure to identify hazardous wastes and assign the appropriate hazardous waste numbers to each waste stream. The following are minimum baseline requirements/standards that site-specific procedures shall include to ensure comparable and consistent characterization of hazardous waste:

  - Compile all of the required information in an auditable record.

  - Review the compiled information and delineate TRU mixed waste streams. Delineation of waste streams must comply with the following definition: a waste stream is defined as waste material generated from a single process or from an activity that is similar in material, physical form, and hazardous constituents.

  - Review the compiled information to determine if the waste stream is compliant with the TSDF-WAC.

  - Review the required information to determine if the waste is listed under 20.4.1.200 NMAC (incorporating 40 CFR §261), Subpart D. Assign all listed hazardous waste numbers unless the sites choose to justify an alternative assignment and document the justification in the auditable record.

  - Review the required information to determine if the waste exhibits a hazardous characteristic or may contain hazardous constituents included in the toxicity characteristics specified in 20.4.1.200 NMAC (incorporating 40 CFR §261), Subpart C. If a toxicity characteristic contaminant is identified and is not included as a listed waste, assign the toxicity characteristic number unless data are available that demonstrate that the concentration of the constituent in the waste is less than the toxicity characteristic regulatory level. When data are not available, the toxicity characteristic hazardous waste number for the identified hazardous constituent shall be applied to the mixed waste stream.

  - Review the compiled information to provide an estimate of material parameter weights for each container to be stored or disposed of at WIPP.

For newly generated wastes, procedures shall be developed and implemented to characterize hazardous waste using acceptable knowledge prior to packaging the waste.

- Sites shall ensure that results of audits of the TRU mixed waste characterization programs at the site are available in the records.

- Sites shall identify all process controls (implemented to ensure that the waste contains no prohibited items and to control hazardous waste content and/or physical form) that may have been applied to retrievably stored waste and/or may presently be applied to newly generated waste. Process controls are applied at the time of waste generation/packaging to control waste content, whereas any activities performed after waste generation/packaging to identify prohibited items, hazardous waste content, or physical form are waste characterization activities, not process controls. The AK record must contain specific process controls and supporting documentation identifying when these process controls are used to control waste content. See Permit Attachment B, Section B-2 for programmatic requirements related to process controls.

B4-3c Criteria for Assembling an Acceptable Knowledge Record and Delineating the Waste Stream

Figure B4-1 provides an overview of the process for assembling acceptable knowledge documentation into an auditable record. The first step is to assemble all of the required acceptable knowledge information and any supporting information regarding the materials and processes that generate a specific waste stream. The Permittees shall require the sites to implement procedures which comply with the following criteria to establish acceptable knowledge records:

- Acceptable knowledge information shall be compiled in an auditable record, including a road map for all applicable information.

- The overview of the facility and TRU mixed waste management operations in the context of the facility's mission shall be correlated to specific waste stream information.

- Correlations between waste streams, with regard to time of generation, waste generating processes, and site-specific facilities shall be clearly described. For newly generated wastes, the rate and quantity of waste to be generated shall be defined.

- A reference list shall be provided that identifies documents, databases, Quality Assurance protocols, and other sources of information that support the acceptable knowledge information.

Container inventories for TRU mixed waste currently in retrievable storage shall be delineated into waste streams by correlating the container identification to all of the required acceptable knowledge information and any supporting acceptable knowledge information.

B4-3d AK Sufficiency Determination Request Contents

Generator/storage sites may submit an AK Sufficiency Determination Request (**Determination Request**) to meet all or part of the waste characterization requirements. The Determination Request shall include, at a minimum:

- Identification of the scenario for which the approval is sought (Permit Attachment B, Section B-0b).

- A complete AK Summary that addresses the following technical requirements:
  - Executive Summary;
  - Waste Stream Identification Summary, including a demonstration that the waste stream has been properly delineated and meets the Permit definition of waste stream (Permit Attachment B, Introduction);
  - Mandatory Program Information (including, but not limited to, facility location and description, mission, defense waste assessment, spent nuclear fuel and high-level waste assessment, description of waste generating processes, research/development [as necessary], facility support operations [as applicable], types and quantities of TRU waste generated, correlation of waste streams to buildings/processes, waste identification and categorization, physical form identifiers);
  - Mandatory Waste Stream Information (including, but not limited to, Area and Building of Generation, waste stream volume/period of generation (including, for newly generated waste, the rate and quantity of waste to be generated), waste generating activities, types of waste generated, material input related to physical form and identification of percentage of each waste material parameter in the waste stream, chemical content information including hazardous constituents and hazardous waste identification, prohibited item content (including documented evidence that the waste meets the TSDF-WAC Permit Conditions II.C.3.a-h), waste packaging, presence of filter vents, number of layers of confinement);
  - Types of supporting information gathered;
  - Container specific data (if available and relevant); and
  - A complete reference list including all mandatory and supporting information.
- An AK roadmap (defined as a cross reference between mandatory programmatic and mandatory waste stream information, with references supporting these requirements).
- A complete reference list including all mandatory and supporting documentation.
- Relevant supporting information for the required programmatic and waste stream data addressed in the AK Summary, examples of which are presented in Permit Attachment B4, Section B4-2c.
- Identification of any mandatory requirements supported only by upper tier documents (i.e., there is insufficient supporting data).
- Description or other means of demonstrating that the AK process described in the Permit was followed (for example, AK personnel were appropriately trained; discrepancies were documented, etc).

- Information showing that the generator/storage site has developed a written procedure for compiling the AK information and assigning hazardous waste numbers as required in Permit Attachment B4-3b.
- Information showing that the generator/storage site has assessed the AK process (e.g. internal audits, Permit Attachment B4-3b).

The Permittees shall evaluate the Determination Request for completeness and technical adequacy as specified in Permit Attachment B.

B4-3e <u>Requirements for Re-evaluating Acceptable Knowledge Information</u>

Acceptable knowledge includes information regarding the physical form of the waste, the base materials composing the waste, and the process that generates the waste. Waste sampling and analysis (i.e., radiography or visual examination, headspace-gas sampling and analysis, and homogeneous waste sampling and analysis) may be used to augment acceptable knowledge information.

The Waste Stream Profile Form (**WSPF**) and Characterization Information Summary (including the acceptable knowledge summary) will be reviewed for each waste stream prior to Permittee approval of the WSPF. The Permittees review will ensure that the submitted AK information was collected under procedures that ensure implementation of the WAP, provides data sufficient to meet the DQOs in Section B-4a(1), and allow the Permittees to demonstrate compliance with the waste analysis requirements of the Permit. A detailed discussion of the Permittees' waste stream review and approval process is provided in Section B -1d.

The Permittees shall require sites to establish procedures for reevaluating acceptable knowledge if the results of waste confirmation indicate that the waste to be shipped does not match the approved waste stream, or if data obtained from radiography or visual examination for waste streams without an AK Sufficiency Determination exhibit this discrepancy. Site procedures shall describe how the waste is reassigned, acceptable knowledge reevaluated, and appropriate hazardous waste numbers assigned. If the reevaluation requires that the Waste Matrix Code be changed for the waste stream or the waste does not match the approved waste stream, the following minimum steps shall be taken to reevaluate acceptable knowledge:

- Review existing information based on the container identification number and document all differences in hazardous waste number assignments

- If differences exist in the hazardous waste numbers that were assigned, reassess and document all required acceptable knowledge information (Section B4-3b) associated with the new designation

- Reassess and document all sampling and analytical data associated with the waste

- Verify and document that the reassigned Waste Matrix Code was generated within the specified time period, area and buildings, waste generating process, and that the process material inputs are consistent with the waste material parameters identified during radiography or visual examination

- Record all changes to acceptable knowledge records

- If discrepancies exist in the acceptable knowledge information for the revised Waste Matrix Code, document the segregation of the affected portion of the waste stream, and define the actions necessary to fully characterize the waste

Potential toxicity characteristics for base materials that compose TRU mixed heterogeneous debris (S5000) waste may be determined without destructive sampling and analysis via acceptable knowledge. Sites will assign a Waste Matrix Code and waste stream to each container of waste using acceptable knowledge. In lieu of sampling and analytical or other data to the contrary (including headspace gas and total/TCLP analysis of solids/soils), sites shall assign the toxicity characteristic hazardous waste numbers based on the presence of the constituent identified by acceptable knowledge, regardless of the quantity or concentration. Procedures shall describe how additions to hazardous waste numbers based on material composition are documented, as necessary (Section B4-3b).

The Permittees shall require sites to use acceptable knowledge to identify spent solvents associated with each TRU mixed waste stream or waste stream lot. Headspace-gas data will be used to resolve the assignment of EPA F-listed hazardous waste numbers to debris waste streams when waste streams do not have an AK Sufficiency Determination approved by the Permittees. In this case, sites shall assign F-listed hazardous waste numbers (20.4.1.200 NMAC, incorporating 40 CFR §261.31) by evaluating the average concentrations of each VOC detected in container headspace gas for each waste stream or waste stream lot using the upper 90 percent confidence limit (**UCL_{90}**). The UCL_{90} for the mean concentration shall be compared to the program required quantitation limit (**PRQL**) for the constituent. If the UCL_{90} for the mean concentration exceeds the PRQL, sites shall reevaluate their acceptable knowledge information and determine the potential source of the constituent. Sites shall provide documentation to support any determination that F-listed organic constituents are associated with packaging materials, radiolysis, or other uses not consistent with solvent use. If the source of the detected F-listed solvents can not be identified, the appropriate spent solvent hazardous waste number will be conservatively applied to the waste stream. In the case of applicable toxicity characteristic VOCs and non-toxic F003 constituents, generator/storage sites may assess whether the head space gas concentration would render the waste non-hazardous for those characteristics and change the initial acceptable knowledge determination accordingly.

EPA hazardous waste numbers associated with S3000 and S4000 waste streams will be assigned based on the results of the total/TCLP analysis of a representative homogeneous waste sample when waste streams do not have an AK Sufficiency Determination approved by the Permittees. As with headspace gas, if the total/TCLP results indicate that the concentration of a characteristic waste or non-toxic constituent of an F003 waste is below regulatory levels, the hazardous waste number assigned initially by acceptable knowledge may be changed. Otherwise, if an F-listed waste constituent is detected, the appropriate hazardous waste number shall be applied.

If the site determines that the source of the F-listed constituent is a spent solvent used in the process or is determined to be the result of mixing a listed waste with a solid waste during waste packaging, or applicable toxicity characteristic or non-toxic F003 wastes are present in excess of regulatory levels, then the site will either: 1) assign the applicable listed hazardous waste number to the entire waste stream, or 2) segregate the drums containing detectable concentrations of the solvent into a separate waste stream and assign applicable hazardous waste numbers. Each site shall document, justify, and consistently delineate waste streams and assign hazardous waste numbers based on site-specific permit requirements and other state-enforced agreements.

To determine the mean concentration of solvent VOCs, all headspace-gas data or homogeneous waste data for a waste stream or waste stream lot (i.e., the portion of the waste stream that is characterized as a unit) will be used, including data qualified with a 'J' flag (i.e., less than the PRQL but greater than the method detection limit [**MDL**]) or qualified with a 'U' flag (i.e., undetected). For data qualified with a 'U' flag, sites shall use one-half the MDL in calculating the mean concentration. Because listed wastes are not defined based on concentration, sites may not remove hazardous waste numbers assigned using acceptable knowledge if hazardous constituents are not detected in the headspace gas or solids/soil analysis.

TRU mixed headspace gases and homogeneous waste matrices may contain one or two constituents (e.g., carbon tetrachloride and 1,1,1-trichloroethane) at concentrations that are orders of magnitude higher than the other target analytes. In these cases, samples shall be diluted to remain within the instrument calibration range for the elevated constituents. Sample dilution results in elevated MDLs for the constituents with elevated concentrations. Only the concentrations of detected constituents will be used to calculate the mean for the purpose of assigning F-listed hazardous waste numbers. Because the presence or absence of F-listed solvents can not be assigned based on the artificially high MDLs that are caused by sample dilution, data flagged as 'U' and showing an elevated MDL will not be used in calculating the mean concentration.

B4-3f Acceptable Knowledge Data Quality Requirements

The data quality objectives for sampling and analysis techniques are provided in Permit Attachment B3. Analytical results will be used to augment the characterization of wastes based on acceptable knowledge. To ensure that the acceptable knowledge process is consistently applied, the Permittees shall require sites to comply with the data quality requirements for acceptable knowledge documentation in Permit Attachment B3.

Each site shall address quality control by tracking its performance with regard to the use of acceptable knowledge by: 1) assessing the frequency of inconsistencies among information, and 2) documenting the results of waste discrepancies identified by the generator/storage site during waste characterization or the Permittees during waste confirmation using radiography, review of radiography audio/video recordings, visual examination, or review of visual examination records. In addition, the acceptable knowledge process and waste stream documentation shall be evaluated through internal assessments by generator/storage site quality assurance organizations.

B4-3g Audits of Acceptable Knowledge

The Permittees will conduct an initial audit of each site prior to certifying the site for shipment of TRU mixed waste to the WIPP facility. This initial audit will establish an approved baseline that will be reassessed annually by the Permittees. These audits will verify compliance with the requirements specified in the WAP (Permit Attachment B). The audits will be used to verify compliance with the compilation, application, and interpretation requirements of acceptable knowledge information specified in this Permit at all sites, and to evaluate the completeness and defensibility of site-specific acceptable knowledge documentation related to hazardous waste characterization. Permit Attachment B6 gives a description of the overall audit program and a required checklist. Figure B4-2 includes the primary steps associated with the audit process of acceptable knowledge.

Site-specific audit plans will be prepared by the Permittees and provided to NMED, and will identify the scope of the audit, requirements to be assessed, participating personnel, activities to be audited, organizations to be notified, applicable documents, and schedule. Audits will be performed in accordance with written procedures and site-specific checklists that will be developed by the Permittees prior to the audit and provided to NMED. The site-specific audit checklists will include items associated with the compilation and evaluation of the required acceptable knowledge information as specified in the checklist required by Permit Attachment B6.

Audit checklists shall include Table B6-3 in Permit Attachment B6, and will include but not be limited to the following elements for review during the audit:

- Documentation of the process used to compile, evaluate, and record acceptable knowledge is available and implemented;
- Personnel qualifications and training are documented;
- All of the required acceptable knowledge documentation specified in Section B4-2 has been compiled in an auditable record;
- All of the required procedures specified in B4-3 have been developed and implemented, including but not limited to:
    - A procedure exists for assigning hazardous waste numbers to waste streams in accordance with Section B4-3;
    - A procedure exists for resolving discrepancies in acceptable knowledge documentation in accordance with Section B4-3; and
- Results of other audits of the TRU mixed waste characterization programs at the site are available in site records.

Members of the audit team will be knowledgeable regarding the required acceptable knowledge information, RCRA regulations and EPA guidance regarding the use of acceptable knowledge for waste characterization, RCRA hazardous waste characterization, and the WAP requirements (Permit Attachment B). Audit team members will be independent of all TRU mixed waste management operations at the site being audited.

Auditors will evaluate acceptable knowledge documentation for at least one waste stream from the Summary Category Group(s) being audited, and will audit acceptable knowledge traceability for at least one container from the audited Summary Category Group(s). For these waste streams, auditors will review all procedures and associated processes developed by the site for documenting the process of compiling acceptable knowledge documentation; correlating information to specific waste inventories; assigning hazardous waste numbers; and identifying, resolving, and documenting discrepancies in acceptable knowledge records. The adequacy of acceptable knowledge procedures and processes will be assessed and any deficiencies in procedures documented in the audit report.

Auditors will review the acceptable knowledge documentation for selected waste streams for logic, completeness, and defensibility. The criteria that will be used by auditors to evaluate the logic and defensibility of the acceptable knowledge documentation include completeness and traceability of the information, consistency of application of information, clarity of presentation, degree of compliance with this Permit Attachment with regard to acceptable knowledge data, nonconformance procedures, and oversight procedures. Auditors will evaluate compliance with written site procedures for developing the acceptable knowledge record. A completeness review will evaluate the availability of all required TRU mixed waste management program information and TRU mixed waste stream information (Section B4-2). Records will be reviewed for correlation to specific waste streams and the basis for characterizing hazardous waste. Auditors will verify that sites include all required information and conservatively include all potential hazardous waste numbers indicated by the acceptable knowledge records. All deficiencies in the acceptable knowledge documentation will be included in the audit report.

Auditors will verify and document that sites use administrative controls and follow written procedures to characterize hazardous waste for newly-generated and retrievably stored wastes. Procedures to document changes in acceptable knowledge documentation and changes to hazardous waste number assignments to specific waste streams also will be evaluated for compliance with the WAP (Permit Attachment B).

After the audit is complete, the Permittees will provide the site with preliminary results at a close-out meeting. The Permittees will prepare a final audit report that includes all observations and findings identified during the audit. Sites shall respond to all audit findings and identify corrective actions. Audit results will be included in the final audit report (Permit Attachment B6). If acceptable knowledge procedures do not exist, the required information is not available, or corrective actions (i.e., CARs) are identified associated with acceptable knowledge compilation, and/or hazardous waste characterization, the Permittees will not manage, store, or dispose TRU mixed waste for the subject waste summary category. Management, storage, or disposal of the subject waste summary category at WIPP will not resume until the Permittees find that all corrective actions have been implemented and the site complies with all applicable requirements of the WAP.

The National TRU Program disseminates information regarding TRU mixed waste characterization requirements and program status through the WIPP Home Page. The Permittees will use this web page to disseminate information regarding TRU mixed waste streams, RCRA compliance, and operational and programmatic issues, methods development, and waste characterization information, including the application of acceptable knowledge. The Permittees are provided the required waste characterization information prior to management, storage, or disposal of that waste at WIPP and also will conduct audits at least annually. The Permittees will maintain an operating record for review during regulatory agency audits. NMED may also review any information relevant to the scope of the audit during site audits. The Permittees will notify NMED regarding any site's failure to implement corrective actions associated with hazardous waste characterization as specified in Modules I and II and Permit Attachment B3.

FIGURES

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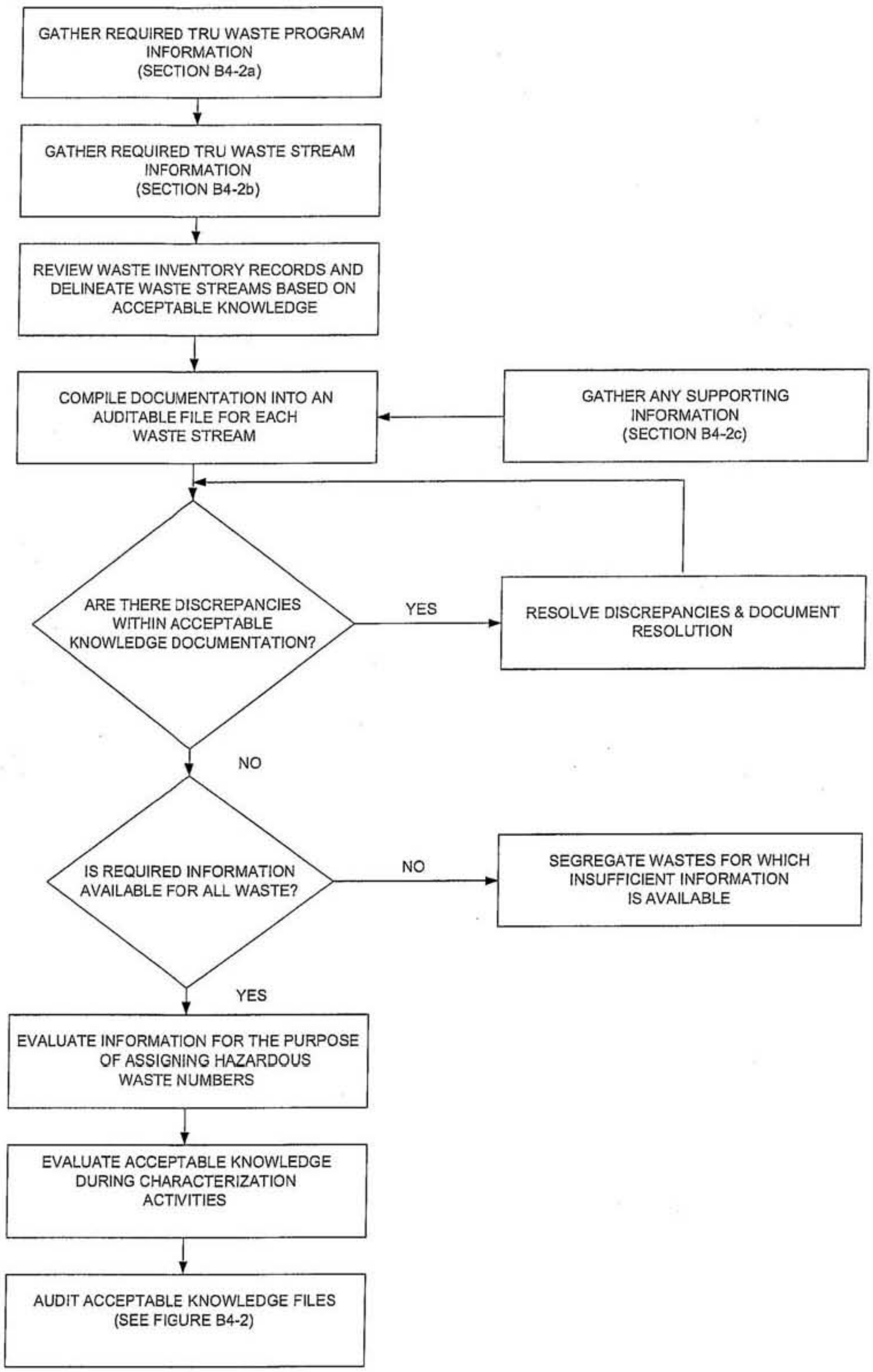

Figure B4-1
Compilation of Acceptable Knowledge Documentation

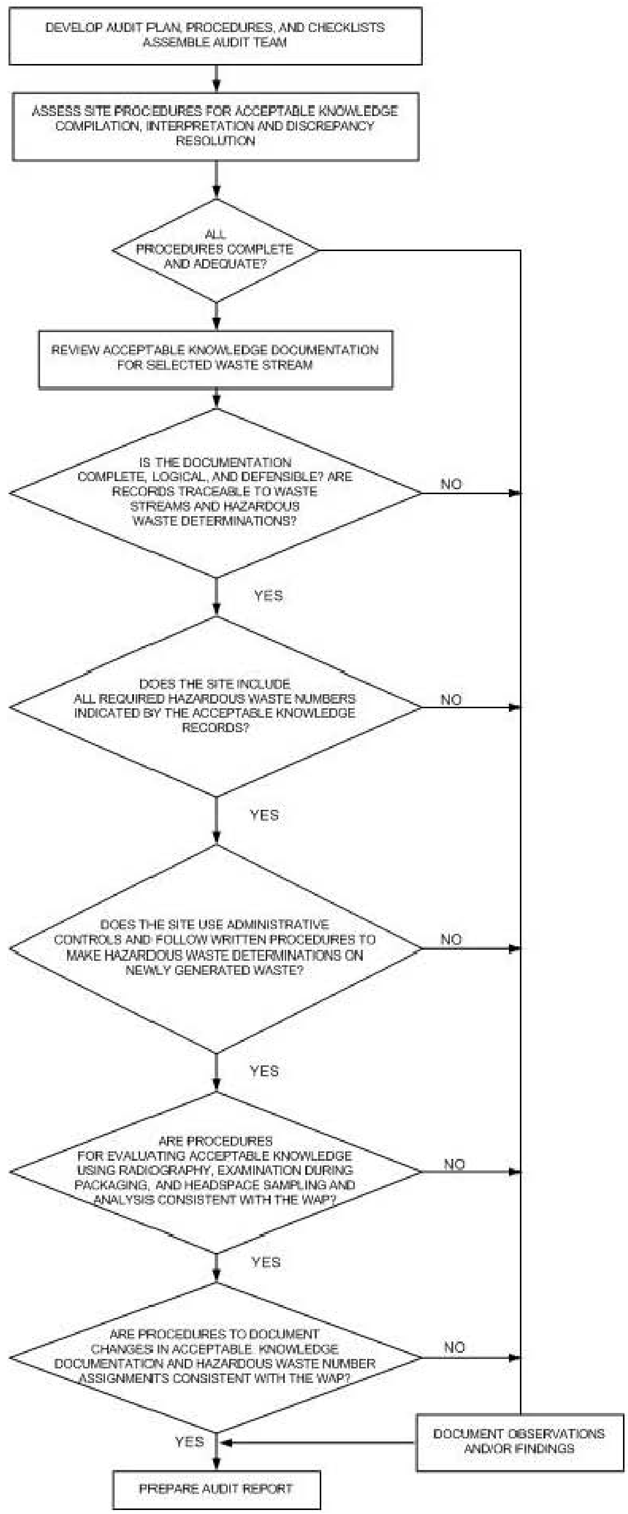

Figure B4-2
Acceptable Knowledge Auditing

APPENDIX B5

QUALITY ASSURANCE PROJECT PLAN REQUIREMENTS

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APPENDIX B5

QUALITY ASSURANCE PROJECT PLAN REQUIREMENTS

TABLE OF CONTENTS

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APPENDIX B5

QUALITY ASSURANCE PROJECT PLAN REQUIREMENTS

B5-1 Quality Assurance Project Plans

Prior to management, storage, or disposal of a generator/storage site's TRU mixed waste at WIPP, the Permittees shall require that each participating site develops and implements a quality assurance project plan (**QAPjP**) that addresses all the applicable requirements specified in Waste Isolation Pilot Plant waste analysis plan (**WAP**) in Permit Attachment B. The Permittees will approve QAPjPs from all generator/storage sites that intend to send TRU mixed waste to the Waste Isolation Pilot Plant. The Permittees shall ensure that these QAPjPs include the qualitative or quantitative criteria for determining whether waste characterization program activities are being satisfactorily performed. The Permittees shall also ensure that QAPjPs identify the organization(s) and position(s) responsible for their implementation. Additionally, the QAPjPs shall also reference site-specific documentation that details how each of the required elements of the characterization program will be performed.

The Permittees shall ensure that prior to the implementation of characterization activities at participating sites, standard operating procedures (**SOPs**) were developed for all activities which affect the quality of the waste characterization program elements specified in the WAP. For the purposes of the quality assurance program, the term SOP refers to any site-specific implementing document. Compliance with SOPs will ensure that tasks are performed in a consistent manner that results in achieving the quality required for the quality assurance program. The organization, format, content, and designation of SOPs shall be described in the QAPjPs. Site-specific SOPs will be reviewed for consistency with the QAPjP according to the Permittees' Audit and Surveillance Program specified in Permit Attachment B6.

B5-2 Document Review, Approval, and Control

The Permittees shall ensure that the preparation, issuance, and change to documents that specify quality requirements or prescribe activities affecting quality for the transuranic mixed waste characterization program elements specified in the WAP be controlled to assure that correct and current documents are used and referenced. The QAPjPs shall include a document control format consisting of a unique document identification number, current revision number, date, and page number which will be placed on the individual pages of the document. All quality documents for the waste characterization program shall be reviewed prior to approval and issuance by qualified and independent individuals. The QAPjP review shall consider the technical adequacy, completeness, and correctness of the QAPjP, and the inclusion of and compliance with the requirements established by the WAP (Permit Attachment B). The Permittees shall ensure that appropriate QAPjP approval is indicated by a signature and date page included in the front of each document.

At a minimum, the Permittees shall ensure that revisions to documents that implement the requirements of the WAP are denoted by including the current revision number on the document title page, the revised signature page, and each page that has been revised. Only revised pages need to be reissued. Changes to documents, other than those defined as editorial changes or minor changes, shall be reviewed and approved by the same functional organizations that performed the original review and approval, unless other organizations are specifically designated in accordance with approved procedures. Editorial or minor changes may be made without the same level of review and approval as the original or otherwise changed document. The following items are considered editorial or minor changes:

- Correcting grammar or spelling (the meaning has not changed)
- Renumbering sections or attachments
- Updating organizational titles
- Changes to nonquality-affecting schedules
- Revised or reformatted forms, providing the original intent of the form has not been altered
- Attachments marked “Example,” “Sample,” or exhibits that are clearly intended to be representative only

A change in an organizational title accompanied by a change in the responsibilities is not considered an editorial change. Changes to the text shall be clearly indicated in the document. The Permittees shall provide the QAPjP for each site and all revisions to NMED upon approval by the Permittees.

The Permittees shall ensure that QAPjPs include a detailed description of the reporting and approval requirements for changes to approved QA documents and SOPs, including procedures for implementing changes to these documents. All members of the site project staff are responsible for reporting any obsolete or superseded information to the site project manager. All site-specific changes shall be evaluated and approved by the site project manager before implementation. The site project manager shall notify the appropriate personnel and the affected documents shall be revised as necessary. The site project manager shall also be responsible for notifying the DOE field office of the changes. The Permittees shall ensure that changes that affect performance criteria or data quality, such as sample handling and custody requirements, sampling and analytical procedures, quality assurance objectives, calibration requirements, or QC sample acceptance criteria comply with the WAP (Permit Attachment B) and shall not be made without prior approval of the Permittees.

APPENDIX B6

WASTE ISOLATION PILOT PLANT PERMITTEES' AUDIT AND SURVEILLANCE PROGRAM

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APPENDIX B6

WASTE ISOLATION PILOT PLANT PERMITTEES' AUDIT AND SURVEILLANCE PROGRAM

TABLE OF CONTENTS

List of Tables

APPENDIX B6

WASTE ISOLATION PILOT PLANT PERMITTEES' AUDIT AND SURVEILLANCE PROGRAM

B6-1 Introduction

The Waste Isolation Pilot Plant (**WIPP**) Permittees' Audit and Surveillance Program shall ensure that: 1) the operators of each generator/storage site (**site**) and Permittee approved laboratory that plan to transport transuranic (**TRU**) mixed waste to the WIPP facility conduct sampling and analysis of wastes in accordance with the current WIPP Waste Analysis Plan (**WAP**) (Permit Attachment B), and 2) the information supplied by each site to satisfy the waste screening and acceptability requirements of Section B-4 of the WAP is being managed properly. The Permittees will conduct these audits and surveillances at each site and Permittee approved laboratory performing these activities in accordance with a standard operating procedure (**SOP**). NMED personnel may observe these audits and surveillances to validate the implementation of WAP requirements (Permit Attachment B) at each site and Permittee approved laboratory. Only personnel with appropriate U.S. Department of Energy clearances will have access to classified information during audits. Classified information will not be included in audit reports and records. The audit SOP will contain steps for selecting audit personnel, reviewing applicable background information, preparing an audit plan, preparing audit checklists, conducting the audit, developing an audit report, and following up audit deficiencies. A deficiency is any failure to comply with an applicable provision of the WAP. The checklists for each site and Permittee approved laboratory shall include, at a minimum, the appropriate checklists found in Tables B6-1 through B6-6 for the summary category groups undergoing audit.

B6-2 Audit Procedures

Audit procedures shall establish the responsibilities and methodology for planning, scheduling, performing, reporting, verifying, and closing announced and unannounced audits of sites and Permittee approved laboratories. Records of all audit activities shall be part of the WIPP Operating Record and maintained at the WIPP facility until closure. NMED shall be provided unlimited access to these records.

Approved procedures shall be used to describe audit activities and requirements. Procedures define the responsibilities of specific positions necessary to manage this audit program. The Permittees' manager who oversees the audit program shall ensure that the following tasks are performed:

- Schedule audits
- Designate lead auditor(s)
- Appoint auditor and lead auditor trainees

- Maintain auditor training and qualification records
- Assure that all auditors have been given appropriate training, including training on the WAP
- Assign auditors and lead auditors to perform annual certification audits
- Review and approve final audit reports
- Oversee tracking and closure of all deficiencies and any observations requiring action
- Assure records are entered into the WIPP Operating Record and are properly maintained until facility closure

B6-3 Audit Position Functions

The Permittees will approve lead auditors, auditors, and technical specialists based upon the expertise required for the functions being examined according to the audit scope. The Permittees will supply auditors/technical specialists with expertise in the Resource Conservation and Recovery Act (**RCRA**) requirements and knowledge of the analysis and documentation methods required to verify the hazardous waste characterization performed by the sites. The Permittees shall identify all audit team members to NMED prior to the audit, and shall provide upon request the qualifications of all audit team members.

The lead auditor assigned to be the audit team leader must perform the following tasks:

- Concur that assigned auditors and technical specialists have the collective experience and training commensurate with the scope, complexity, or special nature of the activities to be audited
- Develop an audit plan and coordinate the preparation of an overall checklist to cover the scope of the audit, with consideration given to all nonconformances reported as specified in Permit Attachment B3 and to previous audit results from that site or Permittee approved laboratory
- Assign specific audit areas to individual auditors and technical specialists within their particular specialty and provide guidance on checklist development
- Review individual auditor checklists to assure complete coverage of assigned scope, and approve the checklists
- Conduct the audit at the site or Permittee approved laboratory
- Encourage observers to participate according to the protocol established by the Permittees

- Communicate audit results at the conclusion of the audit, including any deficiencies and observations

- Prepare and sign the audit report

- Maintain complete records of each audit and transfer them to the manager when the audit report is issued

Auditors and technical specialists assigned to the specific audit will report to the audit team leader for supervision and may perform the following tasks:

- Attend any required specific training and team orientation and planning meetings as directed by the audit team leader

- Prepare specific audit checklists to verify that the WAP Quality Assurance Objectives (QAO) are met for the areas being audited

- Obtain audit team leader approval of checklist

- Review acceptable knowledge documentation packages, test report data, and documentation of data verification activities

- Obtain and evaluate objective evidence by means of observation, document reviews, or the conduct of interviews with operators, analysts, technicians, and others necessary to determine the adequacy and effective implementation of the WAP

- Conduct inspection tours of waste generating stations, sampling areas and equipment, analytical laboratories, calibration facilities, administrative, and document control/record facility

- Complete checklist during the audit indicating the objective evidence observed verifies that the site or Permittee approved laboratory has met the QAOs for the program elements, methods, and the activities being audited. Add other items to the checklist as they are observed or as needed during the audit

- Prepare narrative statements for all deficiencies, and observations that clearly and concisely identify the conditions involved

- Prepare any portion of the final audit report assigned by the lead auditor.

Audits will be conducted at least annually for each site involved in the waste characterization program. Both announced and unannounced audits will address the following:

- Results of previous audits

- Changes in programs or operations
- New programs or activities being implemented
- Changes in key personnel

B6-4 Audit Conduct

The conduct of the audit shall commence with an entrance meeting, conducted by the audit team leader, with site or Permittee approved laboratory management. At this meeting, the audit objectives and scope, the specific areas to be audited, the processes or functions to be observed, and the site or Permittee approved laboratory-participation required, including site interfaces, will be identified. The purpose of this meeting is to confirm the audit scope, discuss the audit sequence, establish channels of communication, and confirm the daily and exit meeting. Audits shall be performed using approved audit checklists that include the checklists in Tables B6-1 to B6-6 for the summary category groups undergoing audit. Consistency of evaluation shall be ensured before the audit through site or Permittee approved laboratory QAPjP approval (see Permit Attachment B5). QAPjPs for each site or Permittee approved laboratory shall incorporate the same requirements from the WAP. Objective evidence shall be examined (to the depth necessary) to determine if the identified activities, procedures, or QAOs are adequate and are being effectively implemented.

Audits may not include all waste summary category groups, and thus some audit checklists or portions of checklists (Tables B6-1 through B6-6) may not be applicable to some sites or Permittee approved laboratory (e.g., headspace gas sampling and analysis is not used because debris waste is not being analyzed by the site). In these instances, the Permittees shall indicate nonapplicability in the appropriate checklist row, and justify the exclusion under the “Comment” column. In addition, in cases where discrepancies exist between the audit checklists in Tables B6-1 through B6-6 and the Permit, Permit requirements take precedence. The Permittees may add to the checklists as necessary to clarify Permit requirements, but any additions will be clearly designated on the checklists (i.e., redline the additions).

Audits shall include site personnel interviews, document and record reviews, observations of operations, and any other activities deemed necessary by the auditors to meet the objectives of the audit. Observations or deficiencies identified during the audit will be investigated or evaluated, as necessary, to determine if they are isolated conditions or represent a general breakdown of the waste characterization quality assurance program. During audit interviews or audit meetings, site or Permittee approved laboratory personnel may be advised of deficiencies identified within their areas of responsibility to establish a clear understanding of the identified condition.

The site or Permittee approved laboratory personnel will be given the opportunity to correct any deficiency that can be corrected during the audit period. Deficiencies and observations will be documented and included as part of the final audit report. Those items that have been resolved during the audit (isolated deficiencies that do not require a root cause determination or actions to preclude recurrence), will be verified prior to the end of the audit, and the resolution will be described in the audit report. Those items that affect the quality of the program, and/or the data generated by that program, which are required by the WAP will be documented on a Corrective Action Report (**CAR**) and included as a part of the final audit report. The CAR will be entered into the Permittees' CAR tracking system and tracked until closure. RCRA-related items will be uniquely identified within the CAR tracking system so that they can be tracked separately. RCRA-related CARs identified by the site or Permittee approved laboratory during self-audits will be evaluated during the Permittees' audit and surveillance program and tracked in the Permittees' tracking systems.

When a deficiency is identified by the audit team, the audit team member who identified the deficiency prepares the CAR. The Permittees review the CAR, determine validity (assures that a requirement has in fact been violated), classify the significance of the deficiency, assign a response due date, and issue the CAR to the site or Permittee approved laboratory. The site or Permittee approved laboratory reviews the CAR, evaluates the extent and cause of the deficiency, and provides a response to the Permittees indicating the remedial actions and actions taken to preclude recurrence. The Permittees review the response from the site or Permittee approved laboratory and, if acceptable, communicate the acceptance to the site or Permittee approved laboratory. The site or Permittee approved laboratory completes remedial actions and actions to preclude recurrence. After all corrective actions have been completed, the Permittees may schedule and perform a verification visit to assure that corrective actions have been completed and are effective. NMED personnel may participate as observers in these verification visits. When all actions have been completed and verified as being effective, the CAR is closed by the Permittees' manager responsible for quality assurance. As part of the planning process for subsequent audits and surveillances, past deficiencies will be reviewed and the previous deficient activity or process is subject to reassessment.

The sites or Permittee approved laboratories shall submit corrective action plans to eliminate the deficiency stated on the CAR, including a resolution of the acceptability of any data generated prior to the resolution of the corrective action.

The corrective action response will include a discussion of the investigation performed to determine the extent and impact of the deficiency, a description of the remedial actions taken, determination of root cause, and actions to preclude recurrence.

An exit meeting will be conducted by the lead auditor prior to departure of the audit team from the site or Permittee approved laboratory. This meeting will include site or Permittee approved laboratory management personnel, and may include DOE field office personnel. All draft audit results will be presented to the site or Permittee approved laboratory management.

The audit report will be prepared, approved, and issued to the site or Permittee approved laboratory within thirty (30) days of the completion of the audit by the Permittees. NMED shall receive a copy of the audit report upon issuance for information purposes. A formal final audit report will be provided to NMED which will include WAP-related CAR resolution results and audit results that will include, as a minimum, sections describing the scope, purpose, summary of deficiencies, and observations in narrative format, completed audit checklists, audited procedures, and other applicable documents which provide evidence of WAP implementation. The report will also include an identification of the organization audited, the dates of the audit, and the requested response date. NMED will make the final audit report available for public review and comment. The audited site or Permittee approved laboratory will respond to any deficiencies and observations within thirty (30) days after receipt of any CARs and indicate the corrective action taken or to be taken. If the corrective action has not been completed, the response must indicate the expected date the action will be completed. CARs applicable to WAP requirements shall be resolved prior to waste shipment. Subsequent audits or specific verifications, announced or unannounced, will determine if the corrective action has been satisfactorily implemented. Deficiencies (items corrected during the audit [CDAs] and CARs) and observations will be tracked to completion according to established procedure(s). In addition, deficiencies will be trended to determine if similar situations exist system wide. Trend reports will be issued as necessary to provide a "lessons learned" announcement to other sites or Permittee approved laboratories who might benefit from program improvements implemented as a result of resolutions to the specific situations discovered at the performance of these audits.

The final audit report provided to NMED and audit records will be maintained at WIPP as a part of the Operating Record. These records will be included on the Record Inventory and Disposition Schedule and maintained on-site until closure of the WIPP facility. NMED shall be provided unlimited access to these records.

TABLES

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Table B6-1 Waste Analysis Plan (WAP) Checklist

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Waste Analysis Plan (WAP)
General Checklist for use at
DOE'S Generator/Storage Sites

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
	WASTE STREAM IDENTIFICATION					
1	Does the generator/storage site define "waste stream" as waste material generated from a single process or from an activity that is similar in material, physical form, and hazardous constituents? (Attachment B Section B-0a)					
2	Are procedures in place to ensure that the generator/storage site assigns one of the Summary Category Groups (S3000-homogeneous solids, S4000-soils/gravel, S5000-debris waste) to each waste stream? (Section B-1b)					
3	Are procedures in place to ensure that the generator/storage site assigns Waste Matrix Code Groups (e.g., solidified inorganics, solidified organics, salt waste, soils, combustible waste, filters, graphite, heterogeneous debris waste, inorganic nonmetal waste, lead/cadmium metal , uncategorized metal) to each waste stream? (Section B-0a)					
4	Are procedures in place to ensure that the generator/storage site assigns a Waste Stream WIPP Identifier (ID) to each waste stream? (Section B3-12b(1))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
4a	Are procedures in place for generator/storage sites to submit an AK Sufficiency Determination (Determination Request) to the Permittees to meet all or part of the waste characterization requirements including: • All information specified in Permit Attachment B4, Section B4-3d • Identification of relevant hazardous constituents, and correctly identifies all toxicity characteristic and listed hazardous waste numbers • All hazardous waste number assignments must be substantiated by supporting data and, if not, whether this lack of substantiation compromises the interpretation • Resolution of data discrepancies between different AK sources must be technically correct and documented • The AK Summary includes all the identification of waste material parameter weights by percentage of the material in the waste stream, and determinations are technically correct • All prohibited items specified in the TSDF-WAC should be addressed, and conclusions drawn are technically adequate and substantiated by supporting information • If the AK record includes process control information specified in Permit Attachment B4, Section B4-3b, the information should include procedures, waste manifests, or other documentation demonstrating that the controls were adequate and sufficient. • The site must provide the supporting information necessary to substantiate technical conclusions within the Determination Request, and this information must be correctly interpreted. (Section B-0b)					
4b	If a generator/storage site does not submit a Determination Request or if the Determination Request is not approved, are procedures in place for the generator/storage site to perform radiography or VE on 100% of the containers in a waste stream and chemical sampling and analysis on a representative sample of the waste stream using headspace gas sampling and analysis (for debris waste) or solids sampling and analysis (for homogeneous solid or soil/gravel waste) as specified in Permit Attachments B1 and B2? (Section B-0b)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
4c	Are procedures in place to ensure that the generator/storage sites complete a Waste Stream Profile Form (WSPF) and Characterization Information Summary (CIS) as specified in Permit Attachment B3, Sections B3-12b(1) and B3-12b(2)? (Section B-0c)					
5	Are procedures in place to ensure that the generator/storage site divides waste streams into waste stream lots if all of the waste within a waste stream is not accessible for sampling and analysis, as required, at one time? If so, is the division of waste streams into waste stream lots based on staging, transportation and handling issues? (Section B-1a)					
6	Are procedures in place to ensure that the generator/storage site assigns EPA hazardous waste numbers associated with the waste? If so, do these assigned EPA hazardous waste numbers correspond to the permitted EPA hazardous waste numbers in Table B-9? Are there any assigned EPA hazardous waste numbers that are not permitted EPA hazardous waste numbers on the Table B-9? If so, did the generator/storage site reject the waste for shipment to and disposal at WIPP? Did the generator assign a state hazardous waste codes or numbers? If so, is it assigned to waste that is permitted at WIPP? (Section B-1b)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
7	Are procedures in place to ensure that Summary Category Groups are defined as follows: S3000- Homogeneous solids are solid material, inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste excluding soils, that do not meet NMED criteria for classification as debris and are at least 50 percent by volume homogeneous solids or comprise the majority of the waste stream S4000- Waste streams that are at least 50 percent by volume soil/gravel, or comprise the majority of the waste stream S5000- Waste streams that are at least 50 percent volume materials that meet the NMED criteria for debris, or comprise the majority matrix of materials. The criteria for debris are solid materials intended for disposal that exceed 2.36 inch particle size and is a manufactured object, plant or animal matter, or natural geologic material. Particles smaller than 2.36 inches in size may be considered debris if the debris is a manufactured object and if it is not a particle of S3000 or S4000 material. (Section B-0a)					
8	Does the generator/storage facility have procedures in place to ensure that the following waste characterization parameters will be obtained : • Determination whether TRU mixed waste streams comply with the applicable provisions of the TSDF-WAC • Determination whether TRU mixed wastes exhibit a hazardous characteristic per 20.4.1.200 NMAC (incorporating 40 CFR 261 Subpart C) • Determination whether TRU mixed wastes are listed per 20.4.1.200 NMAC (incorporating 40 CFR 261 Subpart D) • Estimation of waste material parameter weights (Section B-2)					
9	Are procedures in place to ensure that waste streams identified to contain incompatible materials or materials incompatible with waste containers cannot be shipped unless treated to remove the incompatibility? (Section B-1c)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
10	Are procedures in place to ensure that the generator/storage site uses acceptable knowledge and, as necessary, headspace-gas sampling and analysis, radiography, visual examination, and homogeneous waste sampling and analysis as specified in Table B-5? (Section B-3)					
	UNACCEPTABLE WASTE					
12	Are procedures in place to ensure that the generator/storage site ensures, through administrative and operational procedures and characterization techniques, that waste containers do not include the following unacceptable waste: • liquid waste (waste shall contain as little residual liquid as is reasonably achievable by pouring, pumping and/or aspirating, and internal containers shall contain less than 1 inch or 2.5 centimeters of liquid in the bottom of the container. Total residual liquid in any payload container may not exceed 1 percent volume of that container. Payload containers with U134 waste shall have no detectable liquid) • non-radionuclide pyrophoric materials • hazardous wastes not occurring as co-contaminants with TRU wastes (non-mixed hazardous wastes) • wastes incompatible with backfill, seal and panel closures materials, container and packaging materials, shipping container materials, or other wastes • wastes containing explosives or compressed gases (continued below)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
12a	• wastes with polychlorinated biphenyls (PCBs) not authorized under an EPA PCB waste disposal authorization • wastes exhibiting the characteristic of ignitability, corrosivity, or reactivity (EPA Hazardous Waste Numbers of D001, D002, or D003) • waste that has ever been managed as high-level waste and waste from tanks specified in Table B-8, unless specifically approved through a Class 3 permit modification • any waste container from a waste stream (or waste stream lot) which has not undergone either radiographic or visual examination of a statistically representative subpopulation of the wastes stream in each shipment as described in Permit Attachment B7 • any waste container from a waste stream which has not been preceded by an appropriate, certified Waste Stream Profile Form (see Section B-1d) (Section B-1c)					
	WASTE ACCEPTANCE CONTROL					
14	Are procedures in place to ensure that the generator/storage site uses a Waste Stream Profile Form (WSPF) which includes, at a minimum, the information indicated on the attached WSPF found in Figure B-1 and a Characterization Information Summary (CIS) prior to waste disposal at the WIPP? . (Section B-1d)					
16	Are procedures in place to ensure that additional WSPFs are provided to WIPP and NMED for waste streams or portions of waste streams that are reclassified based upon waste characterization information? (Section B-1d)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
	LABORATORY QUALIFICATION					
17	Are procedures in place to ensure that the generator/storage site conduct analyses using laboratories that are qualified through participation in the Performance Demonstration Program (PDP) for headspace gas sampling and analysis, and PDP homogeneous waste sampling and analysis? (Section B-3a(3))					
18	Are procedures in place to ensure that the generator/storage sites conduct analyses using laboratories that implement the analytical methods through laboratory-documented standard operating procedures (SOPs) that ensure that analytical QAOs are met? (Section B-3a(3))					
19	Are procedures in place to ensure that documented laboratory QA/QC programs include the following: • Facility organization • List of equipment/instrumentation • Operating procedures • Laboratory QA/QC procedures • Quality assurance review • Laboratory records management (Section B-4a(4))					
	GENERAL SAMPLING AND ANALYTICAL REQUIREMENTS					
20	Are procedures in place to ensure that headspace gas sampling and analysis shall be used to: • Determine the types and concentrations of VOCs in the void volume of waste containers • VOC constituents shall be compared to those assigned by Acceptable Knowledge (Section B-3a(1))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
22	Are procedures in place to ensure that compounds not on the list of target analytes are reported as tentatively identified compounds (TICs) and that the TIC will be added to the target analyte list if it appears in the 20.4.1.200 NMAC (incorporating 40 CFR 261) Appendix VIII list and if they are reported in 25% of the waste containers sampled from a given waste stream? (Section B-3a(1))					
23	Are procedures in place to ensure that a randomly selected set of samples will be collected through core sampling or other EPA approved sampling from the population of waste containers for homogeneous and soil/gravel waste streams? Are procedures in place that a sufficient number of samples are collected to evaluate the toxicity characteristic of a waste stream at a 90 percent Upper Confidence limit as specified in Attachment B2? (Section B-3a(2))					
24	Are procedures in place to ensure that total analyses or TCLP of VOCs, SVOCs, and RCRA-regulated metals are performed on all core samples to determine if the waste exhibits a toxicity characteristic? (Section B-3a(2))					
25	Are procedures in place to ensure that Acceptable Knowledge is used in waste characterization activities to delineate TRU mixed waste streams, to assess whether TRU mixed wastes comply with the TSDF-WAC, to assess whether TRU mixed waste exhibits a hazardous characteristic (20.4.1.200 NMAC, incorporating 40 CFR 261 Subpart C), and to assess whether TRU wastes are listed (20.4.1.200 NMAC, incorporating 40 CFR 261 Subpart D), and to estimate waste material parameter weights? (Section B-3b)					
26	Are procedures in place to ensure that radiography and/or visual examination are used as necessary to: • Examine a waste container to determine the physical form • Identify liquids and containerized gases • Verify the physical form matches the waste stream description (Section B-3c)					

<table>
<tr><th rowspan="2"></th><th rowspan="2">WAP Requirement[1]</th><th colspan="2">Procedure Documented</th><th colspan="2">Example of Implementation/ Objective Evidence, as applicable</th><th rowspan="2">Comment (e.g., any change in procedure since last audit, etc.)</th></tr>
<tr><th>Location</th><th>Adequate? Y/N (Why?)</th><th>Item Reviewed</th><th>Adequate? Y/N</th></tr>
<tr><td>27</td><td>Are procedures in place to ensure that the following characterization activities shall occur for newly generated wastes:

• Acceptable Knowledge for all wastes, with sampling and analysis as necessary to augment AK including; :
- Either visual examination during packaging or radiography (or VE in lieu of radiography) after packaging for all waste containers, ensuring this occurs prior to any treatment designed to supercompact waste
- Headspace gas analysis for randomly selected containers , except for qualifying waste containers belonging to LANL sealed sources waste streams
- Total VOC, SVOC, and Metals analyses for a selected number of homogeneous solids and soil/gravel waste containers as specified in Attachment B2
- Evaluation of any TICs found in headspace gas and totals analyses

(Section B-3d(1))</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>27a</td><td>Are procedures in place to ensure that the visual examination during packaging for all waste containers includes the documentation of packaging configuration, type and number of filters, and rigid liner vent hole presence and diameter necessary to determine the appropriate DAC in accordance with Permit Attachment B1, Section B1-1?

(Section B-3d(1))</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
28	Are procedures in place to ensure that the following characterization activities shall occur for retrievably stored wastes: • Acceptable Knowledge for all wastes, with sampling and analysis as necessary to augment AK including; - Visual examination or radiography for all waste containers - Headspace gas analysis for randomly selected containers except for qualifying waste containers belonging to LANL sealed sources waste streams - Total VOC, SVOC, and Metals analyses for a statistically selected number of homogeneous solids and soil/gravel waste containers as specified in Attachment B2 - Evaluation of any TICs found in headspace gas and totals analyses (Section B-3d(2))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
	DATA GENERATION, VERIFICATION, VALIDATION, DOCUMENTATION, AND QUALITY ASSURANCE					
30	Are procedures in place to ensure that the following Data Quality Objectives are met: • Use Acceptable Knowledge to delineate TRU mixed waste streams, assess whether TRU mixed wastes comply with the applicable requirements of the TSDF-WAC, assess whether TRU mixed wastes exhibit a hazardous characteristic, assess whether TRU mixed wastes are listed and to estimate waste material parameter weights • Use Headspace gas sampling and analysis, as necessary, to identify and quantify VOCs in waste containers to resolve the assignment of EPA hazardous waste numbers • Perform totals analyses of homogeneous solids and soils/gravel wastes to establish if the waste is hazardous based on the toxicity characteristics levels in 20.4.1.200 NMAC through a comparison of the upper confidence limits (UCL_{90}) of the mean concentrations to resolve the assignment of hazardous waste numbers • Use radiography or visual examination to determine physical waste form, the absence of prohibited items, and additional waste characterization techniques that may be used based on Summary Category Groups (Section B-4a(1))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
31	Are procedures in place to ensure that the following Quality Assurance Objectives are adequately defined and assessed for each characterization method: • Precision as a measure of the mutual agreement among multiple measurements. • Accuracy as the degree of agreement between a measurement result and a true or known value. • Completeness is a measure of the amount of valid data obtained from a method compared to the total amount of data obtained that is expressed as a percentage. • Comparability is the degree to which one data set can be compared to another data set. • Representativeness as an expression of the degree to which data represent characteristics of a population. (Section B-4a(2))					
32	With respect to data generation, are procedures in place to ensure that the generator/storage site's waste characterization program meets the following general requirements: • Analytical data packages and batch data reports must be reported accurately in a pre-approved format, must be maintained in permanent files, and must be traceable? • All data must receive a technical review by another qualified analyst or the technical supervisor, and the laboratory QA officer? (Section B3-10a)					
33	Are procedures in place to ensure that the generator/storage site performs validation of waste characterization data for each waste container? (Section B-4)					
34	Are procedures in place to ensure that the generator/storage site has a pre-approved format for reporting waste characterization data? (Section B-4a(4))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
35	Are procedures in place to ensure that the generator/storage site prepares analytical, testing, and sampling batch data reports to meet the requirements of their own site-specific QAPjP and/or SOPs? (Section B-4a(4))					
36	Are procedures in place to ensure that all raw data is collected and managed at the data generation level in accordance with the following criteria: • All raw data shall be signed and dated in reproducible ink by the individual collecting the data, or signed and dated using electronic signatures • All data shall be recorded clearly, legibly, and accurately in field and laboratory records and include applicable sample identification numbers • All changes to original data shall be lined out, initialed, and dated by the individual making the change. Original data may not be obliterated or otherwise be made unreadable • All data shall be transferred and reduced from field and laboratory records completely and accurately • All field and laboratory records shall be maintained as specified in Table B- 6 of Attachment B • Data shall be organized into standard reporting formats for reporting purposes. • All electronic and video data must be stored to ensure that waste container, sample and QC data are readily retrievable (Section B3-10a)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
37	Are procedures in place to ensure that 100 % of batch data reports are subject to independent technical review by an individual qualified to review the data. The reviewer shall release the data through signature with an associated review checklist prior to characterization of the associated waste and shipment to the WIPP. The review shall ensure the following, as applicable: • Data generation and reduction were conducted according to the methods used and reported in the proper units and significant figures • Calculations have been verified by a valid calculation program, a spot check of verified calculation programs, and/or a 100 percent check of all hand calculations • The data have been reviewed for transcription errors • The testing, sampling, and analytical QA documentation for BDRs is complete and includes, as applicable, raw data, DAC and equilibrium calculations and times, calculation records, chain of custody forms, calibration records, QC sample results and copies or originals of gas canister sample tags. • All QC sample results are within established control limits, and if not, the data has been appropriately qualified • Reporting flags were assigned correctly • Sample holding times and preservation requirements were met, or exceptions documented • Radiography tapes are reviewed on a waste container basis at a minimum of once per testing batch or once per day of operation, whichever is less frequent. The radiography tape will be reviewed against the data on the radiography form to ensure that data are complete and correct • Field sampling records are complete • QAOs have been met (Section B3-10a(1))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
40	Are procedures in place to ensure that 100 percent of all batch data reports receive a Site Project Manager signature release with an associated review checklist prior to characterization of the associated waste and shipment to the WIPP. This release shall ensure the following: • The Site Project Manager or designee shall determine the validity of the drum age criteria (**DAC**) assignment made at the data generation level based upon an assessment of the data collection and evaluation necessary to make the assignment. • Testing batch QC checks were properly performed. Radiography data are complete and acceptable based on evidence of videotape review of one waste container per day or once per testing batch, whichever is less frequent • Sampling batch QC checks were properly performed, and meet the established QAOs and are within established data useability criteria • Analytical batch QC checks were properly performed and meet the established QAOs and are within established data useability criteria • Online batch QC checks were properly performed and meet the established QAOs and are within established data useability criteria • Proper procedures were followed to ensure representative samples of headspace gas and homogeneous solids and soil/gravel were taken • Data generation level independent technical review, validation, and verification have been performed as evidenced by the completed review checklists and appropriate signature releases. • Batch Data review checklists are complete • Batch Data Reports are complete and data properly reported • Verify that data are within established data assessment criteria and meet all applicable QAOs (Section B3-10b(1))					
42	Are procedures in place to ensure that a repeat of the data review process at the data generation level will be performed on a minimum of one randomly chosen waste container every quarter to determine if the verification and validation is performed according to documented procedures? (Section B3-10b)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
43	Are procedures in place and checklists are available to prepare a Site Project Manager (SPM) Summary and a Data Validation Summary (the summaries may be in the same document)? The SPM Summary includes a validation checklist for each batch that is of sufficient detail to document all aspects of a batch data report that could affect data quality. The Data Validation Summary must identify each Batch Data Report reviewed , describe how the validation was performed, identify all problems, and identify all acceptable and unacceptable data. Summaries must include release signatures. (Section B3-10b(2))					
44	Are procedures in place to ensure that non-administrative, WAP-related nonconformances first identified at the site project manager level are reported to the Permittees within five (5) calendar days of identification, that nonconformance reports are prepared within thirty (30) calendar days, and that corrective action is implemented prior to waste shipment? (Section B3-13)					
45	Are procedures in place to ensure that nonconformances are appropriately identified, reconciled, corrected, and documented? Are nonconformance reports prepared for nonconformances identified? Are nonconformances identified and tracked, and does the Site Project Manager oversee the nonconformance report process? (Section B3-13)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
	SAMPLE CONTROL					
46	Are procedures in place to ensure that the site's sample handling and control program includes the following: • Field documentation of samples including point of origin, date of sample, container identification, sample type, analysis requested, and chain-of-custody (COC) number? • Proper labeling and/or tagging including proper sample numbering, sample identification, sample date, sampling conditions, and analysis requested? • COC record including name of sample relinquisher, sample receiver, and date and time of sample transfer? and • Proper sample handling and preservation? (Section B-4a(3))					
47	Are procedures in place to ensure that the site's QAPjP or site-specific procedures includes COC forms to control the sample from the point of origin to the final analysis result reporting? (Section B-4a(3))					
	DATA TRANSMITTAL					
48	Are procedures in place to ensure that the generator/storage site transmits data by hard copy or electronic copy from the data generation level to the site project level ? If electronic, does the generator/site have a hard copy available on demand? (Section B-4a(6))					
50	Are procedures in place to ensure that the generator/storage site inputs the data into the WWIS manually or electronically? (Section B-4a(6))					
51	Are procedures in place to ensure that the generator/storage site enters the data into the WWIS in the exact format required by the database? (Section B-4a(6))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
51a	Are procedures in place to ensure that if a container was part of a composite headspace gas sample, the analytical results from the composite sample must be assigned as the container headspace gas data results, including associated TICs, for every waste container associated with the composite sample in the WWIS? (Section B3-12b(4))					
52	Are procedures in place to ensure all of the data presented on Table B- 7 of the Permit is transmitted to the WWIS? (Table B-7)					
	RECORDS AND RECORD MANAGEMENT					
55	Are procedures in place to ensure that the generator/storage site's hard copy and/or electronic data reports follow the Permittees format requirements? (Section B-4a(4))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
56	Are procedures in place to ensure that hard copy or electronic Waste Stream Profile Form will include the following • Generator/storage site name • Generator/storage site EPA ID • Date of audit report approval by NMED (if obtained) • Original generator of waste stream • Whether waste is Contact-Handled or Remote-Handled • Waste Stream WIPP Identification Number • Summary Category Group • Waste Matrix Code Group • Waste Material Parameter Weight Estimates per unit of waste • Waste stream name • A description of the waste stream • Applicable EPA hazardous waste numbers • Applicable TRUCON codes • A listing of acceptable knowledge documentation used to identify the waste stream • The waste characterization procedures used and the reference and date of the procedure • Certification signature of Site Project Manager, name, title, and date signed (Section B3-12b(1))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
56a	Are procedures in place to ensure that hard copy or electronic Characterization Information Summary will include the following: • Data reconciliation with DQOs • Headspace gas summary data listing the identification numbers of samples used in the statistical reduction, the maximum, mean, standard deviation, UCL_{90}, RTL, and associated EPA hazardous waste numbers that must be applied to the waste stream. • Total metal, VOC, and SVOC analytical results for homogeneous solids and soil/gravel (if applicable), . • TIC listing and evaluation, • Radiography and visual examination summary to document that all prohibited items are absent in the waste (if applicable) • A complete listing of all container identification numbers used to generate the Waste Stream Profile Form, cross-referenced to each Batch Data Report • Complete AK summary, including stream name and number, point of generation, waste stream volume (current and projected), generation dates, TRUCON codes, Summary Category Group, Waste Matrix Code(s) and Waste Matrix Code Group, other TWBIR information, waste stream description, areas of operation, generating processes, RCRA determinations, radionuclide information, all references used to generate the AK summary, and any other information required by Permit Attachment B4, Section B4-2b. • Method for determining Waste Material Parameter Weights per unit of waste. • List of any AK Sufficiency Determinations requested for the waste stream. • Certification through acceptable knowledge or testing and/or analysis that any waste assigned the hazardous waste number of U134 (hydrofluoric acid) no longer exhibits the characteristic of corrosivity. This is verified by ensuring that no liquid is present in U134 waste. (Section B3-12b(2))					
56b	Are procedures in place to assure that ongoing container characterization results are cross referenced to Batch Data Reports? Section B3-12b					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
58	Are procedures in place to ensure that project level reports are compiled into Characterization Information Summaries (Section B3-12b)					
59	Are procedures in place to ensure that the generator/storage site uses forms for data reporting that are pre-approved forms in site-specific documentation? (Section B3-12)					
60	Are procedures in place to ensure that the generator/storage site's site project manager submits to the WIPP facility a summary of the waste stream information and reconciliation with data quality objectives (DQOs) once a waste stream is characterized? (Section B-4a(6))					
61	Are procedures in place to ensure that the generator/storage site project office completes a WSPF based on the Batch Data Reports? (B3-12b)					
62	Are procedures in place to ensure that the generator/storage Site Project Manager submits the WSPF to the Permittees for approval along with the accompanying Characterization Information Summary for that waste stream? (Section B-4a(6))					
63	Are procedures in place to ensure that the generator/storage site maintains records related to waste characterization sampling and analysis activities in the testing, sampling or analytical facilities files, or site project files for those facilities located on-site? (Section B-4a(7))					
64	Are procedures in place to ensure that the appropriate documented training and indoctrination is performed for all individuals and that procedures are documented in site specific QAPjPs and procedures? (Section B3-14)					
65	Are procedures in place to ensure that the generator/storage site requires contract waste analytical facilities to forward testing, sampling and analytical records along with testing, sampling and analytical batch data reports to the site project office for inclusion in the sites project files? (Section B-4a(7))					
66	Are procedures in place to ensure that the generator/storage site has an appropriate records inventory and disposition schedule (RIDS) or equivalent that was prepared and approved by appropriate site personnel? (Section B-4a(7))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
67	Are procedures in place to ensure that the generator/storage site maintains all records relevant to an enforcement action, regardless of disposition, until they are no longer needed for enforcement action, and then dispositioned per the approved RIDS? (Section B-4a(7))					
68	Are procedures in place to ensure that the generator/storage site maintains records that are designated as Lifetime Records for the life of the waste characterization program plus six years, or that the records have been transferred for permanent archival storage to the WIPP Records Archive facility? Lifetime Records include: • Field sampling data forms, • Field and laboratory COC forms, • Test facility and laboratory Batch Data Reports, • Waste Stream Characterization Package, • Sampling plans, • Data reduction, validation, and reporting documentation, • Acceptable knowledge documentation, • WSPF and Characterization Information Summary (Section B-4a(7), Table B-6)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
69	Are procedures in place to ensure that the generator/storage site maintains records that are designated as Non-Permanent Records for ten years from the date of record generation, and then dispositioned according per the approved RIDS or transferred to the WIPP Records Archive facility? Non-Permanent Records include: • Nonconformance documentation, • Variance documentation, • Assessment documentation, • Gas canister tags, • Methods performance documentation, • PDP documentation, • Sampling equipment certifications, • Calculations and related software documentation, • Training/qualification documentation, • QAPjP documentation (all revisions), • Calibration documentation, • Analytical raw data, • Procurement documentation, • QA procedures (all revisions), • Technical implementing procedures (all revisions), and • Audio/video recording (radiography, visual, etc.). (Section B-4a(7), Table B-6)					
70	Are procedures in place to ensure that the generator/storage site has raw data that is identifiable and legible, and provides documentary evidence of quality? (Section B-4a(7))					
71	Are procedures in place to ensure that if the generator/storage site ceases to operate, that all records be transferred before closeout? (Section B-4a(7))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
	SHIPMENT					
72	Are procedures in place to ensure that the generator/storage site accurately completes an EPA Hazardous Waste Manifest prior to shipping the waste to WIPP that contains the following information: • Generator/storage site name and EPA ID • Generator/storage site contact name and phone number • Quantity of waste • List of up to six state and/or federal hazardous waste numbers in each line item • Listing of all container IDS • Signature of authorized generator representative (Section B-5b)					
73	Are procedures in place to ensure that the generator/storage site accurately completes the following container specific information: • Waste stream identification number • List of hazardous waste numbers per container • Certification data • Shipping data (Section B-5b)					

1. The WAP requirements should be presented in documents, such as procedures. Each of the questions posed under WAP requirements are meant to ask whether procedures are in place or whether documents are evident which demonstrate that the specific WAP requirement is or can be met

Table B6-2 Solids and Soils/Gravel Sampling Checklist

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Solids and Soils/Gravel Sampling Checklist

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
	GENERAL SOLIDS SAMPLING REQUIREMENTS					
75	Are procedures documented that adequately ensure that when a Determination Request has not been approved, sampling and analysis of newly generated homogeneous solid and soil/gravel waste streams shall be conducted in accordance with the requirements specified in Attachment B1, SectionB1-2. (Section B-3d(1)(a))					
76	Are procedures in place to ensure that the number of newly generated soils/gravel waste containers to be randomly sampled will be determined using the procedure specified in Section B2-1, wherein a statistically selected portion of the waste will be sampled ? (Section B-3d(1)(a))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
77	Are procedures in place to ensure that the following sample collection requirements for retrievably stored and newly generated waste streams are met: • The number of random samples collected for characterization of retrievably homogeneous solid and soil/gravel stored waste is performed by developing preliminary mean and variance estimates for each analyte to define the number of required random samples; and that the sample selection process is adequately documented. • A minimum of 5 waste containers in a retrievably stored waste streams are sampled to establish the preliminary estimate for the number of samples. • Based on the number of samples required by the preliminary estimate, the subsequent sample means and deviations for each analyte are evaluated against the regulatory threshold for each constituent to determine if additional samples shall be collected. • Samples (the number of which is statistically determined) are collected to verify that a TRU mixed waste is below the regulatory threshold, where the regulatory threshold is the toxicity limit for toxicity characteristics and the PRQL for listed waste constituents. • Samples from preliminary estimates counted as required samples were randomly selected and were collected, analyzed, and validated using representative methods (Section B2-1a)					
80	Are procedures in place that allow toxicity characteristic contaminants associated with F-numbers for a waste stream to be omitted from sampling requirements ? (Section B2-1a)					
	SOLIDS SAMPLING PROCEDURES					
81	Do procedures ensure that samples for retrievably stored waste are collected using appropriate coring tools or other EPA approved methods, and that newly generated wastes that are sampled from a process as it is generated are sampled using EPA approved methods, including scoops and ladles, that are capable of collecting a representative sample? (Section B1-2a)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
82	Do site specific procedures, QAPjPs, and/or SOPs indicate that rotational coring tools are available for the collection of cores and non-rotational coring tools available for collection of cores in relatively soft media. The method used shall be appropriate to retrieve the maximum core amount. The coring tools will include the following features: • Removable tube liners constructed of rigid materials unlikely to affect the composition and/or concentration of target analytes in the sample core (Teflon®) and sufficiently transparent to allow visual examination of the core. The liner outer diameters are between 1-2 inches and the liner wall thickness is no greater than 1/16 inch. The liner shall fit flush with the coring tool inner wall and be of sufficient length to hold a core representative of the waste along the entire depth of the waste. • Sleeves composed of polycarbonate, Teflon, or glass for most samples and brass or stainless steel for non-metal samples • Liner end caps shall fit tightly around the ends of the liner and shall be composed of materials unlikely to affect the composition and/or concentration of analytes in the core (Teflon®) • Spring retainers shall be used when the physical properties of the sampling media may cause the sample to fall out of the liner. The retainer shall be composed of inert materials and the inner diameter shall not be less than the inner diameter of the liner • Coring tools may have an air lock mechanism . The air lock shall also close when the core is removed from the waste container • Core extruders shall be used to extrude the liner if the liner does not slide freely • Coring tools shall be of sufficient length to hold the liner and shall be constructed to allow placement of the liner leading edge as close as possible to the coring tools leading edge					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
82a	• All surfaces of the coring tool that have the potential to contact the sample core or sample media shall be cleaned prior to use • Rotational coring tools shall have a mechanism to minimize inner liner rotation and shall be designed to minimize frictional heat transfer to the sample core • The leading edge of the coring tool may be sharpened and tapered to a diameter equivalent or slightly smaller than the inner diameter of the liner. • Non-Rotational coring tools shall be designed to minimize the kerf width (½ the difference between the outer diameter of the tool and the tools inlet inner diameter) (Section B1-2a(1))					
83	Does the site adequately document that the liner material and retainers are not likely to contain any analytes of concern? (Section B1-2a(1))					
84	Are procedures in place to ensure that equipment blanks are collected and evaluated to verify that liner material, retainers, or other sampling equipment in contact with the sample do not contain analytes of concern? (Section B1-2b(2))					
	SAMPLE COLLECTION					
85	Are procedures in place to ensure that sampling is completed in a timely manner, within 60 minutes of core collection, or that the core shall remain in the capped liner, or the coring tool shall remain in the waste container with the air lock mechanism attached? (Section B1-2a(2))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
86	Are procedures in place to ensure that VOC samples are sampled prior to extruding the core from the liner and that the sample locations are documented? These sample may be collected by choosing a single sample from the representative subsection of the core, or three equal length VOC sample locations on the core are selected randomly along the long axis of the core to form a single 15-gram composite sample. Smaller sample sizes may be used if method PRQL requirements are met for all analytes. (Section B1-2a(2))					
87	Are procedures documented to ensure that a VOC sample is collected using a metal coring cylinder or equivalent equipment as described in SW-846 and that the sample is immediately extruded into a 40 mL VOA vial (or other containers specified in appropriate SW-846 methods)? (Section B1-2a(2))					
88	Are procedures in place to ensure that SVOC and Metals sample location(s) on the core are selected randomly along the long axis of the core and that the sample locations are documented, or that samples are collected at the same locations as VOC samples? Samples may be collected by splitting or compositing the representative subsection of the core. The representative subsections are chosen by randomly selecting a location along the portion of the core from which the sample was taken. (Section B1-2a(2))					
89	Are procedures in place to ensure that the SVOC and Metals sample s are collected using equipment constructed of materials unlikely to affect the composition or concentrations of the samples? (Section B1-2a(2))					
90	Are procedures in place to ensure that newly generated waste samples collected by means other than coring are collected as soon as possible and that spatial and temporal homogeneity is evaluated to determine if composite or grab samples are appropriate? (Section B1-2a(2))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
91	Are procedures in place to ensure sample volumes, preservatives, containers, and holding times meet the following specifications: **Minimum sample quantity** VOC 15 grams SVOC 50 grams Metals 10 grams (Quantity may be increased or decreased according to the requirements of the analytical laboratory, as long as the QAOs are met.) **Preservative** VOC Cool to 4C SVOC Cool to 4C Metals Cool to 4C **Sample Container** VOC 40 mL VOA glass vial (or other appropriate containers) cap SVOC glass jar with Teflon© lined cap Metals polyethylene or polypropylene bottle **Holding Time from Date of Collection** VOC 14 days prep/40 days analyze SVOC 14 days prep/40 days analyze Metals 180 days/ 28 days Hg (Table B1-4)					
	QUALITY CONTROL SAMPLE COLLECTION					
92	Are procedures in place to ensure that sampling precision will be determined through the collection of co-located core field duplicate samples for core samples and through the collection of co-located samples for samples collected using alternate methods at the frequency of once per 20 sample batch collected over 14 days or once per week, whichever is more frequent? (Section B1-2b(1))					
93	Are procedures in place to ensure that co-located cores are collected side by side as close as feasible to each other, that the cores are collected and handled in the same manner? (Section B1-2b(1))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
94	Are procedures in place to ensure that an additional sampling location is found or new co-located cores are collected if the visual examination of the original co-located cores detects inconsistency in the sample color, texture, or waste type? (Section B1-2b(1))					
95	Are procedures in place to ensure that all surfaces of sampling tools that have the potential to come into contact with the sample, including tube liners, endcaps, spring retainers, extruders, coring tool surfaces, or any other sampling equipment, are either thoroughly decontaminated or disposed of after each sampling event? (Sections B1-2b(2), B1-2b(3))					
96	Are procedures in place to ensure that equipment blanks are collected from randomly selected fully assembled coring tools or randomly selected liners (if they are cleaned separately) and from randomly selected sampling equipment (e.g. VOC subsampler, spoons, bowls) at a frequency of once per equipment cleaning batch and that the sample is collected prior to first use? (Section B1-2b(2))					
97	Are procedures in place to ensure that equipment blanks will be collected in the area where sampling equipment coring tools are cleaned, prior to covering the coring tools with protective wrapping and storage? (Section B1-2b(2))					
99	Are procedures in place to ensure that miscellaneous sampling tool equipment blanks will be collected by pouring deionized or HPLC water over the surface of the equipment and into a clean sample container appropriate for the requested analysis? (Section B1-2b(2))					
100	Are procedures in place to ensure that equipment blanks are analyzed for VOC, SVOC, and Metals and that the entire equipment batch will be re-cleaned and re-sampled if any analytes are detected at levels greater than 3 times the MDL or PRDL (Section B1-2b(2))					
101	Are procedures and processes in place to ensure that equipment blanks are traceable to a specific equipment cleaning batch and that the equipment cleaning batch is traceable to specific identified sampling equipment? Are sampling equipment or coring tools labeled with unique identification numbers that are referenced in field records? (Section B1-2b(3))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
102	Are procedures in place to ensure that disposable sampling equipment is certified as clean prior to use? (Section B1-2b(2))					
	SAMPLE EQUIPMENT TESTING, INSPECTION AND MAINTENANCE					
103	Are procedures in place to ensure that all sampling and coring tools are tested prior to use in accordance with manufacturers specification to ensure that the air-lock mechanism and rotation mechanism are in working order? (Section B1-2c)					
104	Are procedures in place to ensure that malfunctioning sampling and coring tools are repaired or replaced prior to use? (Section B1-2c)					
105	Are procedures in place to ensure that all equipment is cleaned, sealed inside a protective wrapping and stored in a clean area? (Section B1-2c)					
106	Are procedures in place to ensure that an adequate spare part inventory is available? (Section B1-2c)					
107	Are procedures in place to ensure that all equipment maintenance and repair is documented in field records and that field record logbooks are available to document equipment maintenance and repair activities? (Section B1-2c)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
108	Are procedures in place to ensure that inspection of equipment and work area cleanliness will encompass the following: • Sample collection equipment in the immediate area of sample collection shall be inspected daily for cleanliness and that any visible contamination that has a potential to contaminate a waste sample shall be thoroughly cleaned upon discovery • The waste coring and sampling work areas shall be maintained in clean condition • Expendable equipment shall be visually inspected for cleanliness prior to use and properly discarded after use • Protective wrapping on coring tools and other sampling equipment are visually inspected prior to unwrapping. Coring tools or other equipment with torn protective wrappers or with visible contamination are returned to be cleaned or properly discarded prior to use. • All sampling equipment shall be visually inspected prior to use to determine if protective wrapping is torn or if equipment is contaminated after unwrapping. Equipment with torn wrapping or signs of contamination will be returned for cleaning or properly discarded. • Clean sampling and coring equipment is segregated from all equipment that has not been decontaminated. (Section B1-2c)					
109	Are procedures documented to ensure that scales used for weighing sub-samples are calibrated as necessary to maintain its operation within manufacturer's specification, that the calibration is documented, that calibration is verified using NIST traceable weights upon each day of use, and that all calibration verification is documented in field records? (Section B1-2d)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
	SAMPLE HANDLING AND CUSTODY					
111	Do formats for field logs and custody records specify documentation of the following information: • Signature of individual initiating custody control, along with the date and time • Documentation of sample numbers for each sample under custody. Sample numbers will be referenced to a specific sampling event description that will identify the sampler(s) through signature, date and time of sample collection, type/number containers for each sample, sample matrix, preservatives (if applicable), requested methods of analysis, place/address of sample collection and the waste container number • For off-site shipping, method of shipping transfer, responsible shipping organization or corporation, and associated air bill or lading number.					
111a	• Signatures of custodians relinquishing and receiving custody of samples including date and time of transfer. • Description of final sample container disposition, along with signature of individual removing sample container from custody • Comments section • Documentation of discrepancies, breakage or tampering (Section B1-5)					
112	Are procedures in place to ensure that samples and sampling equipment are identified with unique identification numbers? (Section B1-5)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
113	Do sample tags or labels contain the following information: • Sample ID number • Sampler initials and organization • Ambient temperature and pressure (for gas samples only) • Sample description • Requested analysis • Date and time of collection • QC designation (if applicable) (Section B1-5)					
114	Are procedures in place to ensure waste containers and samples are sealed with intact custody seals and that one or more of the following custody conditions are met: • It is in the possession of an authorized individual • It is in the view of an authorized individual, after being in the possession of that individual • It was in the possession of an authorized individual and access to the sample was controlled by locking or placement of signed custody seals that prevent undetected access • It is in a designated secure area, such as a controlled access location with complete documentation of personnel access or a radiological containment area (hot cell or glove box) (Section B1-5)					
117	Are procedures in place to ensure that sample custody is maintained until the sample is released by the SPM or is expended. (Section B1-5)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
118	Are procedures in place to ensure that samples in glass jars are wrapped in plastic to prevent breakage and placed in appropriate containers, such as coolers, for shipment? (Section B1-6)					
119	Are procedures in place to ensure that adequate cold packs are included in the sample shipping container to ensure that all temperature requirements are met? (Section B1-6)					
120	Are procedures in place to ensure that sample COC forms are secured for shipment to the inside of the sealed and locked shipping container and that samples and shipping containers are affixed with tamper proof seals? (Section B1-6)					
121	Are procedures in place to ensure that appropriate blank samples are included with each shipment container containing VOC samples? (Section B1-6)					
122	Are procedures in place to ensure that a custody seal or device is securely affixed across the lid and body of each sample and shipment container, and is traceable to the individual who affixed the seal or device? (Section B1-5)					
	LABORATORY OPERATIONS					
123	Are procedures in place to ensure that only laboratories that are qualified through participation in the Performance Demonstration Program are eligible to analyze waste samples? (Section B-3a(3))					
124	Are procedures available from all participating laboratories that adequately document that custody is maintained until the sample is released by the site project manager or until the sample is expended? (Section B1-5)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
	VOLATILE AND SEMI-VOLATILE ANALYSIS OF CORE SAMPLES					
125	Are procedures documented to ensure that all VOC and SVOC analyses are evaluated using the following criteria: • GC/MS Tunes, Initial Calibrations and Continuing Calibration will be performed and evaluated using criteria in Table B3-5 (VOCs) or Table B3-7 (SVOCs) and SW-846 methods • Precision shall be assessed through analyzing laboratory duplicates or matrix spike duplicates, LCS replicates, and PDP blind-audit samples in comparison to Table B3-4 (VOCs) and Table B3-6 (SVOCs) • Accuracy as %R shall be assessed through evaluation of LCS , Matrix spikes, PDP blind-audit samples, and surrogate compounds in comparison to criteria in Table B3-4 and Table B3-5 (VOCs) and Table B3-6 and Table B3-7(SVOCs) or the SW-846 method. • Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples collected. • Comparability is assessed through use of standardized SW-846 methods sample preparation and methods that meet the QAO requirements in Tables B3-4 and B3-5 (VOCs) and Tables B3-6 and B3-7(SVOCs), traceable standards, and by requiring participation in the PDP. • Representativeness is assured through the use of unbiased sample collection • Results and method detection limits are expressed in Mg/Kg • All method detection limits and program required quantitation limits shall be less than or equal to the limits listed in Table B3-4 or Table B3-6 and the detection limit study procedures shall be documented in SOPs (Section B3-6 and B3-7)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
126	Are procedures documented to ensure that Tentatively Identified Compounds shall be added to the target analyte list if detected in a given waste stream if they are reported in 25% of the waste containers sampled from a given waste stream, and if they appear in the 20.4.1.200 NMAC (incorporating 40 CFR §261) Appendix VIII list? (Section B-3a(1))					
126a	Are procedures documented to ensure that the following criteria are met with regard to the recognition and reporting of TICS for GC/MS Methods for homogeneous solids and soils and gravels in accordance with SW-846 criteria: • Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum. • The relative intensities of the major ions should agree within ± 20 percent. • Molecular ions present in the reference spectrum should be present in the sample spectrum. • Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds. • Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. • The reference spectra used for identifying TICs shall include, at minimum, all of the available spectra for compounds that appear in the 20.4.1.200 NMAC (incorporating 40 CFR Part 261) Appendix VIII list. The reference spectra may be limited to VOCs when analyzing headspace gas samples. • TICs for headspace gas analyses that are performed through FTIR analyses shall be identified in accordance with the specifications of SW-846 Method 8410. (Section B3-1)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
126b	TICs shall be reported as part of the analytical batch data reports for GC/MS Methods in accordance with the following minimum criteria: • a TIC in an individual container headspace gas or solids sample shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 10% of the area of the nearest internal standard. • a TIC in a composited headspace gas sample that contains 2 to 5 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 2% of the area of the nearest internal standard. • a TIC in a composited headspace gas sample that contains 6 to 10 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 1% of the area of the nearest internal standard. • a TIC in a composited headspace gas sample that contains 11 to 20 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 0.5% of the area of the nearest internal standard. (Section B3-1)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
	METALS ANALYSIS OF CORE SAMPLES					
127	Are procedures in place to ensure that all Metals analyses are evaluated using the following criteria: • Precision shall be assessed by analyzing of laboratory sample duplicates or laboratory matrix spike duplicates, LCS replicates, and PDP blind audit samples in comparison to Table B3-8 • Accuracy shall be assessed through analysis of laboratory matrix spikes, PDP blind-audit samples, serial dilutions, interference check samples, and laboratory control samples in comparison to criteria in Tables B3-8 and B3-9 • Instrument detection limits are expressed in ug/L and results are listed in Mg/Kg. • All instrument detection limits and program required detection limits shall be less than the limits listed in Table B3-8 and the detection limit study procedures shall be documented in laboratory SOPs. The Instrument detection limits shall be less than the associated PRDL for each analyte *(This requirement is not mandatory if the sample concentrations are greater than 5 times the instrument detection limit (IDL) for a method)* • Instrument detection limits shall be determined semiannually using procedures documented in laboratory SOPs					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
127a	• Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. • Comparability is assessed through use of standardized SW-846 sample preparation and methods that meet the QAO requirements in Tables B3-8 and B3-9, demonstrating successful participation in the PDP and use of traceable standards. • Representativeness is assured through the use of unbiased sample collection and preparation of samples using unbiased methods. • Results PRQLs are expressed in Mg/Kg wet weight (Section B3-8)					
	QUALITY ASSURANCE OBJECTIVES					
128	Are procedures in place to ensure that the sample completeness rate is expressed as the number of valid samples collected as a percentage of the total samples collected for each waste stream? The rate must be greater than 90 percent for all compounds in a waste stream . (Section B3-3)					
129	Are procedures in place to ensure that sampling operations are comparable through the use of standardized procedures, sampling equipment, and measurement units participation in the PDP? (Section B3-3)					
130	Are procedures in place to ensure that sampling precision shall be determined through the collection of field duplicates at a rate of 1 per sampling batch (up to 20 samples) or 1 per week, whichever is more frequent? (Section B3-3)					
131	Are procedures in place to ensure that the variance measured between co-located core samples is compared to the variance within the waste stream using the F-test ? (Section B3-3)					
132	Are procedures in place to ensure that sampling accuracy as a result of equipment blank evaluation is determined through the collection of equipment blanks at a frequency of once per equipment cleaning batch (Section B3-3)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N(Why?)	Item Reviewed	Adequate? Y/N	
133	Are procedures in place to ensure that the representativeness of samples is demonstrated through the following requirements: • Use of coring tools and sampling equipment that are clean prior to use • The entire depth of the waste minus a documented safety factor shall be cored and the core collected shall have a core length greater than or equal to 50 percent • The core recovery is calculated as the length of the core collected over the depth of the waste in the container • Coring operations and tools should be designed to minimize alteration of the in-place waste characteristics and the minimum waste disturbance shall be verified by visually examining the core and documenting the observation in field logbooks *(Note: if core recovery is less than 50 percent, a second core shall be randomly selected. The core with the best recovery shall be used for sample collection)* (Section B3-3)					

1. The WAP requirements should be presented in documents, such as procedures. Each of the questions posed under WAP requirements are meant to determine whether procedures are in place or whether documents are evident which demonstrate that the specific WAP requirement is or can be met.

Table B6-3 Acceptable Knowledge (AK) Checklist

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1

Acceptable Knowledge (AK) Checklist[1]

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
	GENERAL REQUIREMENTS					
134	Are the primary document(s) required in Permit Attachment B4 containing acceptable knowledge information available? (Section B4-2)					
135	Has the generator developed a methodology whereby a logical sequence of acceptable knowledge information that progresses from general facility to more detailed waste-specific information can be acquired? (Section B4-2)					
136	Does the site have adequate procedures in place to ensure that the Acceptable Knowledge process is adequately implemented? Do these procedures facilitate the mandatory traceability analysis performed for each Summary Waste Category Group examined during the audit? (Section B4-2)					
137	Does the generator site's TRU mixed waste management program information clearly define (or provide a methodology for defining) waste categorization schemes and terminology, provide a breakdown of the types and quantities of TRU mixed waste generated/stored at the site, and describe how waste is tracked and managed at the generator site (including historical and current operations? Do procedures ensure that waste streams are adequately identified? (Section B4-2a)					
138	Does site documentation procedures indicate that the site will document, justify, and consistently define waste streams and assign EPA hazardous waste numbers? (Section B4-2b)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
	REQUIRED AND SUPPLEMENTAL INFORMATION					
140	Does the generator site document that the following must be included in the acceptable knowledge record: • Map of the site with the areas and facilities involved in TRU waste generation, treatment, and storage identified • Facility mission description as related to TRU waste generation and management (e.g., nuclear weapons research may involve metallurgy, radiochemistry, and nuclear physics operations that result in specific waste streams) • Description of the operations that generate TRU waste at the site (e.g., plutonium recovery, weapons design, or weapons fabrication) • Waste identification or categorization schemes used at the facility (e.g., item description codes, content codes) • Types and quantities of TRU mixed waste generated, including historical generation through future projections • Correlation of waste streams generated from the same building and process, as appropriate (e.g., sludge, combustibles, metals, and glass) • Waste certification procedures for retrievably stored and newly generated wastes to be sent to the WIPP facility (Section B4-2a)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
141	Does the generator site document that the following shall be collected for each waste stream: A. Area(s) and/or building(s) from which the waste stream was or is generated B. Waste stream volume and time period of generation (e.g., 100 standard waste boxes of retrievable stored waste generated from June 1977 through December 1977) C. Waste generating process described for each building (e.g., batch waste stream generated during decommissioning operations of glove boxes), including processes associated with U134 waste generation, if applicable. D. Process flow diagrams (e.g., a diagram illustrating glove boxes from a specific building to a size reduction facility to a container storage area). In the case of research/development, analytical laboratory waste, or the similar processes where process flow diagrams cannot be created, a description of the waste generating processes, rather than a formal process flow diagram, may be included if this modification is justified and the justification is placed in the auditable record E. Material inputs or other information that identifies the chemical content of the waste stream and the physical waste form (e.g., glove box materials and chemical handled during glove box operations, events or processes that may have modified the chemical or physical properties of the waste stream after generation, data obtained through visual examination of newly generated waste that later undergoes radiography; information demonstrating neutralization of U134 [hydrofluoric acid] and waste compatibility) (Section B4-2b)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
142	Do site documents/procedures require that the facility will provide a summary to the Permittees that summarizes all information collected, including basis and rationale for all waste stream designations? Is an example of this summary available for audit review? If discrepant hazardous waste data exist in required information, do sites assign all hazardous waste numbers unless the sites choose to justify otherwise? (Section B4-2b)					
143	Do site procedures indicate that if the required AK information is not available for a particular waste stream, that the waste stream will not be eligible for an AK Sufficiency Determination? (Section B4-2)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
144	Have the following procedures been prepared?: A. Procedures for identifying and assigning the physical waste form of the waste B. Procedures for delineating waste streams and assigning Waste Matrix Codes C. Procedures for resolving inconsistencies in acceptable knowledge documentation D. Procedures for headspace gas sampling and analysis, visual examination and/or radiography, and homogeneous waste sampling and analysis, if applicable E. For newly generated waste, procedures describing process controls used to ensure prohibited items (specified in the WAP, Permit Attachment B) are documented and managed F. Procedures to ensure radiography and visual examination include a list of prohibited items that the operator shall verify are not present in each container of waste (e.g. liquids exceeding TSDF-WAC limits, corrosives, ignitables, reactives, and incompatible wastes) G. Procedures to document how changes to Waste Matrix Codes, waste stream assignment, and associated Environmental Protection Agency hazardous waste numbers based on material composition are documented for any waste H. Procedures for assigning EPA hazardous waste numbers to TRU mixed waste I. Procedures for estimating waste material parameter weights (Section B4-2b)	I.				
145	Does the generator provide procedures or written commitment to collect supporting acceptable knowledge information, as available and as necessary to augment mandatory information? (Section B4-2c)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
145a	For waste containers that belong to LANL sealed sources waste streams, and for which headspace gas sampling and analysis is not required, are there procedures in place to assure the collection of the following supplemental AK?: A. Documentation that the waste container contents meet the definition of sealed sources per 10 CFR §30.4 and 10 CFR §835.2 (effective January 1, 2004) B. Documentation of the certification of the sealed sources as U.S. Department of Transportation Special Form Class 7 (Radioactive) Material per 49 CFR §173.403 (effective October 1, 2003) C. Documentation of contamination survey results that validate the integrity of each sealed source per 10 CFR §34.27 (effective January 1, 2004). D. AK documentation does not indicate the use of VOCs or VOC-bearing materials as constituents of the sealed sources. E. The outer casing of each sealed source must be of a non-VOC bearing material, which must be verified at the time of packaging. F. AK documentation that includes but is not limited to, as available and as necessary to determine the hazardous constituents associated with sealed sources, the following: source manufacturer's sales catalogues, original purchase records, source manufacturer's fabrication documents, source manufacturer's drawings, source manufacturer's fuel capture assembly reports, source manufacturer's operational procedures for cleanliness requirements, source manufacturer's shipping documents, source manufacturer's welding records, transuranic batch material records, and information from national databases (e.g., NMMSS). All of this information may not and need not be available for each source, but sufficient information must be included in the auditable record to derive an adequate understanding of source construction and history to ensure that no VOCs are present in association with the sealed source itself that would render the source hazardous. If AK data indicate that assignment of a hazardous waste number related to organic materials is required in association with a source, this specific source will be assigned to a separate waste stream and that waste stream will be subject to headspace gas sampling unless a separate AK Sufficiency Determination is approved for the waste stream. (Section B4-2c)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
146	Does the generator site document that all specific, relevant supplemental information used in the acceptable knowledge process will be identified and its use explained? Is all necessary supplemental information assembled and has it been appropriately used? (Section B4-2c)					
147	Does the generator site discrepancy analysis documentation (for acceptable knowledge supporting and required documentation) indicate that if discrepancies are detected, site must include all hazardous waste numbers indicated in the required and supporting information unless the site chooses to justify an alternative assignment and document justification in the auditable record? (Section B4-2c)					
	TRAINING					
148	Does the generator site have procedures to ensure that all personnel involved with acceptable knowledge waste characterization have the following training, and is this training documented? A. WIPP WAP in Permit Attachment B and the TSDF-WAC specified in this permit B. State and Federal RCRA regulations associated with solid and hazardous waste characterization C. Discrepancy resolution and reporting D. Site-specific procedures associated with waste characterization using acceptable knowledge (Section B4-3a)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
	PROCEDURES					
149	Has the generator site developed the following procedures, and are these procedures technically sufficient? A. Sites must prepare and implement a written procedure outlining the specific methodology used to assemble acceptable knowledge records, including the origin of the documentation, how it will be used, and any limitations associated with the information (e.g., identify the purpose and scope of a study that included limited sampling and analysis data). B. Sites must develop and implement a written procedure to compile the required acceptable knowledge record. C. Sites must develop and implement a written procedure that ensures unacceptable wastes (e.g., reactive, ignitable, corrosive) are identified and segregated from TRU mixed waste populations sent to WIPP. D. Sites must prepare and implement a written procedure to evaluate acceptable knowledge and resolve discrepancies. If different sources of information indicate different hazardous wastes are present, then sites must include all sources of information in its records and conservatively assign all potential hazardous waste numbers, unless the site chooses to justify an alternative assignment and document the justification in the auditable record. The assignment of hazardous waste numbers shall be tracked in the auditable record to all required documentation.					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
149a	E. Sites must prepare and implement a written procedure to identify hazardous wastes and assign the appropriate hazardous waste numbers to each waste stream. The following are minimum baseline requirements/standards that site-specific procedures must include to ensure comparable and consistent characterization of hazardous waste: 1. Compile all of the required information in an auditable record. 2. Review the compiled information and delineate TRU mixed waste streams. Delineation of waste streams must comply with the WAP definition: a waste stream is defined as waste material generated from a single process or from an activity that is similar in material, physical form, and hazardous constituents. 3. Review the compiled information to determine if the waste stream is compliant with the TSDF-WAC 4. Review the required information to determine if the waste is listed under 20.4.1.200 NMAC (incorporating 40 CFR § 261), Subpart D. Assign all listed hazardous waste numbers, unless the site chooses to justify an alternative assignment and document the justification in the auditable record. 5. Review the required information to determine if the waste exhibits a hazardous characteristic or may contain hazardous constituents included in the toxicity characteristics specified in 20.4.1.200 NMAC (incorporating 40 CFR § 261, Subpart C. If a toxicity characteristic contaminant is identified and is not included as a listed waste, assign the toxicity characteristic number, unless data are available which demonstrates that the concentration of the constituent in the waste is less than the toxicity characteristic regulatory level. When data are not available, the toxicity characteristic hazardous waste number for the identified hazardous constituent must be applied to the mixed waste stream. 6. Review the compiled information to provide an estimate of the material parameter weights for each container to be stored or disposed of at WIPP. For newly generated waste, procedures shall be developed and implemented to characterize hazardous waste using acceptable knowledge prior to packaging.					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
149b	F. Sites shall ensure that results of audits of the TRU mixed waste characterization programs at the site are available in the records. G. Sites shall identify all process controls (implemented to ensure that the waste contains no prohibited items and to control hazardous waste content and/or physical form) that have been applied to retrievably stored waste and/or may presently be applied to newly generated waste. Process controls are applied at the time of waste generation/packaging to control waste content, whereas any activities performed after waste generation/packaging to identify prohibited items, hazardous waste content, or physical form are waste characterization activities, not process controls. The AK record must contain specific process control and supporting documentation identifying when these process controls are used to control waste content. See Permit Attachment B, Section B-2 for programmatic requirements related to process controls. (Section B4-3b)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
150	Does the site have implemented procedures which comply with the following criteria to establish acceptable knowledge records: A. Acceptable knowledge information shall be compiled in an auditable record, including a road map for all applicable information. B. The overview of the facility and TRU mixed waste management operations in the context of the facility's mission shall be correlated to specific waste stream information. C. Correlations between waste streams, with regard to time of generation, waste generating processes, and site-specific facilities shall be clearly described. For newly generated wastes, the rate and quantity of waste to be generated shall be defined. D. A reference list shall be provided that identifies documents, databases, Quality Assurance protocols, and other sources of information that support the acceptable knowledge information. E. Container inventories for TRU mixed waste in retrievable storage shall be delineated into waste streams by correlating the container identification to all of the required and supporting AK information (Section B4-3c)					
151	If the generator site submitted an AK Sufficiency Determination Request for a specific waste stream, did the site provide all of the requisite information including the identification of the applicable scenario for which approval is sought? (Section B-0b)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
	RE-EVALUATING ACCEPTABLE KNOWLEDGE					
152	Does the generator site have written procedures for the augmentation of all acceptable knowledge information using sampling and analysis. Sampling and analysis consists of radiography, visual examination, headspace gas, and homogeneous waste sampling and analysis. Do site procedures indicate that the following sampling and analysis will be conducted based upon the results of the Determination Request Any scenario denied - 100% RTR or VE and statistical HSG or solids S&A Scenario 1 Granted -No sampling and analysis radiography/visual examination is required Scenario 2 Granted-Radiography/visual examination is not required but statistical HSG or solids S&A is required Scenario 3 Granted-100% RTR or VE is required, sampling and analysis is not required (Section B4-1, B-0b)					
155	Does the generator site have procedures for reevaluating acceptable knowledge if the results of the waste confirmation indicate that the waste to be shipped does not match the approved waste stream or if the data from radiography or visual examination for waste streams without an AK Sufficiency Determination exhibit this discrepancy? Does this procedure describe how the waste is reassigned, acceptable knowledge reevaluation, and appropriate hazardous waste codes are assigned? (Section B4-3e)					
156	Do site procedures indicate that debris waste are assigned toxicity characteristic EPA numbers based on AK regardless of the quantity or concentration? (B4-3e)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
	CRITERIA FOR ASSEMBLING AN ACCEPTABLE KNOWLEDGE RECORD DELINEATING THE WASTE STREAM					
158	If wastes are reassigned to a different waste matrix code based on site visual examination or radiography or Permittee confirmation activities, does the generator site have written documentation to ensure that the following steps are followed: F. Review existing information based on the container identification number and document all differences in hazardous waste number assignments G. If differences exist in the hazardous waste numbers that were assigned, reassess and document all required acceptable knowledge information (Section B3-b) associated with the new designation H. Reassess and document all sampling and analytical data associated with the waste I. Verify and document that the reassigned waste matrix code was generated within the specified time period, area and buildings, waste generating process, and that the process material inputs are consistent with the waste material parameters identified during radiography or visual examination J. Record all changes to acceptable knowledge records K. If discrepancies exist in the acceptable knowledge information for the revised waste matrix code, document the segregation of the affected portion of the waste stream, and define the actions necessary to fully characterize the waste (Section B4-3e)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
161	Do site procedures ensure that headspace gas and solid/soil analytical data are used to resolve AK assignments for hazardous waste, as necessary? If a constituent is detected in headspace gas that the site believes isn't from the waste process, the site must provide documentation to support any determination that organic constituents are associated with packaging materials, radiolysis, or other uses not consistent with solvent use. If the source of the detected headspace gas solvents cannot be identified, the appropriate F listing will be assigned. If a constituent in a listed waste is present in solid/soil analytical results, the appropriate listed waste shall be added to the waste stream. F-listed waste assigned by acceptable knowledge shall not be removed based on headspace gas or solids analysis. In the case of totals/TCLP analysis, do procedures reflect the allowance for concentration assessments, wherein sites may add or remove total/TCLP and non-toxic F003 constituents found in headspace and solid/soil analyses? (Section B4-3e)					
162	If sampling and analysis conducted to augment AK determines that a hazardous constituent as identified in headspace gas sampling or soil/homogeneous waste sampling is present in the waste, does the generator site indicate that they will: 1) assign the hazardous waste number to the entire waste stream as applicable, or 2) segregate drums containing detectable concentrations of solvent into a separate waste stream, and assign applicable hazardous waste numbers? (Section B4-3e)					
163	Does the generator site document, justify, and consistently delineate waste streams and assign hazardous waste codes based on site specific permit requirements or state-enforced agreements? (Section B4-3e)					
164	Does the generator site have written methodologies for determining the mean concentration of solvent VOCs detected by either headspace gas analysis or homogeneous waste sampling for each waste stream or waste stream lot, and are all data ("U" flags designated as one half the MDL and "J" flags, which are less than the PRQL but greater than the MDL)? (Section B4-3e)					
165	Do procedures ensure that spent solvent assignments are made by using the UCL_{90} (of mean concentration), and comparing this with the PRQLs? If the UCL_{90} exceeds the PRQL, is acceptable knowledge reevaluated and determine potential source of the constituent? (Section B4-3e)					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
167	Does the site have written procedures for situations where concentrations of some VOCs are orders of magnitude higher than other target analytes? In these cases, elevated MDLs may be generated, and those constituents with an elevated MDL but "U" designation will not be used in mean calculations. (Section B4-3e)					
	DATA QUALITY REQUIREMENTS					
168	Are acceptable knowledge processes consistently applied among all generator sites, and does each generator site comply with the following data quality requirements for acceptable knowledge documentation: A. Precision - Precision is the agreement among a set of replicate measurements without assumption of the knowledge of a true value. The qualitative determinations, such as compiling and assessing acceptable knowledge documentation, do not lend themselves to statistical evaluations of precision. However, the acceptable knowledge information will be addressed by the independent review of acceptable knowledge information during internal and external audits. B. Accuracy - Accuracy is the degree of agreement between an observed sample result and the true value. The percentage of waste containers which require reassignment to a new waste matrix code and/or designation of different hazardous waste numbers based on sampling and analysis data and discrepancies identified by the Permittees during waste confirmation will be reported as a measure of acceptable knowledge accuracy. C. Completeness - Completeness is an assessment of the number of waste streams or number of samples collected to the number of samples determined to be useable through the data validation process. The acceptable knowledge record must contain 100 percent of the information (Permit Attachment B4-3). The useability of the acceptable knowledge information will be assessed for completeness during audits.					

	WAP Requirement[2]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
168a	D. Comparability - Data are considered comparable when one set of data can be compared to another set of data. Comparability is ensured through sites meeting the training requirements and complying with the minimum standards outlined for procedures that are used to implement the acceptable knowledge process. All sites must assign hazardous waste codes in accordance with Permit Attachment B4-4 and provide this information regarding its waste to other sites who store or generate a similar waste stream. E. Representativeness - Representativeness expresses the degree to which sample data accurately and precisely represent characteristics of a population. Representativeness is a qualitative parameter that will be satisfied by ensuring that the process of obtaining, evaluating, and documenting acceptable knowledge information is performed in accordance with the minimum standards established in Permit Attachment B4. Sites also must assess and document the limitations of the acceptable knowledge information used to assign hazardous waste codes (e.g., purpose and scope of information, date of publication, type and extent to which waste parameters are addressed) . (Section B3-9)					
169	Does the generator site address quality control by tracking its performance with regard to the use of acceptable knowledge by: 1) assessing the frequency of inconsistencies among information, and 2) documenting the results of waste discrepancies identified by the generator/storage site during waste characterization or the Permittees during waste confirmation using radiography, review of radiography audio/video recordings, visual examination, or review of visual examination records. . In addition, the acceptable knowledge process and waste stream documentation must be evaluated through internal assessments by generator/storage site quality assurance organizations . (Section B4-3e)					

1. NMED expects a traceability analysis to be performed, the results of which should be presented on this checklist under the “Examples of Implementation” column. Further, the traceability analysis process and results should be discussed in the Final Audit Report.

2. The WAP requirements should be presented in documents, such as procedures. Each of the questions posed under WAP requirements are meant to determine whether procedures are in place or whether documents are evident which demonstrate that the specific WAP requirement is or can be met.

Table B6-4 Headspace Gas Checklist

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1

Headspace Gas Checklist

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
	HEADSPACE GAS SAMPLING FREQUENCY					
182	Are procedures in place to ensure that randomly selected retrievably stored and newly generated waste containers will undergo headspace gas sampling and analysis as required to augment AK? (Section B-3a)					
183	Are procedures in place to ensure that randomly selected containers will be allowed to equilibrate to sampling room temperature for 72 hours prior to sampling (18º C or higher) and that the drum ages specified in accordance with Section B1-1a(1) are met? All information necessary to determine drum age criteria must be determined, including but not limited to: • Scenario Determination • Packaging Configuration • Filter Diffusivity • Liner/Lid Opening Diameter ? (Section B1-1a)					
	HEADSPACE GAS SAMPLING GENERAL REQUIREMENTS					
184	Are procedures in place to ensure all containers of waste are vented through filters to ensure that gases are adequately vented preventing over pressurization or development of conditions that would lead to the development of ignitable, corrosive, reactive, or other characteristic waste? (Section B-1c)					
186	Are procedures in place to ensure that the following gas sample container and holding time requirements are met: • The minimum sample volume for VOC. sample collection is 250 mL. (Note: a single 100 mL sample may be collected if the headspace is limited) • Holding temperatures shall be between 0º C and 40º C (Table B1-1)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
187	Are procedures in place to ensure that all sampling is performed in an appropriate radiation containment area? (Section B1-1a)					
188	Are procedures in place to ensure that headspace gas are analyzed for the analytes listed in Table B3-2 of the Attachment B3? (Section B1-1a(1))					
189	Are procedures in place to ensure that all headspace gas analyses utilize either SUMMA® or equivalent canisters or on-line integrated sampling/analysis systems? (Section B1-1a(1))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
	MANIFOLD SAMPLING					
190	Are procedures, processes, and equipment in place to ensure that the following sampling procedures are implemented: • The sampling equipment is leak checked and cleaned upon first use and as needed • The manifold and sample canisters are evacuated to 0.1 mm Hg prior to sample collection • Cleaned and evacuated sample canisters are attached to the evacuated manifold before the manifold inlet valve is opened • The manifold inlet valve is attached to a changeable filter connected to either a side port needle sampling head capable of forming an airtight seal (for penetrating a filter or rigid poly liner when necessary), a drum punch sampling head capable of forming an airtight seal (capable of punching through the metal lid of a drum while maintaining and airtight seal for sampling through the drum lid), or a sampling head with an airtight fitting for sampling through a pipe overpack container filter vent hole. Refer to Section B1-1a(4) for descriptions of these sampling heads. • Field blanks are collected using samples of room air collected in the sampling area in the immediate vicinity of the waste container. *(Note: field blanks for SUMMA® canisters are collected directly into the canister without the use of the manifold.)* • Manifold equipped with purge assembly that allows QC samples to be collected through all sampling components that affect compliance with QAOs • The manifold internal volume is calculated and documented in a field logbook • The total volume of headspace gas collected is calculated by adding the canister volume and internal manifold volume and should be less than 10 percent of the available headspace volume when a volume estimate is available (Section B1-1a(2))					

<table>
<tr><th rowspan="2"></th><th rowspan="2">WAP Requirement[1]</th><th colspan="2">Procedure Documented</th><th colspan="2">Example of Implementation/ Objective Evidence, as applicable</th><th rowspan="2">Comment (e.g., any change in procedure since last audit, etc.)</th></tr>
<tr><th>Location</th><th>Adequate? Y/N (Why?)</th><th>Item Reviewed</th><th>Adequate? Y/N</th></tr>
<tr><td>191</td><td>Are procedures, processes, and equipment in place to ensure that the following manifold sample side conditions are met:
• The sampling head forms a leak-tight connection with the sampling manifold
• A flexible hose allowing movement from the purge assembly to the waste container
• Pressure sensors that are pneumatically connected to the manifold and must be able to measure absolute pressure from 0.05 mm Hg to 1000 mm Hg with a resolution that must be 0.01 mm Hg at 0.05 mm of Hg. The pressure sensors shall have an operating range of 15°C to 40°C.
• Sufficient canister ports shall be available to allow simultaneous collection of headspace gas samples and duplicates for VOC. analysis .
• Ports not occupied with sample canisters require a plug to prevent ambient air from entering the system
• Ports shall have VCR® fittings for connection to the sample canisters to prevent degradation of the fitting on the canister and manifold.
• Sample canisters are leak-free, stainless steel pressure vessels, with a Cr-NiO SUMMA®-passivated interior surface or canisters with equivalently inert surfaces, bellows valve, and a pressure/vacuum gauge. All canisters shall have VCR® fittings to sampling and analytical equipment
• The pressure/vacuum gauge must be mounted on each manifold and shall be helium-leak tested to 1.5 $\times$ 10^{-7} cc/s, have all stainless steel construction, and be capable of operating at temperatures to 125°C</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
191a	• A dry vacuum pump capable of reducing the manifold pressure to 0.05 mm Hg. (Note: If an oil vacuum pump is used precautions such as a molecular sieve or cryogenic trap shall be used to prevent diffusion of oil vapors back into the manifold) • A minimum distance between the needle and the valve that isolates the pump from the manifold in order to minimize the dead volume in the manifold. • If real time equipment blanks are not available, the manifold shall be equipped with an OVA capable of detecting all analytes listed in Table B3-2 and is capable of measuring total VOC concentrations below the lowest headspace gas PRQL (Section B1-1a(2))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
192	Are procedures, processes, and equipment in place to ensure that the following manifold standard side conditions are met: • A cylinder of compressed zero air, helium, argon, or nitrogen that is hydrocarbon and CO_2 free air (only hydrocarbon and CO_2-free gases required for FTIRS) and certified by the manufacturer to contain less than one ppm VOCs. The gas is used to clean the manifold between samples and to provide gas for the collection of equipment and on-line blanks *(Note: a zero air or nitrogen generator may be used, provided a sample of air is collected and found to contain less than 1 ppm total VOCs and the air is humidified)* • Cylinders of reference gas with known concentrations of analytes from Table B3-2 certified by the manufacturer to provide gases for evaluating the accuracy of the headspace gas sampling process • All cylinders of reference gases and zero air shall be connected to flow regulating devices • A humidifier filled with ASTM Type I or II water, connected, and opened to the standard side of the manifold between the compressed gas cylinders and the purge assembly shall be used, if the Fourier Transform Infrared System (FTIRS) is not used. No humidifier if the FTIRS is used *(Note: Compressed gas may include water vapor between 1000 and 10000 ppmv in lieu of a humidifier)* • The humidifier is off-line during system evacuation to prevent manifold flooding					
192a	• A purge assembly that allows the sampling head to be connected to the standard side of the manifold. • A flow indicating device or pressure regulator that is connected downstream of the purge assembly to monitor the flow rate or pressure of gases through the purge assembly to ensure that excess flow is available to prevent ambient air from contaminating the QC samples and allow sample of gas from the compress gas cylinders to be collected near ambient pressure. (Section B1-1a(2))					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
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193	Do procedures ensure that NIST Certified (or equivalent) ambient pressure sensors maintained in the sampling area must have a sufficient measurement range for the expected ambient barometric pressures and a resolution shall be 1.0 mm Hg or less? (Section B1-1a(2))					
194	Do procedures ensure that the NIST traceable (or equivalent) temperature sensor in the sampling location shall have a sufficient measurement range for the ambient temperatures 18 to 50°C? (Section B1-1a(2))					

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	DIRECT CANISTER SAMPLING					
195	Are procedures, processes, and equipment in place to ensure that the following operating conditions are in place for direct canister sampling: • Canisters are evacuated to 0.1 mm Hg prior to use and attached to a changeable filter connected to the sampling head • Sampling heads are capable of either punching through the metal lid of the drums while maintaining an airtight seal for sampling through the drum lid, penetrating a filter or the septum in the orifice of a self-tapping screw, or maintaining an airtight seal for sampling through a pipe overpack container filter vent hole. • Field duplicates are collected in the same manner and at the same time and using the same type of sampling apparatus as used for headspace gas sample collection . • Field blanks shall be samples of room air collected in the immediate vicinity of the waste drum sampling area prior to removal of the drum lid. • Equipment blanks and field reference standards shall be collected using a purge assembly equivalent to the standard side of the manifold • Less than 10 percent of the headspace is withdrawn when a headspace estimate is available (Note: The total volume withdrawn can be determined by adding the canister volume and the internal volume of the sampling head) • Each sample canister shall be equipped with a pressure/vacuum gauge capable of indicating leaks and sample collection volumes. The gauge shall be helium leak tested to 1.5×10^{-7} cc/s, have all stainless steel construction and be capable of tolerating temperatures to 125°C • Summa® canisters or equivalent are used to collect samples (Section B1-1a(3))					

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	SAMPLING HEADS UNDER DRUM LIDS: SAMPLING THROUGH A CARBON FILTER					
196	Are procedures, process, and equipment adequate to ensure that samples collected through a filter meet the following requirements: • The lid of the drum's 90-mil rigid poly liner shall contain a hole for venting to the drum • That non-vented drums are not sampled until an internal nonconformance report is prepared, submitted, and resolved in order to obtain a representative sample • The filter shall be sealed to prevent outside air from entering the drum • The sampling head for collecting drum headspace gas shall consist of a side-port needle, a filter to prevent particle contamination of the sample, and an adapter to connect the side-port needle to the filter • The sampling head is cleaned or replaced after each use • The housing of the filter shall allow insertion of the sampling needle through the filter element or a sampling port with septum that bypasses the filter element into the drum headspace • The side port needle shall be used to reduce the potential for plugging • The purge assembly shall be modified for compatibility with the side port needle. (Section B1-1a(4)(i))					
	SAMPLING HEADS UNDER DRUM LIDS: SAMPLING THROUGH THE DRUM LID					
197	Are procedures in place to establish the criteria for sampling through the drum lid as opposed to sampling through a filter? (Section B1-1a(4)(ii))					
197a	If sampling through a pipe overpack container filter vent hole with an airtight device is used, are procedures in place to ensure that a sampling head with an airtight seal for sampling through a pipe overpack container filter vent hole are available? (Section B1-1a(4)(iii))					

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197b	If sampling through a pipe overpack container filter vent hole is used, are the following criteria met? • The seal between the pipe overpack container surface and sampling apparatus shall be designed to minimize intrusion of ambient air. • The filter shall be replaced as quickly as is practicable with the airtight sampling apparatus to ensure that a representative sample can be taken. • All components of the sampling system that come into contact with sample gases shall be cleaned according to requirements for direct canister sampling or manifold sampling, whichever is appropriate, prior to sample collection. • Equipment blanks and field reference standards shall be collected through all the components of the sampling system that contact the headspace-gas sample. • During sampling, openings in the pipe overpack container shall be sealed to prevent outside air from entering the container. • A flow-indicating device shall be connected to sampling system and operated according to the direct canister or manifold sampling requirements, as appropriate. (Section B1-1a(4)(iii))					
197c	If sampling through a pipe overpack container filter vent hole is used, are the following criteria met? • The site has documentation that demonstrates that they have determined through testing the appropriate length of time for exchanging the filter with the sampling device to assure representative samples are collected. (Section B1-1a(4)(iii))					

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198	Are procedures, process, and equipment adequate to ensure that samples collected through the drum lid by punching meet the following requirements: • The lid of the drum's 90-mil rigid poly liner shall contain a hole for venting to the drum. If the DAC for Scenario 1 is met, a sample may be collected from inside the 90-mil rigid poly liner. • If headspace gas samples are collected from the drum headspace prior to venting the 90-mil rigid poly liner, the sample is not acceptable and a nonconformance report shall be prepared, submitted, and resolved. • The drum lid shall be breached using a punch that forms an airtight seal between the drum lid and the manifold or canister • The seal between the drum lid and the sampling head shall be designed to minimize the intrusion of ambient air • All components of the sampling system that come in contact with sample gases shall be purged with humidified zero air, nitrogen, or helium prior to sample collection • Equipment blanks and field reference standards shall be collected through all components of the punch that contact the headspace gas sample • Pressure shall be applied to the punch until the drum lid has been breached • Provisions shall be made to relieve excessive drum pressure increases during drum punch operations; potential pressure increases may occur during sealing of the drum punch to the drum lid • The filter is sealed to prevent outside air from entering the drum (Section B1-1a(4)(ii))					

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<tr><td>198a</td><td>• A flow indicating device or pressure regulator to verify flow of gases shall be pneumatically connected to the drum punch and operated in the same manner as the flow indicating device
• Equipment are used to secure the drum punch sampling system to the drum lid
• If the headspace gas sample is not taken at the time of drum punching, the presence and diameter of the rigid liner vent hole is documented during the punching operation for use in determining an appropriate Scenario 2 DAC.
(Section B1-1a(4)(ii))</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="6">QUALITY CONTROL SAMPLE COLLECTION</td></tr>
<tr><td>199</td><td>Are procedures in place to ensure that the following QC sample requirements are met:
• Field QC samples are collected on per sample batch basis for manifold and direct canister sampling. A sampling batch is defined as up to 20 samples collected within 14 days of the first sample
• Field samples are collected and analyzed on a per on-line batch basis for on-line sampling/analysis systems. An on-line batch is defined as the number of headspace gas samples that are collected within a 12 hour period from the same on-line integrated analysis system
• For the manifold sampling method, field blanks, equipment blanks, field duplicates, and field reference samples are collected prior to sample collection on a per sampling batch basis or one per day, whichever is more frequent
• For the direct canister sampling method field blanks and field duplicates are collected on a per sampling batch basis prior to sample collection; while equipment blanks and field reference samples are collected after equipment purchase, cleaning, and assembly</td><td></td><td></td><td></td><td></td><td></td></tr>
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199a	• For the On-line sampling method, field blanks, equipment blanks, field duplicates, and field reference samples are collected on a per on-line batch basis. *(Note: The on-line blank replaces the laboratory and equipment blanks, the on-line duplicate replaces the field duplicate and the laboratory duplicate, and the on-line sample control replace the field reference standard and the laboratory control sample.)* (Section B1-1b, B1-1b(1), B1-1b(2), B1-1b(3), B1-1b(4))					
200	Do procedures adequately assign the Site Project QA Officer with the responsibility of monitoring field QC results and initiate the nonconformance report process in the event the following acceptance criteria are not met or sample collection frequencies are not met: • Field and equipment blanks shall be less than 3 times the detection limits specified in Table B3-2 and equipment blank results determined by FTIR shall be less than the PRQL specified in Table B3-2 (Section B1-1b(1) and B1-1b(2)) • Field reference standards shall have a recovery of between 70 and 130% (Table B1-3) • Field Duplicates shall have an RPD of less than or equal to 25 (B1-1b(4); Table B1-3)					

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201	Are procedures in place to ensure that field reference standards meet the following criteria: • Field reference standards shall contain a minimum of 6 analytes listed in Table B3-2 at a range of between 10 and 100 ppmv and at concentrations greater than the MDL • Field reference standards shall be traceable to a nationally recognized standard, if available • If commercial gases are used, they shall be accompanied by a Certificate of Analysis and all field reference standards are traceable to certificates. • Commercial gases are not used past the manufacturer specified shelf life. • Field reference samples are submitted blind to the laboratory at a frequency of one per sampling batch. (Note: Field reference standards may be discontinued for direct canister method if QAO accuracy objectives are met) (Section B1-1b(3))					
202	Are procedures in place to ensure that field duplicate samples are collected sequentially and in accordance with Table B1-1. (Section B1-1b(4))					

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	SAMPLE EQUIPMENT TESTING, INSPECTION AND MAINTENANCE					
203	Are procedures in place to ensure that sample containers are cleaned in accordance with the following specifications: • All sampling components that contact sample gases are constructed of inert materials such as stainless steel or Teflon® • The sampling manifold and canisters are properly cleaned and leak checked prior to each sampling event in accordance to or equivalent with TO-14A or TO-15 methodology • SUMMA® canisters or equivalent are cleaned on an equipment cleaning batch basis. An equipment cleaning batch is defined as the number of canisters that can be cleaned together at one time using the same cleaning method • The cleaning system consists of an optional oven and a vacuum manifold which uses a dry vacuum pump or a cryogenic trap backed by an oil sealed pump • Prior to cleaning a 24 hour leak check shall be performed (+/- 2 psig) on all canisters • Canisters that shall be checked for leaks, repaired, and reprocessed • One canister per equipment cleaning batch is filled with humid zero air or humid high purity nitrogen and analyzed for VOCs • A batch is considered clean if VOC concentrations are less than 3 times the MDLs specified in Table B3-2 • Certified leak-free canisters are evacuated to 0.1 mm Hg or less for storage • Canister cleaning certification documentation is available at the cleaning facility and the cleaning facility initiates canister tags. (Section B1-1c, B1-1c(1))					

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204	Are procedures in place to ensure that manifold pressure sensors and ambient air temperature sensors are certified prior to initial use and annually using NIST traceable standards. In addition OVA's if used shall be calibrated daily using known calibration gases and the balance of the OVA calibration is consistent with the manifold purge gas. (Section B1-1d)					

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205	Are procedures in place to ensure that sampling equipment are cleaned and leak checked using the following specifications: • Surfaces of all sampling equipment that will come in contact with sample gases are thoroughly inspected and cleaned prior to assembly • Manifolds and sampling heads shall be purged with humidified zero air, nitrogen, or helium and leak checked after assembly • The cleaning shall be repeated if routine system cleaning is inadequate • Manifolds and sampling heads which are reused shall be cleaned and leak checked according to procedures in the EPA's Compendium Method TO-14A or TO-15 after sample collection, field duplicate collection, field blank collection, and after the additional cleaning require for field reference samples. All manifold ports shall be capped or closed with valves (sample canisters may be attached as well) • Manifolds are cleaned by heating the sample side of the manifold to 150°C and periodically evacuated and flushed with humidified zero air, nitrogen, or helium • Manifolds not in use are demonstrated as clean before storage with a positive pressure of humidified zero air, nitrogen, or helium gas in the sampling and standard sides • Sampling is suspended when the analysis of an equipment blank indicated the VOC limits have been exceeded or if a leak test fails. • Sampling systems are cleaned after field reference standard collection by installing a gas tight connector in place of the sampling head, between the flexible hose and purge assembly. This allows the sample and standard side to be flushed with humidified zero air, nitrogen, or helium in conjunction with heated pneumatic lines • Needles, airtight fitting or seal, adapters, and filters are cleaned in accordance with the EPA Method TO-14A or TO-15 procedures. Sample heads shall be discarded or cleaned according to Method TO-15. In addition, the needle, the airtight fitting and seal, and the filter should be purged with zero air, nitrogen, or helium and capped for storage (Section B1-1c(2) , Section B1-1c(3), Section B1-1c(4), and Section B1-c(5))					

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	SAMPLE HANDLING AND CUSTODY					
207	Do formats for field logs and custody records specify documentation of the following information: • Name of sampling facility • Waste container identification number • Sample identification number of each sample referenced to waste container • Sample matrix • Time and date of sample collection • Type/number and size of sample container(s) • Method of sample preservation • Requested analyses • Sampler(s) name through signature					
	• Signatures of custodians relinquishing and receiving custody of samples including date and time of transfer until time of final disposition • Analytical laboratory • Off-site shipping information (date, time, shipper, mode, air bill or lading number) (Section B1-5)					
208	Are procedures are in place to ensure that samples and sampling equipment are identified with unique identification numbers ? (Section B1-5)					

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209	Do sample tags or labels contain the following information: • Sample Description • Ambient temperature and pressure • Sample identification number • Analyses requested • Date/Time of collection • QC Designation (if applicable) • Sampler's initials and organization (Section B1- 5)					
210	All sampling equipment, canisters, and samples are identified with unique identification numbers that are traceable to equipment cleaning batches. (Section B1- 5)					
211	Are procedures in place to ensure samples are sealed with intact custody seals and that one or more of the following custody conditions are met: • It is in the possession of an authorized individual • It is in the view of an authorized individual, after being in the possession of that individual • It was in the possession of an authorized individual and access to the sample was controlled by locking or placement of signed custody seals that prevent undetected access • It is in a designated secure area, such as a controlled access location with complete documentation of personnel access or a radiological containment area (hot cell or glove box) (Section B1- 5)					

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212	Are procedures in place to ensure that discrepant sample information, indications of damage, or indications of tampering are documented? (Section B1- 5)					
214	Are procedures in place to ensure that sample custody is maintained until the sample is released by the site project manager or expended? (Section B1- 5)					
215	Are procedures in place to ensure that SUMMA canisters are packaged to prevent damage to the pressure gauge or associated connections by packaging in metal boxes with separate compartments or cardboard boxes with foam inserts? (Section B1- 6)					
216	Are procedures in place to ensure that samples are packaged to prevent damage to the sample container and maintain preservation temperature? (Section B1- 6)					
217	Are procedures in place to ensure that adequate cold packs are included in the DOT approved sample shipping container to ensure that all temperature requirements are met? (Section B1- 6)					
218	Are procedures in place to ensure that sample COC forms are secured for shipment to the inside of the sealed or locked shipping container lid and that samples and shipping containers are affixed with tamper proof seals or devices? (Section B1- 6)					
219	Are procedures in place to ensure that an appropriate blank sample is included with each shipment container to detect any VOC cross-contamination? (Section B1- 6)					

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<tr><td></td><td colspan="6">LABORATORY OPERATIONS</td></tr>
<tr><td>220</td><td>Are procedures in place to ensure that all VOC analyses are evaluated using the following criteria:
• Precision is assessed by analyzing laboratory duplicates, Laboratory Control Sample (LCS) , and PDP blind-audit samples in comparison to Table B3- 2
• Accuracy as %R shall be assessed by analyzing LCS samples and PDP blind-audit samples in comparison to criteria in Table B3-3
• MDL's are expressed in nanograms/ for VOCs and must be less than or equal to those listed in Table 3-2
• Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis . A composited sample is treated as one sample for the purposes of completeness, because only one sample is run through the analytical instrument
• Comparability shall be achieved through the use of standardized methods, traceable standards by requiring successful participation in the PDP program
• Representativeness will be achieved by collecting sufficient numbers of samples using clean sampling equipment that does not introduce sample bias.
• All method detection limits and program required detection limits shall be less than the Program Required Detection Limits listed in Table B3-2 and the detection limit study procedures shall be documented in laboratory SOPs. In addition, the laboratory shall demonstrate that they are capable of meeting the Program Required Detection Limits by analyzing at least one calibration standard below the PRQL
(Section B3-5)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>221</td><td>Are procedures in place to ensure that only laboratories that are qualified through participation in the Performance Demonstration Program are eligible to analyze waste samples? (Section B-3a(3))</td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>222</td><td>Are procedures in place to ensure that Tentatively Identified Compounds shall be added to the target compound list if they are reported in 25% of the waste containers sampled from a given waste stream and if they appear in the 20 NMAC 4.1.200 (incorporating 40 CFR §261) Appendix VIII list? (Section B-3a(1))</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>222a</td><td>Are procedures documented to ensure that the following criteria are met with regard to the recognition and reporting of TICS for GC/MS Methods for headspace gas sampling:
• Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
• The relative intensities of the major ions should agree within ± 20 percent.
• Molecular ions present in the reference spectrum should be present in the sample spectrum.
• Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.
• Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks.
• The reference spectra used for identifying TICs shall include, at minimum, all of the available spectra for compounds that appear in the 20.4.1.200 NMAC (incorporating 40 CFR Part 261) Appendix VIII list. The reference spectra may be limited to VOCs when analyzing headspace gas samples.
• TICs for headspace gas analyses that are performed through FTIR analyses shall be identified in accordance with the specifications of SW-846 Method 8410.
(Section B3-1)</td><td></td><td></td><td></td><td></td><td></td></tr>
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222b	Are procedures in place to assure that TICs are reported as part of the analytical batch data reports for GC/MS Methods in accordance with the following minimum criteria: • a TIC in an individual container headspace gas or solids sample shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 10% of the area of the nearest internal standard. • a TIC in a composited headspace gas sample that contains 2 to 5 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 2% of the area of the nearest internal standard. • a TIC in a composited headspace gas sample that contains 6 to 10 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 1% of the area of the nearest internal standard. • a TIC in a composited headspace gas sample that contains 11 to 20 individual container samples shall be reported in the analytical batch data report if the TIC meets the SW-846 identification criteria listed above and is present with a minimum of 0.5% of the area of the nearest internal standard. (Section B3-1)					
	QUALITY ASSURANCE OBJECTIVES					
224	Are procedures in place to ensure that the precision of the headspace gas sampling and analysis must be assessed by the sequential collection of field duplicates for manifold sampling operations or simultaneous collection of field duplicates for direct canister sampling operations for VOCs? (Section B3-2)					
225	Are procedures in place to ensure that corrective action will be taken if the duplicate RPD exceeds 25% for any analyte found greater than the PRQL in both of the duplicate samples? (Section B3-2)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why?)	Item Reviewed	Adequate? Y/N	
226	Are procedures in place to ensure that the accuracy of headspace gas sampling is assessed through the collection of field reference standards and at a frequency of one field response standard for every 20 containers sampled or per sampling batch and through the collection of equipment blanks at the frequency of one for every equipment cleaning batch ? (Section B3-2)					
227	Are procedures in place to ensure that corrective actions are taken if the field reference standard is less than 70% recovery or greater than 130% and that if the blank concentration for any blank exceeds 3 times the MDL listings in Table B3-2? (Section B3-2)					
228	Are procedures in place to ensure that sampling completeness shall be expressed as the number of valid samples collected as a percent of the total number of samples collected for each waste steam, where a valid sample is defined as a sample collected in accordance with approved sampling methods and the drum was properly prepared for sampling? (Section B3-2)					
229	Are procedures in place to ensure that the minimum sampling completeness percentage for any waste stream is 90 percent? (Section B3-2)					
230	Are procedures in place to ensure that sample comparability is assured through the use and application of uniform procedures and equipment and application of data useability criteria, and that corrective action is taken if the uniform procedures and equipment are not used without approved and justified deviations (Section B3-2)					
231	Are procedures in place to ensure that sample representativeness is maintained (Section B3-2)					

1. The WAP requirements should be presented in documents, such as procedures. Each of the questions posed under WAP requirements are meant to determine whether procedures are in place or whether documents are evident which demonstrate that the specific WAP requirement is or can be met.

Table B6-5 Radiography Checklist

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Radiography Checklist

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	**Adequate? Y/N (Why)**	**Item Reviewed**	**Adequate? Y/N**	
	QUALITY ASSURANCE OBJECTIVES					
233	Are process procedures in place to meet the following Quality Assurance Objectives?: Precision • Does the site describe in its QAPjP and SOP(s) activities to reconcile any discrepancies between two radiography operators with regard to identification of the waste matrix code, liquids in excess of TSDF-WAC limits, and compressed gases through independent replicate scans and independent observations? And additionally, activities to verify the precision of radiography prior to use by tuning precisely enough to demonstrate compliance with QAOs through viewing an image test pattern? Accuracy • Was accuracy obtained by using a target to tune the image for maximum sharpness and by requiring operators to successfully identify 100 percent of the required items in a training container during their initial qualification and subsequent requalification?					
233a	Completeness • Was an audio/videotape (or equivalent media) of the radiography examination and a radiography data form validated according to the requirements in Section B3-10? • Was an audio/videotape (or equivalent media) of the radiography examination and a radiography data form obtained for 100% of the waste containers subject to radiography? Comparability • Is comparability ensured through the use of standardized radiography procedures and operator training and qualifications (Section B3-4a)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
	CHARACTERIZATION AND SYSTEM REQUIREMENTS					
234	Does the site have procedures to ensure that radiography is used to identify and verify waste container contents and verify the waste's physical form? Does the site have procedures to identify prohibited materials? (Section B-3c; B1-3)					
235	Do procedures or other supporting documentation ensure that every waste container will undergo radiography and/or VE as necessary to augment AK? (Section B-3c)					
236	Do procedures ensure that containers whose contents prevent full examination are examined by visual examination rather than by radiography unless the site certifies that visual examination would provide no additional relevant information for that container based on the AK information for the waste stream? (Section B1-3)					
237	Do procedures or other supporting documentation ensure that the physical form determined by radiography is compared with the waste stream descriptions ? If discrepancies are noted, will a new waste stream be identified? (Section B-3c)					
238	Are there procedures to ensure the data is obtained from an audio/video recorded scan provided by trained radiography operators? (Section B1-3)					
239	Were all activities required to achieve the radiography objective described in site Quality Assurance Project Plans (QAPjPs) and Standard Operating Procedures (SOPs)? (Section B3-4)					
240	Did the radiography system consist of the following equipment or equivalent: • an X-ray producing device? • an imaging system? • an enclosure for radiation protection? • a waste container handling system ? • an audio/video recording system or equivalent? • an operator control and data acquisition station? (Section B1-3)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
241	Did the X-ray producing device have controls which allow the operator to vary voltage, thereby controlling image quality? Was it possible to vary the voltage, typically between 150-400 kV, to provide an optimum degree of penetration through the waste? Was high-density material examined with the X-ray device set on the maximum voltage? Was low-density material examined at lower voltage settings to improve contrast and image definition? (Section B1-3)					
242	Do procedures or other documentation ensure that an audio/videotape or equivalent is made of the waste container scan and maintained as a non-permanent record? (Section B1-3)					
	DATA COMPILATION					
243	Are there procedures to ensure that a radiography data form is used to document the waste matrix code, ensure the waste container contains no ignitable, corrosive or reactive waste by documenting the absence of liquids in excess of TSDF-WAC limits or compressed gases, and verify that the physical form of the waste is consistent with the waste stream description documented on the WSPF ? (Section B1-3)					
245	If radiography indicate that the waste does not match the waste stream description, do procedures ensure that the appropriate corrective action was taken? (Section B-3c)					
246	If a discrepancy is noted, do procedures ensure that the proper waste stream assignment is determined, the correct hazardous waste codes assigned, and the resolution documented? (Section B-3c)					
	TRAINING					
247	Do site procedures ensure that only trained personnel are allowed to operate radiography equipment? (Section B1-3)					
248	Do site procedures ensure that training requirements for radiography operators is based upon existing industry standard training requirements? (Section B1-3)					
249	Does the documented training program provide radiography operators with both formal and on-the-job training (OJT)? (Section B1-3)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
250	Does the documented training program ensure that the radiography operators are instructed in the specific waste generating practices and typical packaging configurations expected to be found in each waste stream at the site? (Section B1-3)					
251	Does the documented training program ensure that the OJT and apprenticeship are conducted by an experienced, qualified radiography operator prior to qualification of the candidate? (Section B1-3)					
252	Is the documented training program site specific? (Section B1-3)					
262	Does the documented training program ensure that a training drum with various container sizes is scanned by each operator on a biannual basis? Is the videotape reviewed by a supervisor to ensure that operators' interpretations remain consistent and accurate? (Section B1-3)					
263	Do site procedures ensure that the site prepares Testing Batch Data Reports or equivalent which includes all data pertaining to radiography for up to 20 waste containers without regard to waste matrix? (Section B3-10)					
	QUALITY ASSURANCE					
265	Does the documented training program ensure that the imaging system characteristics are verified on a routine basis? (Section B1-3)					
266	Do procedures ensure that independent replicate scans and replicate observations of the video output of the radiography process are performed under uniform conditions and procedures? Are independent replicate scans performed on one waste container per day or per testing batch of 20 samples , which ever is less frequent? Are independent observations of one scan (not the replicate scan) performed once per day or per testing batch, which ever is less frequent, by a qualified radiography operator (other than the individual who performed the first examination)? (Section B1-3)					

	WAP Requirement[1]	**Procedure Documented**		**Example of Implementation/ Objective Evidence, as applicable**		**Comment (e.g., any change in procedure since last audit, etc.)**
		Location	**Adequate? Y/N (Why)**	**Item Reviewed**	**Adequate? Y/N**	
267	Do procedures ensure that oversight functions include periodic audio/videotape reviews of accepted waste containers, are performed by qualified radiography personnel (other than the operator who dispositioned the waste container)? (Section B1-3)					
268	Is the site project manager responsible for monitoring the quality of the radiography data and calling for corrective action, when necessary? (Section B1-3)					
	DATA VALIDATION, REVIEW, VERIFICATION AND REPORTING					
277	Do procedures ensure that all applicable data generation review verification and validation activities specified in B3-10 are followed, including all signatory releases? (Section B3-10)					
278	Do procedures ensure that radiography tapes have been reviewed at a frequency of one waste container per day or once per testing batch, whichever is less frequent, to ensure data are correct and completed? (Section B1-3)					
279	Do procedures ensure that all applicable project-level signatory releases and DQO's (Section B3-11) as specified in the WAP are performed . (Section B3-10b)					
282	At the data generation level, do procedures ensure that all electronic and video data stored appropriately to ensure that waste container, sample, and associated QA data are readily retrievable? Are radiography tapes reviewed, at a frequency of one waste container per day or once per testing batch, whichever is less frequent, against the data reported on the radiography form? (Section B3-10a, B3-10a(1))					
283	At the project level, do procedures require the Site Project Manager to certify that the radiography data are complete and acceptable based on the videotape review of at least one waste container per testing batch or daily, whichever is less frequent? (Section B3-10b(1))					

1. The WAP requirements should be presented in documents, such as procedures. Each of the questions posed under WAP requirements are meant to determine whether procedures are in place or whether documents are evident which demonstrate that the specific WAP requirement is or can be met.

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Table B6-6 Visual Examination (VE) Checklist

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Visual Examination (VE) Checklist

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
	TRAINING					
296	Is there documentation which shows that a standardized training program for visual examination personnel has been developed? Is it specific to the site and include the various waste configurations generated/stored at the site? (Section B1-4)					
297	Is there documentation which shows that the visual inspectors receive training on the specific waste generating processes, typical packaging configurations, and waste material parameters expected to be found in each waste matrix code at the site? (Section B1-4)					
298	Are the visual examination personnel requalified once every two years? (Section B1-4)					
	VISUAL EXAMINATION EXPERT REQUIREMENTS					
300	Does documentation ensure that the site has designated a visual examination expert? Is the visual examination expert familiar with the waste generating processes that have taken place at the site? Is the visual examination expert familiar with all of the types of waste being characterized at that site? (Section B1-4)					
301	Does documentation ensure that the visual examination expert shall be responsible for the overall t direction and implementation of the visual examination aspects of the program? Does the site's QAPjP specify the selection, qualification, and training requirements of the visual examination expert? (B1-4)					
	VISUAL EXAMINATION PROCEDURES					
304	Do procedures indicate that all visual examination activities are recorded on audio/videotape or alternatively, by using a second operator to provide additional verification by reviewing the contents of the waste container to ensure correct reporting? (Section B1-4)					

	WAP Requirement[1]	Procedure Documented		Example of Implementation/ Objective Evidence, as applicable		Comment (e.g., any change in procedure since last audit, etc.)
		Location	Adequate? Y/N (Why)	Item Reviewed	Adequate? Y/N	
313	Do site procedures ensure that when liquids are found, the non-transparent container holding the liquid will be assumed to be filled with liquid and this volume will be added to the total liquid in the payload container? The payload container would then be rejected and/or repackaged to exclude the container if it is over the TSDF-WAC limits. (Section B-3c)					
	QUALITY ASSURANCE OBJECTIVES					
314	Are process procedures in place to meet the following Quality Assurance Objectives?: Precision • Precision is maintained by reconciling any discrepancies between the operator and the independent technical reviewer with regard to identification of waste matrix code, liquids in excess of TSDF-WAC limits, and compressed gases. Accuracy • Accuracy is maintained by requiring operators to pass a comprehensive examination and demonstrate satisfactory performance in the presence of the VE expert during their initial qualification and subsequent requalification. Completeness • A validated VE data form will be obtained for 100 percent of the wastecontainers subject to VE. Comparability • The comparability of VE data from different operators shall be enhanced byusing standardized VE procedures and operator qualifications. (Section B3-4b)					

1. The WAP requirements should be presented in documents, such as procedures. Each of the questions posed under WAP requirements are meant to determine whether procedures are in place or whether documents are evident which demonstrate that the specific WAP requirement is or can be met.

APPENDIX B7

PERMITTEE LEVEL TRU WASTE CONFIRMATION PROCESSES

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APPENDIX B7

PERMITTEE LEVEL TRU WASTE CONFIRMATION PROCESSES

TABLE OF CONTENTS

List of Figures

APPENDIX B7

PERMITTEE LEVEL TRU WASTE CONFIRMATION PROCESSES

Introduction

This part of the Waste Analysis Plan (**WAP**) describes the actions that the Permittees will take to approve and accept waste for storage and disposal at the Waste Isolation Pilot Plant (**WIPP**), including waste confirmation activities.

The Permittees demonstrate compliance with the Permit by ensuring that the waste characterization processes performed by generator/storage sites (**sites**) produce data compliant with the WAP and through the waste screening and verification processes. Verification occurs at three levels: 1) the data generation level, 2) the project level, and 3) the Permittee level. The Permittees also examine a representative subpopulation of waste prior to shipment to confirm that the waste contains no ignitable, corrosive or reactive waste; and that assigned Environmental Protection Agency (**EPA**) hazardous waste numbers are allowed by the Permit. The waste confirmation activities described herein occur prior to shipment of the waste from the generator/storage site to WIPP.

B7-1 Permittee Confirmation of TRU Mixed Waste

Waste confirmation is defined in Module I as the activities performed by the Permittees to satisfy the requirements specified in Section 310 of Pub. L. 108-447. Waste confirmation occurs after waste containers have been certified for disposal at WIPP. The general confirmation process for WIPP waste is presented in Figure B7-1.

B7-1a Permittees' Confirmation of a Representative Subpopulation of the Waste

The Permittees shall confirm that the waste contains no ignitable, corrosive, or reactive waste through radiography (Section B7-1b) or the use of visual examination (Section B7-1c) of a statistically representative subpopulation of the waste. Prior to shipment to WIPP, waste confirmation will be performed on randomly selected containers from each CH and RH TRU mixed waste stream shipment. Figure B7-1 presents the overall waste verification and confirmation process.

The Permittees' waste confirmation encompasses ensuring that the physical characteristics of the TRU mixed waste correspond with its waste stream description and that the waste does not contain liquids in excess of TSDF-WAC limits or compressed gases. These techniques can detect liquids that exceed 1 percent volume of the container and containerized gases, which are prohibited from storage or disposal at the WIPP facility. The prohibition of liquids and containerized gases prevents the storage or disposal of ignitable, corrosive, or reactive wastes. Radiography and/or visual examination will ensure that the physical form of the waste matches its waste stream description (i.e., Homogeneous Solids, Soil/Gravel, or Debris Waste). The results of the Permittees' waste confirmation activities, including radiography and visual examination records (data sheets, packaging logs, and/or video and audio recordings) will be maintained in the WIPP facility operating record. Noncompliant waste identified during waste confirmation will be managed as described in Section B7-2.

The Permittees shall randomly select at least 7 percent of each waste stream shipment for waste confirmation. This equates to a minimum of one container from each fourteen containers in each waste stream in each designated shipment. If there are less than fourteen containers from a waste stream in a particular shipment, a minimum of one container from the waste stream shipped will be selected. If the random selection of containers in a shipment occurs prior to loading the waste containers into the Shipping Package, the randomly selected containers may be consolidated into a single Type B package consistent with transportation requirements. Documentation of the random selection of containers for waste confirmation will be placed in the WIPP facility operating record.

B7-1a(1) Confirmation Training Requirements

Waste confirmation may be completed by performing actual radiography/visual examination on the waste container(s) or by a review of radiography/visual examination media and records.

Waste confirmation personnel may be trained to either review of radiography/visual examination media and records (Level 1) or to perform actual radiography/visual examination on the waste container(s) (Level 2). Level 2 personnel may also perform waste confirmation by review of media and records.

The Permittees management representative must be trained to the requirements of Level 2.

B7-1b Radiography Methods Requirements

Radiography has been developed by the Permittees specifically to aid in the examination and identification of containerized waste. The Permittees shall describe all activities required to achieve the radiography objectives in standard operating procedures (**SOPs**). These SOPs shall include instructions specific to the radiography system(s) used by the Permittees at an off-site facility (e.g., the generator/storage site). For example, to detect liquids, some systems require the container to be rotated back and forth while other systems require the container to be tilted.

A radiography system (e.g., real time radiography, digital radiography/computed tomography) normally consists of an X-ray-producing device, an imaging system, an enclosure for radiation protection, a waste container handling system, a video and audio recording system, and an operator control and data acquisition station. Although these six components are required, it is expected there will be some variation within a given component between radiography systems. The radiography system shall have controls or an equivalent process which allow the operator to control image quality. On some radiography systems, it should be possible to vary the voltage, typically between 150 to 400 kilovolts (**kV**), to provide an optimum degree of penetration through the waste. For example, high-density material should be examined with the X-ray device set on the maximum voltage. This ensures maximum penetration through the waste container.

Low-density material should be examined at lower voltage settings to improve contrast and image definition. The imaging system typically utilizes either a fluorescent screen and a low-light television camera or x-ray detectors to generate the image.

To perform radiography, the waste container is scanned while the operator views the television screen. A video and audio recording is made of the waste container scan and is maintained in the WIPP facility operating record as a non-permanent record. A radiography data form is also used to document the Waste Matrix Code, ensure that the waste container contains no ignitable, corrosive, or reactive waste by documenting the absence of liquids in excess of TSDF-WAC limits or compressed gases, and verify that the physical form of the waste is consistent with the waste stream description documented on the WSPF. Containers whose contents prevent full examination of the remaining contents shall be subject to visual examination unless the Permittees certify that visual examination would provide no additional relevant information for that container based on the acceptable knowledge information for the waste stream. Such certification shall be documented in the WIPP facility operating record.

For containers that have been characterized using radiography by the generator/storage sites in accordance with the method in Attachment B1, Section B1-3, the Permittees may perform confirmation by review of the generator/storage site’s radiography audio/video recordings.

For containers which contain classified shapes and undergo radiography, the radiography will occur at a facility with appropriate security provisions and the video and audio recording will be considered classified. The radiography data forms will not be considered classified.

B7-1b(1) Radiography Training

The radiography system involves qualitative and semiquantitative evaluations of visual displays. Operator training and experience are the most important considerations for ensuring quality controls in regard to the operation of the radiography system and for interpretation and disposition of radiography results. Only trained personnel shall be allowed to operate radiography equipment.

The Permittee radiography operators performing waste confirmation shall be trained in accordance with the requirements of Permit Attachment H1.

B7-1b(2) Radiography Oversight

The Permittees shall be responsible for monitoring the quality of the radiography data and calling for corrective action, when necessary.

A training drum with internal containers of various sizes shall be scanned biennially by each Level 2 operator. The video and audio media shall then be reviewed by a radiography subject matter expert to ensure that operators’ interpretations remain consistent and accurate. Imaging system characteristics shall be verified on a routine basis.

Independent replicate scans and replicate observations of the video output of the radiography process shall be performed under uniform conditions and procedures. Independent replicate scans shall be performed on one waste container per day or once per shipment, whichever is less frequent. Independent observations of one scan (not the replicate scan) shall also be made once per day or once per shipment, whichever is less frequent, by a qualified radiography operator other than the individual who performed the first examination. When confirmation is performed by review of audio/video recorded scans produced by the generator/storage site as specified in Permit Attachment B1, Section B1-3, independent observations shall be performed on two waste containers per shipment or two containers per day, whichever is less frequent.

B7-1c Visual Examination Methods Requirements

Visual examination (**VE**) may also be used as a waste confirmation method by the Permittees. VE shall be conducted by the Permittees in accordance with written SOPs to describe the contents of a waste container. The description shall clearly identify all discernible waste items, residual materials, packaging materials, or waste material parameters. VE may be used by the Permittees to examine a statistically representative subpopulation of the waste certified for shipment to WIPP to confirm that the waste contains no ignitable, corrosive, or reactive waste. This is achieved by confirming that the waste contains no residual liquids in excess of TSDF-WAC limits or compressed gases, and that the physical form of the waste matches the waste stream description documented on the WSPF. A VE data form is used to document this information. During packaging, the waste container contents are directly examined by trained personnel. This form of waste confirmation may be performed by the Permittees at a generator/storage site. The VE may be recorded on video and audio media, or alternatively, by using a second operator to provide additional verification by reviewing the contents of the waste container to ensure correct reporting.

In order to keep radiation doses as low as reasonably achievable at generator/storage sites, the Permittees may use their own trained VE operators to perform VE for waste confirmation by reviewing video media prepared by the generator/storage site during their VE of the waste. If the Permittees perform waste confirmation by review of video media, the video record of the VE must be sufficiently complete for the Permittees to confirm the Waste Matrix Code and waste stream description, and verify the waste contains no residual liquids in excess of TSDF-WAC limits or compressed gases. Generator/storage site VE video/audio media subject to review by the Permittees shall meet the following minimum requirements:

- The video/audio media shall record the waste packaging event for the container such that all waste items placed into the container are recorded in sufficient detail that a trained Permittee VE expert can determine what the waste items are and their associated waste material parameter.
- The video/audio media shall capture the waste container identification number.
- The personnel loading the waste container shall be identified on the video/audio media or on packaging records traceable to the loading of the waste container.

- The date of loading of the waste container will be recorded on the video/audio media or on packaging records traceable to the loading of the waste container.

The Permittees may also use their own trained VE operators to perform VE for waste confirmation by reviewing VE data forms or packaging logs prepared by the generator during their packaging of the waste. To be acceptable, the generator/storage site VE data must be signed by two generator/storage site personnel who witnessed the packaging of the waste and must provide sufficient information for the Permittees to determine that the waste container contents match the waste stream description on the WSPF and the waste contains no liquids in excess of TSDF-WAC limits or compressed gases. The Permittees will document their review of generator/storage site VE data on Permittee VE data forms. Generator/storage site VE forms or packaging logs subject to review by the Permittees shall meet the following minimum requirements:

- At least two generator site personnel shall approve the data forms or packaging logs attesting to the contents of the waste container.

- The data forms or packaging logs shall contain an inventory of waste items in sufficient detail that a trained Permittee VE expert can identify the associated waste material parameters.

- The waste container identification number shall be recorded on the data forms or packaging logs.

VE video media of containers which contain classified shapes shall be considered classified information. VE data forms will not be considered classified information.

B7-1c(1) Visual Examination Training

The Permittees' VE operators performing waste confirmation shall be trained in accordance with the requirements of Permit Attachment H1.

B7-1c(2) Visual Examination Oversight

The Permittees shall designate at least one VE expert. The VE expert shall be familiar with the processes that were used to generate the waste streams being confirmed using VE. The VE expert shall be responsible for the overall direction and implementation of the Permittees' VE program. The Permittees shall specify the selection, qualification, and training requirements of the visual examination expert in an SOP.

B7-1d Quality Assurance Objectives (QAOs) for Radiography and Visual Examination

The QAOs the Permittees must meet for radiography and visual examination are detailed in this section. If the QAOs described below are not met, then corrective action as specified in Permit Attachment B3, Section B3-13 shall be taken.

B7-1d(1) Radiography QAOs

The QAOs for radiography are detailed in this section. If the QAOs described below are not met, then corrective action shall be taken.

Data to meet these objectives must be obtained from a video and audio recorded scan provided by trained radiography operators. Results must also be recorded on a radiography data form. The precision, accuracy, representativeness, completeness, and comparability objectives for radiography data are presented below.

Precision

Precision is maintained by reconciling any discrepancies between two radiography operators with regard to the waste stream waste confirmation, identification of liquids in excess of TSDF-WAC limits, and identification of compressed gases through independent replicate scans and independent observations.

Accuracy

Accuracy is obtained by using a target to tune the image for maximum sharpness and by requiring operators to successfully identify 100 percent of the required items in a training container during their initial qualification and subsequent requalification.

Representativeness

Representativeness is ensured by performing radiography on a random sample of waste containers from each waste stream in each shipment.

Completeness

A video and audio media recording of the radiography examination and a validated radiography data form will be obtained for 100 percent of the waste containers subject to radiography.

Comparability

The comparability of radiography data from different operators shall be enhanced by using standardized radiography procedures and operator qualifications.

B7-1d(2) Visual Examination QAOs

Results must be recorded on a VE data form. The precision, accuracy, representativeness, completeness, and comparability objectives for VE data are presented below.

Precision

Precision is maintained by reconciling any discrepancies between the operator and the independent technical reviewer with regard to the waste stream waste confirmation, identification of liquids in excess of TSDF-WAC limits, and identification of compressed gases.

Accuracy

Accuracy is maintained by requiring operators to pass a comprehensive examination and demonstrate satisfactory performance in the presence of the VE expert during their initial qualification and subsequent requalification.

Representativeness

Representativeness is ensured by performing VE on a random sample of waste containers within each waste stream in each shipment.

Completeness

A validated VE data form will be obtained for 100 percent of the waste containers subject to VE.

Comparability

The comparability of VE data from different operators shall be enhanced by using standardized VE procedures and operator qualifications.

B7-1e Review and Validation of Radiography and Visual Examination Data Used for Waste Examination

This section describes the requirements for review and validation of radiography and VE data by the Permittees.

B7-1e(1) Independent Technical Review

The radiography and/or VE confirmation data for each shipment shall receive an independent technical review. This review will be performed before the affected waste shipment is shipped to the WIPP facility. The review shall be performed by an individual other than the data generator who is qualified to have performed the work. The review will be performed in accordance with approved Permittee SOPs and will be documented on a review checklist. The reviewer(s) must approve the data as evidenced by signature, and as a consequence, ensure the following:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used (procedure with revision). Data were reported in the proper units and correct number of significant figures.

- The data have been reviewed for transcription errors.

- Radiography video and audio media recordings have been reviewed (independent observation) on a waste container basis at a minimum of once per shipment or once per day of operation, whichever is less frequent. The radiography video/audio recording will be reviewed against the data reported on the Permittees' radiography form to ensure that the data are correct and complete. If review of radiography scans recorded by the generator/storage site was used to perform confirmation, two observations must be performed for each shipment or two observations per day, whichever is less frequent.

B7-1e(2) Permittee Management Review

The radiography and/or visual examination data for each shipment shall receive a Permittee management review. This review will be performed before the affected waste shipment is disposed of at the WIPP. The review shall be performed by a designated member of Permittee management. The review will be performed in accordance with approved Permittee SOPs and will be documented on a review checklist. The reviewer(s) must approve the data as evidenced by signature, and as a consequence, ensure the following:

- The data are technically reasonable based on the technique used.
- The data have received independent technical review.
- The data indicate that the waste examined contained no ignitable, corrosive, or reactive waste and that the physical form of the waste was consistent with the waste stream description in the WSPF.
- QC checks have been performed (e.g., replicate scans, image quality checks).
- The data meet the established QAOs

Upon completion of the Permittee management review, the waste confirmation data for the shipment shall be submitted to the WIPP facility operating record as non-permanent records. Waste confirmation data includes radiography and VE data forms, video/audio media, and review checklists.

B7-2 Noncompliant Waste Identified During Waste Confirmation

If the Permittees identify noncompliant waste during waste confirmation at a generator/storage site (i.e., the waste does not match the waste stream description documented in the WSPF or there are liquids in excess of TSDF-WAC limits or compressed gases) the waste will not be shipped. The Permittees will suspend further shipments of the affected waste stream and issue a CAR to the generator/storage site. Shipments of affected waste streams shall not resume until the CAR has been closed. NMED will be notified within 24 hours of any suspension of waste stream shipments due to the identification of noncompliant waste during waste confirmation.

As part of the corrective action plan in response to the CAR, the generator/storage site will evaluate whether the waste characterization information documented in the Characterization Information Summary and/or WSPF for the waste stream must be updated because the results of waste confirmation for the waste stream indicated that the TRU mixed waste being examined did not match the waste stream description. The generator/storage site will thoroughly evaluate the potential impacts on waste that has been shipped to WIPP. The Permittees will evaluate the potential that prohibited items were shipped to WIPP and what remedial actions should occur, if any. The results of these evaluations will be provided to NMED before shipments of affected waste streams resume. If the Characterization Information Summary and/or WSPF requires revision, shipments of the affected waste stream shall not resume until the revised waste stream waste characterization information has been reviewed and approved by the Permittees.

If a generator/storage site certifies noncompliant waste more than once during a running 90-day period, the Permittees will suspend acceptance of that site’s waste until the Permittees find that all corrective actions have been implemented and the site complies with all applicable requirements of the WAP.

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FIGURES

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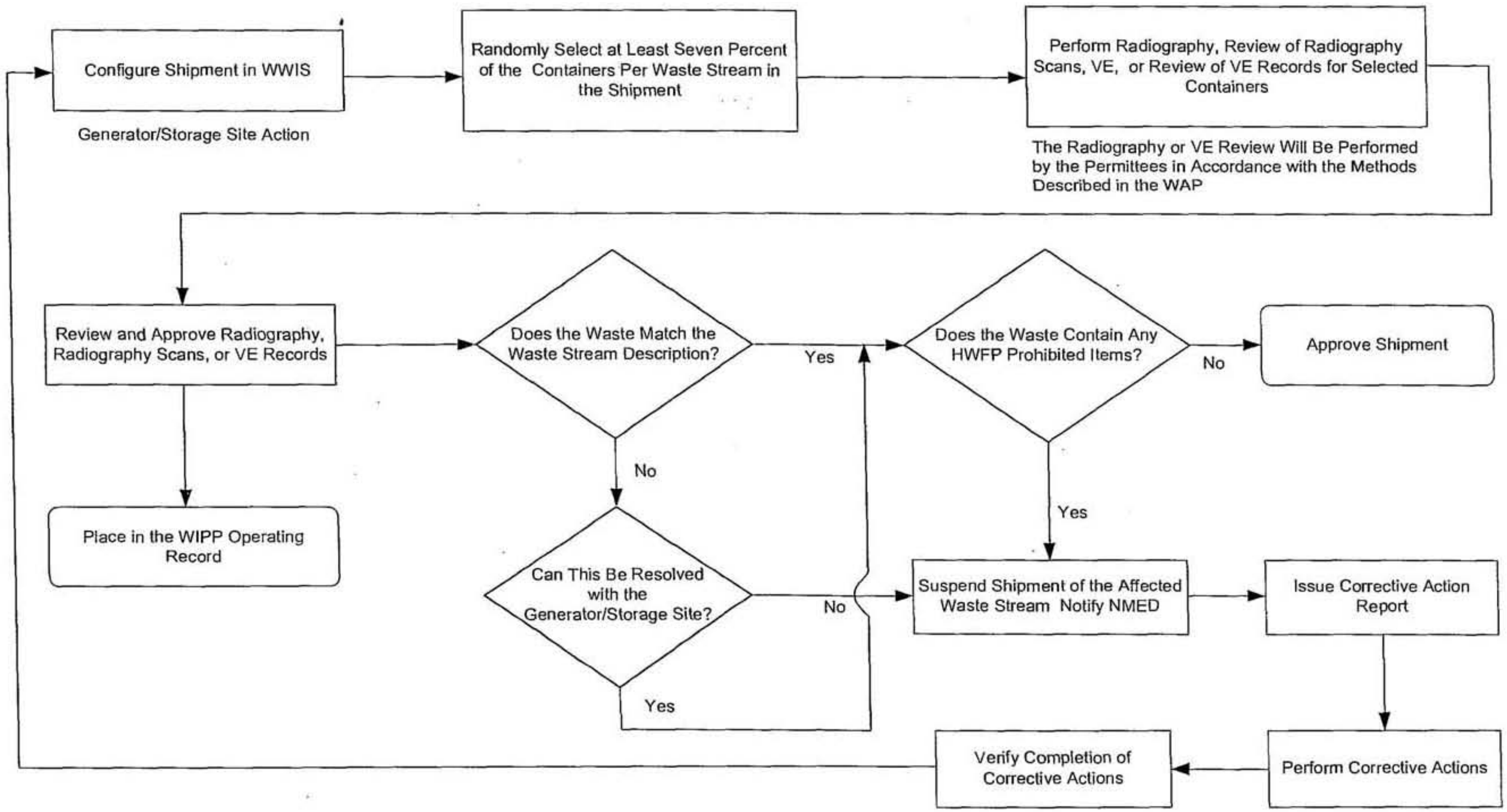

Figure B7-1
Overview of Waste Confirmation

RENEWAL APPLICATION
ADDENDUM B1

DISPUTE RESOLUTION

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RENEWAL APPLICATION
ADDENDUM B1

DISPUTE RESOLUTION

Applicability

In the event the Permittees disagree, in whole or in part, with either an action on a final audit report by New Mexico Environment Department (**NMED**) or an evaluation by NMED of the Permittees' provisional approval of an Acceptable Knowledge Sufficiency Determination (**AKSD**) Request for a particular waste stream (as specified in Renewal Application Chapter B), the Permittees may seek dispute resolution. The dispute resolution procedure shall be the exclusive mechanism for resolving disputes related to NMED's final audit report action or a determination that the Permittees' provisional approval of an AKSD for a particular waste stream is inadequate.

Notice to NMED

To invoke dispute resolution, the Permittees shall notify NMED in writing within seven calendar days of receipt of the action or determination in dispute. Such notice shall be sent to the hazardous Waste Bureau Chief and must set forth the specific matters in dispute, the position the Permittees assert should be adopted, a detailed explanation for the Permittees' position, and any other matters considered necessary for the dispute resolution. For AKSD disputes, the Permittees shall also submit all factual data, analysis, opinion, and other documentation upon which they relied for their provisional approval, and any other information that supports their position. NMED shall acknowledge receipt of notification by e-mail sent to the Permittees' representative as designated in their written notification.

Tier I - Informal Negotiations

The Permittees and NMED shall make all reasonable, good faith efforts to informally resolve disputes related to NMED's determination. The Permittees and NMED shall meet or teleconference within 15 calendar days from NMED's receipt of notice to commence negotiations to resolve the dispute. The Permittees and NMED shall have 30 calendar days from NMED's receipt of notice to resolve the dispute. If an agreement is reached, NMED shall promptly inform the Permittees of the terms of the agreement in writing. The Permittees shall comply with the terms of such agreement or, if appropriate, submit a revised submittal and implement the same in accordance with such agreement. If an agreement is not reached, NMED shall promptly inform the Permittees in writing that an agreement has not been reached.

Tier II - Final Decision of the Secretary

In the event agreement is not reached within the 30 calendar day period, the Permittees may submit a written Request for Final Decision to the Secretary. The Request must be submitted within seven calendar days after receipt of notification from NMED that an agreement under Tier I was not reached. The Secretary will notify the Permittees in writing of the decision on the dispute, and the Permittees shall comply with the terms and conditions of the decision. Such decision shall be the final resolution of the dispute.

Actions Not Affected by Dispute

With the exception of those matters under dispute, the Permittees shall proceed to take any action required by those portions of the submission and of this Renewal Application that NMED determines are not affected by the dispute.

E-Mail Notifications

If the Permittees submit a notice to NMED, the Permittees shall concurrently post a link to the notice on the Waste Isolation Pilot Plant (**WIPP**) Home Page, and inform those on the e-mail notification list. Within seven calendar days after receipt of NMED's letter concerning the conclusion of any Tier I negotiations, the Permittees shall post a link to the NMED letter on the WIPP Home Page, and shall inform those on the e-mail notification list. If a Tier I agreement is not reached and the Permittees submit a Tier II request for final decision to the Secretary, the Permittees shall concurrently post a link to the request on the WIPP Home Page, and shall inform those on the e-mail notification list. Within seven calendar days after receiving notice of the final action by the Secretary, the Permittees shall post a link to the final action on the WIPP Home Page and shall inform those on the e-mail notification list.

CHAPTER C

SECURITY

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CHAPTER C

SECURITY

TABLE OF CONTENTS

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CHAPTER C

SECURITY

Introduction

This Permit Attachment describes the security measures taken at the Waste Isolation Pilot Plant (**WIPP**) during the Disposal Phase. It describes the security equipment and procedures in place at the WIPP facility that continuously monitor and control entry onto the active portion[1] of the facility, including 24-hour security surveillance, fencing, and signs.

C-1 Security

The security requirements contained in Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20.4.1.500 NMAC (incorporating 40 CFR §264.14)), and in 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(4)), require that security be provided by 24-hour surveillance or that a barrier be provided to control entry to the active portion of the facility at all times.

C-1a Security Procedures and Equipment

The WIPP facility has been designed and will be operated to fully meet the security requirements contained in 20.4.1.500 NMAC (incorporating 40 CFR §264.14(b) and (c)). The WIPP facility has 24-hour security surveillance and the means to control entry to the active portion of the facility. In addition, warning signs are provided. These security requirements are discussed below.

C-1a(1) 24-Hour Surveillance System

The WIPP facility's 24-hour surveillance system is comprised of security officers that provide protection 24 hours per day, 365 days per year. Security officers work to written procedures that require visitors, contractors, and vendors to log in before they are allowed to proceed to the Main Gate for access into the Property Protection Area (**PPA**) and require continuous monitoring of

[1] The active portion of the facility is the Property Protection Area (**PPA**) as described in Permit Module III. Within this area, the only area where transuranic (**TRU**) mixed wastes are handled outside of the Contact-Handled or Remote-Handled Packaging is inside the Waste Handling Building (**WHB**), the waste hoist, and the underground. Whenever TRU mixed waste is handled, a Controlled Area (**CA**) is established, for the purpose of radiation protection, which limits access to only trained personnel or to untrained personnel (visitors) who are continuously under the escort of trained personnel. CAs are established in accordance with the WIPP Radiation Safety Manual and are managed to limit the radiation exposure to personnel to less than 100 millirem per year. The CA is initially set at the entrances to the Parking Area Container Storage Unit (Parking Area Unit), Waste Handling Building Container Storage Unit (WHB Unit) Bay, and portions of the underground. The boundary of the CA is posted with signs as specified by the Permittees.

the active portion of the facility. This system will be maintained to fulfill the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.14(b)(1)).

The major duties of the security officers are to control personnel, vehicle, and material access/egress 24 hours per day, 365 days per year. During non-operational hours, the security officers conduct documented security patrols outside of the PPA, at a minimum rate of two per 12-hour shift. Whenever scheduled security patrols cannot be made, for situations such as inclement weather or an emergency, the reason for missing the patrol will be documented in the security logbook. In addition to the security officers, WIPP facility employees are called upon to challenge any person in the WIPP facility who is not wearing a badge or who is not under escort when an escort is required. Further physical protection is provided by fences, protective lighting, and locked buildings.

C-1a(2) Barrier and Means to Control Entry

The existence of a barrier and a means to control entry demonstrates compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.14(b)(2)). Each is discussed in detail in the following sections.

C-1a(2)(a) Barrier

The surface portion of the WIPP facility PPA is contained within a 35 acre (14 hectare) fenced area. This area is surrounded by a permanent 7 foot (ft) (2.13 meter [m]) high chain-link fence that is topped by three strands of barbed wire, for a total height of 8 ft (2.44 m). The fence encloses major surface structures. The regularly inspected chain-link fencing at the WIPP facility completely surrounds the active portion of the facility, thereby complying with 20.4.1.500 NMAC (incorporating 40 CFR §264.14(b)(2)(i)). Access is normally through the Main Gate on the west side of the PPA. Two other gates are available for emergency use. One of these gates is opened to allow salt trucks access to the salt pile. Use of all gates is under the supervision of security.

C-1a(2)(b) Means to Control Entry

Entry into the PPA, whether by personnel or vehicles, is through controlled gates and doors. WIPP-facility access-control procedures are designed to ensure that only properly identified and authorized persons, vehicles, and property are allowed entrance to and exit from the facility. A personnel identification and access control system is maintained within the facility. Employees identify themselves with an identification badge when entering or leaving the premises. Security officers require visitors to show proper authorization prior to allowing them to enter the facility. In addition, visitors are required to wear a temporary badge and may require an authorized escort. Because the WIPP facility controls entry to the active portion of the facility at all times, the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.14(b)(2)(ii)), are met.

For the purposes of entry control to areas where wastes are being handled, the Waste Handling Building Container Storage Unit (**WHB Unit**), the boundaries of the Parking Area Unit south of the WHB, and those portions of the underground where wastes are disposed are posted as Controlled Areas (**CAs**). The WIPP allows access to a CA by anyone who has successfully completed General Employee Radiological Training, which is included in the General Employee Training Course. Access for visitors can also be arranged with proper training.

Areas within the CA, however, may have further access restricted. Smaller areas may be designated as Radiological Buffer Areas, Radiation Areas, and Radioactive Materials Area. These smaller areas are generally within the direct vicinity of waste handling activities or waste storage or disposal areas. They are sized and posted in accordance with strict guidelines. Activities in these areas are performed under a Radiological Work Permit (**RWP**), and personnel must be listed on the RWP before they are allowed to enter. To be listed on the RWP, personnel must have the appropriate radiological and hazardous waste worker training and must have available radiation dose for the task. In addition, the individuals must sign the RWP acknowledging that they intend to comply with the radiological controls that are in place. Personnel may be escorted into the smaller areas if they are escorted by a person who meets all of the above requirements and is not performing any work in the area.

The WHB Unit, the Parking Area Unit, and the underground Hazardous Waste Disposal Units (HWDUs) will be posted with a sign that states: “Danger: Authorized Personnel Only” in both English and Spanish.

C-1a(3) Warning Signs

The permanent chain-link fence surrounding the PPA is posted at approximately 50 ft (15.24 m) intervals with “No Trespassing” signs and with “Danger: Authorized Personnel Only” signs in English and Spanish. The signs are legible from a distance of 25 ft (7.62 m) and can be seen from any approach to the facility. These same signs, plus security and traffic signs, are also located on the controlled gates. The fence and gate signs at the WIPP facility fully comply with 20.4.1.500 NMAC (incorporating 40 CFR §264.14(c)). Warning signs with “Controlled Area” and “Hazardous Waste Management Unit” will be posted at entrances to the HWDUs prior to the emplacement of waste.

CHAPTER D

INSPECTION SCHEDULE, PROCESS AND FORMS

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CHAPTER D

INSPECTION SCHEDULE, PROCESS AND FORMS

TABLE OF CONTENTS

List of Figures

Figure	Title

List of Tables

Table	Title

CHAPTER D

INSPECTION SCHEDULE, PROCESS AND FORMS

Introduction

This Permit Attachment describes the facility inspections (including container inspections) that are conducted to detect malfunctions, deterioration, operator errors, and discharges that may cause or lead to releases of hazardous waste or hazardous waste constituents to the environment or that could be a threat to human health.

D-1 Inspection Schedule

Equipment instrumental in preventing, detecting, or responding to environmental or human health hazards, such as monitoring equipment, safety and emergency equipment, security devices, and operating or structural equipment are inspected. The equipment will be inspected for malfunctions, deterioration, potential for operator errors, and discharges which could lead to a release of hazardous waste constituents to the environment or pose a threat to human health.

The WIPP facility has developed and will maintain a series of written procedures that include all the detailed inspection procedures and forms necessary to comply with 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)), during the Disposal Phase. Tables D-1 and D-1a list each item or system requiring inspection under these regulations, the inspection frequency, the organization responsible for the inspection, the applicable inspection procedure, and what to look for during the inspection. 20.4.1.500 NMAC (incorporating 40 CFR §§264.15(b), 264.174, and 264.602) list requirements that are applicable to the WIPP facility.

Operational procedures detailing the inspections required under 20.4.1.500 NMAC (incorporating 40 CFR §§264.15(a) and (b)), are maintained in electronic format on the WIPP computer network, in the Operating Record and, as appropriate, in controlled document locations at the WIPP facility. Frequency of inspections is discussed in detail in Section D-1a(2). Inspections are conducted often enough to identify problems in time to correct them before they pose a threat to human health or the environment and are based on regulatory requirements. The operational procedures assign responsibility for conducting the inspection, the frequency of each inspection, the types of problems to be watched for, what to do if items fail inspection, directions on record keeping, and inspector signature, date, and time. The operational procedures are maintained at the WIPP facility. Tables D-1 and D-1a summarize inspections, frequencies, responsible organizations, personnel making the inspection (by job title), and the types of anticipated problems as well as the references for the operational procedures. Inspection records are maintained at the WIPP site for three years by the responsible organization shown in Tables D-1 and D-1a.

Waste handling equipment and area inspections are typically controlled through established procedures and the results are recorded in logbooks or on data sheets. Operators are trained to consult the logbook to identify the status of any piece of waste handling equipment prior to its use. Once a piece of equipment is identified to be operable, a preoperational inspection is initiated in accordance with the appropriate inspection procedure in Tables D-1. D-1a, or in operational procedures. Inspection results as described below are entered in the applicable logbook.

Inspections include identifying malfunctions or deteriorating equipment and structures. Inspection results and data, including deficiencies, discrepancies, or needed repairs are recorded. A negative inspection result does not necessarily lead to a repair. A deficiency, such as low fluid level, may be corrected by the inspector immediately. A discrepancy, such as an increasing trend of a data point, may necessitate additional inspection prior to the next scheduled frequency. The actions taken (corrected, additional inspection, or Action Request (**AR**) for repair submitted) are recorded on the inspection form, the WIPP automated Maintenance Management tracking program (**CHAMPS**) work order sheet, or the equipment logbook, whichever is applicable.

Items that are operational with restrictions are tagged with those restrictions. Items that are not operational are tagged and locked to prevent their use. Tagged and locked items are listed on the Tagout/Lockout Index. Once a scheduled repair or replacement is accomplished in accordance with the work authorization procedures, the tag or lock is removed from the item in accordance with the equipment tagout/lockout procedures. Normally, the individual inspecting the equipment/system is not qualified to make repairs and consequently, prepares an AR if repairs are needed. The AR is tracked by the CHAMPS system through the work control process. When parts are received and work instructions are completed, the work order can be scheduled on the Plan of the Day (**POD**). The POD is held daily to ensure facility configuration can support scheduled work items and to allocate and coordinate the resources necessary to complete the items.

Work orders are released for work by the responsible organization. When repairs are complete the responsible organization tests the equipment to ensure the repairs corrected the problem, then closes out the work order, to return the equipment to an operational status for normal operations to resume. Implementation of these procedures constitutes compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.15(c)).

Requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.15(d)), are met by the inspections for each item or system included in Tables D-1 and D-1a. The results of the inspections are maintained in the operating record for at least three years. The inspection logs or summary records include the date and time of inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions. Major pieces of waste handling equipment are inspected using proceduralized inspections. Current copies of inspection forms are maintained in the Operating Record. Non-administrative changes (i.e., changes that affect the frequency or content of inspections) to inspection forms must be submitted to the NMED in accordance with the appropriate portions of 20 NMAC 4.1.900 (incorporating 40 CFR §270.42). The status of these pieces of equipment is maintained in an equipment logbook that is separate from the checklist. The logbook contains information regarding the condition of the equipment. Equipment operators are required, by the inspection checklist, to consult the logbook as the first activity in the inspection procedure. This logbook is maintained in the operating record. CH transuranic (**TRU**) mixed waste equipment that is controlled by a logbook includes the waste handling fork lifts, all waste handling cranes, the adjustable center of gravity lift fixture, the CH TRU underground transporter, the facility transfer vehicle, the trailer jockey, and the push-pull attachment. RH TRU mixed waste equipment that is controlled by a logbook includes the 140/25-ton RH Bay overhead bridge crane, cask transfer cars, 25-ton cask unloading room crane, transfer cell shuttle car, RH Bay cask lifting yoke, facility grapple, 6.2- ton overhead hoist, facility cask rotating device, hot cell overhead powered manipulator, 15-ton hot cell crane, facility cask transfer car, 41-ton forklift, facility cask, and horizontal emplacement and retrieval equipment. Inspections of the Cask Unloading Room, Hot Cell, Transfer Cell, Facility Cask Loading Room, RH Bay and radiation monitoring equipment will be recorded on data sheets. In addition to the inspections listed in Tables D-1 and D-1a, many pieces of equipment are subject to regular preventive maintenance. This includes more in-depth inspections of mechanical systems, load testing of lifting systems, calibration of measurement equipment and other actions as recommended by the equipment manufacturer or as required by DOE Orders. These preventive maintenance activities along with the inspections in Tables D-1 and D-1a make mechanical failure of waste handling equipment unlikely. The WIPP Safety Analysis Report (DOE, 1999) and the WIPP Remote-Handled Waste Preliminary Safety Analysis Report (RH PSAR) (DOE, 2000) contain the results of a systematic analysis of waste handling equipment and the hazards associated with potential mechanical failures. Equipment subject to failures that cannot practically be mitigated is retained for analysis and is the basis for contingency planning. The inspection procedures maintained in the Operating Record for operational and preventive maintenance are implemented to assure the equipment is maintained. An example equipment inspection checklist and a typical logbook form are shown as Figures D-1 and D-2. Actual checklists or forms are maintained within the Operating Record.

D-1a General Inspection Requirements

Tables D-1, D-1a, and D-2 of this Permit Attachment list the major categories of monitoring equipment, safety and emergency systems, security devices, and operating and structural equipment that are important to the prevention or detection of, or the response to, environmental or human health hazards caused by hazardous waste. These systems may include numerous subsystems. These systems are inspected according to the frequency listed in Tables D-1 and D-1a, a copy of which is maintained at the WIPP facility. The frequency of inspections is based on the nature of the equipment or the hazard and regulatory requirements. When in use, daily inspections are made of areas subject to spills, such as TRU mixed waste loading and unloading areas in the WHB Unit, looking for deterioration in structures, mechanical items, floor coatings, equipment, malfunctions, etc., in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(4)).

As required in 20.4.1.500 NMAC (incorporating 40 CFR §264.33), the WIPP facility inspection procedures for communication and alarm systems, fire-protection equipment, and spill control and decontamination equipment include provisions for testing and maintenance to ensure that the equipment will be operable in an emergency.

D-1a(1) Types of Problems

The inspections for the systems, equipment, structures, etc., listed in Tables D-1 and D-1a, include the types of problems (e.g., malfunctions, visible cracks in coatings or welds, and deterioration) to be looked for during the inspection of each item or system, if applicable, and are in compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(3)).

D-1a(2) Frequency of Inspections

Tables D-1, D-1a, and D-2 of this Permit Attachment list the inspection frequencies and monitoring schedule for equipment and systems subject to the 20.4.1 NMAC hazardous waste management requirements. The frequency is based on the rate of possible deterioration of the equipment and the probability of an environmental or human health incident if the deterioration or malfunction, or any operator error, goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, are inspected daily when in use, consistent with the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(4)).

When RH TRU mixed waste is present in the RH Complex, inspections are conducted visually and/or using closed-circuit video cameras in order to manage worker dose and to minimize occupational radiation exposures to as low as reasonably achievable (**ALARA**). More extensive inspections of these areas are performed at least annually during routine maintenance periods and when RH TRU mixed waste is not present.

D-1a(3) Monitoring Systems

There are two monitoring systems used at the WIPP to provide assurance that facility systems are operating correctly, that areas can be used safely, and that there have been no releases of hazardous waste constituents. These systems are shown in Table D-2 and include the geomechanical monitoring system and the central monitoring system (**CMS**). The geomechanical monitoring system is used to assess the condition of mined excavations to assure no unsafe conditions are allowed to develop. The CMS continuously assesses the status of the fixed radiation monitoring equipment, electrical power, fire alarm systems, ventilation system, and other facility systems including water tank levels. In addition, the CMS collects data from the meteorological monitoring system.

D-1b Specific Process Inspection Requirements

20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(4)), requires inspections of specific portions of a facility, rather than the general facility. These include container storage areas and miscellaneous units. Both are addressed below.

D-1b(1) Container Inspection

Containers are used to manage TRU mixed waste at the WIPP facility. These containers are described in Permit Module III. Off-site CH TRU mixed waste will arrive in 55-gallon drums arranged as seven (7)-packs, in Ten Drum Overpacks (**TDOP**), in 85-gallon drums arranged as four (4) packs, in 100-gallon drums arranged as three (3) packs, or in standard waste boxes (**SWB**). The waste containers will be visually inspected to ensure that the waste containers are in good condition and that there are no signs that a release has occurred. This visual inspection shall not include the center drums of 7-packs and waste containers positioned such that visual observation is precluded due to the arrangement of waste assemblies on the facility pallets. If CH TRU mixed waste handling operations should stop for any reason with containers located on the TRUPACT-II Unloading Dock (**TRUDOCK** storage area of the WHB Unit) in the Contact-Handled Packages, primary waste container inspections could not be accomplished until the containers of waste are removed from the shipping containers.

As described in Permit Attachment M1, Section M1-1d(3), RH TRU mixed waste will arrive in containers inside Nuclear Regulatory Commission (**NRC**)-certified casks designed to provide shielding and facilitate safe handling. Canisters, will be loaded singly into an RH-TRU 72-B cask. Drums will be loaded into a CNS 10-160B cask. The cask will be visually inspected upon arrival. Because RH TRU mixed waste is stored in the Parking Area Unit in sealed casks, there are no additional requirements for engineered secondary containment systems. Following removal of the canisters and drums, the interior of the cask will be inspected and surveyed for evidence of contamination that may have occurred during transport.

RH TRU mixed waste is handled and stored in the RH Complex of the WHB. The RH Complex includes the following: RH Bay, the Cask Unloading Room, the Hot Cell, the Transfer Cell, and the Facility Cask Loading Room. As RH TRU mixed waste is held in canisters within a canister rack the physical inspection of the drum or canister is not possible. Inspections of RH TRU mixed waste in these areas occurs remotely via closed-circuit cameras a minimum of once weekly when stored waste is present. Because RH TRU mixed waste is in sealed casks, there are no additional requirements for engineered secondary containment systems. However, the floors in the RH Complex (including the RH Bay, Facility Cask Loading Room and Cask Unloading Room) are coated concrete and during normal operations (i.e., when waste is present), the floor of the RH Complex is inspected visually or by using close-circuit cameras on a weekly basis to verify that it is in good condition and free of visible cracks and gaps.

Inspections of RH TRU mixed waste containers stored in the Hot Cell and Transfer Cell are conducted using remotely operated cameras. RH TRU mixed waste in the Hot Cell is stored in either drums or canisters. The containers in the Hot Cell are inspected to ensure that they are in acceptable condition. RH TRU mixed waste in the Transfer Cell is stored in the RH-TRU 72-B cask or shielded insert; therefore, inspections in this area focus on the integrity of the cask or shielded insert. RH TRU mixed waste in the Facility Cask Loading Room is stored in the facility cask; therefore, inspections in this area focus on the integrity of the facility cask.

Inspections will be conducted in the Parking Area Unit at a frequency not less than once weekly when waste is present. These inspections are applicable to loaded Contact- Handled and Remote-Handled Packages. The perimeter fence located at the lateral limit of the Parking Area Unit, coupled with personnel access restrictions into the WHB Unit, will provide the needed security. The perimeter fence and the southern border of the WHB shall mark the lateral limit of the

Parking Area Unit. Radiologically controlled areas can be established temporarily with barricades. More permanent structures can be installed. The western boundary can be established with temporary barricades since this area is within the perimeter fence. Access to radiologically controlled areas will only be permitted to personnel who have completed General Employee Radiological Training (**GERT**), a program defined by the Permittees, or escorted by personnel who have completed GERT. This program ensures that personnel have adequate knowledge to understand radiological posting they may encounter at the WIPP site. The fence of the Radiologically Controlled Area, south from the WHB airlocks, was moved to provide more maneuvering space for the trucks delivering waste. Since TRU mixed waste to be stored in the Parking Area Unit will be in sealed Contact-Handled or Remote-Handled Packages, there will be no additional requirements for engineered secondary containment systems. Inspections of the Contact-Handled and Remote-Handled Packages stored in the Parking Area Unit shall be conducted at a frequency no less than once weekly and will focus on the inventory and integrity of the shipping containers and the spacing between trailers carrying the Contact-Handled or Remote-Handled Packages. This spacing will be maintained at a minimum of four feet.

Container inspections will be included as part of the surface TRU mixed waste handling areas (i.e. Parking Area Unit and WHB Unit) inspections described in Tables D-1 and D-1a. These inspections will also include the Derived Waste Storage Areas of the WHB Unit. The Derived Waste Storage Areas will consist of containers of 55 or 85-gallon drums or SWBs for CH TRU mixed waste and 55-gallon drums for RH TRU mixed waste. A Satellite accumulation area (**SAA**) may be required in an area adjacent to the TRUDOCKs for CH TRU mixed waste. A SAA may also be required in the RH Bay and Hot Cell for RH TRU mixed waste. These SAAs will be set up on an as needed basis at or near the point of generation and the derived waste will be discarded into the active derived waste container. All SAAs will be inspected in accordance with 20.4.1.300 NMAC (incorporating 40 CFR §262.34).

D-1b(2) Miscellaneous Unit Inspection

20.4.1.500 NMAC (incorporating 40 CFR §264.602), requires that inspections required in 20.4.1.500 NMAC (incorporating 40 CFR §264.15 and §264.33), as well as any additional requirements needed to protect human health and the environment, be met. The requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.15 and §264.33) are discussed in Section D-1 of this Permit Attachment, along with how the WIPP facility complies with those requirements for standard types of inspections. Inspection frequencies for geomechanical monitoring equipment are provided in Table D-1. The monitoring schedule for geomechanical instrumentation is given in Table D-2.

References

DOE, 1999. "WIPP Safety Analysis Report," DOE/WIPP-95-2065. Rev. 4, U.S. Department of Energy. Washington, D.C.

DOE, 2000. "WIPP Remote-Handled Waste Preliminary Safety Analysis" (RH PSAR), U.S. Department of Energy. Washington, D.C.

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FIGURES

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TYPICAL EQUIPMENT
WEEKLY CHECK LIST

_√_ OK **_X_ Adjustment Made** **_O_ Repairs Required**

AR Written [ ] Yes [ ] No AR # ______________

(check or complete appropriate information)

ITEM INSPECTED	**Condition**	**Comments/Corrective Action**
Mechanical Checks: (examples)		
Oil level		
Radiator fluid level		
Automatic transmission fluid level		
Operate all valves/check gauges		
Emergency brake		
Fuel level (> ¾ full)		
Oil pressure (at warm idle)		
Tire Pressure		
Sirens, horn, & back-up alarm		
Deterioration Checks: (examples)		
Fan belts		
Battery (terminals, cables)		
Run generator 5 min.		
Hose, nozzles & valves		
Leaks/Spills Checks: (examples)		
Leaks around pump		
Foam tank level		
Required Equipment: (examples)		
Inspect SCBAs (> 4050 psi)		
Hand tools & equipment		
Trauma Kit		

Inspected by: ____
Print Name Signature Time/Date

Inspected by: ____
Print Name Signature Time/Date

Reviewed by: ____
Print Name Signature Time/Date

Comments: ____
____
____

1 **NOTE: All items that are mandatory for every inspection form are shown in bold.**

2 Figure D-1
3 Typical Inspection Checklist

HOUR METER READING ______________ EQUIPMENT NO. ______________

DEFICIENCIES NOTED: ____

____

____

____

____

PRE OPS COMPLETED PER __{Procedure Number}__ SAT ______ **PROBLEMS NOTED** _____

CORRECTIVE ACTIONS TAKEN: ____

____

____

____

____

____

____

OPERATOR SIGNATURE	**DATE**	**TIME**	**SUPERVISOR SIGNATURE/DATE**
____________	________	________	____________

NOTE: All items that are mandatory for every inspection form are shown in bold.

Figure D-2
Typical Logbook Entry

TABLES

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TABLE D-1
INSPECTION SCHEDULE/PROCEDURES

System/Equipment Name	Responsible Organization	Inspection [a] Frequency and Job Title of Personnel Normally Making Inspection	Procedure Number and Inspection Criteria
Air Intake Shaft Hoist	Underground Operations	Preoperational [c] See Lists 1b and c	WP 04-HO1004 Inspecting for Deterioration[b], Safety Equipment, Communication Systems, and Mechanical Operability[m] in accordance with Mine Safety and Health Administration (MSHA) requirements
Ambulances (Surface and Underground) and related emergency supplies and equipment	Emergency Services	Weekly See List 11	PM000030 Inspecting for Mechanical Operability[m], Deterioration[b], and Required Equipment[n]
Adjustable Center of Gravity Lift Fixture	Waste Handling	Preoperational See List 8	WP 05-WH1410 Inspecting for Mechanical Operability[m] and Deterioration[b]
Backup Power Supply Diesel Generators	Facility Operations	Monthly See List 3	WP 04-ED1301 Inspecting for Mechanical Operability[m] and Leaks/Spills by starting and operating both generators. Results of this inspection are logged in accordance with WP 04-AD3008.
Facility Inspections (Water Diversion Berms)	Facility Engineering	Annually See List 4	WP 10-WC3008 Inspecting for Damage, Impediments to water flow, and Deterioration[b]
Central Monitoring Systems (CMS)	Facility Operations	Continuous See List 3	Automatic Self-Checking
Contact-Handled (CH) TRU Underground Transporter	Waste Handling	Preoperational See List 8	WP 05-WH1603 Inspecting for Mechanical Operability[m], Deterioration[b], and area around transporter clear of obstacles
Facility Transfer Vehicle	Waste Handling	Preoperational See List 8	WP 05-WH1406 and WP 05-WH1408 Inspecting for Mechanical Operability[m], Deterioration[b], path clear of obstacles, and guards in the proper place
Exhaust Shaft	Underground Operations	Quarterly See List 1a	PM041099 Inspecting for Deterioration[b] and Leaks/Spills
Eye Wash and Shower Equipment	Equipment Custodian	Weekly See List 5	WP 12-IS1832 Inspecting for Deterioration[b]
		Semi-annually See List 2a	WP 12-IS1832 Inspecting for Deterioration[b] and Fluid Levels–Replace as Required

TABLE D-1 INSPECTION SCHEDULE/PROCEDURES			
System/Equipment Name	**Responsible Organization**	**Inspection [a] Frequency and Job Title of Personnel Normally Making Inspection**	**Procedure Number and Inspection Criteria**
Fire Detection and Alarm System	Emergency Services	Semiannually See List 11	PM000027 Inspecting for Deterioration[b], Operability of indicator lights and, underground fuel station dry chemical suppression system. Inspection is per NFPA 72
Fire Extinguishers[j]	Emergency Services	Monthly See List 11	PM000036 Inspecting for Deterioration[b], Leaks/Spills, Expiration, seals, fullness, and pressure
Fire Hoses	Emergency Services	Annually (minimum) See List 11	PM000031 Inspecting for Deterioration[b] and Leaks/Spills
Fire Hydrants	Emergency Services	Semi-annual/ annually See List 11	PM000034 Inspecting for Deterioration[b] and Leaks/Spills
Fire Pumps	Emergency Services	Weekly/annually See List 11	PM000026 Inspecting for Deterioration[b], Leaks/Spills, valves, and panel lights
Fire Sprinkler Systems	Emergency Services	Monthly/ quarterly See List 11	PM000025 Inspecting for Deterioration[b], Leaks/Spills, static pressures, and removable strainers
Fire and Emergency Response Trucks (Seagrave Fire Apparatus, Emergency One Apparatus, and Underground Rescue Truck)	Emergency Services	Weekly See List 11	PM000033 Inspecting for Mechanical Operability[m], Deterioration[b], Leaks/Spills, and Required Equipment[n]
Forklifts Used for Waste Handling (Electric and Diesel forklifts, Push-Pull Attachment)	Waste Handling	Preoperational See List 8	WP 05-WH1401, WP 05-WH1402, WP 05-WH1403, and WP 05-WH1412 Inspecting for Mechanical Operability[m], Deterioration[b], and On board fire suppression system
Hazardous Material Response Equipment	Emergency Services	Weekly See List 11	PM000033 Inspecting for Mechanical Operability[m], Deterioration[b], and Required Equipment[n]
Miners First Aid Station	Emergency Services	Quarterly See List 11	PM000035 Inspecting for Required Equipment[n]
Mine Pager Phones (between surface and underground)	Facility Operations	Monthly See List 3	WP 04-PC3017 Testing of PA and Underground Alarms and Mine Page Phones at essential locations

TABLE D-1
INSPECTION SCHEDULE/PROCEDURES

System/Equipment Name	Responsible Organization	Inspection [a] Frequency and Job Title of Personnel Normally Making Inspection	Procedure Number and Inspection Criteria
MSHA Air Quality Monitor	Maintenance/ Underground Operations	Daily[l] See Lists 1 and 10	WP 12-IH1828 Inspecting for Air Quality Monitoring Equipment Functional Check
Perimeter Fence, Gates, Signs	Security	Daily See List 6	PF0-011 Inspecting for Deterioration[b] and Posted Warnings
Personal Protective Equipment (not otherwise contained in emergency vehicles or issued to individuals): —Self-Contained Breathing Apparatus	Emergency Services	Weekly See List 11	PM000029 Inspecting for Deterioration[b] and Pressure
Public Address (and Intercom System)	Facility Operations	Monthly See List 3	WP 04-PC3017 Testing of PA and Underground Alarms and Mine Page Phones at essential locations Systems operated in test mode
Radio Equipment	Facility Operations	Daily[i] See List 3	Radios are operated daily and are repaired upon failure
Rescue Truck (Surface and Underground)	Emergency Services	Weekly See List 11	PM000030 and PM000033 Inspecting for Mechanical Operability[m], Deterioration[b], Leaks/Spills, and Required Equipment[n]
Salt Handling Shaft Hoist	Underground Operations	Preoperational See List 1b and c	WP 04-HO1002 Inspecting for Deterioration[b], Safety Equipment, Communication Systems, and Mechanical Operability[m] in accordance with MSHA requirements
Self-Rescuers	Underground Operations	Quarterly See List 1c	WP 04-AU1026 Inspecting for Deterioration[b] and Functionality in accordance with MSHA requirements
Surface TRU Mixed Waste Handling Area [k]	Waste Handling	Preoperational or Weekly [e] See List 8	WP 05-WH1101 Inspecting for Deterioration[b], Leaks/Spills, Required Aisle Space, Posted Warnings, Communication Systems, Container Condition, and Floor coating integrity
TRU Mixed Waste Decontamination Equipment	Waste Handling	Annually See List 8	WP 05-WH1101 Inspecting for Required Equipment[n]
Underground Openings—Roof Bolts and Travelways	Underground Operations	Weekly See List 1a	WP 04-AU1007 Inspecting for Deterioration[b]
Underground—Geomechanical Instrumentation System (GIS)	Geotechnical Engineering	Monthly See List 9	WP 07-EU1301 Inspecting for Deterioration[b]

TABLE D-1
INSPECTION SCHEDULE/PROCEDURES

System/Equipment Name	Responsible Organization	Inspection [a] Frequency and Job Title of Personnel Normally Making Inspection	Procedure Number and Inspection Criteria
Underground TRU Mixed Waste Disposal Area	Waste Handling	Preoperational See List 8	WP 05-WH1810 Inspecting for Deterioration[b], Leaks/Spills, mine pager phones, equipment, unobstructed access, signs, debris, and ventilation
Uninterruptible Power Supply (Central UPS)	Facility Operations	Daily See List 3	WP 04-ED1542 Inspecting for Mechanical Operability[m] and Deterioration[b] with no malfunction alarms. Results of this inspection are logged in accordance with WP 04-AD3008.
TDOP Upender	Waste Handling	Preoperational See List 8	WP 05-WH1010 Inspecting for Mechanical Operability[m] and Deterioration[b]
Vehicle Siren	Emergency Services	Weekly See List 11	Functional Test included with inspection of the Ambulances, Fire Trucks, and Rescue Trucks
Ventilation Exhaust	Maintenance Operations	Quarterly See List 10	IC041098 Check for Deterioration[b] and Calibration of Mine Ventilation Rate Monitoring Equipment
Waste Handling Cranes	Waste Handling	Preoperational See List 8	WP 05-WH1407 Inspecting for Mechanical Operability[m], Deterioration[b], and Leaks/Spills
Waste Hoist	Underground Operations	Preoperational See List 1b and c	WP 04-HO1003 Inspecting for Deterioration[b], Safety Equipment, Communication Systems, and Mechanical Operability[m], Leaks/Spills, in accordance with MSHA requirements
Water Tank Level	Facility Operations	Daily See List 3	SDD-WD00 Inspecting for Deterioration[b], and water levels. Results of this inspection are logged in accordance with WP 04-AD3008.
Push-Pull Attachment	Waste Handling	Preoperational See List 8	WP 05-WH1401 Inspecting for Damage and Deterioration[b]
Trailer Jockey	Waste Handling	Preoperational See List 8	WP 05-WH1405 Inspecting for Mechanical Operability[m] and Deterioration[b]
Explosion-Isolation Walls	Underground Operations	Quarterly See List 1	Integrity and Deterioration[b] of Accessible Areas
Bulkhead in Filled Panels	Underground Operations	Monthly See List 1	Integrity and Deterioration[b] of Accessible Areas

TABLE D-1 (CONTINUED)
INSPECTION SCHEDULE/PROCEDURES LISTS

<u>List 1: Underground Operations</u>

a. Mining Technician *
   Senior Mining Technician *
   Continuous Mining Specialist *
   Senior Mining Specialist *
   Mine OPS Supervisor *
b. Waste Hoist Operator
   Waste Hoist Shaft Tender
c. U/G Facility Operations* - Self Rescuers
   Shaft Technician *
d. Operations Engineer
   Supervisor U/G Services*
   Senior Operations Engineer*

<u>List 2: Industrial Safety</u>

a. Safety Technician *
   Senior Safety Technician *
   Safety Specialist *
   Safety Engineer *
   Industrial Hygienist *
b. Fire Protection Engineering *

<u>List 3: Facility Operations</u>

Facilities Technician *
Senior Facilities Technician *
Facility Operations Specialist *
Central Monitoring Room Operator *
Central Monitoring Room Specialist *
Operations Engineer
Senior Operations Engineer *
Facility Shift Manager
Operations Technical Coordinator *

<u>List 4: Facility Engineering</u>

Senior Engineer *

<u>List 5: General</u>

Equipment Custodian*

<u>List 6: Security</u>

Security Protective *
Security Protective Supervisor *

<u>List 8: Waste Handling</u>

Manager, Waste Operations
TRU-Waste Handler

<u>List 9: Geotechnical Engineering</u>

Engineer Technician *
Associate Engineer *
Engineer *
Senior Engineer *
Principal Engineer*

<u>List 10: Maintenance Operations</u>

Maintenance Technician *
Maintenance Specialist *
Senior Maintenance Specialist *
Contractor *

<u>List 11: Emergency Services</u>

Qualified Emergency Services Personnel
Fire Protection Technician

TABLE D-1 (CONTINUED)
INSPECTION SCHEDULE/PROCEDURES NOTES

[a] Inspection may be accomplished as part of or in addition to regularly scheduled preventive maintenance inspections for each item or system. Certain structural systems of the WHB, Waste Hoist and Station A are also subject to inspection following severe natural events including earthquakes, tornados, and severe storms. Structural systems include columns, beams, girders, anchor bolts and concrete walls.

[b] Deterioration includes: obvious visible cracks, erosion, salt build-up, damage, corrosion, loose or missing parts, malfunctions, and structural deterioration.

[c] “Preoperational” signifies that inspections are required prior to the first use during a calendar day. For calendar days in which the equipment is not in use, no inspections are required. For an area this includes: area is clean and free of obstructions (for emergency equipment); adequate aisle space; emergency and communications equipment is readily available, properly located and sign-posted, visible, and operational. For equipment, this includes: checking fluid levels, pressures, valve and switch positions, battery charge levels, pressures, general cleanliness, and that all functional components and emergency equipment is present and operational.

[e] These weekly inspections apply to container storage areas when containers of waste are present for a week or more.

[g] In addition, the water tank levels are maintained by the CMR and level readouts are available at any time.

[h] This organization is responsible for obtaining licenses for radios and frequency assignments. They do periodic checks of frequencies and handle repairs which are performed by a vendor.

[i] Radios are not routinely “inspected.” They are operated daily and many are used in day-to-day operations. They are used until they fail, at which time they are replaced and repaired. Radios are used routinely by Emergency Services, Security, Environmental Monitoring, and Facility Operations.

[j] Fire extinguisher inspection is paperless. Information is recorded into a database using barcodes. The database is then printed out.

[k] Surface CH TRU mixed waste handling areas include the Parking Area Unit, the WHB unit, and unloading areas.

[l] No log forms are used for daily readings. However, readings that are out of tolerance are reported to the CMR and logged by CMR operator. Inspection includes daily functional checks of portable equipment.

[m] Mechanical Operability means that the equipment has been checked and is operating in accordance with site safety requirements (e.g. proper fluid levels and tire pressure; functioning lights, alarms, sirens, and power/battery units; and belts, cables, nuts/bolts, and gears in good condition), as appropriate.

[n] Required Equipment means that the equipment identified in Table F-6 is available and usable (i.e. not expired/depleted and works as designed).

* Positions are not considered RCRA positions (i.e., personnel do not manage TRU mixed waste).

TABLE D-1a
RH TRU MIXED WASTE INSPECTION SCHEDULE/PROCEDURES

System/ Equipment Name	Responsible Organization [J]	Inspection [a] Frequency and Job Title of Personnel Normally Making Inspection [J]	Procedure Number (Latest Revision)	Inspection Criteria		
				Deterioration[b]	Leaks/ Spills	Other
Cask Transfer Car(s)	Waste Operations	Pre-evolution [c,d,e] See List 1	WP05-WH1701 PM041187 (Semi-Annual)	Yes	NA	Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication
RH Bay Overhead Bridge Crane	Waste Operations	Preoperational [c,d,e,i] See List 1	WP05-WH1741 PM041232 (Quarterly) PM041117 (Annual)	Yes	Yes	Pre-operational Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication
Facility Cask	Waste Operations	Pre-evolution [c,d,e,f] See List 1	WP05-WH1713 PM041201 (Annual) PM041203 (Annual)	Yes	NA	Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication. Electrical PM.
RH Bay Cask Lifting Yoke	Waste Operations	Preoperational [c,d,e,i] See List 1	WP05-WH1741 PM041169 (Annual)	Yes	NA	Pre-operational Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication
Facility Cask Transfer Car	Waste Operations	Pre-evolution [c,d,e,f] See List 1	WP05-WH1704 PM041186 (Quarterly) PM041195 (Annual)	Yes	Yes	Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication Electrical Inspection
Facility Cask Rotating Device	Waste Operations	Pre-evolution [c,d,e,f] See List 1	WP05-WH1713 PM041175 (Annual) PM041176 (Annual)	Yes	Yes	Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication Electrical Inspection
Facility Grapple	Waste Operations	Pre-evolution [c,d,e,f] See List 1	WP05-WH1721 PM041172 (Quarterly) PM041177 (Annual)	Yes	NA	Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear. Non-Destructive Examination
6.25-Ton Grapple Hoist	Waste Operations	Pre-evolution [c,d,e,f] See List 1	WP05-WH1721 PM041173 (Annual)	Yes	Yes	Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication
Transfer Cell Shuttle Car	Waste Operations	Pre-evolution [c,d,e,f] See List 1	WP05-WH1705 PM041184 (Semi-Annual) PM041222 (Annual)	Yes	Yes	Pre-evolution Pre-operational Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication. Electrical Inspection.
Cask Unloading Room	Waste Operations	Preoperational [c,d,e,f,h,i] See List 1	WP05-WH1744	Yes	NA	Floor integrity

TABLE D-1a
RH TRU MIXED WASTE INSPECTION SCHEDULE/PROCEDURES

System/ Equipment Name	Responsible Organization [J]	Inspection [a] Frequency and Job Title of Personnel Normally Making Inspection [J]	Procedure Number (Latest Revision)	Inspection Criteria		
				Deterioration[b]	Leaks/ Spills	Other
Hot Cell	Waste Operations	Preoperational [c,d,e,f,g,h,i] See List 1	WP05-WH1744	Yes	NA	Floor integrity
Hot Cell Overhead Powered Manipulator	Waste Operations	Preoperational [c,d,e,i] See List 1	WP05-WH1743 PM041215 (Annual) PM041216 (Annual) IC411037 (Annual)	Yes	Yes	Pre-operational Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication. Electrical Inspection. Load Cell Calibration
Hot Cell Bridge Crane	Waste Operations	Preoperational [c,d,e,i] See List 1	WP05-WH1742 PM041217 (Annual) PM041209 (Annual) IC411038 (Annual)	Yes	Yes	Pre-operational Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication. Electrical Inspection. Load Cell Calibration.
Transfer Cell	Waste Operations	Preoperational [c,d,e,f,h,i] See List 1	WP05-WH1744	Yes	NA	Floor integrity
Facility Cask Loading Room	Waste Operations	Preoperational [c,d,e,f,h,i] See List 1	WP05-WH1744	Yes	NA	Floor integrity
Closed Circuit Television Camera	Waste Operations	Preoperational [c,i] See List 1	WP05-WH1757	NA	NA	Operability
Radiation Monitoring Equipment	Radiation Control	Preoperational [c,d,e] See List 2	WP12-HP1245 IC240010 WP12-HP1307 IC240007 WP12-HP1314 (Annual)	Yes	NA	Operability Checks, Functional Checks, Instrument calibrations, Flow Calibration, Efficiency Checks.
Cask Unloading Room Crane	Waste Operations	Preoperational [c,d,e,i] See List 1	WP05-WH1719 PM041190 (Quarterly) PM041191 (Annual) PM041192 (Annual) IC411035 (Annual)	Yes	Yes	Pre-operational Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication. Electrical Inspection. Load Cell Calibration.
Horizontal Emplacement and Retrieval Equipment	Waste Operations	Pre-evolution [c,d,e,f] See List 1	WP05-WH1700 PM052010 (Semi-Annual)k PM052011 (Annual) PM052013 PM052012 PM052014 (Annual)	Yes	Yes	Assembly and Operating Instructions. Electrical Inspection. Position Transducer Calibration. Tilt Sensor Calibration.

TABLE D-1a
RH TRU MIXED WASTE INSPECTION SCHEDULE/PROCEDURES

System/ Equipment Name	Responsible Organization [J]	Inspection [a] Frequency and Job Title of Personnel Normally Making Inspection [J]	Procedure Number (Latest Revision)	Inspection Criteria		
				Deterioration[b]	Leaks/ Spills	Other
41-Ton Forklift	Waste Operations	Preoperational [c,d,e,i] See List 1	WP05-WH1602 PM074061 PM052003 (Hours of Use) PM074027 (Quarterly) PM074029 &PM074051 (Annual)	Yes	Yes	Pre-Operational Checks. PM performed every 100 hours of operation, every 500 hours of operation or every 5 Years. Quarterly Engine Emission Test. Annual Electrical Inspection. Annual NDE.
RH Bay	Waste Operations	Preoperational [c,d,e,h,i] See List 1	WP05-WH1744	Yes	NA	Floor integrity
Surface RH TRU Mixed Waste Handling Area	Waste Operations	Preoperational [i] See List 1	WP- 05 WH1744	Yes	Yes	Posted Warning, Communications

TABLE D-1A (CONTINUED)
RH TRU MIXED WASTE INSPECTION SCHEDULE/PROCEDURES LISTS

List 1: Waste Operations

RH Waste Handling Engineer
Qualified TRU-Waste Handler

List 2: Radiological Control

Radiological Control Technician

TABLE D-1a (CONTINUED)
RH TRU MIXED WASTE INSPECTION SCHEDULE/PROCEDURES NOTES

[a] Inspection may be accomplished as part of or in addition to regularly scheduled preventive maintenance inspections for each item or system. Certain structural systems of the WHB are also subject to inspection following severe natural events including earthquakes, tornados, and severe storms. Structural systems include columns, beams, girders, anchor bolts, and concrete walls.

[b] Deterioration includes: visible cracks, erosion, salt build-up, damage, corrosion, loose or missing parts, malfunctions, and structural deterioration.

[c] “Pre-evolution” signifies that inspections are required prior to equipment use in the waste handling process. (An evolution is considered to be from the receipt of a cask into the RH Bay through canister emplacement in the underground.) For an area, preoperational inspection includes: area is clean and free of obstructions (for emergency equipment); adequate aisle space; emergency and communications equipment is readily available, properly located and sign-posted, visible, and operational. For equipment, this includes: checking fluid levels, pressures, valve and switch positions, battery charge levels, pressures, general cleanliness, and that functional components and emergency equipment are present and operational. When the equipment is not in use, no inspections are required.

[d] When equipment needs to be inspected while handling waste (i.e., during waste unloading or transfer operations), general cleanliness and functional components will be inspected to detect any problem that may harm human health or the environment. The inspection will verify that emergency equipment is present.

[e] Inspection of RH TRU mixed waste equipment and areas in the RH Complex applies only after RH TRU mixed waste receipt begins.

[f] The inspection/maintenance activities associated with these pieces of equipment are performed when the RH Complex is empty of RH TRU mixed waste. If contamination is present, a radiation work permit may be needed.

[g] For the Hot Cell and Transfer Cell, if RH TRU mixed waste is present, camera inspections will be performed in lieu of physical inspection.

[h] The integrity of the floor coating will be inspected weekly if RH TRU mixed waste is present.

[i] “Preoperational” signifies that inspections are required prior to the first use in a calendar day.

[J] Responsible organizations refers to the organization that owns the equipment. Preventive Maintenance (PM) procedures are conducted by either mine maintenance or surface operations maintenance personnel and Instrument Calibration (IC) procedures are conducted by instrument and calibration maintenance personnel.

[k] Inspection will be performed after 250 evolutions (actual and training emplacements), if such usage occurs prior to the semi-annual inspection.

TABLE D-2
MONITORING SCHEDULE

System/Equipment Name	Responsible Organization	Monitoring Frequency	Purpose
Geomechanical [b]	Geotechnical Engineering	Monthly	To evaluate the geotechnical performance of the underground facility and to detect ground conditions that could affect operational safety
Central Monitoring System	Facility Operations	System Dependent	Monitor and provide status for the following facility parameters: Electrical Power Status [d] Fire Alarm System [e] Ventilation System Status [f] Meteorological Data System [g] Facility Systems (compressors [g], pumps [h], water tank levels [i], waste hoists [j])

[b] Equipment is listed as Underground-Geomechanical Instrumentation System (GIS) in Table D-1.
[d] Equipment listed as Backup Power Supply Diesel Generator in Table D-1.
[e] Equipment listed as Fire Detection and Alarm System in Table D-1.
[f] Equipment listed as Ventilation Exhaust in Table D-1.
[g] Not RCRA equipment.
[h] Equipment listed as Fire Pumps in Table D-1.
[i] Equipment listed as Water Tank Level in Table D-1.
[j] Equipment listed as Waste Hoist in Table D-1.

APPENDIX D1

INSPECTION SHEETS, LOGS, AND INSTRUCTION SHEETS FOR SYSTEMS/EQUIPMENT REQUIRING INSPECTION

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APPENDIX D1

INSPECTION SHEETS, LOGS, AND INSTRUCTION SHEETS FOR SYSTEMS/EQUIPMENT REQUIRING INSPECTION

TABLE OF CONTENTS

TRU Mixed Waste Decontamination Equipment
Underground Openings, Roofbolts, Travelways
Underground Geomechanical Instrumentation System (GIS)
Underground TRU Mixed Waste Disposal Area
Uninterruptible Power Supply (Central UPS)
Vehicle Siren
Ventilation Exhaust
Waste Handling Cranes
Waste Shaft Hoist
Water Tank Level
Push-Pull Attachment
Trailer Jockey

CHAPTER E

PREPAREDNESS AND PREVENTION

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CHAPTER E

PREPAREDNESS AND PREVENTION

TABLE OF CONTENTS

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CHAPTER E

PREPAREDNESS AND PREVENTION

E-1 Preparedness and Prevention Requirements

Preparedness and Prevention Requirements are as described in the following sections.

E-1a Equipment Requirements

The WIPP facility is well equipped with internal and external communications systems, emergency equipment, and water for fire control. As shown in the following sections, the Permittees fully commit to meeting the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.32 and §264.34).

E-1a(1) Internal Communications

20.4.1.500 NMAC (incorporating 40 CFR §264.32(a)), requires a facility to have an internal communications or alarm system capable of providing immediate emergency instructions (voice or signal) to facility personnel. In addition, 20.4.1.500 NMAC (incorporating 40 CFR §264.34(a)), requires that employees have immediate access to an internal alarm or emergency communication device when handling transuranic (**TRU**) mixed waste. The following discussions show that the WIPP facility is well equipped for internal communications and that the Permittees fully commit to complying with the regulations.

The intraplant communication systems, designed to provide immediate emergency instructions to facility personnel, include two-way communication by the public address (**PA**) system and its intercom phones and paging channels, an intraplant telephone system, mine phones, pagers and plectrons, portable two-way radios, and local and facility wide alarm systems. The procedures for notifying facility personnel in an emergency are contained in the Contingency Plan, Permit Attachment F of this Permit.

The intercom system (with an integral PA system) consists of handset stations and loudspeaker assemblies, with multiple amplifiers. The system has multiple channels in the main buildings. Initial communication between parties within the plant can be established by using the paging channel. Each designated location has a single set of electrically isolated speakers and a handset. In order to cover most areas in the plant, loudspeakers are properly oriented, and volume levels are adjusted. If one station fails, the remaining stations are isolated from the out-of-service unit to prevent a failure in the remaining system.

Private branch automatic exchange two-way communication is provided between any two telephones located above or below ground. Direct dialing to outside telephones and direct dialing to WIPP facility telephones are provided by this system. Failure of a single telephone station does not affect the balance of the telephone system. If the telephone system should fail, the PA system, the plectrons, and the portable two-way radios provide backup surface communications.

The Site Notification System (**SNS**) consists of pagers in the possession of office wardens and plectrons located in various buildings. The SNS pagers and plectrons are tone-activated radio receivers that are activated by the two-way radio system. To generate a tone on the pagers and plectrons or to send a verbal message, the radio operator enters a security code into the two-way radio system and begins broadcasting. The SNS pagers are portable and battery-operated. The plectrons are portable and can be plugged into a standard electrical circuit or powered from internal batteries that are continuously recharged when connected to the electrical circuit.

A plant radio station in the Guard and Security Building, one located in the Emergency Operations Center in the Safety and Emergency Services Building, and one in the Central Monitoring Room (**CMR**), allow two-way radio communication with on-site personnel and with mobile/portable WIPP facility radios operating on and off the WIPP site. The two-way radio also allows one-way emergency notification on the portable SNS pagers and plectrons. The two-way radio system located in the CMR is supplied with power from the uninterruptible power supply if the off-site power supply fails.

There are various alarm systems used at the WIPP facility. The PA system has two alarm tones in use, a yelp and a gong. Its signals are produced in the master PA console by a tone generator and are transmitted sitewide over the paging channel of the system, overriding its normal use. The signals are intermittent and of high intensity. The evacuation tone is a yelp tone and is used for, and limited to, situations requiring immediate, rapid, and complete (or selective area) evacuation. The evacuation tone is initiated manually on the surface. In the underground, the evacuation tone may be initiated manually or automatically by underground fire detection and alarm systems. This tone is also a yelp tone. It is accompanied with strobe lights for high noise areas. These alarm signals take priority over other signals on the paging channel but do not affect the intercom channels. Evacuation alarms using the PA system, local and plantwide, also can be initiated manually from the CMR in the Support Building. The audible alarm signals are supplemented by warning lights in high ambient-noise areas underground, such as active mining areas. These alarms are supplied with power from the uninterruptible power supply if the off-site power supply fails. The PA system may also produce a gong tone followed by a message. Local fire alarms are bell tones.

Whenever TRU mixed wastes are handled, two persons, at a minimum, are involved in the operation. The WHB contains readily accessible telephones and PA stations throughout. The mine phones are the main means of communication underground, although the PA system is also available.

Underground communication and alarm systems will be arranged to meet the requirements of 30 CFR Part 57. Telephones or other two-way communication equipment with instructions for their use will be provided for communications from underground to the surface. These communications are typically moved to ensure communications are maintained close to the work areas. Alarm systems capable of promptly warning every person underground, will be provided and maintained in operating condition. If persons are assigned to work areas beyond the warning capabilities of the system, provisions will be made to alert them in a proper manner to provide for their safe evacuation. Typically, these provisions include a flashing light capable of being seen easily. As part of the preoperational inspection, prior to initiating waste handling operations underground, waste handling personnel verify that underground communications are ready and are working. If they are not working, repairs are initiated.

Table F-6 in Permit Attachment F describes the capabilities and locations of the various internal communication systems.

E-1a(2) External Communications

20.4.1.500 NMAC (incorporating 40 CFR §264.32(b)), requires that a communications device be available for contacting outside agencies for emergency assistance. In addition, 20.4.1.500 NMAC (incorporating 40 CFR §264.34(b)), requires that if just one employee is on the premises, the employee must have immediate access to a device capable of summoning outside help. TRU mixed waste handling operations are not conducted at the WIPP facility when only one person is present on the premises. TRU mixed waste handling operations are conducted by two or more persons. The security officers and staff from Facility Operations are also present at the WIPP facility during TRU mixed waste handling operations. When no TRU mixed waste handling operations are being conducted at the WIPP facility, at a minimum, the security officers and staff from Facility Operations are present. As discussed below, the WIPP facility has the required external communication devices and will operate in a manner that fully complies with these regulations.

The external communication systems, designed to provide two-way communication with outside agencies or for summoning emergency assistance from off site, include the commercial telephone system and two-way radios.

Direct dialing through any telephone located above or below ground allows contact with outside agencies. Failure of a single telephone station does not affect the balance of the telephone system. Sixty percent of the direct-dial incoming and outgoing lines are routed via a microwave system located on the edge of the parking lot. The remaining 40 percent of the direct-dial lines are routed to Carlsbad by means of a buried cable. In the unlikely event that both routing modes are inoperable, direct dial telephone capability still exists via cellular telephone or Satellite Communications (**SATCOM**) linkage in the Emergency Operations Center.

Plant radio stations in the Guard and Security Building and in the Emergency Operations Center in the Safety and Emergency Services Building allow two-way radio communication with the CMR, the Eddy County and Lea County Sheriff's Departments, the New Mexico State Police, and the Otis Fire Response Teams. Communication is available with the Lea County Sheriff's Department, the Hobbs Fire Department, the Carlsbad Medical Center, and the Columbia Regional Hospital via the Eddy County dispatcher. Another base station is in the CMR, however it is not normally used to communicate with offsite agencies. Radios are not inspected, instead, they are operated daily and repaired if they fail.

Table F-6 in Permit Attachment F describes the capabilities and locations of the various external communication systems.

E-1a(3) Emergency Equipment

Contingency Plan (Permit Attachment F) describes the capabilities and locations of the fire-suppression equipment and systems. Table F-7 lists the types of fire-suppression systems by structure. Figure F-5 displays the underground locations of emergency equipment. Figure F-6 shows the fire-water distribution system on the surface. Figure F-7 shows the underground fuel area fire protection system. The information contained in these tables and figures in Permit Attachment F demonstrates that the WIPP facility has the portable fire extinguishers, fire-control equipment (including special extinguishing equipment that use foam, inert gas, or dry chemicals), spill-control equipment, and decontamination equipment needed for compliance with the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.32(c)).

E-1a(4) Water for Fire Control

20.4.1.500 NMAC (incorporating 40 CFR §264.32(d)), requires that the WIPP facility be equipped with water at an adequate volume and pressure to supply water-hose streams, foam-producing equipment, automatic sprinklers, or water-spray systems. The following discussion on fire control systems at the WIPP facility demonstrates the Permittees commitment to comply with this requirement.

The primary function of the WIPP facility water system is to supply water for domestic use and fire protection. Water is furnished by the Double Eagle Water Company, owned by the City of Carlsbad. Wells located 30 miles (mi) (48.3 kilometers [km]) north of the WIPP facility are the source of the water. Water is supplied by gravity flow through a 24 inch (in.) (61 centimeter [cm]) diameter pipeline to a junction point about 13 mi (20.9 km) north of the site at U.S. Highway 62/180. This line is sized to provide 6,000 gallons (gal) (22,712 liters [L]) per minute for use by others, in addition to the peak flow rate required by the WIPP facility. Controls at the junction point give the WIPP facility priority over flows to all other users. A 10 in. (25 cm) diameter pipeline supplies water by gravity flow from the tie-in point to the WIPP facility.

At the WIPP facility, the water enters a pair of 180,000-gal (681,372-L) aboveground storage tanks located adjacent to the Pumphouse. These tanks are 32 ft (9.75 m) in diameter and are constructed of welded steel. The water level in each tank is monitored in the CMR. One tank stores water for use by the facility's fire-water system. The other tank stores water for use by the facility's domestic water system, and to reserve approximately 100,000 gal (378,540 L) of water for use by the fire-water system. Separate sets of pumps for the domestic water and fire-water systems are provided in the Pumphouse. During a fire, the fire-water pump is automatically started, and available domestic water is used first. Upon depletion of the domestic-water inventory, the domestic-water pumps are automatically shut off, and the dedicated fire-water reserve is available for fire-suppression use only. The primary fire-water pump is a 100-percent-capacity electric pump. A 100-percent-capacity diesel fire-water pump provides backup in case of a power failure or when maintenance is required on the electric pump. Each fire-water pump is rated at 1,500 gal (5,678 L) per minute at 125 pounds (lb) (56.7 kilograms [kg]) per square in.

The following buildings are connected to and protected by the wet-pipe sprinkler system: the Pumphouse, the Guard and Security Building, the Support Building, the WHB, the Exhaust Filter Building, the TRUPACT Maintenance Facility, the Engineering Building, the Safety and Emergency Services Building, the Training Building, and several other warehouse and maintenance buildings. The physical layout of the facilities allows for full hose stream access by firefighters. There is no firefighting water-supply system underground. Instead, the underground is equipped with fire extinguishers of various types and in various locations (including vehicles) and a fire truck with a 125 lb (56.7 kg) chemical extinguisher. The underground fuel station is equipped with an automatic, 1,000-lb (453.5 kg) chemical extinguishing systems. Only dry chemical materials or water are used to fight fires involving TRU mixed waste.

E-1b Aisle Space Requirement

20.4.1.500 NMAC (incorporating 40 CFR §264.35), requires that a facility maintain sufficient aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to areas of the facility during an emergency (other than a permanent disposal stack). Aisle space for each regulated unit is specified below.

Waste Handling Building Container Storage Unit (WHB Unit) and Parking Area Container Storage Unit (Parking Area Unit)

During TRU mixed waste handling operations, sufficient room is maintained for unobstructed movement of personnel, fire-protection equipment, spill control equipment, or decontamination equipment to areas in the WHB Unit.

Waste containers will remain inside the Contact-Handled (**CH**) or Remote-Handled (**RH**) Packages in the Parking Area Unit until TRU mixed waste handlers are prepared to handle them. As shown in Figure M1-1 in Permit Attachment M1, there is ready access to all areas within the WHB Unit where hazardous wastes are handled. Waste containers are unloaded from the Contact-Handled Package in to the WHB Unit (see Figure M1-12 in Permit Attachment M1). The WHB Unit can handle the unloading of four CH Packages at one time. Single RH TRU mixed waste canisters are unloaded from the RH-TRU 72-B casks in the Transfer Cell of the WHB Unit where they are transferred to facility casks (see Figures M1-23 and M1-24 in Permit Attachment M1). RH TRU mixed waste drums in CNS 10-160B casks, which may contain up to 10 55-gallon drums configured in two 5-drum baskets (see Figure M1-25 in Permit Attachment M1), are unloaded from the cask staged in the Cask Unloading Room into the Hot Cell.

At all times, written procedures ensure that loaded CH or RH Packages, facility pallets, containment pallets, and waste containers in the WHB Unit and Parking Area Unit are managed in a manner to prevent obstructing the movement of personnel, fire-protection equipment, spill-control equipment, and decontamination equipment.

For CH TRU mixed waste, an aisle space of at least 44 in. (1.1 m) between loaded facility or containment pallets will be maintained in all CH waste storage areas of the WHB Unit. For RH TRU mixed waste, a minimum of 44 in. (1.1 m) between loaded casks in the RH Bay will be maintained. A maximum of two loaded casks may be stored in the RH Bay at one time. Implementation of written procedures ensures that loaded casks, transfer cars, and canisters are managed in the RH Bay in a manner to allow the movement of personnel, fire-protection equipment, spill-control equipment, and decontamination equipment. Within the Hot Cell, waste containers are not stored in multiple rows; similarly, within the Transfer Cell, the canister is located in a rack on the Transfer Cell Shuttle Car. Thus, aisle space does not apply to these areas. Aisle space requirements also do not apply to empty casks in racks. When CH or RH Packages contain waste in the Parking Area Container Storage Unit, the Permittees shall maintain a minimum spacing of 4 ft (1.2 m) between trailers loaded with CH or RH Packages or between CH or RH Packages not on trailers.

Underground Hazardous Waste Disposal Units (HWDUs)

The mined areas underground are all maintained to provide free access to the repository and to the face of the waste disposal areas in the active panels. As specified in 30 CFR 57, adequate access is provided for movement of personnel, fire equipment, or spill-controlled equipment to any area of operations during an emergency or response action, as provided in the facility Contingency Plan (Permit Attachment F). These items are subject to inspection by Federal mine inspectors at least quarterly. Waste emplacement occurs sequentially on a room-by-room basis until each room in a HWDU panel has been filled with waste. Derived waste will be emplaced in the disposal rooms along with the TRU mixed waste. Once panel closure has been effected, the waste is considered disposed of, and access is no longer provided beyond the panel closure barrier to closed HWDUs.

Proper airflow distribution to all areas of the underground is achieved through a multi-step process. Tests and balances of the underground ventilation system are conducted on a periodic basis with the frequency depending on changes that are occurring in the configuration of the underground. These tests and balances physically measure airflow, pressure, and system resistance. Computer modeling is performed to determine the configuration necessary to achieve any desired underground airflow distribution. Administrative procedures are used as the means of assuring control of the configuration of the ventilation control devices such as bulkheads, doors, fans, and air regulators needed to achieve the desired configuration. Underground Facility Operations makes daily checks of air quality in all parts of the repository where personnel will be working. Air quantity checks are made on an as-needed basis as changing conditions warrant such checks.

E-2 Preventive Procedures, Structures, and Equipment

The WIPP facility has been designed and will be operated to fully meet each of the requirements of 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(8)), to prevent hazards associated with unloading operations, prevent runoff from hazardous waste handling areas, prevent contamination of water supplies, mitigate the effects of equipment and power failures, prevent undue exposure of personnel to hazardous waste, and prevent releases to the atmosphere. The individual regulatory requirements are discussed below.

E-2a Unloading Operations

The WIPP facility's equipment, structures, and procedures are specially designed for the safe handling of TRU mixed waste. Permit Attachments M1 and M2 detail how CH and RH TRU mixed waste is handled, including unloading and transport operations. The following is a summary of the activities, structures, and equipment that were developed to prevent hazards in unloading of TRU mixed waste, as required by 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(8)(i)).

CH TRU Mixed Waste

The TRUPACT-II shipping container has a gross loaded weight of 19,265 lbs (8,737 kgs). The HalfPACT shipping container has a gross loaded weight of 18,100 lbs (8,210 kgs). The gross loaded weight is defined as the weight of the payload and the weight of the Contact Handled Package itself. The Contact Handled Packages have forklift pockets at the bottom of the container specifically for lifting the container with a forklift (see Figure M1-8 in Permit Attachment M1). The 13 ton (11.8 metric tons) electric forklift unloads the TRUPACT-II from the trailer and transfers it to an unloading dock in the WHB Unit. The unloading dock is designed to accommodate the Contact Handled Package and functions as a work platform, providing TRU mixed waste handling and health physics personnel with easy access to the container during unloading operations.

An overhead 6-ton (5.4-metric ton) crane and adjustable center-of-gravity lift fixture transfer TRU mixed waste containers from the Contact Handled Package to a pallet on the WHB Unit floor. The facility pallet is a fabricated steel structure designed to securely hold waste containers. Each facility pallet has a rated load capacity of 25,000 lb (11,340 kg). The upper surface of the facility pallet has two recesses sized to accept the waste containers, ensuring that the containers are held in place. Up to four SWBs, four 7-packs of 55-gallon drums, four 4-packs consisting of 85-gallon drums, four 3-packs of 100-gallon drums, or two TDOPs may be placed on a facility pallet. Each stack of waste containers is strapped down to holding bars in the top reinforcement plate of the facility pallet to avoid spillage during movement. Two rectangular tube openings in the bed allow the facility pallet to be securely lifted by forklift. In order to assure a facility pallet is not overloaded, operationally it will hold the contents of two Contact Handled Packages, as specified in Permit Attachment M1.

The WIPP facility has the capability to handle each of the CH TRU containers singly using forklifts and single container attachments. In such cases, the container would be loaded on the waste shaft conveyance and moved underground as a single unit.

All unloading equipment is inspected in accordance with the schedule shown in Tables D-1 and D-1a. Cranes that are used in the unloading and handling of TRU mixed waste have been designed and constructed so that they will retain their loads in the event of a loss of power. Cranes in the WHB Unit are also designed to withstand a design basis earthquake without moving off of their rails and without dropping their load. Lowering loads is a priority activity after a disruptive event.

The following is a summary of the activities, structures, and equipment that were developed to prevent hazards in transporting TRU mixed waste.

Palletized CH TRU mixed waste is either transferred by a 13-ton (11.8-metric ton) forklift or the facility transfer vehicle, which is designed with an adjustable bed height that is used to transfer the facility pallets to the special pallet-support stands in the waste shaft conveyance.

The waste hoist system in the waste shaft and all waste shaft furnishings are designed to resist the dynamic forces of the hoisting system, which are greater than the seismic forces on the underground facilities. In addition the waste shaft conveyance headframe is designed to withstand the design-basis earthquake (**DBE**). Maximum operating speed of the hoist is 500 ft (152.4 m) per minute. During loading and unloading operations, the waste hoist is steadied by fixed guides. The waste hoist is equipped with a control system that will detect malfunctions or abnormal operations of the hoist system, such as overtravel, overspeed, power loss, or circuitry failure. The control response is to annunciate the condition and shut the hoist down. Operator response is required to recover from the automatic shutdown. Waste hoist operation is continuously monitored by the CMS. A battery powered FM transmitter/receiver allow communication between the hoist conveyance and the hoist house.

The waste hoist has two pairs of brake calipers acting on independent brake paths. The hoist motor is normally used for braking action of the hoist. The brakes are used to hold the hoist in position during normal operations and to stop the hoist under emergency conditions. Each pair of brake calipers is capable of holding the hoist in position during normal operating conditions and stopping the hoist under emergency conditions. In the event of power failure, the brakes will set automatically.

The hoist is protected by a fixed automatic fire suppression system. Portable fire extinguishers are also provided on the hoist floor and in equipment areas.

Once underground, the facility pallet is removed from the hoist cage by the underground waste transporter (see Figure M2-6 in Permit Attachment M2), a commercially available articulated diesel vehicle. The trailer is designed specifically for transporting palletized TRU mixed waste and is sized to accommodate the facility pallet. All motorized waste handling equipment is equipped with on-board fire-suppression systems.

The underground waste transporter is equipped with a fire suppression system, rupture-resistant diesel fuel tanks, and reinforced fuel lines to minimize the potential for a fire involving the fuel system. Waste containers will be placed into underground HWDUs using a forklift and attachments.

All CH TRU mixed waste transport equipment is inspected at a frequency indicated in Table D-1.

RH TRU Mixed Waste

Cranes and forklifts that are used to unload and handle RH TRU mixed waste have been designed and constructed to retain their loads in the event of a loss of power. RH TRU mixed waste received in an RH-TRU 72-B cask is unloaded from the trailer in the RH Bay, using the RH Bay Overhead Bridge Crane, and is placed on the cask transfer car. The cask transfer car moves the RH-TRU 72-B cask into the Cask Unloading Room, where a bridge crane lifts the cask from the cask transfer car and lowers it into the Transfer Cell and onto the Transfer Cell shuttle car. The Transfer Cell shuttle car moves the RH-TRU 72-B cask into position for transferring the canister to the facility cask.

RH TRU mixed waste received in a CNS 10-160B cask is unloaded from the trailer in the RH Bay using the RH Bay overhead bridge crane and is placed on the cask transfer car. The cask transfer car moves the CNS 10-160B cask into the Facility Cask Unloading Room. The Hot Cell crane lifts the two drum carriage units from the CNS 10-160B cask in the Facility Cask Unloading Room into the Hot Cell, where the drums are transferred into RH TRU mixed waste facility canisters using the Overhead Powered Manipulator or Hot Cell Crane. The facility canisters are then lowered into a shielded insert on the Transfer Cell Shuttle Car in the Transfer Cell. The Transfer Cell Shuttle Car moves the shielded insert into position for transferring the facility canister to the facility cask.

A remotely-operated fixed hoist grapple lifts the canister from the RH-TRU 72-B cask or from the shielded insert on the Transfer Cell shuttle car and transfers the canister into the facility cask located on the facility cask transfer car in the Facility Cask Loading Room. The facility cask is rotated to a horizontal position on the Facility Cask Transfer Car and the Facility Cask Transfer Car moves onto the waste shaft conveyance and is lowered underground.

Once underground, the RH TRU mixed waste handling forklift lifts the facility cask from the Facility Cask Transfer Car and carries the facility cask to the Horizontal Emplacement and Retrieval Equipment (**HERE**). After placing the facility cask on the HERE, the canister is emplaced in the wall of the disposal room.

Pertinent RH TRU mixed waste transport equipment is inspected at a frequency indicated in Table D-1a.

Figures of RH TRU mixed waste emplacement equipment are included in Attachments M1 and M2.

E-2b Runoff

The following description of procedures, structures, or equipment used at the WIPP facility to prevent runoff from TRU mixed waste handling areas to other areas of the facility or environment or to prevent flooding is required by 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(8)(ii)).

The WHB Unit is a physical barrier that will prevent TRU mixed waste spills from reaching the environment before a cleanup could be initiated and completed. A detailed description of the WHB containment capability for the CH Bay and RH Complex is contained in Permit Attachment M1. Secondary containment is also provided by the shipping containers while waste are within them. These are sealed vessels with no open vents and therefore cannot leak.

TRU mixed waste received for emplacement at the WIPP facility must be certified under this Permit's Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (**TSDF-WAC**) as nonliquid waste; in some cases, the Permit allows up to one percent residual liquids. The TSDF-WAC are procedural controls that must be met at the generator or storage site and the data must be verified by the WIPP facility staff prior to acceptance for the Disposal Phase and shipment to the WIPP facility. Permit Module II and Permit Attachment B contain information regarding TSDF-WAC requirements for shipping and discusses receipt and verification of the TRU mixed waste at the WIPP facility. Derived waste must also meet all TSDF-WAC requirements prior to disposal. Calculations in Permit Attachment M1 demonstrate that one percent residual liquid in TRU mixed waste containers is easily contained by the WHB Unit floor.

The WIPP facility does not lie within a 100-year floodplain. There are no major surface-water bodies within 5 mi (8 km) of the site, and the nearest river, the Pecos River, is approximately 12 mi (19 km) away. The general ground elevation in the vicinity of the surface facilities (approximately 3,400 ft [1,036 m] above mean sea level) is about 500 ft (152 m) above the riverbed and 400 ft (122 m) above the 100-year floodplain. Protection from flooding or ponding caused by probable maximum precipitation (**PMP**) events is provided by the diversion of water away from the WIPP facility by a system of peripheral interceptor berms and dikes. Additionally, grade elevations of roads and surface facilities are designed so that storm water will not collect on the site under the most severe conditions.

Repository shafts are elevated at least 6 in. (15.2 cm) to prevent surface water from entering the shafts. The floor levels of all surface facilities are above the levels calculated for local flooding due to PMP events. Therefore, flooding of WIPP facility roads and surface structures is not expected from the flooding of surface waters as a result of PMP events or because of site-runoff design.

Flood-control structures are inspected as part of a general facility inspection at least annually. During this inspection, the structures are checked to assure there has been no wind or rain erosion or animal-caused damage that would cause the structures to fail. Further, the areas around the structures are inspected to ensure they are free of vegetation, debris, or other items that would impede the diversion of water. Experience with these structures has shown that annual structural inspections are adequate for the climate and soil conditions at the WIPP facility; however, inspections are also conducted after severe natural events, such as severe storms and a design basis earthquake.

Whenever TRU mixed waste is outside the WHB Unit, it will be contained in CH or RH Packages. TRU mixed waste containers are only unloaded from the shipping containers inside the WHB Unit and shipping containers are never opened outside this facility; therefore, TRU mixed waste is not expected to reach the outside environment or other parts of the facility from the TRU mixed waste handling facilities in nonflood circumstances. Flooding of the TRU mixed waste handling facilities is prevented by drainage ditches and berms such that there is no mechanism that might transport TRU mixed waste to the outside environment and between parts of the WIPP facility. Neither is there a mechanism to allow TRU mixed waste to find its way to an area of the WIPP site where it would be carried off site by flood or precipitation waters.

E-2c Water Supplies

At the WIPP facility, water supplied by a local water company enters a pair of 180,000-gal (681,372-L) aboveground storage tanks located adjacent to the Pumphouse. The 360,000-gal (1,362,744-L) combined capacity of the tanks is used as the potable water source and for fire control. These tanks are 32 ft (9.8 m) in diameter and are constructed of welded steel. The water level in each tank is inspected daily. Potable water is piped to the site and stored in tanks until distributed by pipe to the fire hydrants and buildings. Managing the potable water supply in this manner prevents the contamination of the supply by TRU mixed waste.

E-2d Equipment and Power Failure

The following description of procedures, structures, or equipment used at the facility to mitigate effects of equipment failure and power outages is required by 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(8)(iv)). The specific systems and facilities related to the protection of human health and the environment during waste handling and management operations are discussed in the in Permit Attachment M1.

Utility power is fed to the WIPP site by two separate feeds in a ring bus configuration. This provides the capability to supply uninterruptible, redundant power to the site upon the loss of one feed. A redundant Southwestern Public Service (**SPS**) power feed has been installed. In the event that normal utility power is lost, on-site diesel generators will provide alternating current (**AC**) power to important WIPP facility electrical loads. Uninterruptible power supply (**UPS**) units are also on line providing power to important monitoring systems.

If utility power fails, the exhaust filter system goes into the fail position, and the system high-efficiency particulate-air filter dampers are placed into filtration position. When power is restored by the diesel generators, a decision is made whether to remain in filtration mode and energize a filtration fan or to realign the dampers into the minimum exhaust mode. Without any indication of a radiological release, the decision is usually the latter. TRU mixed waste handling and related operations cease upon loss of utility power and are not resumed until normal utility power is returned. All waste handling equipment will "fail safe," meaning that it will retain its load during a power outage.

In case of a loss of utility power, backup power to predetermined loads can be supplied by either of the two on-site diesel generators. Each of these units provide 480 volts (**V**) of power with a high degree of reliability and are sized to feed the selected loads. Each of the diesel generators can carry all preselected monitoring loads plus operation of the Air Intake Shaft hoist for personnel evacuation and other selected backup loads. The diesel generators can be brought on line within 30 minutes.

Upon loss of normal power, the diesel generators are manually started from the local control panel or from the CMR. The starter system is a 24-V battery system with a 300-ampere-hour capacity. Although it is standard practice to start the diesel generators from the local control panel, each unit can be remotely started from the CMR when the generator start switch is placed in the "remote" position. The diesel generators and associated breakers can be monitored in the CMR, thus providing the ability to feed selected facility loads from the backup power source, in sequence, without exceeding generator capacity. The on-site fuel storage capacity is sufficient for the operation of one generator at an expected load of 62 percent for three days. Additional fuel supplies are readily available within a few hours by tank truck, allowing on-line refueling and continued operation.

There is a Central UPS, located in the Support Building, that supplies power to selected loads located in the Support Building and WHB Unit. The Central UPS provides back-up power to equipment associated with radiation monitoring, communications, and central monitoring systems. In addition, individual UPSs are provided for the selected equipment associated with these same systems, but are located remotely from the Support Building and the WHB Unit. The CMR is also connected to the Central UPS.

In case of loss of AC power input to the UPSs, the dedicated batteries were designed to supply power to a fully loaded UPS for 30 minutes. It is expected that the AC power input to the UPS will be restored within 30 minutes, either from the off-site electric utility or from the site back-up power generator system.

Human health and the environment are protected during a loss of off-site power by a combination of factors:

- The underground filtration system fails in the “filter” mode so that no releases of contaminated particulates will occur

- The UPS maintains all monitoring systems and alarms in waste handling areas so that fires or pressure loss will be detected and an appropriate response initiated

- Generators are brought on line within 30 minutes, at which time hoisting can be initiated so that personnel do not have to stay underground for extended lengths of time.

- Decisions to evacuate underground personnel will be made in accordance with the requirements of the Mine Safety and Health Administration (**MSHA**)

- The waste hoist brakes set automatically so that loads do not fall

- Cranes retain their loads so that spills do not occur from dropped containers

- Communication systems are maintained
- The emergency operations center is powered if it is needed.

The CMS is a computerized system that collects, records, and displays data for all critical facility systems. The system is designed to provide a centralized, integrated location for collecting, monitoring, and storing facility parameters and is informed from signals provided by the seismic, meteorological, radiological effluent, and fire detection and alarm systems. Additionally, the CMS monitors heating, ventilation, air conditioning and electrical system status. Certain control functions of the underground ventilation fans, major facility electrical systems, and the backup diesel generators can be performed by the CMS from the CMR. The CMS can be set to alarm upon failure of the equipment monitored.

The CMS components of the WHB Unit and the Support Building are powered from the central UPS. The UPS features automatic switching without a loss of power from primary power to alternate power to battery backup power. The components located throughout the facility are powered by various electrical switchboards, with UPS battery backup.

The major components of the system are interconnected by means of a redundant network. The network is the communications medium for the CMS and consists of network cables routed throughout the facility. The network is designed such that no single point failure will cause failure of the entire network. Parameters or status are monitored by Local Processing Units strategically located throughout the surface and underground facility.

In addition, a number of automatic checks are performed on the internal processes associated with system components and network communications. If any fault is detected, the system has the capability to remove a component from the network and alert the CMR Operator (**CMRO**) of the fault. The status of the network is continuously monitored by the CMRO 24 hours per day, seven days per week. If a fault occurs, the CMRO initiates an AR within the Work Control system to correct the problem.

The RH Complex is included in the WHB. The Central UPS supplies power to the WHB which includes the RH Complex. The RH Bay, Hot Cell and Transfer Cell equipment are serviced by dual 1,300 KW diesel powered generators located between the exhaust shaft and the WHB. The generators provide backup power to both CH and RH waste handling operations. The RH waste handling equipment is designed to stop as a result of loss of power in a fail-safe condition. Power from the back-up generators may be utilized to place RH TRU mixed waste containers in process into a safe configuration. During a total power outage condition selected RH loads can be powered by the Central UPS. Within a short time selected RH loads at 480 volts and below can be powered by the Backup Diesel Generators. The backup central UPS for the WHB would also supply backup power to the RH Complex.

E-2e Personnel Protection

The following description of procedures, structures, or equipment used at the facility to prevent undue exposure of personnel to hazardous waste is required by 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(8)(v)).

Procedures used at the WIPP facility to prevent undue exposure of personnel to hazardous waste and the sections in this permit application where these procedures are discussed in detail are listed below.

- The TSDF-WAC are criteria designed to prevent the shipment or acceptance of TRU mixed waste exhibiting the characteristics of ignitability, corrosivity, or reactivity.

- Written procedures to prevent the addition of materials to the TRU mixed waste that could exhibit incompatibility or the characteristics of reactivity and/or ignitability are discussed in Section E-3 of this Permit Attachment.

- TRU mixed waste handling operations are conducted so that the need for TRU mixed waste handling personnel to touch the TRU mixed waste containers during unloading, overpacking (if necessary), and emplacement operations is minimized. Appropriate personal protective equipment (**PPE**) will be used depending on locations and operations (e.g., steel-toed shoes, hard hat, safety glasses inside a crane operating envelope; steel-toed shoes, hard hat, mine lamp, self rescuer, and safety glasses in the Underground).

- Tagout/Lockout and work authorization procedures, discussed in Section D-1, prohibit WIPP facility personnel from utilizing TRU mixed waste handling equipment that is temporarily out of service and prevent inappropriate use of TRU mixed waste handling equipment that is not operational for all uses.

- A system for monitoring and inspecting monitoring equipment, safety and emergency systems, security devices, and operating and structural equipment is in place to prevent, detect, or respond to environmental or human health hazards caused by hazardous waste. The inspection/monitoring requirements are described in Permit Attachment D.

- Adequate aisle space is maintained for emergency response purposes, as discussed in Section E-1b of this Permit Attachment.

- Procedures to protect personnel from hazardous and/or TRU mixed waste during nonroutine events are detailed in Permit Attachment F.

The following discusses the structures and equipment that prevent undue exposures of personnel at the WIPP facility to hazardous constituents:

- The WIPP facility was sited and designed to be protective of human health and ensure safe operations during the Disposal Phase.

- TRU mixed waste containers are required to meet shipping/structural requirements.

- The shipping container, forklifts, unloading dock, crane, facility pallets, containment pallets, facility transfer vehicle, waste shaft conveyance, and underground waste transporter were designed or selected for use in order to minimize the need for CH TRU mixed waste handling personnel to come into contact with CH TRU mixed waste. Each of these items is discussed in detail in Permit Attachments M1 and M2; Section E-2a of this Permit Attachment discusses prevention of hazards to personnel during unloading operations.

- The shipping containers, forklifts, cranes, cask shuttle, transfer cars, manipulators, Hot Cell, waste shaft conveyance, and HERE were designed or selected for use in order to minimize the need for RH TRU mixed waste handling personnel to come into contact with RH TRU mixed waste. These items are discussed in Permit Attachments M1 and M2. Section E-2a of this Permit Attachment discusses in detail prevention of hazards to personnel during unloading operations.

- The hood ventilation system, used during the initial opening of Contact Handled Packages, is used to vent any potential release of radioactive contaminants into the ventilation system of the WHB Unit (Permit Attachment M1).

- Differential air pressure between the RH TRU mixed waste handling locations in the RH Complex protects workers and prevents potential spread of contamination during handling of RH TRU mixed waste. Airflow between key rooms in the WHB are controlled by maintaining differential pressures between the rooms. The CH Receiving Bay is maintained with a negative pressure relative to outside atmosphere. The RH Receiving Bay is maintained with a requirement to be positive pressure relative to the CH Receiving Bay. The RH Hot Cell is maintained with a negative differential pressure relative to the RH Receiving Bay. The Hot Cell ventilation is exhausted through high-efficiency particulate air filters prior to venting through the WHB filtered exhaust.

- The WIPP facility has internal and external communications and alarm systems to notify personnel of emergency situations and provide instructions for response, evacuation, etc. as discussed in this Permit Attachment and Permit Attachment F.

- The WIPP facility is well equipped with spill-response equipment, transport vehicles, emergency medical equipment and rescue vehicles, fire detection, fire-suppression and firefighting equipment (including water for fire control), PPE, emergency lighting and backup power, and showers and eye-wash fountains. These are discussed in Sections E-1a, E-2c and E-2d of this Permit Attachment and are listed in Permit Attachment F.

- The surface and underground ventilation systems, discussed in Permit Attachment M2, are designed to provide personnel with a suitable environment during routine operations.

E-2f Releases to Atmosphere

The following description of procedures, structures, or equipment used at the facility to prevent releases to the atmosphere is required by 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(8)(vi)).

All TRU mixed waste will be contained. TRU mixed waste container vents employ particulate filters that prevent particulate releases to the atmosphere. The nature of the waste itself also mitigates potential releases to the atmosphere. Lead and other heavy metals, which could exhibit the characteristic of toxicity, may be present in some TRU mixed waste forms. The metal in the TRU mixed waste, most of which is lead in monolithic form, is present in bricks and shielding rather than in particulate form. The primary sources of other metals are sheets, rods, plating, equipment parts, or solidified sludges.

A release of hazardous waste or hazardous constituents to the air that may have adverse effects on human health or the environment is unlikely. Although VOCs could be present in the TRU mixed waste emplaced within the unit and could potentially be a source of release to the air, the volatile organic compound monitoring plan described in Permit Attachment N will be used to confirm that there is no adverse effects on human health and the environment.

E-2g Flammable Gas Concentration Control

Gas concentrations in the mine and around the underground HWDUs are controlled by mechanically induced ventilation. There are two primary ventilation fans and three filtration fans. If only one primary ventilation fan is ventilating the mine, it typically will be set to draw 260,000 ft^3 (7,358 m^3) per minute of air through the mine, which is sufficient to adequately ventilate all active areas in the mine. If both primary fans are operating, they will typically be set to draw 425,000 ft^3 (12,028 m^3) per minute of air through the mine. The filtration fans are interlocked so that only one filtration fan can operate at any time in the filtration mode. One filtration fan is normally set to draw 60,000 ft^3 (1,698 m^3) per minute of air through the mine. The air is routed through the underground facility with bulkhead doors and dampers to achieve the most efficient use of the air in ventilating for possible gases and maintaining required differential pressures in the underground facility.

The WIPP Mine Ventilation Plan are updated a least once a year or more often to accommodate changing underground conditions. Dead end drifts are fairly common in underground mines. Ventilation to accessible dead end drifts is provided by auxiliary fans and ducts to the extent necessary. Minimum requirements for air quantity, quality, and air flow velocity depend on the level of activity in a given area and are governed by Federal (30 CFR §57, Subpart G) and State regulations. Compliance with those regulations is monitored by facility personnel and through frequent inspections by regulatory authorities.

The WIPP Industrial Hygienist is responsible for monitoring and/or testing the air in the underground. The tests are on an as needed basis, in areas where chemicals are stored, and in areas where people are working that may contain hazardous concentrations of airborne fumes, mists, or vapors. All surveys are recorded; records contain location, time, job description, or occurrences associated with the contaminants, and the identification of instruments used.

Underground Facility Operations checks the underground air quality on a daily basis in all open drifts utilizing instrumentation which indicates Oxygen, Carbon Monoxide, and Flammable Gas concentration. The results of the monitoring are entered in the Shift Log Daily. If conditions are found that exceed established criteria, additional notification is made to the CMR. Appropriate actions are taken to determine the type of gases and impact on mine activities. The readings taken during specific tests for unusual conditions are recorded in the Daily Shift Log. All the monitoring performed by Underground Facility Operations is in accordance with MSHA (30 CFR §57).

Portable air monitoring equipment is used to assure access to all areas where air quality may be of concern. Two types of measuring systems are used at the WIPP: Draeger Pump Systems and Portable Air Monitoring Instruments. Prior to use, all instruments must have certification of current calibration and check gases must also be certified as accurate within one percent of the label concentration. Instruments are used within the guidelines established by the manufacturers and are accompanied with suitable temperature, barometric and relative humidity measurements (as required). Functional testing of instruments must be done before each use and the results must fall within the ranges specified in air monitoring procedures. Gases that are to be tested include oxygen, methane, carbon monoxide, hydrogen sulfide, sulphur dioxide, nitrogen dioxide, and chlorine. Alarm levels are set for each gas. Typical settings are as follows: O_2: 19.5% LOW; 23.0% HIGH; CH_4: 0.25%; CO: 25 ppm; H_2S: 10 ppm; SO_2: 2 ppm; NO_2: 1 ppm; Cl_2: 0.5 ppm. When alarm levels are reached, Industrial Safety is contacted to evaluate the conditions and to determine the appropriate actions. Equipment operation is by trained personnel only, or under the supervision of trained personnel. Air Quality sampling is performed as often as needed to assure safe working conditions. If conditions are worsening, or action has been taken to mitigate high levels of contamination, the frequency of measurement is increased. Underground air quality is checked at the beginning of the day when personnel are underground.

E-3 Prevention of Reaction of Ignitable, Reactive, and Incompatible Waste

20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(9)), requires a description of precautions taken to prevent accidental ignition or reaction of ignitable, reactive, or incompatible TRU mixed waste as required to demonstrate compliance with 20.4.1.900 NMAC (incorporating 40 CFR §270.15(c)), and 20.4.1.500 NMAC (incorporating 40 CFR §264.17). Because the TRU mixed waste (including the container) received at the facility during the Disposal Phase and any derived TRU mixed waste have been demonstrated to be compatible and do not exhibit the characteristics of ignitability, reactivity, or corrosivity, the WIPP facility is in full compliance with these regulations.

CHAPTER F

RCRA CONTINGENCY PLAN

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CHAPTER F

RCRA CONTINGENCY PLAN

TABLE OF CONTENTS

List of Tables

List of Figures

List of Drawings

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CHAPTER F

RCRA CONTINGENCY PLAN

Introduction

The WIPP facility is owned and co-operated by the Department of Energy (**DOE**) and co-operated by its designated Management and Operating Contractor (**MOC**) (Permit Condition I.D.3).

This Contingency Plan was prepared in accordance with the Resource Conservation and Recovery Act (**RCRA**) requirements codified in Title 20 of the New Mexico Administrative Code, Chapter 4.1.500 (20.4.1.500 NMAC, incorporating 40 CFR §264.50 to §264.56), "Contingency Plan and Emergency Procedures," and submitted in compliance with 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(7)). The purpose of this document is to define responsibilities, to describe coordination of activities, and to minimize hazards to human health and the environment from fires, explosions, or any sudden or nonsudden release of hazardous waste, or hazardous waste constituents to air, soil, or surface water (20.4.1.500 NMAC (incorporating 40 CFR §264.51 [a])). This plan consists of descriptions of processes and emergency responses specific to hazardous substances, contact-handled (**CH**) and remote-handled (**RH**) transuranic (**TRU**) mixed waste and other hazardous waste handled at the WIPP facility.

F-1 General Information

The WIPP facility is located 26 miles (mi) (42 kilometers [km]) east of Carlsbad, in Eddy County in southeastern New Mexico, and includes an area of 10,240 acres (ac) (4,144 hectares [ha]). The facility is located in an area of low-population density, with fewer than 30 permanent residents living within a 10 mi (16 km) radius of the facility. The area surrounding the facility is used primarily for grazing, potash mining, and mineral exploration. Resource development that would affect WIPP facility operations or the long-term integrity of the facility is not allowed within the 10,240 ac (4,144 ha) that have been set aside for the WIPP Project.

The WIPP facility is designed to receive containers of TRU waste, which will be transported to the WIPP facility from the ten major and other minor DOE TRU mixed waste generator and/or storage sites. The waste will be emplaced in the bedded salt of the Salado Formation, 2,150 feet (ft) (655 meters [m]) below ground surface.

As a geologic facility for the management of TRU mixed waste, the WIPP repository is regulated as a "miscellaneous unit," as defined under 20.4.1.500 NMAC (incorporating 40 CFR §264.601 to §264.603). The areas at the WIPP facility subject to this permit include the surface container storage areas in the Waste Handling Building (**WHB**) Container Storage Unit (**WHB Unit**) and the Parking Area Container Storage Unit (**Parking Area Unit**), located south of the WHB, and the areas below ground in which waste will be emplaced.

The WIPP facility includes other surface structures, shafts, and underground areas (Figures F-1, F-2, and F-3). Surface structures other than the WHB, that support TRU mixed waste management include:

Exhaust Filter Building - houses the filter banks to which the underground ventilation can be diverted in the unlikely event of an underground release of radionuclides.

Guard and Security Building - houses the facility security personnel and communications equipment necessary for them to perform their duties. Section F-4a specifies the duties of the security officers relative to contingency actions.

Safety and Emergency Services Building - houses the surface emergency response vehicles (fire truck, rescue truck, ambulance), Health Services (first aid), Emergency Operations Center, and the Dosimetry Laboratory. The Hazardous Material Response Trailer is staged at the WIPP facility in an area that is readily accessible to Emergency Services. Emergency Services is located in Building 452. Table F-6 describes emergency equipment and associated locations.

Support Building - houses the Central Monitoring Room (see section F-4a).

Transuranic Package Transporter-II (**TRUPACT-II**) Maintenance Facility - is located west of the CH bay. No TRU mixed waste management activities will occur in this facility.

Surface facilities used for storage of support equipment are identified in Table F-6.

Building 452, Safety and Emergency Services Facility, houses the emergency response vehicles, emergency equipment, the mine rescue room, mine rescue team equipment, and the Emergency Operations Center (**EOC**). The Hazardous Material Response Trailer is staged at the WIPP facility in an area readily accessible to Emergency Services. Emergency Services is located in Building 452.

The RCRA permit addresses TRU mixed waste management activities in the WHB Unit, the Parking Area Unit, and the disposal units. The provisions of this Contingency Plan apply to hazardous waste disposal units (**HWDU**) in the underground waste disposal panels, storage in the WHB Unit and the Parking Area Unit, the Waste Shaft, and supporting TRU mixed waste handling areas. The remainder of the facility will not manage TRU mixed waste. This Contingency Plan has also been designed in accordance with 20.4.1.300 NMAC (incorporating 40 CFR § 262.34(a)(4) - Standards for Generators of Hazardous Waste), and will be implemented whenever there is a fire, explosion, or release of hazardous waste which could threaten human health or the environment. Hazardous substances in the remainder of the facility are included as possible triggers of the Contingency Plan but are outside the scope of the regulations promulgated pursuant to RCRA. This allows WIPP to maintain one emergency response plan which is consistent with the National Response Teams Integrated Contingency Plan Guidance (Federal Register, Vol. 61, No. 109, June 5, 1996). Inclusion is based on their National Fire Protection Association (**NFPA**) ratings in addition to their storage quantities. The majority of hazardous substances on-site are not expected to trigger the Contingency Plan because they are present in the same form and concentration as the product packaged for distribution and use by the general public or are used in a laboratory under the direct supervision of a technically qualified individual. Superfund Amendments and Reauthorization Act (**SARA**) Title III excludes these from emergency planning reporting. The list of hazardous substances in large enough quantities to constitute a Level II incident (Section F-3) is provided in Table F-1. In addition to TRU mixed waste, these are the only hazardous substances currently on site which, if spilled, may be of sufficient impact to cause this Contingency Plan to be implemented. Magnesium Oxide (**MgO**) is stored on-site in large quantities. It is used as backfill in the waste emplacement rooms as a pH buffer. The pH buffer will limit the solubility of radionuclides after the underground rooms are filled and closed. MgO is not a hazardous substance, a release of MgO will not create hazardous waste and poses no threat to human health or the environment, and is therefore not addressed in the Contingency Plan.

Wastes generated as a result of maintenance or response actions will be categorized into one of three groups and disposed of accordingly. These are: 1) nonhazardous wastes to be disposed of in an approved landfill, 2) hazardous nonradioactive wastes to be disposed of at an off-site RCRA permitted facility, and 3) TRU mixed waste to be disposed of in the underground HWDUs. Disposal of TRU mixed waste in the WIPP facility is subject to regulation under 20.4.1.500 NMAC. As required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601), the Permittees will demonstrate that the environmental performance standards for a miscellaneous unit, which are applied to the HWDUs in the underground, will be met. In addition, the technical requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.170 to §264.178) are applied to the operation of the container storage units in the WHB Unit and in the Parking Area Unit south of the WHB. Liquid wastes that may be generated as a result of the fire fighting water or decontamination solutions will be managed as follows:

Non-Mixed - Hazardous waste liquids contaminated only with hazardous constituents will be placed into containers and managed in accordance with 20.4.1.300 NMAC (incorporating 40 CFR §262.34) requirements. The waste will be shipped to an approved off-site treatment, storage, or disposal facility.

Mixed - Liquids contaminated with TRU mixed waste (inside the WHB Unit) will be solidified as they are placed into containers with cement, Aquaset, or absorbent material in them. The solidified materials will be disposed of in the underground WIPP repository as derived waste.

This chapter of the permit application describes the HWDUs, the TRU mixed waste management facilities and operations, compliance with the environmental performance standards, and with the applicable technical requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.170 to §264.178 and §264.601, respectively). The configuration of the WIPP facility consists of completed structures; including all buildings and systems for the operation of the facility.

F-1a Disposal Phase Overview

The Disposal Phase will consist of receiving CH TRU mixed waste shipping containers, unloading and transporting the waste containers to the underground HWDUs, emplacing the waste in the underground HWDUs, and subsequently achieving closure of the underground HWDUs in compliance with applicable State and Federal regulations.

The TRU mixed waste that will be disposed at the WIPP facility results primarily from activities related to the reprocessing of plutonium-bearing reactor fuel and fabrication of plutonium-bearing weapons, as well as from research and development. This TRU mixed waste consists largely of such items as paper, cloth, and other organic material; laboratory glassware and utensils; tools; scrap metal; shielding; and solidified sludges from the treatment of wastewater. Much of this TRU mixed waste is also contaminated with substances that are defined as hazardous under 20.4.1.200 NMAC.

F-1b Waste Description

Waste destined for WIPP are, or were, produced as a byproduct of weapons production and have been identified in terms of waste streams based on the processes that produced them. Each waste stream identified by generators is assigned to a Waste Summary Category to facilitate RCRA waste characterization, and reflect the final waste forms acceptable for WIPP disposal.

These Waste Summary Categories are:

S3000—Homogeneous Solids
Solid process residues defined as solid materials, excluding soil, that do not meet the applicable regulatory criteria for classification as debris (20.4.1.800 NMAC (incorporating 40 CFR §268.2[g] and [h])). Included in solid process residues are inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste. Other waste streams are included in this Waste Summary Category based on the specific waste stream types and final waste form. This category includes wastes that are at least 50 percent by volume solid process residues.

S4000—Soils/Gravel
This waste summary category includes waste streams that are at least 50 percent by volume soil. Soils are further categorized by the amount of debris included in the matrix.

S5000—Debris Wastes
This waste summary category includes waste that is at least 50 percent by volume materials that meet the criteria for classification as debris (20.4.1.800 NMAC (incorporating 40 CFR §268.2)). Debris is a material for which a specific treatment is not provided by 20.4.1.800 NMAC (incorporating 40 CFR §268 Subpart D), including process residuals such as smelter slag from the treatment of wastewater, sludges or emission residues.

> Debris means solid material exceeding a 2.36 inch (60 millimeter) particle size that is intended for disposal and that is: 1) a manufactured object, 2) plant or animal matter, or 3) natural geologic material.

Included in the S5000 Waste Summary Category are metal debris, lead containing metal debris, inorganic nonmetal debris, asbestos debris, combustible debris, graphite debris, heterogeneous debris, and composite filters, as well as other minor waste streams. Particles smaller than 2.36 inches in size may be considered debris if the debris is a manufactured object and if it is not a particle of S3000 or S4000 material.

Examples of waste that might be included in the S5000 Waste Summary Category are asbestos-containing gloves, fire hoses, aprons, flooring tiles, pipe insulation, boiler jackets, and laboratory tabletops. Also included are combustible debris constructed of plastic, rubber, wood, paper, cloth, graphite, and biological materials. Examples of graphite waste that would be included are crucibles, graphite components, and pure graphite.

Wastes may be generated at the WIPP facility as a direct result of managing the TRU and TRU mixed wastes received from the off-site generators. Such generated waste may occur in either the WHB Unit or the Underground. For example, when TRU mixed wastes are received at the WHB Unit, the CH or RH Package shipping containers and the TRU mixed waste containers are checked for surface contamination. Under some circumstances,[1] if contamination is detected, the shipping container and/or the TRU mixed waste containers will be decontaminated. In the underground, waste may be generated as a result of radiation control procedures used during monitoring activities. The waste generated from radiation control procedures will be assumed to be TRU and/or TRU mixed waste. Throughout the remainder of this plan, this waste is referred to as "derived waste." All such derived waste will be placed in the rooms in HWDUs along with the TRU mixed waste for disposal.

F-1c <u>Containers</u>

The waste containers that will be used at the WIPP facility qualify as "containers," in accordance with 20.4.1.101 NMAC (incorporating 40 CFR §260.10). That is, they are "portable devices in which a material is stored, transported, treated, disposed of, or otherwise handled."

TRU mixed waste containers, containing off-site waste, will not be opened at the WIPP facility. Derived waste containers are kept closed at all times unless waste is being added or removed.

Liquid waste, including "derived waste" containing liquids, will not be emplaced in the WIPP. TRU mixed waste for emplacement in the WIPP shall contain as little residual liquid as is reasonably achievable. All internal containers (e.g., bottles, cans, etc.) will be well-drained, but

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[1] Typically contamination that is less than six square feet in area and less than 2000 disintegrations per minute (dpm) alpha or 20,000 dpm beta/gamma, may be decontaminated. Containers that exceed these thresholds will be returned to the point of origin for decontamination.

may contain residual liquids. As a guideline, residual liquids in well-drained containers will be restricted to approximately one percent of the volume of the internal container. In no case shall the total liquid equal or exceed one volume percent of the waste container (i.e., drum, standard waste box [**SWB**], ten-drum overpack, or canister).

Special requirements for ignitable, reactive, and incompatible waste are addressed in 20.4.1.500 NMAC (incorporating 40 CFR §§264.176 and 177). The RCRA Permit Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (**TSDF-WAC**) precludes ignitable, reactive, or incompatible TRU mixed waste from being placed into storage or disposed of at WIPP.

F-1d Description of Containers

CH TRU mixed waste containers will be either 55-gallon (gal) (208-liter (L)) drums singly or arranged into seven (7)-packs, 85-gal (321-L) drums (used as singly or arranged into four (4)-packs, 100-gal (379 L) drums singly or arranged into three (3)-packs, ten-drum overpacks (**TDOP**), or 66.3 ft^3 (1.88 m^3) SWBs.

RH TRU mixed waste containers are either canisters or drums. Canisters will be loaded singly in an RH-TRU 72-B cask and drums will be loaded in a CNS 10-160B cask. Drums in the CNS 10-160B cask will be arranged singly or in drum carriage units containing up to five drums each. Canisters and drums are described in Permit Attachment M1.

F-1e Description of Surface Hazardous Waste Management Units

The WHB is the surface facility where waste handling activities will take place. The WHB has a total area of approximately 84,000 square feet (ft^2) (7,804 square meters [m^2]) of which 43,554 ft^2 (4,047 m^2) are designated as the WHB Unit for TRU mixed waste management. Within the WHB Unit, 26,151 ft^2 (2,430 m^2) are designated for the waste handling and container storage of CH TRU mixed waste and 17,403 ft^2 (1,617 m^2) are designated for the handling and storage of RH TRU mixed waste. These areas are being permitted as container storage units. The concrete floors within the WHB Unit are sealed with an impermeable coating that has excellent resistance to the chemicals in TRU mixed waste and, consequently, provide secondary containment for TRU mixed waste. In addition, a Parking Area Unit south of the WHB will be used for storage of waste in sealed shipping containers awaiting unloading. This area is also being permitted as a container storage unit. The sealed shipping containers provide secondary containment in this hazardous waste management unit (**HWMU**).

F-1e(1) CH Bay Operations

Once unloaded from the Contact-Handled Package, CH TRU mixed waste containers (7-packs of 55-gal drums, 3-packs of 100-gal drums, 4-packs of 85-gal drums, SWBs, or TDOPs) are placed in one of two positions on the facility pallet. The waste containers are stacked on the facility pallets (one- or two-high, depending on weight considerations). The use of facility pallets will elevate the waste at least 6 inches (in.) (15 centimeters [cm]) from the floor surface. Pallets of waste will then be stored in the CH bay. This storage area will be clearly marked to indicate the lateral limits of the storage area. This storage area will have a maximum capacity of thirteen facility pallets of waste during normal operations. These pallets will typically be in the CH Bay storage area for a period of up to five days.

In addition, four Contact-Handled Packages, containing up to 640 ft^3 of CH TRU waste in containers, may occupy positions at the TRUPACT-II Unloading Docks (**TRUDOCK**).

Aisle space shall be maintained in all CH Bay waste storage areas. The aisle space shall be adequate to allow unobstructed movement of fire response personnel, spill-control equipment, and decontamination equipment that would be used in the event of an off-normal event. An aisle space between facility and containment pallets will be maintained in all CH TRU mixed waste storage areas.

F-1e(2) RH Complex Operations

Loaded RH TRU casks are received in the RH Bay of the WHB. The RH Bay is served by an overhead bridge crane used for cask handling and maintenance operations. Storage in the RH Bay occurs in the RH-TRU 72-B or CNS 10-160B casks. A maximum of two loaded casks may be stored in the RH Bay and a maximum of one cask in the Cask Unloading Room may be stored at one time. A minimum of 44 inches (1.1 m) will be maintained between loaded casks in the RH Bay. The cask serves as secondary containment in the RH Bay for the RH TRU mixed waste payload container. In addition, the RH Bay has a concrete floor.

Single RH TRU mixed waste canisters are unloaded from the RH-TRU 72-B casks in the Transfer Cell of the RH Complex where they are transferred to facility casks. Drums of RH TRU mixed waste will be transferred remotely from the CNS 10-160B cask, into the Hot Cell, and loaded into a canister. Storage in the Hot Cell occurs in either drums or canisters. A maximum of 12 55-gallon drums of RH TRU mixed waste and one 55-gallon drum of derived waste (94.9 ft^3 (2.7 m^3)) may be stored in the Hot Cell. Except for the derived waste drum, individual 55-gallon drums may not be stored in the Hot Cell for more than 25 days. The Transfer Cell houses the Transfer Cell Shuttle Car, which is used to facilitate transferring the canister to the facility cask. Storage in this area typically occurs at the end of a shift or in an off-normal event that results in the suspension of waste handling. A maximum of one canister (31.4 ft^3 (0.89 m^3)) may be stored in the Transfer Cell in a shielded insert in the Transfer Cell Shuttle Car or in a RH-TRU 72-B cask.

The Facility Cask Loading Room provides for transfer of a canister to the facility cask for subsequent transfer to the waste shaft conveyance and to the Underground Hazardous Waste Disposal Unit. The Facility Cask Loading Room also functions as an air lock between the waste shaft and the Transfer Cell. Storage in this area typically occurs at the end of a shift or in an off-normal event that results in the suspension of waste handling. A maximum of one canister (31.4 ft^3 (0.89 m^3)) may be stored in the Facility Cask in the Facility Cask Loading Room.

Derived waste will be stored in the RH Bay and in the Hot Cell.

F-1e(3) Parking Area Container Storage Unit (Parking Area Unit)

The area extending south from the WHB within the fenced enclosure identified as the Controlled Area on Figure M1-2 is defined as the Parking Area Container Storage Unit. This area provides storage for up to 6,734 ft^3 (191 m^3) of CH and/or RH TRU mixed waste contained in up to 40 loaded Contact-Handled Packages and 8 Remote-Handled Packages. Secondary containment and protection of the waste containers from standing rainwater are provided by the transportation containers. Up to 12 additional Contact-Handled Packages and four additional Remote-Handled Packages may be stored in the Parking Area Surge Area so long as the requirements of Permit Conditions III.A.2.c and III.A.2.d are met. No more than 50 Contact-Handled and 12 Remote-Handled Packages may be stored in the Parking Area Storage Unit.

The safety criteria for Contact-Handled and Remote-Handled Packages require that they be opened and vented at a frequency of at least once every 60 days. During normal operations, Contact-Handled and Remote-Handled Packages will not require venting while located in the Parking Area Unit. Any off-normal event which results in the need to store a waste container in the Parking Area Unit for a period of time approaching fifty-nine (59) days shall be mitigated by returning the shipment to the generator prior to the expiration of the 60 day NRC venting period or by moving the Contact-Handled or Remote-Handled Package inside the WHB Unit where the waste will be removed and placed in one of the permitted storage areas or in the underground hazardous waste disposal unit.

F-1f Off-Normal Events

Off-normal events could interrupt normal operations in the waste management process line. Shipments of waste from the generator sites will be stopped in any event which results in an interruption to normal waste handling operations that exceeds three days.

F-1g Containment

The WHB Unit has concrete floors, which are sealed with a coating designed to resist all but the strongest oxidizing agents. Such oxidizing agents do not meet the TSDF-WAC and will not be accepted in TRU mixed waste at the WIPP facility. Therefore, TRU mixed wastes pose no compatibility problems with respect to the WHB Unit floor.

During normal operations, the floor of the normal storage areas within the CH Bay and RH Complex shall be visually inspected on a weekly basis to verify that it is in good condition and free of obvious cracks and gaps. When a RH TRU mixed waste container is present in the RH Complex, inspections will be conducted visually and/or using closed-circuit television cameras in order to manage worker dose and minimize radiation exposures. Manual inspections of the areas are performed at least annually during routine maintenance periods when waste is not present.

Floor areas of the WHB used during off-normal events will be inspected prior to use and weekly while in use. Containers located in the permitted storage areas shall be elevated from the surface of the floor. Facility pallets provide at least 6 in (15 centimeters [cm]) of elevation from the surface of the floor. TRU mixed waste containers that have been removed from Contact-Handled or Remote-Handled Packages shall be stored at a designated storage area inside the WHB so as to preclude exposure to the elements.

Secondary containment at permitted storage areas inside the WHB Unit shall be provided by the floor. The Parking Area Unit and TRUDOCK storage area of the WHB Unit do not require engineered secondary containment, since waste is not stored there unless it is protected by the Contact-Handled or Remote-Handled Packaging. Floor drains, the fire suppression water collection sump, and portable dikes, if needed, will provide containment for liquids that may be generated by fire fighting. Sump capacities and locations are shown in Drawing 41-F-087-014. Residual fire fighting liquids will be placed in containers and managed as described above. Secondary containment at storage locations inside the RH Bay, Cask Unloading Room, Transfer Cell, and Facility Cask Loading Room is provided by the cask or canisters that contain drums of RH TRU mixed waste. In the Hot Cell, secondary containment is provided by the Hot Cell subfloor. In addition, the RH Complex contains a 220-gallon (833-L) sump in the Hot Cell, a 11,400-gallon (43,152-L) sump in the RH Bay, and a 220-gallon (833-L) sump in the Transfer Cell to collect any liquids.

F-2 Response Personnel

Persons qualified to act as the RCRA Emergency Coordinator, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.55), are listed in Table F-2.

A RCRA Emergency Coordinator will be on-site at the WIPP facility 24 hours a day, seven days a week, with the responsibility for coordinating emergency response measures. RCRA Emergency Coordinators are listed in Table F-2, where four individuals have been designated primary RCRA Emergency Coordinators. This is because the on-duty Facility Shift Manager (**FSM**) is designated as the RCRA Emergency Coordinator. The four individuals shown serve as FSM on a rotating shift basis.

Persons qualified to act as the RCRA Emergency Coordinator are thoroughly familiar with this Contingency Plan, the TRU mixed waste and hazardous waste operations and activities at the WIPP facility, the locations of TRU mixed waste and hazardous waste activities, the locations on the site where hazardous materials are stored and used, and the locations of waste staging and accumulation areas. They are familiar with the characteristics of hazardous substances, TRU mixed waste and hazardous waste handled at the WIPP facility, the location of TRU mixed waste and hazardous waste records within the WIPP facility, and the facility layout. In addition, persons qualified to act as the RCRA Emergency Coordinator have the authority to commit the necessary resources to implement this Contingency Plan. Figure F-4 outlines the RCRA Emergency Coordinator's position relative to other organizations that provide support.

In addition to the RCRA Emergency Coordinator, the following individuals or groups have specified responsibilities during any WIPP facility emergency:

- Assistant Chief Office Warden (**ACOW**)—Persons assigned to take accountability for sections of the site, and then reporting the accountability to the Chief Office Warden.

- Central Monitoring Room Operator (**CMRO**)—The on-shift operator responsible for Central Monitoring Room (**CMR**) operations, including coordination of facility communications. The facility log is maintained by the CMRO.

- Chief Office Warden (**COW**)—A predesignated individual with responsibilities for complete surface accountability at staging areas in the event of an evacuation. The Chief Office Warden receives reports from the ACOWs.

- Emergency Response Team (**ERT**)—Supplemental group trained to respond to surface emergencies, to provide emergency first aid, and to respond to releases of hazardous waste or hazardous material. ERT members are part of the WIPP Supplemental Emergency Response Program.

- Emergency Services Technician (**EST**)/Fire Protection Technician (**FPT**)—Regular employee whose job is that of full-time emergency responder. During non-emergency conditions, the EST/FPT inspects facility fire suppression systems and emergency equipment. The EST/FPT completes specific sections of the "WIPP Hazardous Material Incident Report." Additional technical personnel complete identified sections of the report.

- Fire Brigade—The fire brigade is a team of five personnel who respond to site emergencies. The team consists of an Incident Commander and four fire fighters. The fire fighters are trained in accordance with NFPA Standards for Industrial Fire Brigades (Fire Brigades that perform both advanced exterior and interior structural fire fighting).

- First Line Initial Response Team (**FLIRT**)—Supplemental primary responders in the event of a general underground emergency for medical and hazardous material response. The FLIRT also provides backup support for the ERT in the event of a general surface-facility emergency. FLIRT members are part of the WIPP Supplemental Emergency Response Program.

- Mine Rescue Team (**MRT**)—Supplemental group responsible for underground reentry and rescue after an emergency evacuation. The MRT responds in accordance with 30 CFR Part 49 requirements. MRT members are part of the WIPP Supplemental Emergency Response Program.

- Office Warden—An individual assigned responsibility for assuring that personnel are evacuated from his/her assigned area or building during evacuations. Office Wardens maintain a list of all personnel in their specific area. This list is compared with the physical presence of personnel who assemble at the staging areas. The Office Wardens report area accountability to the ACOWs.

- EOC Staff-The EOC consists of a minimum staff of three MOC management positions (the Crisis Manager, a Safety Representative and an Operations Representative) to activate the EOC. The full EOC Staff includes the Crisis Manager, the Deputy Crisis Manager, a Safety Representative, an Operations Representative and the EOC Coordinator. Additional technical and logistics personnel will provide support as necessary. The EOC is activated by the FSM. Since EOC staff are performing duties similar to their normal job functions and providing support related to their area of expertise, no specific RCRA training is required.

F-3 Implementation

The provisions of this Contingency Plan will be implemented immediately whenever there is an emergency event (e.g., a fire, an explosion, or a natural occurrence that involves or threatens hazardous or TRU mixed wastes or a release of hazardous substances, hazardous materials, or hazardous wastes) that could threaten human health or the environment, or whenever the potential for such an event exists as determined by the RCRA Emergency Coordinator, as required under 20.4.1.500 NMAC (incorporating 40 CFR §264.51(b)). The following information is utilized for categorization of events to determine implementation of the Contingency Plan:

1. Medical Emergencies (does not implement the Contingency Plan)

2. Non-emergency (does not implement the Contingency Plan)

    a. Fire already out, did not involve any hazardous materials.
    b. Spill or release involved materials excluded according to the SARA Title III, Statute 42 U.S.C. 11021 (e). Such as:

        1) Any substance present in the same form and concentration as product packaged for distribution and use by the general public. (Example: Cleaning solutions)
        2) Any substance to the extent it is used in a laboratory under the direct supervision of a technically qualified individual.
        3) Petroleum, including crude oil or any fraction thereof, which is not otherwise specifically listed or designated as a hazardous substance by Comprehensive Environmental Response, Compensation and Liability Act (**CERCLA**).

3. Incident Level I: According to the NFPA 471, Responding to Hazardous Materials Incidents (See Table F-3). If the product(s) involved in the fire, explosion, spill or leakage meets the following criteria, it will be classified as a Level I incident and does not implement the Contingency Plan.

a. The product does not require a U.S. Department of Transportation (**DOT**) placard, is a NFPA listed 0 or 1 for all categories, or is Other Regulated Materials A, B, C, or D.
b. The fire is under control and the reactivity rating of the material is less than a rating 2, indicating a low potential for subsequent explosion as the hazardous material can be considered normally stable.
c. There was no release or the release can be confined with readily available resources.
d. There is no life-threatening situation.
e. There is no potential environmental impact.

4. Incident Level II: According to NFPA 471, Responding to Hazardous Materials Incidents, (See Table F-3). If the product(s) involved in the fire, explosion, spill or leakage meets the following criteria, it will be classified as a Level II incident and the Contingency Plan will be implemented by the RCRA Emergency Coordinator.

a. The product requires a DOT placard, is an NFPA 2 for any categories, or is Environmental Protection Agency (**EPA**) regulated waste (Site-specific: Table F-1 and TRU mixed waste) AND
b. The incident involves multiple packages.
c. There is potential for the fire to spread since the hazardous material's flammability level (rating 2) is below 200 degrees Fahrenheit, or the reactivity (rating 2) indicates that violent chemical changes are possible and thus may be explosive.
d. The release may not be controllable without special resources.
e. The incident requires evacuation of a limited area for life safety.
f. The potential for environmental impact is limited to soil and air within incident boundaries.
g. The container is damaged but able to contain the contents to allow handling or transfer of product.

5. Incident Level III: According to NFPA 471, Responding to Hazardous Materials Incidents. (See Table F-3) If the product(s) involved in the fire, explosion, spill or leakage meet the following criteria, it will be classified as a Level III incident and the Contingency Plan will be implemented by the RCRA Emergency Coordinator.

a. The product is a poison A (gas), an explosive A/B, organic peroxide, flammable solid, material that is dangerous when wet, chlorine, fluorine, anhydrous ammonia, NFPA 3 and 4 for any categories including special hazards, EPA extremely hazardous substances, and cryogenics.
b. The site-specific container size for this incident level will be a tank truck.
c. There is potential for the fire to spread since the hazardous material's flammability level (rating 3 or 4) is below 100 degrees Fahrenheit, or the reactivity (rating 3 or 4) indicates that the material may explode.
d. The release may not be controlled even with special resources.
e. The incident requires mass evacuation of a large area for life safety.

f. Even though the NFPA guidelines for this incident level indicate that the potential for environmental impact is severe, due to the site engineering controls, the impact is contained within the HWMUs.
g. The container is damaged to such an extent that catastrophic rupture is possible.

The above categories include fire situations, weather conditions, natural phenomena, and explosions which will have to be evaluated to make an incident level determination. A Level II (potential threat to human health in localized area, potential for moderate on-site environmental impact) or Level III (potential threat to human health in a larger area, potential for severe environmental impact) incident by definition is considered to be a potential threat to human health or the environment and, therefore, is considered to be an emergency requiring activation of the Contingency Plan.

F-4 Emergency Response Method

Methods that describe how and when the WIPP Contingency Plan will be implemented cover the following 11 implementation areas:

1. Notification (Section F-4a)
2. Identification of hazardous materials (Section F-4b)
3. Assessment of the nature and extent of the emergency (Section F-4c)
4. Control, containment, and correction of the emergency (Section F-4d)
5. Prevention of recurrence or spread of fires, explosions, or releases (Section F-4e)
6. Management and containment of released material and waste (Section F-4f)
7. Incompatible waste (Section F-4g)
8. Post-emergency facility and equipment maintenance and reporting (Section F-4h)
9. Container spills and leakage (Section F-4i)
10. Tank spills and leakage (Section F-4j)
11. Surface impoundment spills and leakage (Section F-4k)

F-4a Notification

Notification requirements in the event of an emergency at a RCRA hazardous waste management facility are defined by 20.4.1.500 NMAC (incorporating 40 CFR §§264.56(a) and (d)). Necessary notifications in case of an emergency at the WIPP facility are described in this section (Figure F-4a). Personnel at the WIPP facility are trained to respond to emergency notifications.

F-4a(1) Initial Emergency Response and Alerting the RCRA Emergency Coordinator

The first person to become aware of an incident shall immediately report the situation to the CMRO, and provide the following information, as appropriate:

- Name and telephone number of the caller
- Location of the incident and the caller
- Time and type of incident
- Severity of the incident
- Magnitude of the incident
- Cause of the incident
- Assistance needed to deal with or control the incident
- Areas or personnel affected by the incident

In addition to receiving incident reports, the CMRO, who is located in the Support Building (Building 451) (Figure F-1), continuously monitors (24 hours a day) the status of mechanical, electrical, and/or radiological conditions at selected points on the site, both above and below ground. Alarms to indicate abnormal conditions are located throughout the WIPP facility. The alarm(s) (e.g., fire, radiation) may be the first notification of an emergency situation received by the CMRO. The CMRO monitors alarms, takes telephone calls and radio messages, and initiates outgoing calls to emergency staff and outside agencies.

Once the CMRO is notified of a fire, explosion, or a release anywhere in the facility (either by eyewitness or an alarm), the RCRA Emergency Coordinator is immediately notified. Once notified, the RCRA Emergency Coordinator assumes responsibility for the management of activities related to the assessment, abatement, and/or cleanup of the incident.

A RCRA Emergency Coordinator is on-site at all times and, therefore, can be reached at any time via a two-way radio or over the public address (**PA**) and plectrons on-site. If the RCRA Emergency Coordinator is unavailable or unable to perform these duties, a qualified alternate RCRA Emergency Coordinator is available.

The EST/FPT is also notified in case of fire, explosion, or release. The RCRA Emergency Coordinator, as incident commander, determines if supplemental emergency responders are necessary. Notification of the ERT (surface) is made by using the ERT pagers and/or the public announcement system. Notification of the FLIRT is by using the Mine Page Phone System. If the MRT is needed the RCRA Emergency Coordinator will instruct the CMRO to make a PA announcement for the MRT to assemble in the Mine Rescue Room, located in a predetermined location.

Off-shift personnel may be notified using the on-call list, which is updated weekly by the Permittees. The FSM/CMRO, each individual on the on-call list, and WIPP Security receive copies of the on-call list. The CMRO may direct Security to make the notifications.

The response to an unplanned event will be performed in accordance with procedures based on the applicable Federal, State, or local regulations and/or guidelines for that response. These include the U.S. Mine Safety and Health Administration (**MSHA**); NMAC; CERCLA; Chapter 74, Article 4B, New Mexico Statutes Annotated 1978, New Mexico Emergency Management Act; and agreements between the Permittees and local authorities (Section F-6) for emergencies throughout the WIPP facility.

After notification by the CMRO, the EST/FPT shall immediately investigate to determine pertinent information relevant to the actual or potential threat posed to human health or the environment. The information will include the location of release, type, and quantity of spilled or released material (or potential for release due to fire, explosion, weather conditions, or other naturally occurring phenomena), source, areal extent, and date and time of release. The EST/FPT shall provide information for classification of the incident, according to the emergency response guidelines, to the RCRA Emergency Coordinator. The RCRA Emergency Coordinator then classifies the incident after evaluation of all pertinent information. This classification will consider both direct and indirect effects of the release, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water run-off from water or chemical agents used to control fire and heat-induced explosions).

When the RCRA Emergency Coordinator determines that an Incident Level II or III has occurred, the Contingency Plan is implemented. The RCRA Emergency Coordinator then may choose to activate the EOC for additional support (Figure F-4). If the RCRA Emergency Coordinator determines that due to extenuating circumstances the potential to upgrade to an incident Level II or III exists, the RCRA Emergency Coordinator also may activate the EOC. The EOC will assist the RCRA Emergency Coordinator in mitigation of the incident with use of communications equipment and technical expertise from any WIPP organization (see Section F-4c).

The EOC staff will assess opportunities for coordination and the use of mutual-aid agreements with local outside agencies making additional emergency personnel and equipment available (Section F-6), as well as the use of specialized response teams available through various State and Federal agencies. As a DOE-owned facility, the WIPP facility may use the resources available from the Federal Response Plan, signed by 27 Federal departments and agencies in April 1987, and developed under the authorities of the Earthquake Hazards Reduction Act of 1977 (42 U.S.C. 7701 et seq.) and amended by the Stafford Disaster Relief Act of 1988. Most resources are available within 24 hours. The WIPP facility maintains its own emergency response capabilities on-site. In addition to the supplemental emergency responders, radiological control technicians, environmental sampling technicians, wildlife biologists, and various other technical experts are available for use on an as-needed basis.

F-4a(2) Communication of Emergency Conditions to Facility Employees

Procedures for notifying facility personnel of emergencies depend upon the type of emergency. Methods of notification are:

- Local Fire Alarms

  The local fire alarms sound a bell tone and may be activated automatically or manually in the event of a fire.

- Surface Evacuation Signal

  The evacuation signal is a yelp[2] tone and is manually activated by the CMRO when needed. The CMRO shall follow the evacuation signal with verbal instructions and ensure the Site Notification System (i.e., the plectron) has been activated.

- Underground Evacuation Warning System

  The evacuation signal is a yelp tone and flashing strobe light. In the event of an evacuation signal, underground personnel will proceed to the nearest egress hoist station (Section F-7b) to be apprised of the nature of the emergency and the evacuation route to take. Underground personnel are trained to report to the underground assembly areas and await further instruction if all power fails or if ventilation stops. If evacuation of underground personnel is required, this will be done using the backup electric generators and in accordance with the applicable requirements of MSHA.

- Contingency Evacuation Notification

  If the primary warning system consisting of alarms and signals fails to operate when activated (as in a total power outage and failure of the back-up power systems), WIPP Security will be notified by the CMRO to initiate the contingency evacuation plan. In this event Security officers will alert personnel to evacuate the area and will check trailers, if possible, to ensure that personnel have been alerted/evacuated.

WIPP facility personnel are trained and given instruction during General Employee Training to recognize the various alarm signals and the significance of each alarm. WIPP facility employees and site visitors are required to comply with directions from emergency personnel and alarm system notifications and to follow instructions concerning emergency equipment, shutdown procedures, and emergency evacuation routes and exits.

[2] The yelp tone increases from 500 to 1,000 hertz and drops to 500 hertz.

F-4a(3) Notification of Local, State, and Federal Authorities

If it is determined that the facility has had a fire, an explosion, a spill, or a release of hazardous waste or hazardous waste constituents (included in 20.4.1.200 NMAC (incorporating 40 CFR § 261)) in the miscellaneous unit or TRU mixed waste handling areas, or an emergency resulting in a release of a hazardous substance (included in 40 CFR §302.4 and §302.6 or the New Mexico Emergency Management Act, §74-4B-3 and §74-4B-5) that could threaten human health or the environment outside the facility, the RCRA Emergency Coordinator, after consultation with the DOE as the owner of the facility, will assure that local authorities are notified by telephone and/or radio, including:

- Carlsbad Police Department (telephone number: [505] 885-2111) (or 911)
- Carlsbad Fire Department (telephone number: [505] 885-2111) (or 911)
- Eddy County Sheriff (telephone number: [505] 887-7551)
- Hobbs Fire Department (telephone number: [505] 397-9265)

After local authorities are notified, the RCRA Emergency Coordinator will ensure notification of the following:

- New Mexico Environment Department (**NMED**)
  Department of Public Safety
  24-Hour Emergency Reporting Telephone Number: (505) 827-9329
  FAX number: (505) 827-9368

- Department of Public Safety WIPP Coordinator
  Telephone Number: (505) 827-9221
  FAX number: (505) 829-3434

- Hazardous Materials Emergency Response, Chemical Safety Office, Department of Public Safety, State Emergency Response Commission
  Telephone number: (505) 476-9681
  FAX number: (505) 476-9695

- National Response Center
  Telephone number: 1-800-424-8802
  FAX number: (202) 479-7181

- Local Emergency Planning Committee
  Telephone number: (505) 885-3581
  Fax number: (505) 628-3973

The first notification of public safety and regulatory agencies will include the following:

- The name and address of the facility and the name and phone number of the reporter
- The type of incident (fire, explosion, or release)
- The date and time of the incident
- The type and quantity of material(s) involved, to the extent known
- The exact location of the incident
- The source of the incident
- The extent of injuries, if any
- Possible hazards to human health and the environment (air, soil, water, wildlife, etc.) outside the facility
- The name, address, and telephone number of the party in charge of or responsible for the facility or activity associated with the incident
- The name and the phone number of the RCRA Emergency Coordinator
- The identity of any surface and/or groundwater involved or threatened and the extent of actual and potential water pollution
- The steps being taken or proposed to contain and clean up the material involved in the incident

The RCRA Emergency Coordinator will also be available to advise the appropriate local, State, or Federal officials on whether or not local areas should be evacuated.

F-4a(4) Notification of the General Public

Immediate notification of the general public through the public safety and emergency agencies listed above will be made by, or under the direction of, the RCRA Emergency Coordinator following an evaluation to determine if local adjacent areas need to be evacuated. This evaluation will be made in consultation with the DOE who, as the owner of the facility, has management responsibility for the land withdrawal area. DOE policy is to provide accurate and timely information to the public by the most expeditious means possible concerning emergency situations at the WIPP site that may affect off-site personnel, public health and safety, and/or the environment. A DOE Carlsbad Field Office (**DOE/CBFO**) Management representative is always on-call. This person is available by pager or telephone 24 hours a day.

A Hazards Assessment was conducted, which indicated no need for protective actions or emergency action levels, as defined by the Permittees, for the facility. Therefore, no procedures are in place for evacuation of the public. Procedures are in place for notification of the public by radio, television, and newspapers for news items which might include notification of on-site emergency situations. These procedures include a Public Affairs Coordinator in the EOC who writes and transmits press releases to the DOE/CBFO office, where formal press conferences are conducted.

F-4b Identification of Hazardous Materials

The identification of hazardous wastes, hazardous waste constituents, or hazardous materials involved in a fire, an explosion, or a release to the environment is a necessary part of the assessment of an incident, as described in 20.4.1.500 NMAC (incorporating 40 CFR §264.56(b)). RCRA hazardous waste and hazardous substances and materials listed in 40 CFR §302.4 and §302.6 or New Mexico Emergency Management Act, §74-4B-3 and §74-4B-5 and, involved in any release at the WIPP facility will be identified. The identification of likely hazardous materials at any location is enhanced because hazardous materials and hazardous waste are only stored or managed in specified locations throughout the WIPP facility. An attempt will be made to identify products involved by occupancy/location, container shape, markings/color, placards/labels, United Nations/North America/Product Identification Number, on-site technical experts, or field sampling. Further, the ES&H department maintains an updated inventory of hazardous materials/substances that are brought on site, and a master MSDS listing in the Safety and Emergency Services Facility, Building 452.

Sources of information available to identify the hazardous wastes, substances, or materials involved in a fire, an explosion, or a release at the WIPP facility include operator/supervisor knowledge of their work areas, materials used, and work activities underway; the WIPP Waste Information System (**WWIS**), which identifies the location within the facility of emplaced TRU mixed waste, including emplaced derived waste; and waste manifests and other waste characterization information in the operating record. The WWIS also includes information on wastes that are in the waste handling process. Also available are MSDSs for hazardous material in the various user areas throughout the facility, waste acceptance records, and materials inventories for buildings and operating groups at the WIPP facility. Information or data from the derived waste accumulation areas, the hazardous waste staging area, satellite staging areas, and nonregulated waste accumulation areas are included.

TRU mixed waste received by the WIPP facility during the Disposal Phase will be characterized for hazardous constituents prior to receipt, and acceptable knowledge will be used to characterize derived waste prior to emplacement.

Information required for identifying TRU mixed hazardous constituents in case of an incident is readily available through the WWIS and the waste acceptance records. Waste accepted at WIPP is already known to be compatible with all materials used to respond to an emergency. All non-TRU mixed waste materials received on site, other than those listed in Table F-1, are in such small quantities that no reaction could develop which would trigger an Incident Level II or III response.

The RCRA Emergency Coordinator will have access to the WWIS through Operations, or through the Facility Shift Manager's Office.

The RCRA Emergency Coordinator has access to the inventory lists and MSDSs in the Safety and Emergency Services Facility at all times.

F-4c Assessment of the Nature and Extent of the Emergency

Once the required notifications have been made, the RCRA Emergency Coordinator will ensure that the identity, exact source, amount, and areal extent of any released materials are determined, as required under 20.4.1.500 NMAC (incorporating 40 CFR §264.56(b)). The RCRA Emergency Coordinator will determine whether the occurrence constitutes an emergency based on knowledge of the area and access to the waste identification/characterization information described in Section F-4b. An emergency will require response by only trained emergency response personnel. The RCRA Emergency Coordinator will be responsible for responding to immediate and potential hazards, using the services of trained personnel to determine: 1) the identity of hazardous wastes, hazardous waste constituents, and other hazardous materials involved in a release, as described in Section F-4b; 2) whether or not a release involved a reportable quantity of a hazardous substance; 3) the areal extent of a release; 4) the exact source of a release; and 5) the potential hazards to human health or to the environment.

After the materials involved in an emergency are identified, the specific information on the associated hazards, appropriate personal protective equipment (**PPE**), decontamination, etc., will be obtained from MSDSs and from appropriate chemical reference materials at the same location. These information sources may be accessed by the RCRA Emergency Coordinator or through several WIPP facility organizations.

The emergency assessment requires determination of hazards involving evaluation of several criteria, including:

- Exposure: magnitude of actual or potential exposure to employees, the general public, and the environment; duration of human and environmental exposure; pathways of exposure

- Toxicity: types of adverse health or environmental effects associated with exposures; the relationship between the magnitude of exposure and adverse effects

- Reactivity: hazardous materials or hazardous wastes, which are not TRU mixed wastes, involved in an incident will be assessed for reactivity through accessing the MSDSs for the affected material and the recommended method(s) for managing such waste

- Uncertainties: considerations for undeterminable or future exposures; uncertain or unknown health effects, including future health effects

F-4d Control, Containment, and Correction of the Emergency

The WIPP facility is required to control an emergency and to minimize the potential for the occurrence, recurrence, or spread of releases due to the emergency situation, as described in 20.4.1.500 NMAC (incorporating 40 CFR §264.56 (e)). The WIPP Emergency Response procedures utilize the incident mitigation guidelines in NFPA 471, Responding to Hazardous Materials Incidents, with initial response priority being on control, and those actions necessary to ensure confinement and containment (the first line of defense) in the early, critical stages of a spill or leak. The RCRA Emergency Coordinator is responsible for stopping processes and operations when necessary, and removing or isolating containers. TRU mixed waste will remain within the WHB Unit, the Parking Area Unit, and the underground HWDU.

F-4d(1) All Emergencies

The WIPP Emergency Response procedures include, but are not limited to, the following actions appropriate for control:

1. Isolate the area from unauthorized person by fences, barricades, warning signs, or other security and site control precautions. Isolation and evacuation distances vary, depending upon the chemical/product, fire, and weather situations.
2. Identify the chemical/product according to Section F-4b.
3. Drainage controls.
4. Stabilization of physical controls (such as dikes or impoundment[s]).
5. Capping of contaminated soils to reduce migration.
6. Using chemicals and other materials to retard the spread of the release or to mitigate its effects.
7. Excavation, consolidation, removal, or disposal of contaminated soils.
8. Removal of drums, barrels, or tanks where it will reduce exposure risk during situations such as fires.

If the facility stops operations in response to a fire, explosion, or release, the RCRA Emergency Coordinator shall ensure continued monitoring for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever appropriate. If operations continue, personnel normally assigned to these tasks will continue.

Both natural and synthetic methods will be employed to limit the releases of hazardous materials so that effective recovery and treatment can be accomplished with minimum additional risk to human health or the environment. A combination of the above methods to achieve protection of human health and the environment, with emphasis on two basic methods for mitigation of hazardous materials incidents - Physical and Chemical (Tables F-4, F-5) mitigation, will be used.

1. Physical methods of control involve any of several processes to reduce the area of the spill/leak, or other release mechanism (such as fire suppression).

    A. Absorption is the process in which materials hold liquids through the process of wetting. Absorption is accompanied by an increase in the volume of the sorbate/sorbent system through the process of swelling. Some of the materials utilized in response to Level I incidents or Level II incidents involving liquids will be absorbent sheets of polyolefin-type fibers, spill control bucket materials (specifically for solvents, neutralization, or for acids/caustics), and absorbent socks for general liquids or oils.

    B. Covering refers to a temporary form of mitigation for radioactive incidents that will be utilized in response to Level II or Level III incidents involving CH TRU mixed waste. These could include absorbent sheets, plastic, or actual ambulance blankets.

    C. Dikes or Diversions refer to the use of physical barriers to prevent or reduce the quantity of liquid flowing into the environment. Dikes may be soil or other barriers temporarily utilized to hold back the spill or leak. Diversion refers to the methods used to physically change the direction of the flow of the liquid. Absorbent socks or earth may be utilized as dikes or diversions for all levels of incidents.

    D. Overpacking is accomplished by the use of an oversized container. Overpack containers will be compatible with the hazards of the materials involved.

    E. Plug and Patch refers to the use of compatible plugs and patches to reduce or temporarily stop the flow of materials from small holes, rips, tears, or gashes in containers. A Series “A” hazardous response kit containing nonsparking equipment to control and plug leaks may be utilized for response to all levels of incidents.

    F. Transfer refers to the process of moving a liquid, gas, or some forms of solids, either manually or by pump, from a leaking or damaged container. Scoops, shovels, jugs, and pails as well as drum transfer pumps for chemical and petroleum transfer are utilized as needed in response to all levels of incidents.

    G. Vapor Suppression refers to the reduction or elimination of vapors emanating from a spilled or released material through the most efficient method or application of specially designed agents such as an aqueous foam blanket.

2. Chemical Methods of Mitigation

    A. Neutralization is the process of applying acids or bases to a spill to form a neutral salt. The application of solids for neutralizing can often result in confinement of the spilled material. This would include using the neutralizing adsorbents.

B. Solidification is the process whereby a hazardous liquid is added to material such as an absorbent so that a solid material results.

The established procedures are based upon the incident level and a graded approach for nonradioactive or CH TRU waste emergencies and initiated to:

1. Minimize contamination or contact (through PPE, etc.)
2. Limit migration of contaminants
3. Properly dispose of contaminated materials

For RH TRU mixed waste, the detection of contamination on or damage to a RH TRU mixed waste canister or a facility canister may occur outside the Hot Cell during cask to cask transfer of the canister or during loading of the Shielded Insert in the Transfer Cell. When such contamination or damage is found, the Permittees have the option to decontaminate or return the canister to the generator/storage site or another site for remediation. In the case of a damaged facility canister, the Shielded Insert may be used as an overpack to facilitate further management. Contamination may also be detected within the Hot Cell during the unloading of the CNS 10-160B shipping cask. In this case, the Permittees may decontaminate the 55-gallon drums or return them to the generator/storage site or another site for remediation. Spills or releases that occur within the RH Complex or the underground as the result of RH TRU mixed waste handling will be mitigated by using appropriate measures which may include the items above.

F-4d(2) Fire

The incident level emergency response identified in Section F-3 includes fire/explosion potential. WIPP fire response includes incipient, exterior structure fires, and internal structure fires. The RCRA Emergency Coordinator can implement the Memoranda of Understanding (**MOU**) for additional support.

The first option in mine fire response will be to apply mechanical methods to stop fires (e.g., cut electrical power). The last option in mine fire response will be to reconfigure ventilation using control doors associated with the underground ventilation system. The following actions are implemented in the event of a fire:

1. All emergency response personnel at an incident will wear appropriate PPE.

2. Only fire extinguishing materials that are compatible with the materials involved in the fire will be used to extinguish fires. Compatibility with materials involved in a fire are determined by pre-fire plans, Emergency Response Guide Book (DOT, 1993), DOT labeling, and site-specific knowledge of the emergency response personnel. Water and dry chemical materials have been determined to be compatible with all components of the TRU mixed waste. Pre-fire plans for the WHB are included in Figures F-10 and F-11.

   Fires in areas of the WHB Unit should not propagate, due to limited amount of combustibles, and the concrete and steel construction of the structures. Administrative controls, such as landlord inspections and EST/FPT inspections, help to insure good housekeeping is maintained. Combustible material and TRU mixed waste will be isolated, if possible. Firewater drain trenches collect the water and channel it into a sump. In areas not adjacent to the trenches, portable absorbent dikes (pigs) will be used to retain as much as possible, until it can be transferred to containers or sampled and analyzed for hazardous constituents.

3. If the fire spreads or increases in intensity, personnel will be directed to evacuate.

4. The RCRA Emergency Coordinator will remain in contact with responding personnel to advise them of the known hazards.

5. In order to ensure that storm drains and/or sewers do not receive potentially hazardous runoff, dikes will be built around storm drains to control discharge as needed. Collected waste will be sampled and analyzed for hazardous constituents, before being discharged to evaporation ponds. There are two ponds south of the security fence, opposite the WHB Unit, that will collect drainage from the parking area. The rest of the site, inside the security fence, drains to the large pond to the west. Samples will be taken from these ponds, after the emergency has been abated, to determine any cleanup requirements. NMED will approve any procedures associated with the sampling and analysis of the ponds.

6. The RCRA Emergency Coordinator maintains overall control of the emergency and may accept and evaluate the advice of WIPP facility personnel and emergency response organization members, but retains overall responsibility.

7. The RCRA Emergency Coordinator will be in overall control of WIPP facility emergency response efforts until the emergency is terminated.

8. Materials involved in a fire can be identified in the following ways:

   - According to Section F-4b.

   - If the contents of the waste container cannot be determined based on its location and the label is destroyed by fire, the material will be treated as an unknown, evaluated for radiological contamination, and analyzed according to methods in the EPA’s “Test Methods for Evaluating Solid Waste Physical/Chemical Methods” (**SW-846**), Third Edition, after the fire has been extinguished.

   - Airborne radioactivity samples may be obtained during a fire involving radioactive materials, using portable and fixed air samplers. Response personnel will be adequately protected from airborne radioactivity by their PPE required for fire response.

9. Only materials compatible with the waste may be used for fire response.

10. When cleanup has proceeded to the point of finding no radionuclide activity, then the "swipe" can be sent for analysis for hazardous constituents. The use of these confirmation analyses is as follows:

    - For waste containers, once radiologically clean and free of any visible evidence of hazardous waste spills on the container, it will be placed in the underground without further action.

    - For area contamination, once the area is cleaned up and is shown to be radiologically clean, it will be sampled for the presence of hazardous waste residues (for further information see Section F-4d, Emergency Termination Procedures).

11. Fire suppression materials used in response to incidents will be retained on-scene, where an evaluation will be performed to determine appropriate recovery and disposal methods.

F-4d(3) Explosion

The following actions will be implemented in the event that an explosion that involves or threatens hazardous or TRU mixed waste or hazardous materials has occurred:

1. The area will be evacuated immediately.

2. The CMRO will immediately notify the appropriate emergency response personnel and the RCRA Emergency Coordinator about the explosion.

3. Injured personnel will be treated and transported as necessary.

4. The RCRA Emergency Coordinator will remain in contact with responding personnel to advise them of the known hazards involved and the degree and location of the explosion and associated fires.

5. The RCRA Emergency Coordinator will be in command and may accept and evaluate the advice of WIPP facility personnel and emergency response organization members, but retains the overall responsibility. Selections of methods and tactics of response are the responsibility of the Incident Commander.

6. The RCRA Emergency Coordinator will be in overall control of WIPP facility emergency response efforts until the emergency is terminated.

7. When cleanup has proceeded to the point of finding no radionuclide activity, then samples may be taken for chemical analysis if there is visible evidence to suspect additional hazardous waste residues. Chemical residues on floor surfaces resulting from a hazardous waste explosion will be evaluated, sampled, analyzed (if required), isolated,

and returned to appropriate containers, and surfaces will be cleaned using appropriate cleaners.

8. The RCRA Emergency Coordinator may shut down operational units (e.g., process equipment and ventilation equipment) that have been affected directly or indirectly by the explosion. Once the areas have been determined safe for reentry, processes may be reactivated.

F-4d(4) Spills

Protection of response personnel at a hazardous material incident is paramount. The primary methods to protect personnel are time, distance, and shielding. If a Level II or III incident exists, the RCRA Emergency Coordinator will implement the following actions:

1. The immediate area will be evacuated.

2. The RCRA Emergency Coordinator will review facility records to determine the identity and chemical nature of released material.

3. Entry team procedures will be utilized, with special attention to the following:

   - Buddy system
   - Appropriate PPE
   - Backup rescue team
   - Supplemental communication signals (hand signals and hand-light signals)
   - Monitoring equipment
   - Exposure time limitations

4. If possible, the source of the release will be secured.

5. A dike to contain runoff may be built.

6. Emergency responders will ensure that storm drains and/or sewers do not receive potentially hazardous runoff or spilled material. They may build dikes around storm drains to control discharge.

7. Released wastes may be collected and contained by stabilizing or neutralizing the spilled material, as appropriate, pouring an absorbent over the spilled material, and sweeping or shoveling the absorbed material into drums or other appropriate containers. The absorbents have been determined to be compatible with all components of the TRU mixed waste.

8. No TRU mixed waste that may be incompatible with the released material will be managed in the affected area until cleanup procedures are complete.

9. The RCRA Emergency Coordinator will direct spill control, decontamination, and termination procedures described below.

F-4d(5) Decontamination of Personnel

Decontamination of personnel with radioactive contamination is the responsibility of the Radiological Control (**RC**) section. If a person is contaminated with radioactivity during a site evacuation to the staging areas, the contaminated area will be covered before the person can be moved (under escort by RC personnel) to the staging area. The RC personnel will ensure the contaminated person remains segregated from other site personnel while under RC supervision.

In the event of an emergency that requires immediate evacuation of the area, the contamination can be covered by any method warranted, given the circumstance (e.g., clean clothing wrapped around the area). If the size of the radioactive contamination on the body is small and localized, it can be covered with clothing (e.g., glove, shoe cover, coveralls). If the size of the radioactive contamination on the body is large, it may be covered by dressing the individual in a full set of Anti-Contamination clothing (coveralls, hood, gloves, shoe covers, etc.).

If time and location permit and the contamination is on the face, it will be decontaminated immediately using a cloth moistened with tepid water (and a mild detergent, if necessary). If the size of the radioactive contamination on the individual's body is small and localized, it will be decontaminated using the same method as for the face, but after the individual has been transferred to an area appropriate for conducting decontamination.

If the individual is transferred to the staging area prior to decontamination, he/she will be decontaminated at the staging area using site procedures for personnel decontamination and using decontamination supplies and equipment as appropriate for the extent and magnitude of the contamination.

F-4d(6) Control of Spills or Leaking or Punctured Containers of CH and RH TRU Mixed Waste

In the event of spills or leaking or punctured containers of CH and RH TRU mixed waste, the WIPP responds to three distinct phases: 1) the event, 2) the re-entry, and 3) the recovery.

During the event, the following immediate actions are completed: 1) stop work, 2) warn others (notify CMR), 3) isolate the area, 4) minimize exposure, and 5) close off unfiltered ventilation. These actions can take place simultaneously, as long as they are completed before proceeding to the re-entry phase.

CH TRU Mixed Waste

Prior to the re-entry following an event involving containers of CH TRU mixed waste, a Radiological Work Permit (**RWP**) is written for personnel to enter with protective clothing to assess the conditions, take surveys and samples, and mitigate problems that could compound the hazards in the area (cover up spilled material with plastic material sheeting and or any approved fixatives such as polyvinyl alcohol (**PVA**) or paint, place equipment in a safe configuration, etc.). During the re-entry phase, smears and air sample filters are taken and counted. This information is used by cognizant managers, RC personnel, and As Low As Reasonably Achievable (**ALARA**) Committee representatives to determine an appropriate course of action to recover the area. A plan to decontaminate and recover affected areas and equipment will be approved with a separate RWP written to establish the radiological controls required for the recovery.

During the recovery phase, the plan will be executed to utilize the necessary resources to conduct decontamination and/or overpacking operations as needed. The completion of this phase will occur prior to returning the affected area and/or equipment to normal activities. The recovery phase will include activities to minimize the spread of contamination to other areas. These activities will involve placing the waste material in another container; vacuuming the waste material; overpacking or plugging/patching the spilled, leaking, or punctured waste container; and/or decontaminating the affected area(s). If an affected surface cannot be decontaminated to releasable levels, it may be covered with a fixative coating and established as a Fixed Contamination Area to prevent spread of contamination, or it may be removed using heavy machinery and tools, packaged in approved waste containers, and emplaced in the underground. Every reasonable effort to minimize the amount of derived waste, while providing for the health and safety of personnel, will be made.

Should a breach of a CH TRU mixed waste container occur at the WIPP that results in removable contamination exceeding the small area “spot” decontamination levels, the affected container(s) (e.g., breached and contaminated) will be placed into an available overpack container (e.g., 85-gal drum, SWB, TDOP), except that TDOP’s will be decontaminated, repaired/patched in accordance with 49 CFR §173 and §178 (e.g., 49 CFR §173.28), or returned to the generator. The decontamination of equipment and the overpacking of contaminated/damaged waste containers will be performed in the vicinity of the incident. For example, under normal operations CH TRU mixed waste will be handled only in the areas of the WHB Unit. Therefore, it is within these same areas that decontamination and/or overpacking operations would occur. By eliminating the transport of contaminated equipment to other areas for decontamination or overpacking, the risk of spreading contamination is reduced.

Equipment used during a spill cleanup or CH TRU mixed waste overpacking operation could include: cloths, brushes, scoops, absorbents, squeegees, tape, bags, pails, slings, hand tools, and others as needed for a given incident.

At the underground emplacement room, salt contaminated by a spill of CH TRU mixed waste would be either covered or cleaned up, depending on location, extent, and spilled material, due to potential radioactive contamination spread via the salt dust. The contaminated salt would be covered to isolate it from the workers, and the stacking of waste containers would resume or would be removed and packaged as site-derived waste using applicable site procedures for decontaminating surfaces.

The decontamination methods will initially involve wiping down structures, equipment, and other containers in the area with absorbent cloths moistened with tepid water. Surveys of these structures will take place and the need to continue decontamination activities will be established. If further decontamination is required, nonhazardous decontaminating agents, such as Liquinox©, Simple Green©, Windex©, citric acid, Bartlett Strip Coat©, and high pressure CO_2 will be used to prevent generating CH TRU mixed waste.

RWPs and other administrative controls provide protective measures to help ensure that new hazardous constituents will not be added during decontamination activities.

Certain structures and/or equipment may be disassembled to facilitate decontamination or may be placed directly into a derived waste container. Items used in the spill cleanup and decontamination operations (e.g., swipes, tools, PPE, etc.) may also be placed into a derived waste container.

When decontamination is deemed by the recovery team to be complete, RC personnel will conduct one final, intensive radcon survey of the area and components in the area to release it for uncontrolled use. The free release criteria for items, equipment, and areas is < 20 dpm/100 cm^2 for alpha radioactivity and < 200 dpm/100 cm^2 for beta-gamma radioactivity. Personnel will then perform hazardous material sampling after decontamination efforts are complete to verify the removal of hazardous waste substances. After cleanup is complete, facility personnel will complete an inspection and include the details of the spill and cleanup in the log.

RH TRU Mixed Waste

For RH TRU mixed waste, the detection of contamination on or damage to a RH TRU mixed waste canister or a facility canister may occur outside the Hot Cell during cask to cask transfer of the canister or during loading of the Shielded Insert in the Transfer Cell. When such contamination or damage is found, the Permittees have the option to decontaminate or return the canister to the generator/storage site or another site for remediation. In the case of a damaged facility canister, the Shielded Insert may be used as an overpack to facilitate further management. Contamination may also be detected within the Hot Cell during the unloading of the CNS 10-160B shipping cask. In this case, the Permittees may decontaminate the 55-gallon drums or return them to the generator/storage site or another site for remediation. Spills or releases that occur within the RH Complex or the underground as the result of RH TRU mixed waste handling will be mitigated by using the following measures, as appropriate:

During the re-entry phase, an evaluation of the incident, including the nature of the release, amount, location, and other appropriate factors, will be performed. A RWP will be written and approved prior to personnel entering the Hot Cell with the appropriate PPE to further assess the situation, perform surveys and take samples, and, if possible, mitigate problems that could compound the hazards in the area. Based on the results of the evaluation, a determination will be made by the RCRA Emergency Coordinator, with input from the cognizant managers, radiological control personnel, and ALARA Committee representatives whether to implement the Contingency Plan and to determine the appropriate course of action to recover from the event. An action response plan to decontaminate and recover affected areas and equipment, together with an RWP establishing the radiological controls required for the recovery will be developed and approved.

Should a breach of a RH TRU mixed waste container occur in the Hot Cell that results in removable contamination exceeding the small area “spot” decontamination levels, the affected container(s) (e.g., breached and contaminated) will be placed into a canister and processed for disposal. The decontamination of equipment, cleanup of spilled material and the overpacking of contaminated/damaged waste containers will be performed in the vicinity of the incident. For example, under normal operations RH TRU mixed waste in 55-gallon drums will be handled only in the Hot Cell. Therefore, it is within this area that decontamination and/or overpacking operations would occur. By eliminating the transport of contaminated equipment to other areas for decontamination or overpacking, the risk of spreading contamination is reduced. Contaminated materials for the cleanup and overpacking of a breached RH TRU mixed waste container may be managed as CH TRU mixed waste, depending on the surface dose rate.

Equipment used during a spill cleanup or RH TRU mixed waste overpacking operation could include: cloths, brushes, scoops, absorbents, squeegees, tape, bags, pails, slings, hand tools, and other equipment as needed for a given incident.

The decontamination methods may initially involve wiping down structures, equipment, and other containers in the area with absorbent cloths moistened with tepid water. Surveys of these structures will take place and the need to continue decontamination activities will be established. If further decontamination is required, nonhazardous decontaminating agents, such as Liquinox©, Simple Green©, Windex©, citric acid, Bartlett Strip Coat©, and high pressure CO_2 will be used to prevent generating CH TRU mixed waste.

RWPs and other administrative controls provide protective measures to help ensure that new hazardous constituents will not be added during decontamination activities.

Certain structures and/or equipment within the Hot Cell may be disassembled to facilitate decontamination or may be placed directly into a derived waste container. Items used in the spill cleanup and decontamination operations (e.g., swipes, tools, PPE, etc.) may also be placed into a derived waste container.

When decontamination of the Hot Cell is deemed by the recovery team to be complete, RC personnel will conduct one final, intensive radcon survey of the area and components in the area to release it for continued use. The free release criteria for items and equipment that will be released for uncontrolled use are < 20 dpm/100 cm^2 for alpha radioactivity and < 200 dpm/100 cm^2 for beta-gamma radioactivity. Personnel will then perform hazardous material sampling after decontamination efforts are complete to confirm the removal of hazardous waste substances. After cleanup is complete, facility personnel will complete an inspection and include the details of the spill and cleanup in the log. The recovery phase must be completed before the affected area and/or equipment are returned to service.

F-4d(7) Natural Emergencies

After a natural emergency (earthquake, flood, lightning strike, etc.) that involves hazardous waste or hazardous materials, the FSM will ensure the following actions are taken:

1. Inspect containers which have not been disposed and containment for signs of leakage or damage. Inspect areas where containers are stored looking for leaking containers and for deterioration of containers and the containment system.

2. Inspect affected equipment or areas associated with hazardous waste management activities for proper operating mode in accordance with site procedures and manually check to ensure automatic and alarmed features on the units are working.

3. Inspect affected equipment or areas within the HWMUs in accordance with site procedures for damage.

4. Inspect electrical boards and overhead electrical lines for damage.

5. Check container areas for signs of leakage or damage to drums and containers.

6. Check affected buildings and fencing directly related to hazardous waste management activities for damage.

7. Conduct a general survey of the site looking for signs of land movement, etc.

8. Take any necessary corrective measures, however temporary, to rectify potential or real problems.

9. Record inspection results.

F-4d(8) Roof Fall

Roof fall is not expected to affect RH TRU mixed waste because it is emplaced in the rib of the disposal room and not subject to impact from a roof fall. The following incident description and mitigation apply to CH TRU mixed waste.

The WIPP underground is routinely evaluated for stability and safety of the underground openings. These evaluations can be as simple as the MSHA required visual checks by personnel working in the area or as extensive as the expert review of the roof support system for Room 1 Panel 1 conducted in 1991. An in-depth evaluation of all of the accessible underground is performed on an annual basis as part of the formal ground control operating plans. Weekly visual and sounding inspections are performed by the Permittees. More frequent inspections and evaluations are performed in areas where roof or ribs are in need of evaluations, based on visual observations, analysis of rock deformation data, excavation effects program data acquired from observation holes, and support system performance.

This process applies not only to the waste disposal rooms but to the entire WIPP underground. Prior to waste emplacement, stability of each room will be evaluated. This evaluation will concentrate on the age and current performance of the installed support systems (if any) and the rate of roof beam expansion based on data from installed instrumentation. The roof support system's performance and surety, to provide the support necessary for the required time will be addressed. Criteria used will include design parameters such as the amount of load, the deformation of the installed system, and the number and type of component failures observed, if any. Geotechnical criteria will include parameters such as the type and quantity of fracturing, roof beam expansion rates, and future ground performance based on a predictive model.

Should the evaluation results indicate that remedial actions are necessary prior to placement of waste, experiences at the WIPP indicate that rebolting or installing supplemental support can extend the safe life of a room for several years.

After waste emplacement commences, geomechanical monitoring will continue with monitors that are tied into a computer network program. The readings obtained will provide information needed for the roof beam stability assessment. Visual observations of the ground and the support systems will also continue in all accessible areas. Based on the experiences from the Site and Preliminary Design Validation test rooms, it has been proven that any developing instability will be detected through monitoring. Multiple measures to deal with the observed conditions can be implemented months before an event to mitigate any risk associated with a roof fall in the storage room or any affected area within the mine. At a minimum, the affected area will be isolated and withdrawn from ventilation flow. Isolation operations will utilize current available methods, materials, and equipment.

Ground control conditions which could result in a fall can be divided into two scenarios: The first consists of spalling (falling) of individual small and localized rock falling on waste containers.

By definition, they can be considered insignificant as no damage to the drums can occur. The second consists of an entire section of roof falling on multiple stacks of waste containers. Each of these scenarios is discussed below.

Spalling-of-Ground Scenario

The maximum distance between the room roof and a container of waste is 10 ft. Waste containers are designed to withstand impact loads of at least 1,000 pounds (lbs) dropped from a height of 6 ft. flat or 450 lbs dropped on a circumferential edge from a height of 4 ft. Both of which correspond to an allowable impact stress of 25,450 pounds per square inch (psi). Rocks from spalling are small and would not be of sufficient weight when striking a drum from a 10 ft vertical height to cause an impact stress of more than 25,450 psi. Taking into account the falling distance, average weight, and the typical shape of the salt rock, the conclusion is that puncturing a drum by spalling is non-credible.

Fall-of-Ground Scenario

Fall-of-ground occurs when a large section of roof beam falls onto the waste containers. As previously discussed, the possibility of this occurring in an active room is remote, due to continuous monitoring and engineered roof support systems.

The following actions have been developed and will be taken by the RCRA Emergency Coordinator should a rock fall occur in an active waste emplacement area of the repository:

Spalling-of-Ground Actions

1. Determine whether the roof conditions allow for safe entry and if the waste container or containers in question are accessible.

   The process used to determine if a roof condition of a room will allow for safe entry is the same as the ground control inspection process used for inspection of the ground conditions and roof bolt integrity. The inspection will begin at a safe and sound roof starting point and consist of visual inspections of roof bolts, roof, and rib areas for missing or damaged bolts; deformed roof bolt plates; or roof and rib cracks, fractures, or separations. If during the visual inspection suspicious roof bolts, roof, or ribs are found, then operators will proceed with sounding the area in question with a scaling bar for loose roof bolts, bad roof, or ribs (loose roof bolts will not ring when sounded). Bad roof or ribs will have a drummy, hollow, or un-solid sound when struck with the scaling bar. When this operation is performed, a safe avenue for retreat is always maintained. Also maintained is a position such that an unexpected event will not place personnel in a position where the scaling bar or material being scaled could fall on personnel. If the inspection reveals ground that cannot be safely scaled manually or with the available mining equipment, the affected area, up to and including the entire room, will be barricaded and removed from ventilation flow.

   The criteria used to determine whether a waste container is accessible is based on the location of the container, the amount of waste in the room, and the expense of reaching the waste container safely versus the expense of abandonment of the room. For example, if the room is 95% filled and spalling-of-ground punctured a waste container at or near the exit of the room, the decision to isolate the room and move waste emplacement activities to the next room would be prudent.

2. Restrict access in ventilation flow path downstream of the incident.

3. Restrict ventilation to the affected room to ensure that there is no spread of contamination that may have been released. Survey for contamination and establish the boundaries.

4. Inspect accessible and affected containers and containment for signs of leakage or damage.

5. Cover the spill area with material such as plastic or fabric sheets or PVA, in a way that would safely isolate the area.

6. Determine if the covered spill area safely allows for continued waste disposal operations or whether further cleanup is required. If further cleanup is required, provide with cleanup methods described below. Note: Cleaning may not be required since this is the permitted disposal area.

7. Inspect any affected equipment (vehicles, handling equipment, and communication and alarm equipment) for proper function.

8. Repackage spilled waste and repackage, plug, or patch breached waste containers into 55 or 85-gallon drums, SWBs, or TDOPs, depending on volume. Temporarily locate overpack waste containers in an adjacent room. Remove only those intact waste containers necessary to clear the area for decontamination.

9. At the underground emplacement room, salt contaminated by a spill of TRU mixed waste will be covered with materials such as salt, plastic or fabric sheets or PVA to isolate it from the workers or removed and packaged as site derived waste in accordance with site procedures for decontaminating surfaces.

10. Manage the radioactive debris as derived waste.

11. Characterize containers of waste based on the waste containers that were damaged.

12. Replace the removed and derived waste containers into the waste stack as appropriate and update the WWIS.

13. Document activities and record results.

<u>Fall-of-Ground Actions</u>

1. Restrict access in ventilation flow path downstream of the incident.

2. Restrict the room from ventilation flow by closing bulkhead regulators.
3. Survey for radiological contamination and establish the boundary for a Radiological Buffer Area.

4. Install barricade devices to remove access.

5. At the underground emplacement room, salt contaminated by a spill of TRU mixed waste will be covered with materials such as salt, plastic or fabric sheets, or PVA to isolate it from the worker or removed and packaged as site derived waste using damp rags, hand tools, and HEPA filtered vacuums.

The criteria used to determine whether to close the entire panel or just the affected room of waste containers would include the location of the roof fall and the stability of the unaffected roof area in the panel. Techniques to determine the stability would be the same as previously described in this section.

F-4d(9) Structural Integrity Emergencies

In the event of a WIPP facility emergency involving underground structural integrity, the situation will be handled as a natural emergency. Monitoring and inspection procedures ensure the safety and integrity of the WIPP facility underground.

F-4d(10) Emergency Termination Procedures

For the transition from emergency phase to cleanup phase, the following items will be complete:

- Emergency scene will be stable
- Release of hazardous substance will be stopped
- Reaction of hazardous substance will be controlled
- The released hazardous substance will be contained within a localized and manageable area
- The area of contamination will be adequately secure from unauthorized entry

At every incident involving hazardous materials, there is a possibility that response personnel and their equipment will become contaminated. Emergency response personnel have procedures to minimize contamination or contact, and to properly dispose of contaminated materials.

For nonemergencies and Incident Level I emergencies, the following methods of decontamination are available for personnel, environment, and/or equipment according to emergency response procedures:

- Absorption
- Adsorption
- Chemical degradation
- Dilution
- Disposal
- Isolation

- Neutralization
- Solidification

Any necessary verification of air, soil, or water samples will be directed by the RCRA Emergency Coordinator. Immediately after an emergency, the RCRA Emergency Coordinator will provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility in accordance with standard operating procedures.

For Level II and III incidents after the emergency itself is controlled and contained, the RCRA Emergency Coordinator will be responsible for the development and implementation of an incident-specific decontamination plan.

PPE will be decontaminated or disposed according to procedure before it is returned to its storage location.

As part of the facility's defense-in-depth approach, equipment will be assumed to be contaminated after each hazardous material response and a thorough check for radioactive contamination will be conducted. If contamination is found, a technically sound decontamination process will be followed. Many types of equipment are difficult to decontaminate and may have to be discarded as hazardous or derived waste. Whenever possible, pieces of equipment will be disposable or made of nonporous material.

If radioactive contamination is detected on equipment or on structures, it will be assumed that hazardous constituents may also be present. Radiological surveys to determine whether a potential release of hazardous constituents has occurred (Permit Attachment I3) will be used along with other techniques as a detection method to determine when decontamination is required. Radiological cleanup standards will be used to determine the effectiveness of decontamination efforts. To provide verification of the effectiveness of the removal of hazardous waste constituents, once a contaminated surface is demonstrated to be radiologically clean, the "swipe" can be sent for analysis for hazardous constituents. The use of these confirmation analyses is as follows:

> For waste containers, the analyses become documentation of the condition of the container at the time of emplacement. These containers will be placed in the underground without further action, once the radiological contamination is removed, unless there is visible evidence of hazardous waste spills or hazardous waste on the container and this contamination is considered likely to be released prior to emplacement in the underground. In no case shall these containers contain a total liquid content equal to, or which exceeds, one volume percent of the container.

> For area contamination, once the area is cleaned up and is shown to be radiologically clean, it will be sampled for the presence of hazardous waste residues. If the area is large, a sampling plan will be developed. The sampling plan will be approved by the NMED before it is

implemented. If the area is small, swipes will be used. If the results of the analysis show that residual contamination remains, a decision will be made whether further cleaning will be beneficial or whether final clean up will be deferred until closure. Appropriate notations will be entered into the operating record to assure proper consideration of formerly contaminated areas at the time of closure. Furthermore, measures such as covering, barricading, and/or placarding will be used as needed to mark areas that remain contaminated.

For all Contingency Plan emergency responses, the RCRA Emergency Coordinator will ensure, in keeping with standard operating procedures, that, in the affected area(s) of the facility:

- No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed

- All emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use, or replaced before operations are resumed

F-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases

During an emergency, the RCRA Emergency Coordinator will ensure that reasonable measures are taken so that fires, explosions, and releases do not occur, recur, or spread to TRU mixed waste or other hazardous materials at the facility, as required under 20.4.1.500 NMAC (incorporating 40 CFR §§264.56(e) and (f)). These measures include:

- Stopping processes and operations.

- Collecting and containing released wastes and materials.

- Removing or isolating containers of waste or hazardous substances posing a threat.

- Ensuring that wastes managed during an emergency are handled, stored, or treated with due consideration for compatibility with other wastes and materials on site and with containers utilized (Section F-4h).

- Restricting personnel not needed for response activities from the scene of the incident.

- Evacuating the area.

- Curtailing nonessential activities in the area.

- Conducting preliminary inspections of adjacent facilities and equipment to assess damage.

- Overpacking and/or removing damaged containers/drums from affected areas. Damaged equipment and facilities will be repaired as appropriate.

- Constructing, monitoring, and reinforcing temporary dikes as needed.
- Maintaining fire equipment on standby at the incident site in cases where ignitable liquids have been or may be released and ensuring that all ignition sources are kept out of the area. Ignitable liquids will be segregated, contained, confined, diluted, or otherwise controlled to preclude inadvertent explosion or detonation.

No operation that has been shut down in response to the incident will be restarted until authorized by the RCRA Emergency Coordinator. Sections F-4g, Incompatible Waste, and F-4h, Post-Emergency Facility and Equipment Maintenance and Reporting, address specific issues related to decreasing the possibility of a recurrence or spread of a release, a fire, or an explosion.

After resolution of the incident, a Root Cause Analysis will be conducted to review all Level II and Level III incidents for determination of cause, and the corrective action plan to prevent recurrence.

F-4f Management and Containment of Released Material and Waste

Once initial release or spill containment has been completed, the RCRA Emergency Coordinator will ensure that recovered hazardous materials and waste are properly stored and/or disposed, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.56(g)). For spills of liquid, the perimeter of the spill will be diked with an absorbent material that is compatible with the material(s) released. Free-standing liquid will be transferred to a marked compatible container. The remaining liquid will be absorbed with an absorbent material and swept or scooped into a marked compatible container. Spill residue will be removed. Spills of dry material will be swept or shoveled into a labeled compatible recovery container. Material recovered from the spill will be transferred to clean containers or tanks or to containers or tanks that have held a compatible material. All containers will meet DOT specifications for shipping the wastes, and materials will be recovered.

Nonradioactive hazardous waste resulting from the cleanup of a fire, an explosion, or a release involving a nonradioactive hazardous waste or hazardous substance at the WIPP facility will be contained and managed as a hazardous waste until such time as the waste is disposed of, or determined to be nonhazardous, as defined in 20.4.1.200 NMAC (incorporating 40 CFR §261) Subparts C and D. In most cases, hazardous materials inventories for the various buildings and areas at the facility will allow a determination of the hazardous materials present in any cleanup of a release or of the residues from an emergency condition. (The quantities of such spills are so small, it is not likely to trigger an Incident Level II or III.) When necessary samples of the waste will be collected and analyzed to determine the presence of any hazardous characteristics and/or hazardous waste constituents; this information is needed to evaluate disposal options. EPA-approved sampling and analytical methods will be utilized. Hazardous wastes will be transferred to the Hazardous Waste Staging Area. The staging area is used to store hazardous waste awaiting transfer to an off-site treatment or disposal facility in accordance with applicable regulations (e.g., 20.4.1 NMAC and DOT regulations). The Hazardous Waste Staging Area for nonradioactive hazardous waste is Buildings 474A and 474B, as shown in Figure F-1.

Nonradioactive hazardous wastes will be shipped off-site for disposal at a RCRA permitted disposal facility.

Under normal operations, administrative controls will be implemented to ensure that hazardous materials and incompatible materials will not be introduced to the radioactive materials area during TRU mixed waste handling operations. Examples of administrative controls include restricting the waste received in the TRU mixed waste management area(s) to TRU mixed waste properly manifested from the generator sites and ensuring that materials used in these area(s) are restricted to only those that have previously been determined to be compatible with the TRU mixed waste. The RCRA Emergency Coordinator will have access to building design information and information on specific equipment used within an area upon which to base a determination of the compatibility of materials with the area. If necessary, the RCRA Emergency Coordinator will use EPA-600/2-80-076, "A Method for Determining the Compatibility of Hazardous Waste," (EPA, 1980) for making compatibility determinations. Waste resulting from the cleanup of a fire, explosion, or release in the miscellaneous unit, the CH TRU mixed waste handling areas, or the RH Complex will be considered derived from the received TRU mixed waste and may be treated and managed as CH TRU mixed waste depending on the surface dose rate.

In the event of a prolonged cessation of TRU mixed waste handling operations, TRU mixed waste can be placed in areas of the WHB Unit that are available for such contingencies. These areas and the TRU mixed waste containers in them would be located so that adequate aisle space would be maintained for unobstructed movement of personnel and equipment in an emergency. Permit Attachments M, M1, and M2 describe the HWMUs in detail, including the facility description, support structures and equipment, security, waste handling areas, ventilation, and fire protection.

The contaminated area will be decontaminated. If a release is to a permeable surface, such as soil, asphalt, concrete, or other surface, the surface material will be removed and placed in containers meeting applicable DOT requirements. Contaminated soil, asphalt, concrete, or other surface material, as well as materials used in the cleanup (e.g., rags and absorbent material) will be contained and disposed of in the same manner as dictated for the contaminant. Clean soil, new asphalt, or new concrete will be emplaced at the spill location.

If a spill occurs on an impermeable surface, the surface will be decontaminated with water and/or a detergent. In the event that the spilled material is water reactive, a compatible nonhazardous cleaning solution will be used. Contaminated wash water or cleaning solution will be transferred to an appropriate container, marked, and managed as described above for nonradioactive or radioactive liquid wastes.

In the event of a hazardous material or hazardous waste release, the RCRA Emergency Coordinator will ensure that no wastes will be received or disposed of in the affected areas until cleanup operations have been completed. This is to ensure that incompatible waste will not be present in the vicinity of the release.

Because of the restrictions which the WIPP facility places on generators, and because of control of WIPP operations, TRU mixed wastes and derived wastes will not contain any incompatible wastes. However, the areas established for the temporary holding of nonradioactive waste routinely generated at the WIPP facility is divided into bays to accommodate the management of wastes that may be incompatible. If waste is generated as the result of a spill or release of hazardous materials or nonradioactive hazardous waste, the waste generated as a result of abatement and cleanup will be evaluated to determine its compatibility with other wastes being managed in the temporary holding areas. The evaluation will be by identifying the material or waste that was spilled or released and determining its characteristics (e.g., ignitable, reactive, corrosive, or toxic). The waste generated by the abatement and cleanup activities will be stored in that part of the temporary holding area that has been established to manage wastes with which it is compatible.

For small nonemergency liquid spills (e.g., a detergent solution leaking out of the pump handle during decontamination, a spill of hydraulic fluid while servicing a vehicle), spill control procedures will be used to contain and absorb free-standing liquid. The contaminated absorbent will be swept or shoveled into a compatible container and managed as described above. No notifications will be required, but site procedures require documentation of the incident.

F-4g Incompatible Waste

Implementation of the TSDF-WAC for the WIPP ensures that incompatible TRU mixed waste will not be shipped to the WIPP facility. Nonradioactive waste at the WIPP facility will be carefully segregated during handling and holding and will be transported within and off the facility. The RCRA Emergency Coordinator will not allow hazardous or TRU mixed waste operations to resume in a building or area in which incompatible materials have been released prior to completion of necessary post-emergency cleanup operations to remove potentially incompatible materials. In making the determination of compatibility, the RCRA Emergency Coordinator will have available the resources and information described in Section F-4b, Identification of Hazardous Materials. In addition, ES&H department personnel will be available for consultation. Finally, the RCRA Emergency Coordinator may use EPA-600/2-80-076, (EPA, 1980).

F-4h Post-Emergency Facility and Equipment Maintenance and Reporting

The RCRA Emergency Coordinator will ensure that emergency equipment that is located or used in the affected area(s) of the facility and listed in the Contingency Plan is cleaned and ready for its intended use before operations are resumed, as specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.56(h)(2)). Any equipment that cannot be decontaminated will be discarded as waste (e.g., hazardous, mixed, solid), as appropriate. The WIPP facility is committed to replacing any needed equipment or supplies that cannot be reused following an emergency. After the equipment has been cleaned, repaired, or replaced, a post-emergency facility and equipment inspection will be performed, and the results will be documented.

Cleaning and decontaminating equipment will be accomplished by physically removing gross or solid residue; rinsing with water or another suitable liquid, if required; and/or washing with detergent and water. Decontamination and cleaning will be conducted in a confined area, such as a wash pad or building equipped with a floor drain and sump isolated from the environment. Care will be taken to prevent wind dispersion of particles and spray. Liquid or particulate resulting from cleaning and decontamination of equipment will be placed in clean, compatible containers. Waste produced in an emergency cleanup in the TRU mixed waste handling areas is derived waste and will be emplaced in the underground derived waste emplacement area. Waste resulting from decontamination operations elsewhere in the WIPP facility will be analyzed for hazardous waste constituents and/or hazardous waste characteristics to ensure proper management.

When the WIPP facility has completed post-emergency cleanup of waste and hazardous residues from areas where waste management operations are ready to resume and the RCRA Emergency Coordinator has ensured that emergency equipment used in managing the emergency has been cleaned or replaced and is fit for service, the notifications will be made by the Permittees to the following: the EPA Region VI Administrator; the Secretary of the NMED; and any relevant local authorities. This post-emergency notification complies with 20.4.1.500 NMAC (incorporating 40 CFR §264.56(i)), and is the responsibility of the RCRA Emergency Coordinator.

F-4i Container Spills and Leakage

The waste received at the WIPP facility will meet stringent TSDF-WAC (e.g., no free liquids and less than one percent residual liquids), which will minimize the possibility of waste container degradation and liquid spills. Should a spill or release occur from a container, following an initial assessment of the event, the WIPP facility will immediately take the following actions, in compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.52(a) and §264.171):

- Assemble the required response equipment, such as protective clothing and gear, heavy equipment, empty drums, overpack drums, and hand tools

- Transfer the released material to a container that is in good condition or overpack the leaking container into another container that is in good condition

- Once the release has been contained, determine the areal extent of migration of the release and proceed with appropriate cleanup action, such as chemical neutralization, vacuuming, or excavation

F-4j Tank Spills and Leakage

The TRU mixed waste handling areas at the WIPP facility do not include tank storage or treatment of hazardous waste, as defined in 20.4.1.101 NMAC (incorporating 40 CFR §260.10), and as regulated under 20.4.1.500 NMAC (incorporating 40 CFR §264) Subpart J. At the WIPP facility, tanks are used to store water and petroleum fuels only. The petroleum tanks store diesel and unleaded gasoline.

F-4k Surface Impoundment Spills and Leakage

The WIPP facility does not manage hazardous or TRU mixed waste using a surface impoundment, as defined in 20.4.1.101 NMAC (incorporating 40 CFR §260.10), and as regulated under 20.4.1.500 NMAC (incorporating 40 CFR, §264) Subpart K. Surface impoundment regulations are not applicable to the WIPP facility.

F-5 Emergency Equipment

A variety of equipment is available at the facility for emergency response, containment, and cleanup operations in both the HWMUs and the facility in general. This includes equipment for spill control, fire control, personnel protection, monitoring, first aid and medical attention, communications, and alarms. This equipment is immediately available to emergency response personnel. A listing of major emergency equipment available at the WIPP facility, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.52(e)), is shown in Table F-6. Table F-7 identifies the locations where fire suppression systems are provided. Locations of the underground emergency equipment are shown in Figure F-5. The firewater-distribution system map is shown in Figure F-6. The underground fuel area fire-protection system is shown in Figure F-7.

F-6 Coordination Agreements

The Permittees have established MOUs with off-site emergency response agencies for firefighting, medical assistance, hazardous materials response, and law enforcement. In the event that on-site response resources are unable to provide all the needed response actions during either a medical, fire, hazardous materials, or security emergency, the RCRA Emergency Coordinator will notify appropriate off-site response agencies and request assistance. Once on site, off-site emergency response agency personnel will be under the direction of the RCRA Emergency Coordinator.

The MOUs with off-site cooperating agencies are available from the Permittees. A listing and description of the MOUs with state and local agencies and mining operations in the vicinity of the WIPP facility, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.37 and §264.52(c)), are:

- An agreement among the Permittees, Intrepid Potash NM LLC, and Mosaic Potash Carlsbad Inc., provides for the mutual aid and assistance, in the form of MRTs, in the event of a mine disaster or other circumstance at either of the two facilities. This provision ensures that the WIPP MOC will have two MRTs available at all times when miners are underground.

- A memorandum of agreement between the City of Carlsbad, New Mexico, and the WIPP MOC for ambulance service assistance provides that, upon notification by the WIPP MOC, the Carlsbad Fire Department/Ambulance Service will be dispatched from Carlsbad toward the WIPP site by a designated route and will accept the transfer of patient(s) being transported by the WIPP facility ambulance at the point both ambulances meet. If the patient(s) is not transferrable, the Carlsbad Fire Department/Ambulance Service will provide equipment and personnel to the WIPP facility ambulance, as necessary.

- A MOU between the DOE and the Carlsbad Medical Center provides for the treatment of radiologically contaminated personnel who have incurred injuries beyond the treatment capabilities at the WIPP facility. The DOE will provide transport of the patient(s) to the Carlsbad Medical Center for decontamination and medical treatment.

- A MOU between the DOE and the Lea Regional Medical Center provides for the treatment of radiologically contaminated personnel who have incurred injuries beyond the treatment capabilities at the WIPP facility. The DOE will provide transport of the patient(s) to the Lea Regional Medical Center for decontamination and medical treatment.

- A MOU between the DOE and the U.S. Department of Interior (**DOI**), represented by the Bureau of Land Management (**BLM**), Roswell District, provides for a fire-management program that will ensure a timely, well-coordinated, and cost-effective response to suppress wild fire within the withdrawal area using the WIPP incident commander for fire-management activities. The DOI will provide firefighting support if requested. In addition, the MOU provides for responsibilities concerning cultural resources, grazing, wildlife, mining, gas and oil production, realty/lands/rights-of-way, and reclamation.

- A mutual-aid firefighting agreement between the Eddy County Commission and the DOE provides for the assistance of the Otis and Joel Fire Departments (a volunteer fire district created under the Eddy County Commission and the New Mexico State Fire Marshall's Office), including equipment and personnel, at any location within the WIPP Fire Protection Area upon request by an authorized representative of the WIPP Project. These responsibilities are reciprocal.

- A mutual-aid agreement between the City of Hobbs and the DOE provides for mutual ambulance, medical, fire, rescue, and hazardous material response services; provides for joint annual exercises; provides for use of WIPP facility radio frequencies by the City of Hobbs during emergencies; and provides for mutual security and law enforcement services, within the appropriate jurisdiction limits of each party.

- A mutual-aid agreement between the City of Carlsbad and the DOE provides for mutual ambulance, medical, fire, rescue, and hazardous material response services; provides for joint annual exercises; provides for use of WIPP facility radio frequencies by the City of Carlsbad during emergencies; and provides for mutual security and law enforcement services, within the appropriate jurisdiction limits of each party.

- A MOU between the DOE and the New Mexico Department of Public Safety (**DPS**) concerning Mutual Assistance and Emergency Management applies to any actual or potential emergency or incident that: 1) involves a significant threat to employees of the Permittees or general public; 2) involves property under the control or jurisdiction of either the DOE or the State; 3) involves a threat to the environment which is reportable to an off-site agency; 4) requires the combined resources of the DOE and the state; 5) requires a resource that the DOE has which the State does not have, or a resource the State has which DOE does not have; or 6) involves any other incident for which a joint determination has been made by the DOE and the State that the provisions of this MOU will apply. The MOU provides that the DPS shall permit qualified and security cleared DOE Emergency Management members into the State EOC for the purpose of: a) coordinating communications functions; b) evaluating and maintaining communications capabilities; c) participating in exercises; d) link the State's High Frequency radio communications network with the DOE; and e) assisting the State during radioactive materials accidents that require joint operations or the use of the DOE Radiological Assistance Program team. The DOE shall permit qualified and security cleared members the State Emergency Management community into the DOE's EOCs for the purposes of coordinating communications and activities. Additional duties for each participant are specified for assistance in incidents or emergencies.

F-7 Evacuation Plan

If it becomes necessary to evacuate the WIPP facility, the assigned on-site and off-site staging areas have been established. The off-site staging areas are outside the security fence. The WIPP facility has implementation procedures for both surface and underground evacuations. Drills are performed on these procedures at the WIPP facility at least once annually. The following sections describe the evacuation plan for the WIPP facility, as required under 20.4.1.500 NMAC (incorporating 40 CFR §264.52(f)).

F-7a Surface Evacuation On-site and Off-site Staging Areas

Figure F-8 shows the surface staging areas. Personnel report to their Office Wardens at designated staging areas where accountability is conducted. If site evacuation is necessary, the RCRA Emergency Coordinator will decide which staging areas are to be used and will advise Office Wardens of the selections. The RCRA Emergency Coordinator will communicate the locations to Office Wardens via office warden pager, radio, plectron, WIPP Security, or telephone, as appropriate. Office Wardens will direct personnel to the selected staging area outside the security fence. Personnel who are working in a contaminated area when site evacuation is announced, will assemble at specific staging areas to minimize contact with other personnel during the evacuation (Figure F-8).

Office Wardens conduct accountability of personnel assigned to their specific areas. For complete surface accountability, the Office Wardens report to their ACOW, who reports to the COW. When the COW has reports from all ACOWs, surface accountability is reported to the CMRO, who then notifies the RCRA Emergency Coordinator of the accountability.

The COW and all ACOWs have radios for communication between them and the CMRO. The Office Wardens, Assistant Office Wardens, ACOWs, and COW also have pagers with which they are notified of evacuations. At the staging areas Office Wardens report directly to their ACOW.

There are three off-site staging areas identified on Figure F-8. The RCRA Emergency Coordinator determines which staging area will be used. Security officers remain at the primary staging area gate 24 hours a day, and the vehicle trap is opened for personnel during emergency evacuations. The north gate has a single person gate and large gate which can be opened, similar to the main gates for the primary staging area. The east gate is a turnstile gate. Upon notification by the RCRA Emergency Coordinator, Security will respond, open gates, and facilitate egress for evacuation.

The on-site staging areas are identified in Figure F-8. These are used for building or area evacuations as determined by the RCRA Emergency Coordinator.

F-7b Underground Assembly Areas and Egress Hoist Stations

In the event of an underground or surface event, the RCRA Emergency Coordinator can call for underground personnel to report to assembly areas (Figure F-9). Underground personnel are also trained to immediately report to assembly areas under specific circumstances (i.e. loss of underground power or ventilation). If accountability is required, the underground will be evacuated. The Underground Controller is responsible for underground accountability by comparing the brass numbers with the brass tags signed out in the lamproom. Each assembly area contains a Mine Page Phone, miners aid station, and evacuation maps.

In accordance with 30 CFR §57.11, the mine maintains two escapeways. These escapeways are designated as Egress Hoist Stations. When an underground evacuation is called for, all underground personnel report to the Egress Hoist Stations.

Decontamination of underground personnel will be conducted the same way as described for surface decontamination. Contaminated personnel are trained to remain segregated from other personnel until RC personnel can respond to the incident at the underground location.

F-7c Plan for Surface Evacuation

Surface evacuation notification is initiated by the RCRA Emergency Coordinator directing the CMRO to sound the surface evacuation alarm. The Office Wardens assist personnel in evacuation from their areas. Evacuation routes and instructions are posted throughout the site.

If the EST/FPT notifies the ERT members by pager to respond to an identified area, these members will not depart the site during an evacuation, but will report to the EST/FPT for instructions and accountability. The EST/FPT notifies the COW of response members present. These personnel will not evacuate until released by the RCRA Emergency Coordinator.

F-7d Plan for Underground Evacuation

Notification for underground evacuation will be made using the underground evacuation alarm and strobe light signals.

Personnel will evacuate to the nearest egress hoist station. Primary underground evacuation routes (identified by green reflectors on the rib) will be used, if possible. Secondary underground evacuation routes (identified by red reflectors on the rib) will be used if necessary (Figure F-5). Brass tags will be collected from personnel at the hoist collar on the surface, and taken to the Underground Controller, who functions as an Office Warden. When all brass tags are accounted for, underground accountability is reported to the RCRA Emergency Coordinator.

Upon reaching the surface, personnel will report to their on-site staging area to receive further instructions.

Members of the FLIRT and the MRT who may be underground, will evacuate the underground when an underground evacuation is called for. A reentry by the MRT will be performed according to 30 CFR 49 and MSHA regulations for reentry into a mine. The two MRTs are trained in compliance with 30 CFR 49 in mine mapping, mine gases, ventilation, exploration, mine fires, rescue, and recovery.

F-7e Further Site Evacuation

In the event of an evacuation involving the need to transport employees, the following transportation will be available:

- Buses/vans—WIPP facility buses/vans will be available for evacuation of personnel. The buses/vans are stationed in the employee parking lot.

- Privately Owned Vehicles—Because many employees drive to work in their own vehicles, these vehicles may be utilized in an emergency. Personnel may be directed as to routes to be taken when leaving the facility.

These vehicles may be used to transport personnel who have been released from the site by the RCRA Emergency Coordinator.

F-8 Required Reports

The RCRA Emergency Coordinator, on behalf of the Permittees, will note in the operating record the time, date, and details of any incident that requires implementing this Contingency Plan. This notation will be in the facility log maintained by the CMRO. In compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.56(j)), within 15 days after the incident, the Permittees will ensure that a written report on the incident will be submitted to the EPA Region VI Administrator and to the Secretary of the NMED. The report will include:

- The name, address, and telephone number of the Owner/Operator
- The name, address, and telephone number of the facility
- The date, time, and type of incident (e.g., fire, explosion or release)
- The name and quantity of material(s) involved
- The extent of injuries, if any
- An assessment of actual or potential hazards to human health or the environment, where this is applicable
- The estimated quantity and disposition of recovered material that resulted from the incident

In addition to the above report, the Permittees will ensure that the ES&H Manager, or designee, submits reports to the appropriate agencies as listed in Tables F-8 and F-9.

In accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.56(i)), the Permittees will notify the Secretary of the NMED and EPA Region VI Administrator that the WIPP facility is in compliance with requirements for the cleanup of areas affected by the emergency and that emergency equipment used in the emergency response has been cleaned, repaired, or replaced and is fit for its intended use prior to the resumption of waste management operations in affected areas. The means the WIPP facility will use to meet these requirements are described in Sections F-4e, F-4f, F-4g, and F-4h.

The WIPP requires the EST/FPT to initiate the "WIPP Hazardous Materials Incident Report" if the Contingency Plan is implemented. A form is attached as Figure F-12. The form is initiated by the EST/FPT. The RCRA Emergency Coordinator, CMRO, and Environmental Compliance representatives complete their respective sections.

F-9 Location of the Contingency Plan and Plan Revision

The owner/operator of the WIPP facility will ensure that copies of this Contingency Plan are available through the WIPP electronic controlled-document distribution system or in appropriate controlled-document locations throughout the facility, and the alternate Emergency Operations Center and the Joint Information Center at the Skeen Whitlock Building, and are, consequently, available to all emergency personnel and organizations described in Section F-2. In addition, the owner/operator will make copies available to the following outside agencies:

- Intrepid Potash NM LLC and Mosaic Potash Carlsbad Inc.
- Carlsbad Fire Department, Carlsbad

- Carlsbad Medical Center, Carlsbad
- Lea Regional Medical Center, Hobbs
- Otis Fire Department, Otis
- Hobbs Fire Department, Hobbs
- Joel Fire Department, Carlsbad
- BLM, Carlsbad
- New Mexico State Police

The owner/operator of the WIPP facility will ensure that this plan is reviewed annually and amended whenever:

- Applicable regulations are revised
- The RCRA Part B permit for the WIPP facility is revised in any way that would affect the Contingency Plan
- This plan fails in an emergency
- The WIPP facility design, construction, operation, maintenance, or other circumstances change in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous constituents or change the response necessary in an emergency
- The list of RCRA Emergency Coordinators change
- The list of WIPP facility emergency equipment changes.

References

U.S. Environmental Protection Agency, “A Method for Determining the Compatibility of Hazardous Waste,” EPA-600/2-80-076, 1980.

U.S. Department of Transportation, Emergency Response Guidebook, U.S. Government Printing Office, 1993.

Westinghouse Electric Corporation, 1994, “Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling,” WP 02-EM1, Westinghouse Electric Corporation, Carlsbad, New Mexico.

U. S. Department of Energy, “WIPP Safety Analysis Report,” DOE/WIPP-95-2065, Rev. 2

U. S. Department of Energy, “WP 12-5, WIPP Radiation Safety Manual”.

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TABLES

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TABLE F-1
HAZARDOUS SUBSTANCES IN LARGE ENOUGH QUANTITIES TO CONSTITUTE A LEVEL II INCIDENT

Chemical Description	Building Location	Hazard Category
Ethylene Glycol Solution - 35%	Buildings 411; 412; 451; 452; 486; 463; 474C; FAC 414	Immediate (acute) Delayed (chronic)
Gasoline, Unleaded GASC0001	FAC 480	Fire Immediate (acute) Delayed (chronic)
No. 1 Diesel Fuel Oil GASC0210	Oil Depot U/G; FACs 480, 255.1 & 255.2; Transport Tank; Building 456 Trailer 911F	Fire Immediate (acute) Delayed (chronic)
Multiple containers of TRU Waste as described in Permit Condition III.C.1	WHB Waste Shaft U/G	Delayed (chronic)
Hazardous materials in quantities that exceed 5 times the Reportable Quantity (Per DOE O 151.1) values as defined in 40 CFR 302	It should be noted that WIPP is not expected to possess such quantities.	Fire Immediate (acute) Delayed (chronic)

TABLE F-2
RESOURCE CONSERVATION AND RECOVERY ACT
EMERGENCY COORDINATORS

Name	Address*	Office Phone	Home Phone*
R. A. (Richard) Marshall (primary)[1]		234-8276 or 234-8695	
R. C. (Russ) Stroble (primary)[1]		234-8276 or 234-8554	
M. L. (Tex) Winans (primary)[1]		234-8276 or 234-8273	
J.E. (Joseph) Bealler[2]		234-8276 or 234-8916	
M.G. (Mike) Proctor[2]		234-8457	
G. L. (Gary) Kessler[2]		234-8326	
A. E. (Alvy) Williams[1] (primary)		234-8216 or 234-8276	
P.J. (Paul) Paneral[2]		234-8498	
J. R. (Joel) Howard[2]		234-8276	
M. L. (Mark) Long[2]		234-8170	

* NOTE: Personal information (home addresses and phone numbers) has been removed from information copies of this application.

[1] The on-duty Facility Shift Manager is the primary RCRA Emergency Coordinator pursuant to 20.4.1.500 NMAC (incorporating 40 CFR §264.52), and is designated to serve as the RCRA Emergency Coordinator.

[2] The on-duty Facility Operations Engineer is the alternate RCRA Emergency Coordinator and is available as needed.

TABLE F-3
PLANNING GUIDE FOR DETERMINING INCIDENT LEVELS AND RESPONSE

INCIDENT CONDITION	INCIDENT LEVEL		
	I	**II ***	**III ***
Product identifications	Placard not required, NFPA 0 or 1 all categories, all Other Regulated Materials A, B, C, and D.	DOT placarded, NFPA 2 for any categories, PCBs without fire, EPA regulated waste. SITE SPECIFIC: Table F-1 and TRU mixed waste AND	Poison A (gas), explosive A/B, organic peroxide, flammable, solid, materials dangerous when wet, chlorine, fluorine, anhydrous ammonia, radioactive materials, NFPA 3 and 4 for any categories including special hazards, PCBs and fire including special hazards, PCBs and fire DOT inhalation hazard, EPA extremely hazardous substances, and cryogenics.
Container size	Container size does not impact this incident level.	Involves multiple packages.	Tank truck.
Fire/explosion potential	Under control.	May spread/may be explosive.	May spread/may be explosive.
Leak severity	No release or small release contained or confined with readily available resources.	Release may not be controllable without special resources.	Release may not be controllable even with special resources.
Life safety	No life-threatening situation from materials involved.	Localized area, limited evacuation area.	Localized area, limited evacuation area.
Environmental impact (Potential)	None.	Limited to incident boundaries	Contained within the Hazardous waste Management Units.
Container integrity	Not damaged.	Damaged but able to contain the contents to allow handling or transfer of product.	Damaged to such an extent that catastrophic rupture is possible.

* Contingency Plan is implemented

TABLE F-4
PHYSICAL METHODS OF MITIGATION

METHOD	CHEMICAL		RADIOLOGICAL	
	LIQUID	SOLID	LIQUID	SOLID
ABSORPTION	YES	NO	YES	NO
COVERING	YES	YES	YES	YES
DIKES, DIVERSIONS	YES	YES	YES	YES
OVERPACK	YES	YES	YES	YES
PLUG/PATCH	YES	YES	YES	YES
TRANSFER	YES	YES	YES	YES
VAPOR SUPPRESSION	YES	YES	NO	NO

TABLE F-5
CHEMICAL METHODS OF MITIGATION

METHOD	CHEMICAL		RADIOLOGICAL	
	LIQUID	SOLID	LIQUID	SOLID
NEUTRALIZATION	YES	YES(1)	NO	NO
SOLIDIFICATION	YES	NO	YES(2)	NO

(1) When solid neutralizing agents are used, they will be used simultaneously with water.
(2) This method could be utilized for mitigation of firewater involving TRU-waste.

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
	Communications	
Building Fire Alarms	Manual pull stations and automatic devices (sprinkler system flow, and smoke and thermal detectors) trigger fire alarm; locally visible and audible; visual display and alarm in Central Monitoring Room (CMR)	Guard and Security Building, Pumphouse, Warehouse/Shops, Exhaust Filter Building, Support Building, CMR/ Computer Room, Waste Handling Building, TRUPACT Maintenance Facility, SH Hoisthouse, Maintenance Shops, Guard Shack*, Auxiliary Warehouse, Core Storage Building, Engineering Building, Training Facility, Safety Building, Maintenance Shop, Hazardous Waste Storage (non-TRU) Area (Facility 474) *local alarms; not connected to the CMR
Underground Fire Alarms	Automatic/Manual; have priority over other paging channel signals but not override intercom channels; alarms sound in the general area of the control panel and are connected to the underground evacuation alarms; they also interface with the CMR.	Fire detection and control panel locations: Waste Shaft Underground Station, SH Shaft Underground Station, Between E-140 and E-300 in S-2180 Drift, E-O/N-1200, Fuel Station
Site-wide Evacuation Alarm	Transmitted over paging channel of the public address system, overriding its normal use; manually initiated according to procedures requiring evacuation; audible alarm produced by tone generator at 10 decibels above ambient noise level (or at least 75 decibels); flashing strobe lights; radios and/or pagers are used to notify facility personnel outside alarm range. Monthly test are performed on the PA, site notification alarms, and plectrons.	Site-wide
Vehicle Siren	Manual; oscillating; emergency services/surface response vehicles, is mechanical and electronic.	WIPP surface emergency vehicles
Public Address System	Includes intercom phones; handset stations and loudspeaker assemblies, each with own amplifiers; multichannel, one for public address and pages, and others for independent party lines.	Surface and underground
Intraplant Phones	Private automatic branch exchange; direct dial; provide communication link between surface and underground operations	Throughout surface and underground

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Mine Page Phones	Battery-operated paging system	CMR, Mine Rescue Room, EOC, lamproom, underground at S550/W30, S100/W30, S1950/E140, SH Shaft Collar and Underground Station, Waste Shaft Collar and Underground Station, FSM desk.
Emergency Pagers	Manual; , intermittent alarm signals	Issued to appropriate emergency personnel
Plectrons	Tone-alert radio receivers placed in areas not accessible by the public address system	Site-wide
Portable Radios	Two-way, portable; transmits and monitors information to/from other transmitters	Issued to individuals
Plant Base Radios	Two-way, stationary, VHF-FM; linked to Eddy County Sheriff Department, NM State Police, and Otis Fire Department), and WIPP Channels 1-18 (Communication with the Lea County Sheriff's Department, the Hobbs Fire Department, Carlsbad Medical Center and Lea Regional Hospital is available via the Eddy County dispatcher) (Site Security, Site Operations and Site Emergency, maintenance, repeater to Carlsbad). Wireless communications such as cellular phones may be used to contact the Eddy County emergency responders.	Various site locations
Mobile Phones	Provide communications link between WIPP Security and key personnel	Issued to individuals plus emergency vehicles,
	Spill Response	
SPILL-X-S Guns and Recharge Powder	Containment; (1)SPILL-X model SC-30-C(Gun) (1)SPILL-X model XC-30-S(Gun) (1)SPILL-X model SC-30-A(Gun); (1) A-Acid, 5 gallon bucket (Recharge Powder) (1)S-Solvent, 5 gallon bucket (Recharge Powder) (1)C-Caustic, 5 gallon bucket (Recharge Powder)	HAZMAT trailer
Absorbent Sheets	Containment or cleanup; (1) 3' x 100' Sheet	HAZMAT trailer
Absorbents	Grab and Go container; spill control bucket; (1) for solvents and neutralizing absorbents; 5 gallon bucket (1) for acids/caustics; 5 gallon bucket	HAZMAT trailer
Absorbent Material	Containment or cleanup; (1) 100 ft. rolled or equivalent socks "Pig" for general liquid (1) 100 ft. rolled or equivalent socks "Pig" for oil	HAZMAT trailer
Air Bag System	Extrication, Stabilization, Cribbing (1) bag system with tank kit and the following bag sizes: (1)12-ton, (1) 21.8-ton, (1)17-ton	Surface rescue truck

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Air Chisel	Extrication (1) Capable of cutting 3/16" steel	Surface rescue truck
Drum Transfer Pumps and Drum Opener	Containment or cleanup; (1) unit for chemical transfer (1) hand operated pump for petroleum transfer (1) drum opener	HAZMAT trailer
Floor Squeegee	Containment or cleanup; (1) straight rubber blade, nonwood handle	HAZMAT trailer
Foam Concentrate	AFFF 6% (4) 5-gallon pail	Fire truck # 1
Gas Cylinder Leak Control Kit	(1)Series A Hazardous Material Response Kit; contains nonsparking equipment to control and plug leaks	HAZMAT trailer
Portable Generator	(1)Backup power; 5,000 watt; 120 or 240 volt	Surface rescue truck
Hand Tools	Containment and cleanup; Underground rescue truck: (1)12# Sledge Hammer (1)3/8" Drive Socket Set (1)½" Drive Socket Set (1)3/4" Drive Socket Set (1)25' ½" Chain (1)6' Wrecking Bar (1)Bottle Jack (1)4# Hammer (1)18" Crescent Wrench (1)5' Pry Bar (1)2' Pry Bar (1)100' Extension Cord (1)4' Nylon Sling (1)6' Nylon Sling (1)10' Nylon Sling These tools are located in the HAZMAT Trailer. They are non-sparking. (1)14"L adjustable pipe wrench (1)15" multi-opening bung wrench (1)hammer/crate opener (1)8" pipe pliers (1)8" blade Phillips (1)#2 screwdriver (1)6" blade standard screwdriver (1)Claw Hammer	Underground rescue truck, HAZMAT trailer
Come-a-longs	(1) 4-ton; cable-type Ratchet lever tool designed specifically for lifting, lowering and pulling applications including jobs requiring rigging, positioning, and stretching. Used in rescue for extrication.	Surface rescue truck and underground rescue truck
Porta-power	(1) 10-ton hydraulic, hand-powered jaws used for extrication during rescues.	Surface rescue truck

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Jugs	Containment or cleanup; (4) 1-gallon plastic	HAZMAT trailer
Pails	Containment or cleanup; (3) 5-gallon plastic with lid	HAZMAT trailer
Portable Lighting	(1) Emergency lighting system; 120 volts; 500-watt bulbs, suitable for wet location	Underground rescue truck
Patching Kit	Series A Hazardous Response Kit; Class A; contains nonsparking equipment to control and plug leaks.	HAZMAT trailer
Scoops and Shovels	Cleanup; plastic; various sizes; nonsparking; nonwood handles (1) Scoop (3) Shovels	HAZMAT trailer
Medical Resources		
Ambulance #1	Equipped as per Federal Specifications KKK-A-1822 and New Mexico Emergency Medical Services Act General Order 35; equipped with a radio to Carlsbad Medical Center, VHF radio, UHF medical frequency, cellular phone	Surface (Safety and Emergency Services Facility)
Ambulance #2	Diesel hardcab ambulance equipped with first aid kit, 2 stretchers, and other associated medical supplies	Underground
Rescue Truck	Special purpose vehicle; light and heavy duty rescue equipment; transports 1 litter patient, medical oxygen and supplies for mass casualties, fire suppression support equipment (rescue tool, air bag, K-12 Rescue Saw, 5,000-watt generator, self-contained breathing apparatus (SCBA), and much more equipment	Surface (Safety and Emergency Services Facility)
Fire Detection and Fire Suppression Equipment		
Building Smoke, Thermal Detectors, or Manual Pull Stations	Ionization and photoelectric or fixed temperature/rate of rise detectors; visual display and alarm in CMR; manual pull stations. The underground has manual fire alarm pull stations located where personnel have access when evacuating. These are connected to the U/G evacuation alarm.	Guard and Security Building, Warehouse/Shops, Support Building, CMR/Computer Room, Waste Handling Building, TRUPACT Maintenance Facility, Waste Shaft Collar, Underground Fuel Station, SH Hoisthouse, Engineering Building, Industrial Safety Building, Training Facility
Fire Truck # 1	Equipped per Class "A" fire truck per NFPA; capacity 750 gallons, with pump capacity of 1200 gallons per minute	Surface (Safety and Emergency Services Facility)
Rescue Truck # 2 (U/G)	(1) 125-pound dry chemical extinguisher (1) 150-pound foam extinguisher	Underground
Extinguishers	Individual fire extinguisher stations; various types located throughout the facility, conforming to NFPA-10.	Buildings, underground, and underground vehicles

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Automatic Dry Chemical Extinguishing Systems	Automatic; 1,000-pound system (Purple K); actuated by thermal detectors or by manual pull stations	Underground fuel station
Sprinkler Systems	Fire alarms activated by water flow	Pumphouse, Guard and Security Building, Support Building, Waste Handling Building (contact- transuranic waste area only), Warehouse/Shops Building, Auxiliary Warehouse Building, TRUPACT Maintenance Facility, Training Facility, SH Shaft Hoisthouse, Exhaust Filter Building, Engineering Building, and Safety Building
Water Tanks, Hydrants	Fire suppression water supply; one 180,000-gallon capacity tank, plus a second tank with 100,000 gallon reserve	Tanks are at southwestern edge of WIPP facility; pipelines and hydrants are throughout the surface
Fire Water Pumps	Fire suppression water supply; 125 pounds per square inch, 1,500 gallons per minute centrifugal pump, one with electric motor drive, the other with diesel engine; pressure maintenance pump	Pumphouse
Personal Protection Equipment		
Headlamps	Mounted on hard hat; battery operated	Each person underground
Underground Self-Rescuer Units	Short-term rebreathers; approximately 300	Each person underground
Self-Contained Self-Rescuer	At least 60 minutes of oxygen available. Approximately 400 units cached throughout the underground	Cached throughout the underground
Self-Contained Breathing Apparatus (SCBA)	Oxygen supply; 4-hour units; approximately 14 Mine Rescue Team Draeger units	Mine Rescue Training Room
Chemical and Chemical-Supported Gloves	Body protection; (12 pair) inner-cloth, (12 pair) outer-pvc, (5 pair) outer-viton	HAZMAT trailer
Suit, Acid	Body protection; (4) acid	HAZMAT trailer
Suit, Fully Encapsulated	Body protection; used with SCBAs; full outerboot; (4) Level A; (4) Level B	HAZMAT trailer
Emergency Medical Equipment		
Antishock Trousers	Shock treatment; (2) inflatable, one on each ambulance	Ambulance # 1 and # 2

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Zoll 1600 Heart Monitor and Defibrillator	Heart Monitor/defibrillator	Ambulance # 1 and # 2
Oxygen	Patient care; Size D: (2) Ambulance #1 (1) Underground Ambulance (1) Health Services Size E: (1) Rescue Truck (2) Underground Ambulance Size M: (1) Ambulance #1	Ambulance # 1 and # 2, surface rescue truck
Resuscitators (Bag)	Disposable bag resuscitation Ambulance #1: (2) adult size (1) child size Underground Ambulance: (2) adult size	Ambulance # 1, Ambulance # 2
Splints	Immobilize limbs; (1) Adult traction splint, lower extremity, with limb-supporting slings, padded ankle hitch and traction device per ambulance. (2) Rigid splinting devices or equivalents, suitable for immobilization of upper extremities per ambulance. (2) Rigid splinting devices or equivalents, suitable for the immobilization of lower extremities. (1) Set of Airsplints: 6 assorted splints; hand/wrist, half arm, full arm, foot/ankle, half leg, and full leg per miner's aid stations.	Ambulance # 1 and # 2, Miner's Aid Stations
Stretchers	Patient transport; (2) Spine Boards, one short and one long, with nylon straps per ambulance. (also used to perform cardiopulmonary resuscitation) (2) Emergency Stretchers or scoops, or combination per ambulance (1) All-purpose multi-level ambulance stretch (gurney), with 3 safety straps and locking mechanism per ambulance. (1) Stretcher in each miner's aid station.	Various combinations in Ambulance # 1 and # 2, Miner’s Aid Station
Suctions	For medical emergencies: Portable (1) Suction unit, capable of delivering at least 300 mm. HG on each ambulance.	Ambulances #1 and #2

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Trauma Kits	(1) adult blood pressure cuff and stethoscope (4) soft-roller bandages (3) triangular bandages (1) pkg. band-aids (2) trauma dressings (25) 4X4 sponges (1) roll adhesive tape (1) bite stick (1) penlight (1) sterile burn sheet (1) oropharyngeal airway (1) glucose substance (2) sterile gauze dressings	(1) kit in each: Ambulances #1 and #2, surface rescue truck
Miner's Aid Station	For First Aid Stations in the Underground (1) Stretcher--as referenced above per station (1) Set of airsplints--as referenced above per station (1) Blanket per station (1) Box of latex gloves (50) per station (5) Pathogen Wipes per station (1) First Aid Kit (24) per station; includes, (3) Band-Aid Combo Paks (2) Swabs, PVP (1) Antibiotic Ointment (1) Sting-Kill Swab (2) Dressing, compresses (2) Roller Bandages (2) Tape (2) Triangle Bandage (1) Eyedressing Pak (1) Burn Dressing (1) Ammonia Inhalants (1) User Log Sheet	Miner's Aid Stations - Various Underground Locations

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
First Aid Supplies	According to General Order #35 (12) bandages, soft roller, self-adhering type--4" or 6" x 5 yards. (6) triangular bandages, 40" (1) box band-aids (1) 1 pair bandage shears (6) Trauma dressings, 30" x 10" (6) Trauma dressings, 5" x 7" (50) 4" x 4" sponges, individually wrapped and sterile (2) rolls adhesive tape (1) penlight (2) sterile burn sheets (2) oropharyngeal airways -- adult (2) oropharyngeal airways -- child (Ambulance #1 only) (2) oropharyngeal airways -- infant (Ambulance #1 only) (1) Glucose substance (3) Occlusive dressings (1) Roll aluminum foil (6) Rigid cervical collars--2 each small, medium and large sizes (4) Cold packs (4) Heat packs (2) Bite sticks	Ambulance #1
First Aid Supplies	(2) Transfer sheets (2) Blankets	Ambulances #1 and #2
First Aid Supplies	(2) #16g angiosets (2) #18g angiosets (2) #20g angiosets (1) 1000cc LR IV fluid (1) 500cc NS IV fluid	Ambulances #1 and #2, surface rescue truck
General Plant Emergency Equipment		
Emergency Lighting	For employee rescue and evacuation, and fire/spill containment; linked to main power supply, and selectively linked to back up diesel power supply and/or battery-backed power supply	Surface and underground
Backup Power Sources	Two diesel generators, and battery-powered uninterruptible power supply (UPS); use limited to essential loads; manual or remote starting 1,100-kilowatt diesel generators with on-site fuel for 62% load for 3 days for selected loads; 30-minute battery capacity for essential loads	Generators are east of Safety and Emergency Services Building; UPS is located at the essential loads
Hoists	Hoists in Waste Shaft, Air Intake Shaft, and SH Shaft	Waste Shaft, Air Intake Shaft, SH Shaft
Radiation Monitoring Equipment	(5) Portable alpha and beta survey meters, portable air samplers, and portable continuous air monitors	Building 412
Emergency Shower	For emergency flushing of contaminated individual	Surface
Eye Wash Fountains	For emergency flushing of affected eyes	Various locations on surface and in the underground

TABLE F-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Decon Shower Equipment	Self-contained decon shower trailer, portable decon shower unit, disposable decon shower	Surface
Overpack containers	14-85 Gallon drums 4-SWBs 1-TDOP	Building 481 Building 481 Building 481
HEPA Vacuums	2 HEPA Vacuums to be utilized for removal of contamination.	Building 481
Aquaset or Cement	100 lbs. of aquaset or cement material for solidification of liquid waste generated as a result of fire fighting water or decontamination solutions.	Building 481
Polyvinyl Alcohol or Paint	1 - 5 gallon bucket of approved fixative to be used during recovery.	Building 481
TDOP Upender	Upender facilitates overpacking standard waste boxes	Building 481
Non hazardous Decontaminating Agents	4-1 Gallon bottles for decontamination of surfaces, equipment, and personnel	Building 481

TABLE F-7
TYPES OF FIRE SUPPRESSION SYSTEMS BY LOCATION

LOCATION	AS	AD	MPS	PFE
Waste Handling Building	*		*	*
Support Building	*		*	*
Exhaust Filter Building	*		*	*
Water Pumphouse	*		*	*
Underground Support Areas (also has rescue truck) (as illustrated in Figure F-5)		*	*	*
Station A Effluent Monitoring Shed			*	*
Station B Effluent Monitoring Shed			*	*

(1) Symbols for WIPP fire-protection systems:
AS = Automatic Wet Pipe Sprinkler System
AD = Automatic Dry Chemical Extinguishing System
MPS = Manual Pull Stations
PFE = Portable Fire Extinguishers

(2) The Waste Handling Building and the Support Building contain the following:
- Automatic wet pipe sprinklers
- Fire detection in the heating, ventilation, and air conditioning instrumentation (Support Building, only)
- Manual pull stations
- Portable fire extinguishers
- Automatic detectors

The Safety and Emergency Services Building contains the following:
- Automatic wet pipe sprinklers
- Manual pull stations
- Portable fire extinguishers
- Automatic detectors

The Core Storage Building contains the following:
- Automatic wet pipe sprinklers
- Portable fire extinguishers

(3) The Exhaust Filter Building, Underground Facilities, Warehouse/Shops Building, Water Pumphouse, and Salt Handling Hoist house also have portable fire extinguishers, manual pull stations, and automatic detectors.

TABLE F-8
HAZARDOUS RELEASE REPORTING, FEDERAL

Statute	Chemical Releases Covered	To Whom Report Will Be Made	What Will Be Reported	
			Immediately (Oral)	Subsequently (Written)
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA) (40 CFR Part 302)	"Reportable quantities" of CERCLA/SARA "hazardous substances."	National Response Center: (800) 424-8802, State Emergency Response Commission: (505) 476-9681 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (505) 885-3581	1) Chemical identification; 2) what hazardous substance; 3) quantity released; 4) time, location and duration of release; 5) media of release; 6) health risks and medical advice; 7) proper precautions (e.g., evacuation); and 8) name and phone number of reporter and facility.	As soon as practicable, update of oral notice and response action taken. Send report to: New Mexico State Emergency Response Commission, Department of Public Safety, Title III Bureau, P.O. Box 1628, Santa Fe, New Mexico, 87504-1628, and Local Emergency Planning Committee, 324 S. Canyon Street, Suite B, Carlsbad, New Mexico 88220. National Response Center will contact the U.S. Environmental Protection Agency (EPA). EPA may request a written report.
Emergency Planning and Community Right-to-Know Act (SARA Title III) (40 CFR Parts 302 and 355)	SARA Title III "extremely hazardous substances."	National Response Center: (800) 424-8802, State Emergency Response Commission: (505) 476-9681 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (505) 885-3581.	1) Chemical identification; 2) what extremely hazardous substance; 3) quantity released; 4) time, location and duration of release; 5) media of release; 6) health risks and medical advice; 7) proper precautions (e.g. evacuation); and 8) name and phone number of reporter and facility.	As soon as practicable, update of oral notice and response action taken. Send report to: New Mexico State Emergency Response Commission, Department of Public Safety, Title III Bureau, P.O. Box 1628, Santa Fe, New Mexico, 87504-1628, and Local Emergency Planning Committee, 324 S. Canyon Street, Suite B, Carlsbad, New Mexico 88220. National Response Center will contact the U.S. Environmental Protection Agency (EPA) for an address if a written report is requested by EPA.

TABLE F-8
HAZARDOUS RELEASE REPORTING, FEDERAL

Statute	Chemical Releases Covered	To Whom Report Will Be Made	What Will Be Reported	
			Immediately (Oral)	Subsequently (Written)
Resource Conservation and Recovery Act (RCRA), 40 CFR §§264.56(a) and 265.56(a)	Any imminent or actual emergency situation.	State or local agencies with designated response roles, if their help is needed: Carlsbad Police Department: 885-2111; Carlsbad Fire Department: 885-2111; Eddy County Sheriff: 887-7551.	What assistance is required.	Not Applicable (NA)
RCRA, 40 CFR §§264.56(d), 264.56(i), 265.56(d), and 265.56(i)	RCRA “hazardous waste” release, fire, or explosion, which could threaten human health or environment outside the facility.	National Response Center: (800) 424-8802 and State Emergency Response Commission: (505) 476-9681 (New Mexico State Police, Hazardous Materials Emergency Response).	(1) Name and telephone number of reporter; (2) name and telephone number of facility; (3) time and type of incident; (4) name and quantity of materials involved; (5) extent of injuries, if any; and (6) possible health or environmental hazards outside the facility.	Prior to resumption of operations, notify that: (1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and (2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.

TABLE F-8
HAZARDOUS RELEASE REPORTING, FEDERAL

Statute	Chemical Releases Covered	To Whom Report Will Be Made	What Will Be Reported	
			Immediately (Oral)	Subsequently (Written)
RCRA, 40 CFR §§264.56(i), 264.56(j), 265.56(i), and 265.56(j)	Any incident which triggers implementation of Contingency Plan.	New Mexico Environment Department, Emergency Response Office, 24-hour telephone: (505) 827-9329 (emergencies); for non-emergencies contact (866) 428-6535 (24 hour voice mail) or Monday to Friday, 8 am to 5 pm: (505) 428-2500.	NA	Within 15 days: 1) name, address and telephone number of owner/operator; 2) name, address and telephone number of facility; 3) date, time and type of incident (e.g. fire, explosion); 4) name and quantity of materials involved; 5) extent of injuries, if any; 6) possible hazards to human health or the environment; 7) estimated quantity of material that resulted from the incident. Prior to resumption of operations, notify that: 1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and 2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.

TABLE F-9
HAZARDOUS RELEASE REPORTING, STATE OF NEW MEXICO

Regulations	Chemical Releases Covered	To Whom Report Will Be Made	What Will Be Reported	
			Immediately (Oral)	Subsequently (Written)
Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20.4.1 NMAC), Subpart V and Subpart VI	RCRA “hazardous waste” releases, fire, or explosion, which could threaten human health or environment outside the facility.	National Response Center: (800) 424-8802; State Emergency Response Commission and (505) 476-9620 (New Mexico State Police, Hazardous Materials Emergency Response)	1) Name and telephone number of reporter; 2) name and telephone number of facility; 3) time and type of incident; 4) name and quantity of material involved; 5) extent of injuries, if any; and 6) possible health or environmental hazards outside the facility.	Prior to resumption of operations, notify that: 1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and 2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.

TABLE F-9
HAZARDOUS RELEASE REPORTING, STATE OF NEW MEXICO

Regulations	Chemical Releases Covered	To Whom Report Will Be Made	What Will Be Reported	
			Immediately (Oral)	Subsequently (Written)
20.4.1 NMAC, Subpart V and Subpart VI	Any incident which triggers implementation of Contingency Plan.	New Mexico Environment Department, Emergency Response Office, 24-hour telephone: (505) 827-9329 (emergencies); for non-emergencies contact (866) 428-6535 (24 hour voice mail) or Monday to Friday, 8 am to 5 pm: (505)428-2500.	1) Name and telephone number of reporter; 2) name and address of facility; 3) name and quantity of materials involved, to extent known; 4) extent of injuries, if any; and 5) possible hazards to human health or the environment, outside the facility.	Within 15 days: 1) name, address and telephone number of owner/operator; 2) name, address and telephone number of facility; 3) date, time and type of incident (e.g., fire, explosion); 4) name and quantity of materials involved; 5) extent of injuries, if any; 6) possible hazards to human health or the environment; and 7) estimated quantity of material that resulted from the incident. Prior to resumption of operations, notify that: 1) no waste that may be incompatible with released material is treated, stored or disposed of until cleanup is complete, and 2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.

TABLE F-9
HAZARDOUS RELEASE REPORTING, STATE OF NEW MEXICO

Regulations	Chemical Releases Covered	To Whom Report Will Be Made	What Will Be Reported	
			Immediately (Oral)	Subsequently (Written)
New Mexico Emergency Management Act, Section 74-4B-5	Any accident (spill) involving hazardous materials (including hazardous substances, radioactive substances, or a combination thereof) which may endanger human health or the environment.	New Mexico Environment Department: (505) 827-9329, State Emergency Response Commission: (505) 476-9681 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (505) 885-3581	1) Name, address and telephone number of owner or operator; 2) name, address and telephone number of facility; 3) date, time and type of incident; 4) name and quantity of material(s) involved; 5) extent of any injuries; 6) assessment of actual or potential threat to environment or human health; and 7) estimated quantity and disposition of recovered material.	Written submission within one week of time permittees become aware of discharge. Same as oral and description of noncompliance and its cause, the period of noncompliance including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence. Send reports to New Mexico Environment Department, Chief, Ground Water Quality Bureau, P.O. Box 26110, Santa Fe, New Mexico, 87502, New Mexico State Emergency Response Commission Department of Public Safety, Title III Bureau, P.O. Box 1628 Santa Fe, New Mexico, 87504-1628, and Local Emergency Planning Committee, 324 S. Canyon Street, Suite B, Carlsbad, New Mexico 88220.

TABLE F-9
HAZARDOUS RELEASE REPORTING, STATE OF NEW MEXICO

Regulations	Chemical Releases Covered	To Whom Report Will Be Made	What Will Be Reported	
			Immediately (Oral)	Subsequently (Written)
New Mexico Water Quality Control Commission, Part 1, Section 203	Any discharge from any facility of oil or any other water contaminant in such quantities as may, with reasonable probability, injure or be detrimental to human health, animal or plant life, or property.	Chief, Ground Water Quality Bureau, New Mexico Environment Department, or his counterpart in any constituent agency delegated responsibility for enforcement of the rules as to any facility subject to such delegation (505) 827-2918.	Within 24 hours: 1) the name, address, and telephone number of the person or persons in charge of the facility; 2) the name, address, and telephone number of the owner/operator of the facility; 3) the date, time, location, and duration of the discharge; 4) the source and cause of the discharge; 5) a description of the discharge, including its chemical composition; and 6) the estimated volume of discharge, and immediate damage from the discharge.	Submit within seven days: verification of the prior oral notification, also provide any appropriate additions or corrections to the information contained in the prior oral notification. Within 15 days: submit a written report describing any corrective actions taken and/or to be taken relative to the discharge. Send reports to Chief, Ground Water Quality Bureau, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.
New Mexico Underground Storage Tank Regulations-2	Any known or suspected release from an Underground Storage Tank (UST) system, any spill or any other emergency situation.	New Mexico Environment Department Petroleum Storage Tank Bureau (505) 984-1741.	Within 24 hours: 1) the name, address, and telephone number of the agent in charge of the site at which the UST system is located, as well as the owner/operator of the system; 2) the name and address of the site and the location of the UST system on that site; 3) the date, time, location, and duration of the spill, release, or suspected release; 4) the source and cause of the spill, release, or suspected release; 5) a description of the spill, release, or suspected release, including its chemical composition; 6) the estimated volume of the spill, release, or suspected release; and 7) action taken to mitigate immediate damage from the spill, release, or suspected release.	Mail or deliver within seven days of the incident, a written notice describing the spill, release, or suspected release and any investigation or follow-up action taken or to be taken. Send reports to Petroleum Storage Tank Bureau, New Mexico Environment Department, 2044 Galisteo Street, Santa Fe, New Mexico, 87504.

1

FIGURES

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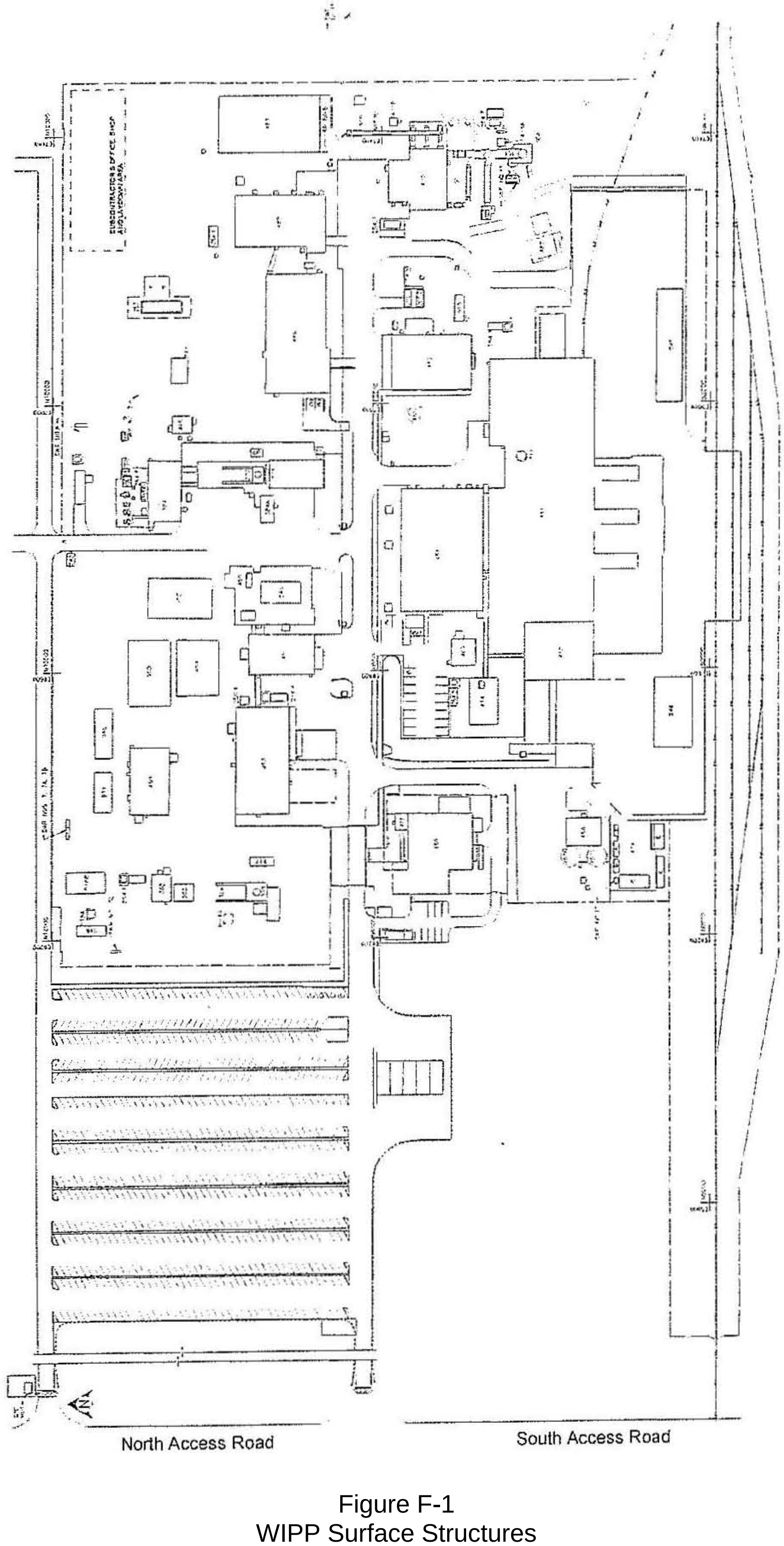
1 

2 Figure F-1
3 WIPP Surface Structures

BLDG./ FAC.#	DESCRIPTION	BLDG./ FAC.#	DESCRIPTION	BLDG./ FAC.#	DESCRIPTION
#241	EQUIPMENT SHED	#384	SALT HANDLING SHAFT HOISTHOUSE	#475	GATEHOUSE
#242	GUARDSHACK	#384A	MINING OPERATIONS	#480	VEHICLE FUEL STATION
#243	SALT HAULING TRUCKS SHELTER	#411	WASTE HANDLING BUILDING	#481	WAREHOUSE ANNEX
#245	TRUPACT TRAILER SHELTER	#412	TRUPACT MAINTENANCE BUILDING	#482	EXHAUST SHAFT HOIST EQUIP. WAREHOUSE
#246	MgO STORAGE SHELTER	#413	EXHAUST SHAFT FILTER BUILDING	#485	SULLAIR COMPRESSOR BUILDING
#253	13.8 KV SWITCHGEAR 25p-SWG15/1	#413A	MONITORING STATION A	#486	ENGINEERING BUILDING
#254.1	AREA SUBSTATION NO. 1 25P-SW15.1	#413B	MONITORING STATION B	#489	TRAINING BUILDING
#254.2	AREA SUBSTATION NO. 2 25P-SW15.2	#414	WATER CHILLER FACILITY & BLDG	#H-16	SANDIA TEST WELL
#254.3	AREA SUBSTATION NO. 3 25P-SW15.3	#451	SUPPORT BUILDING	#917	AIS MONITORING
#254.4	AREA SUBSTATION NO. 4 25P-SW15.4	#452	SAFETY & EMERGENCY SERVICES FACILITY	#918	VOC TRAILER
#254.5	AREA SUBSTATION NO. 5 25P-SW15.5	#453	WAREHOUSE/SHOPS BUILDING	#918A	VOC AIR MONITORING STATION
#254.6	AREA SUBSTATION NO. 6 25P-SW15.6	#455	AUXILIARY WAREHOUSE BUILDING	#918B	VOC LAB TRAILER
#254.7	AREA SUBSTATION NO. 7 25P-SW15.7	#456	WATER PUMPHOUSE	#950	WORK CONTROL TRAILER
#254.8	AREA SUBSTATION NO. 8 25P-SW15.8	#457N	WATER TANK 25-D-001B	#951	PROCUREMENT/PURCHASING
#254.9	480V SWITCHGEAR (25P-SWGO4/9)	#457S	WATER TANK 25-D-001A	#952	TRAILER
#255.1	BACK-UP DIESEL GENERATOR #1 25-PE 503	#458	GUARD AND SECURITY BUILDING	#965	SAMPLE LABORATORY TRAILER
#255.2	BACK-UP DIESEL GENERATOR #2 25-PE 504	#459	CORE STORAGE BUILDING	#971	HUMAN RESOURCES TRAILER
#256.4	SWITCHBOARD #4 (25P-SBD04/4)	#463	COMPRESSOR BUILDING	#986	PUBLICATIONS & PROCEDURES TRAILER
#311	WASTE SHAFT	#465	AUXILIARY AIR INTAKE	SWR NO 6	SWITCHRACK NO. 6
#351	EXHAUST SHAFT	#468	TELEPHONE HUT	SWR NO. 7	7A, 7B SWITCHRACK NO 7, 7A, 7B
#361	AIR INTAKE SHAFT	#473	ARMORY BUILDING	SWR NO. 7C	SWITCHRACK NO. 7C
#362	AIR INTAKE SHAFT/HOIST HOUSE	#474	HAZARDOUS WASTE STORAGE FACILITY	SWR NO 10	SWITCHRACK NO. 10
#363	AIR INTAKE SHAFT/WINCH HOUSE	#474A	HAZARDOUS WASTE STORAGE BUILDING	SWR NO. 11	SWITCHRACK NO. 11
#364	EFFLUENT MONITORING INSTRUMENT SHED A	#474B	HAZARDOUS WASTE STORAGE BUILDING	SWR NO 12	SWITCHRACK NO. 12
#365	EFFLUENT MONITORING INSTRUMENT SHED B	#474C	OIL & GREASE STORAGE BUILDING	SWR NO. 15	SWITCHRACK NO. 15
#366	AIR INTAKE SHAFT HEADFRAME	#474D	GAS BOTTLE STORAGE BUILDING		
#371	SALT HANDLING SHAFT	#474E	HAZARD MATERIAL STORAGE BUILDING		
#372	SALT HANDLING SHAFT HEADFRAME	#474F	WASTE OIL RETAINER		

Figure F-1a
Legend to Figure F-1

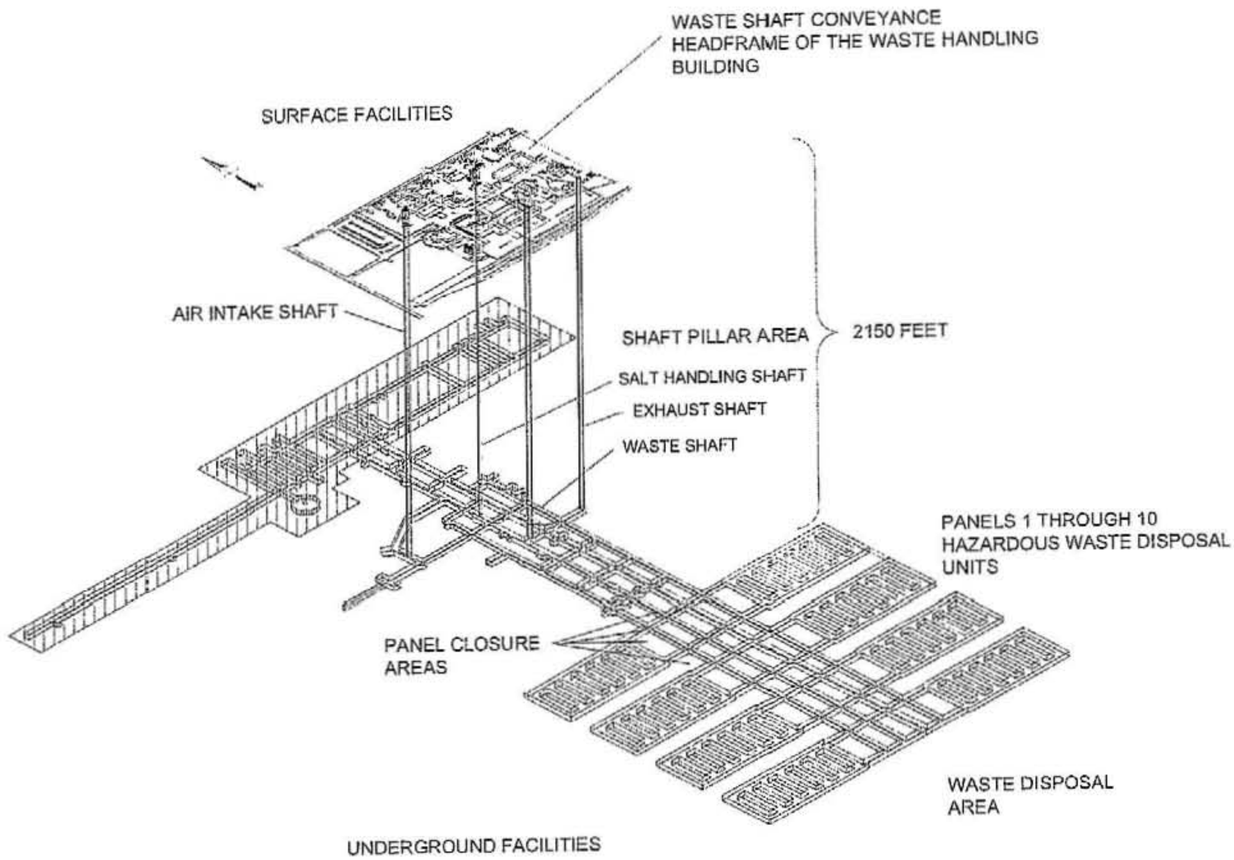
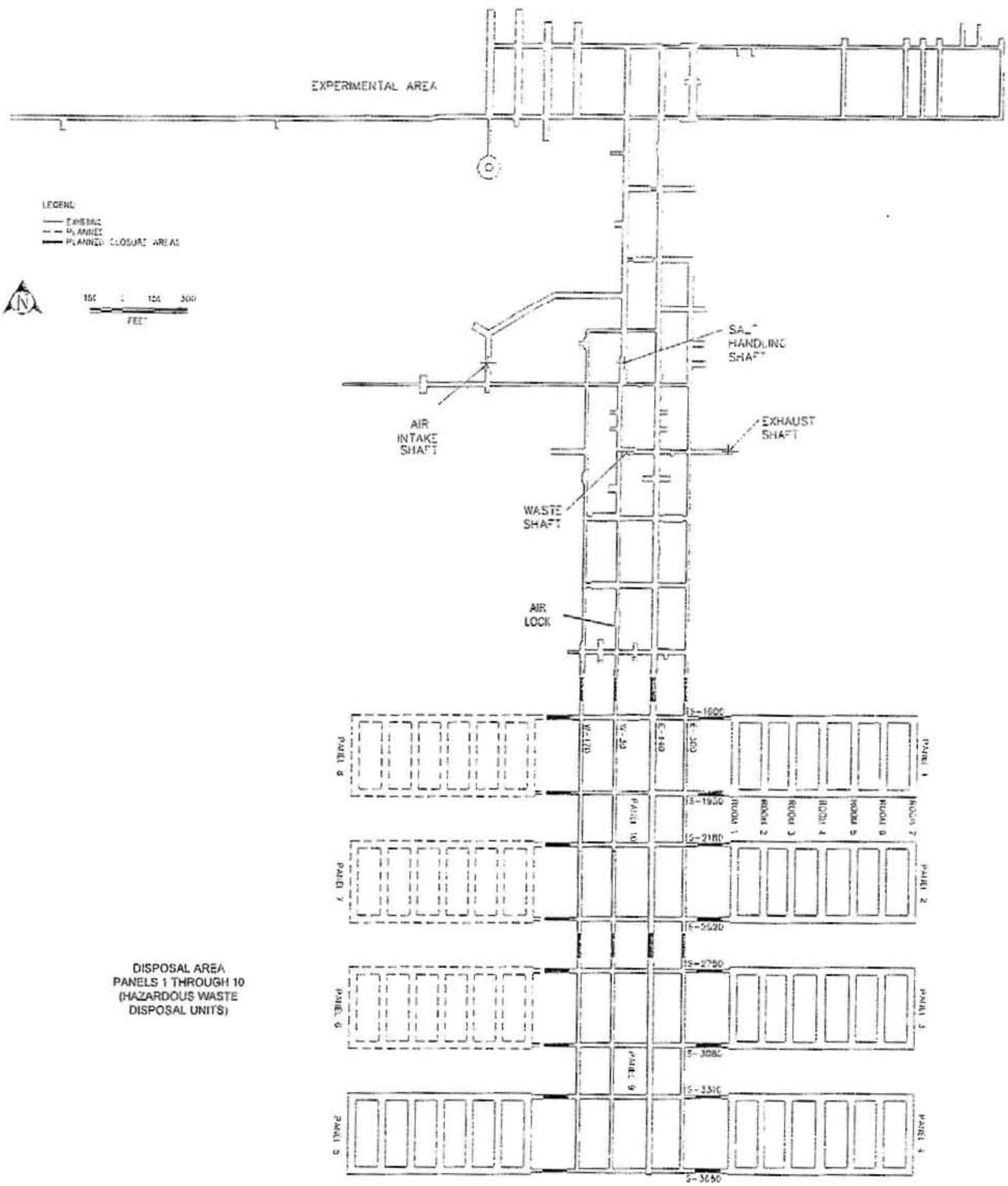
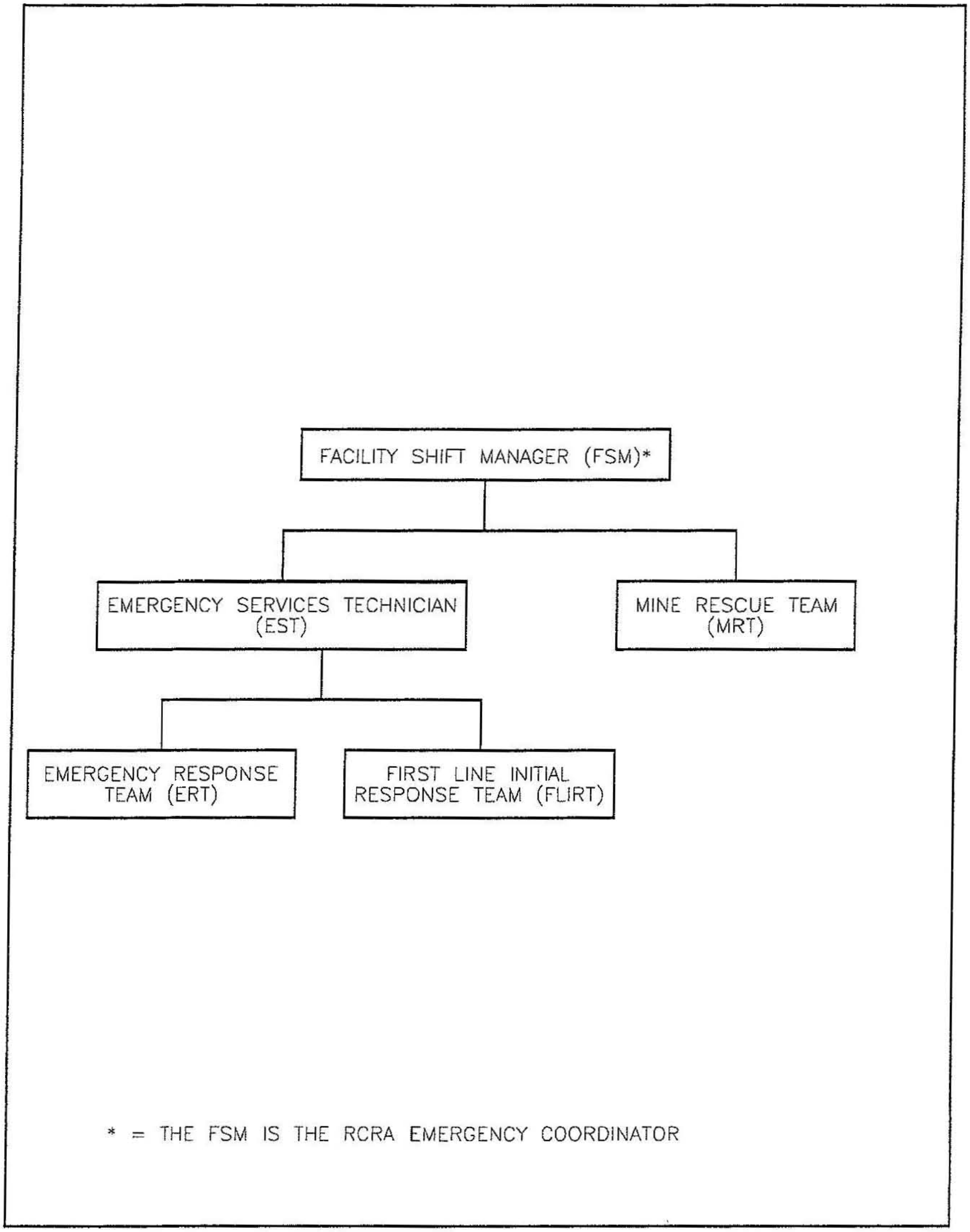


Figure F-2
Spatial View of the WIPP Facility

1



2 Figure F-3
3 WIPP Underground Facilities



1

2 Figure F-4
3 Direction and Control Under Emergency Conditions in Which the Plan Has Been Implemented

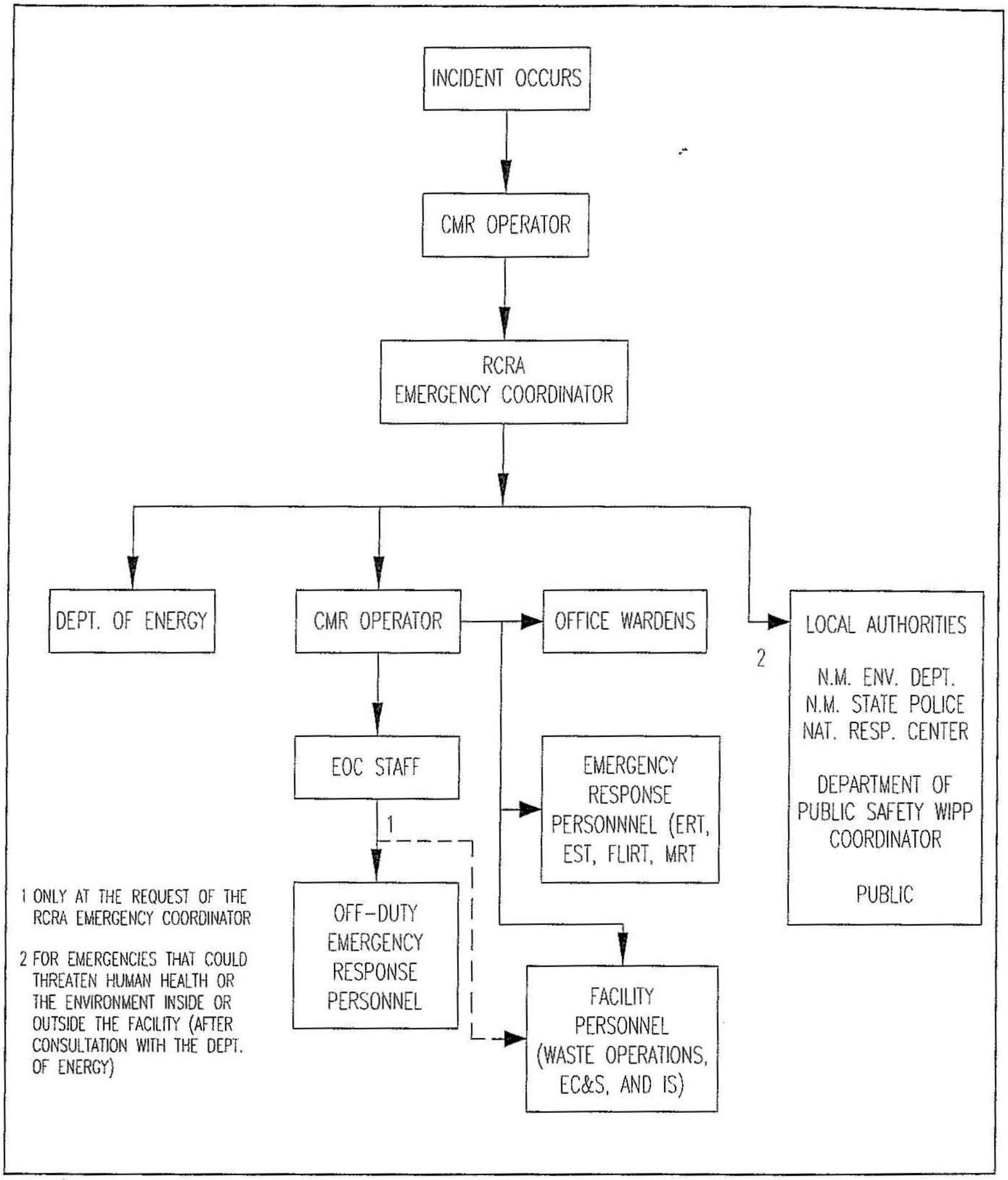


Figure F-4a
WIPP Facility Emergency Notifications

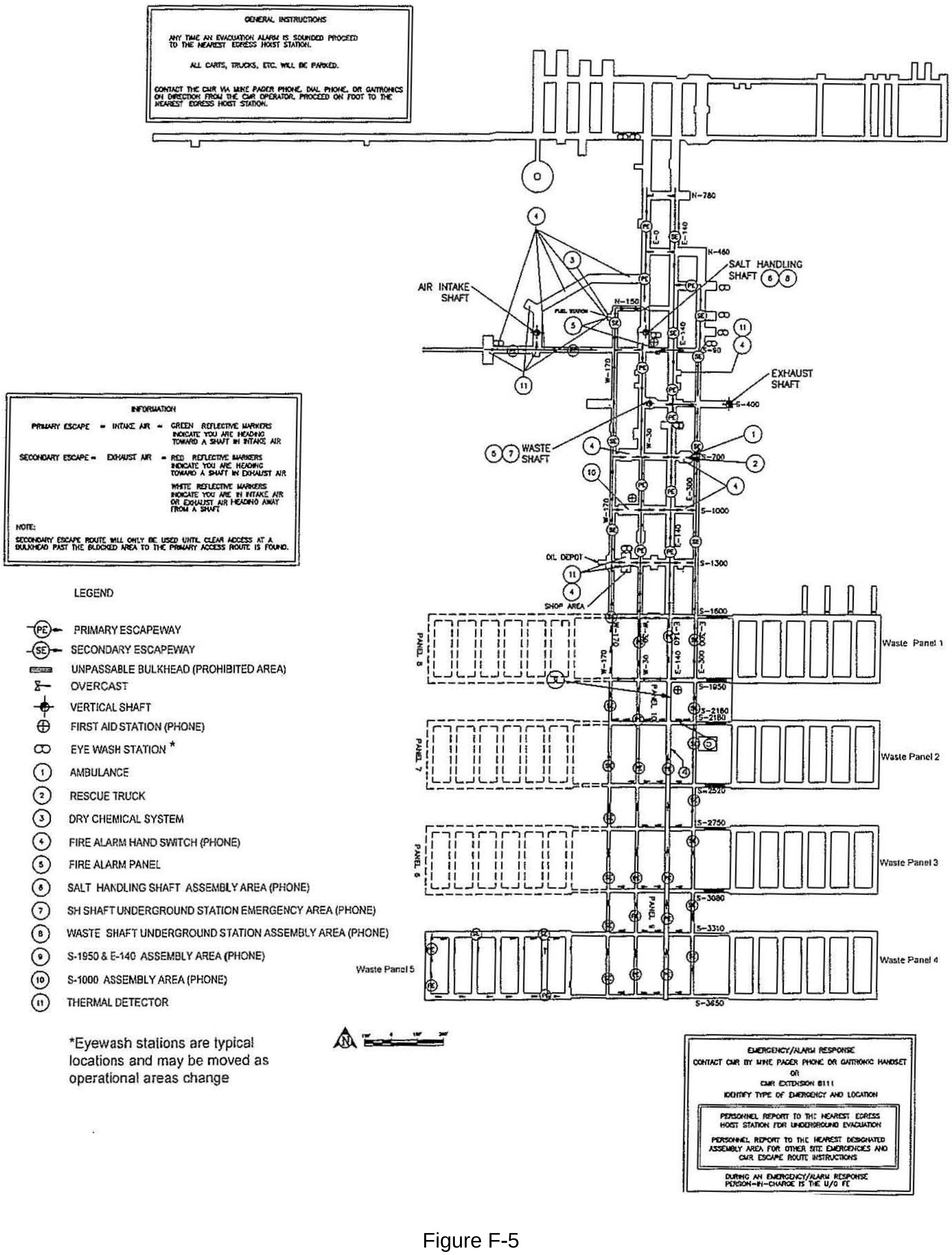


Figure F-5
Underground Emergency Equipment Locations and Underground Evacuation Routes

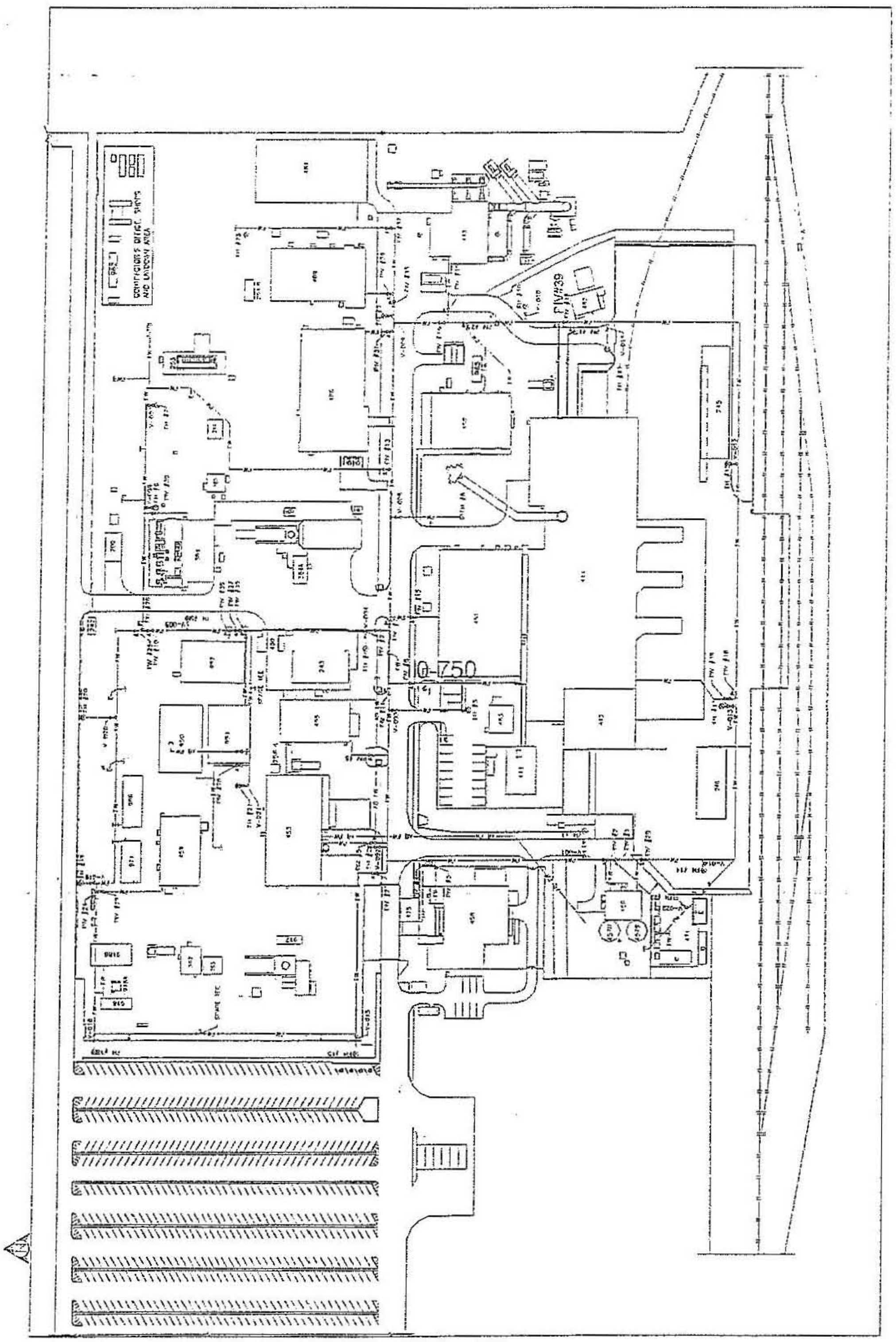


Figure F-6
Fire-Water Distribution System

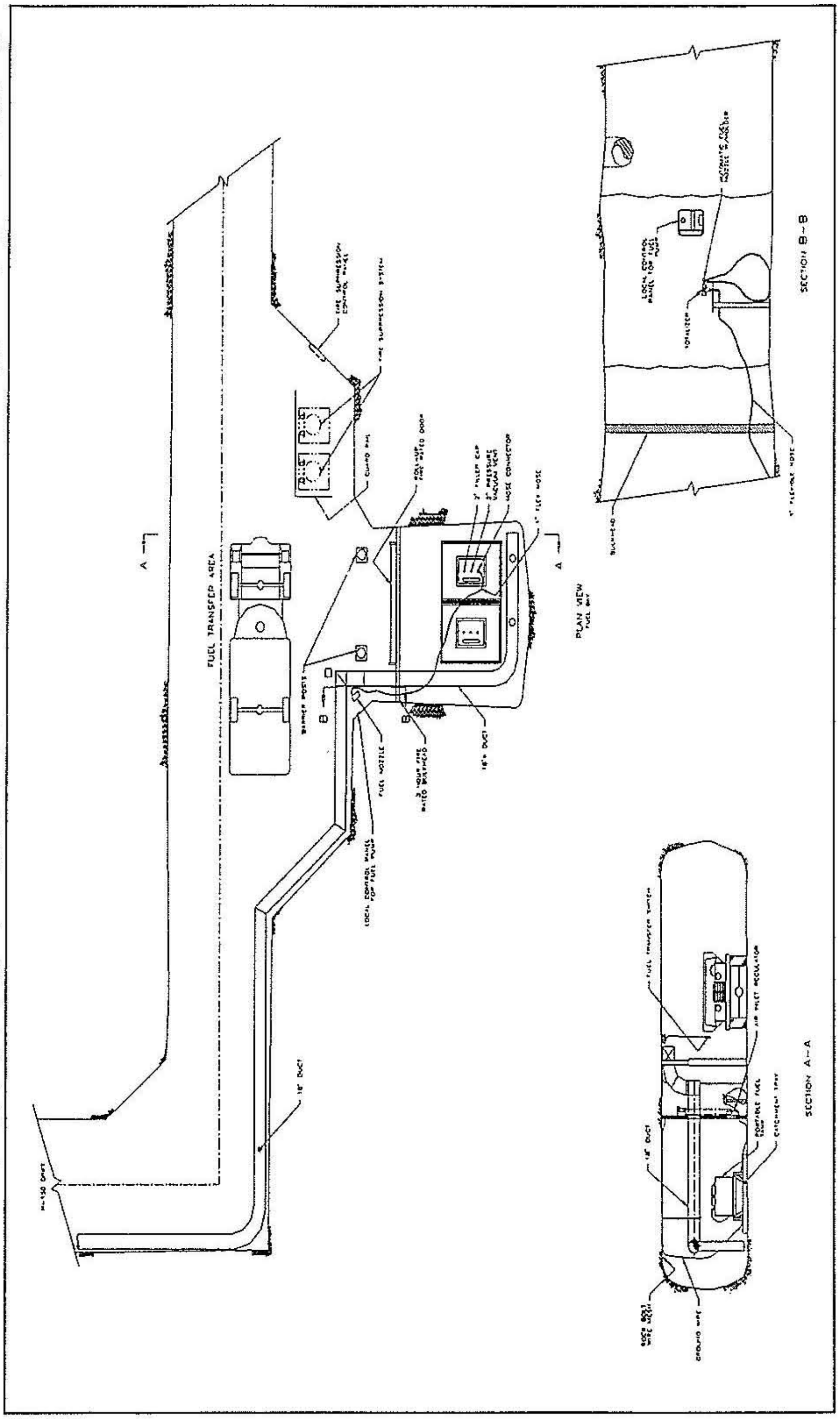


Figure F-7
Underground Diesel Fuel-Station Area Fire-Protection System

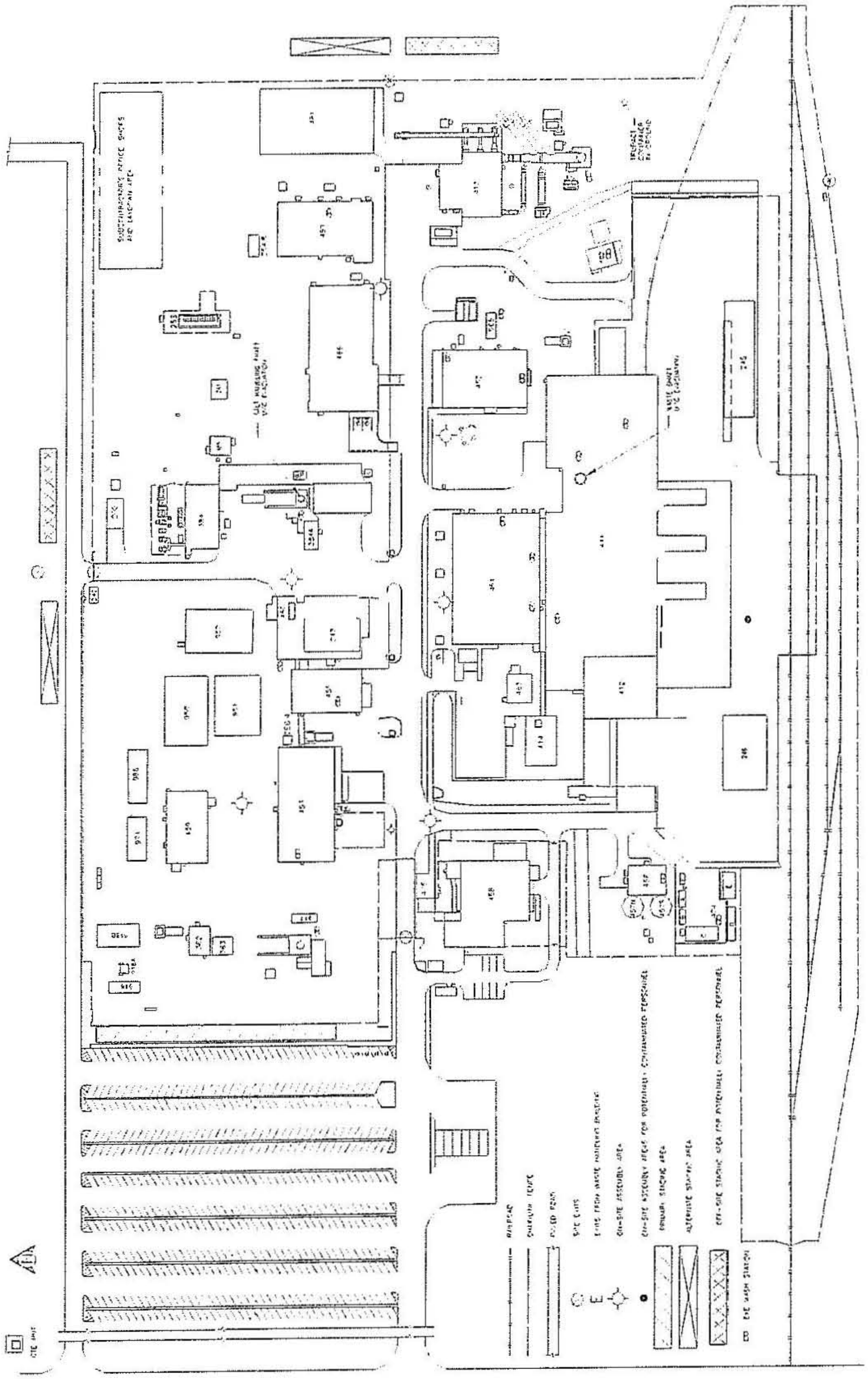


Figure F-8
WIPP On-Site Assembly Areas and WIPP Staging Areas

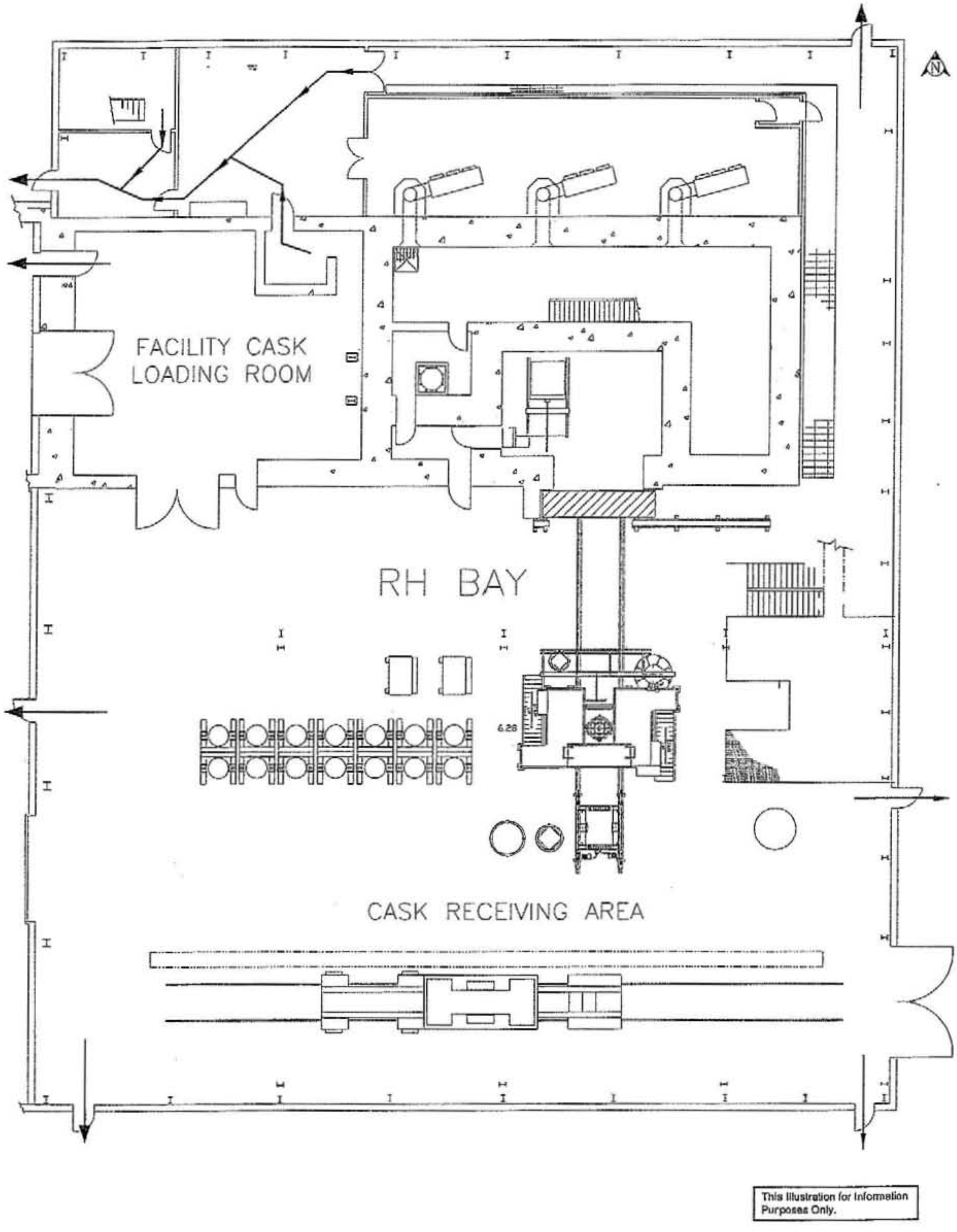
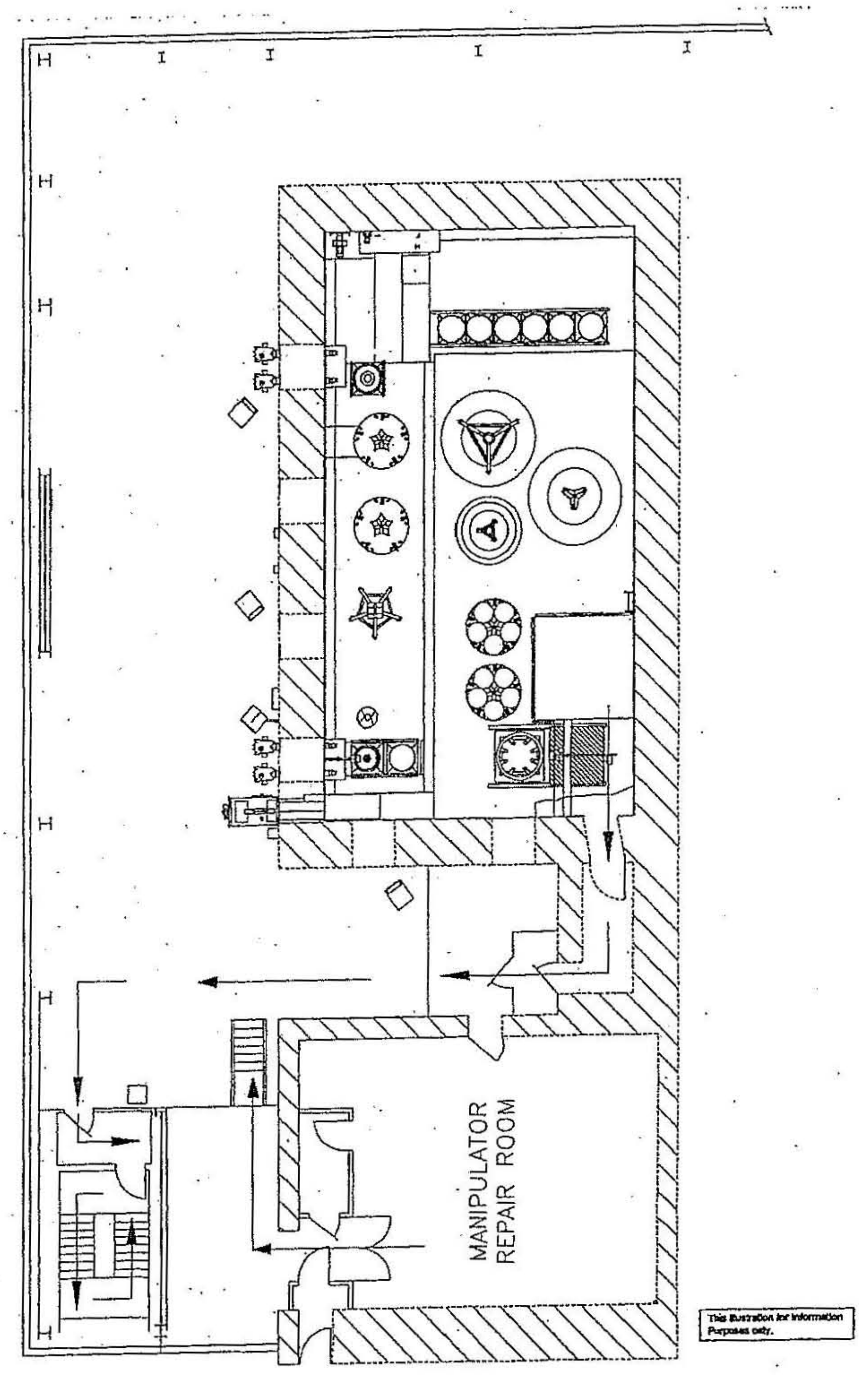


Figure F-8a
RH Bay Evacuation Routes

1 

2 Figure F-8b
3 RH Bay Hot Cell Evacuation Route

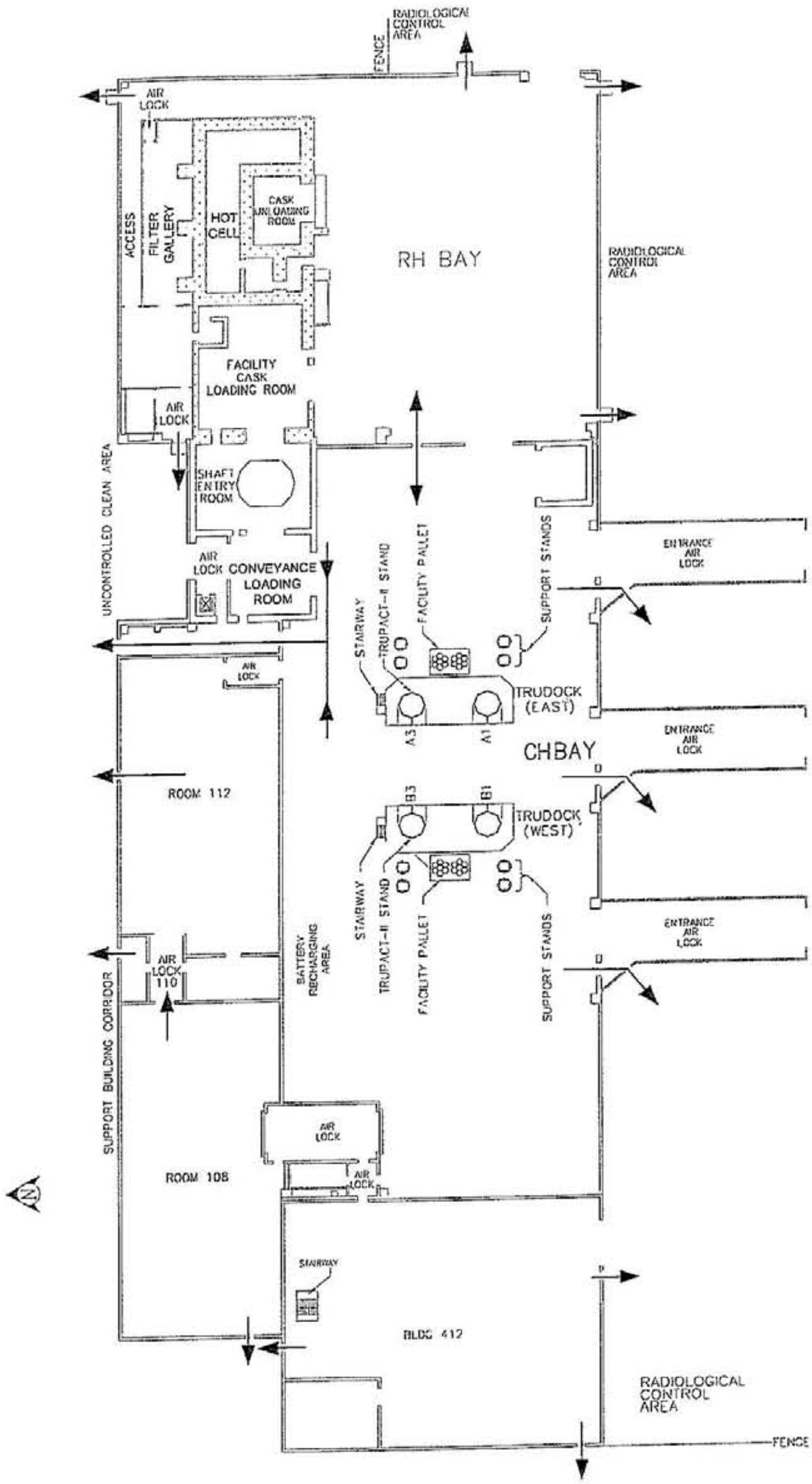


Figure F-8c
Evacuation Routes in the Waste Handling Building

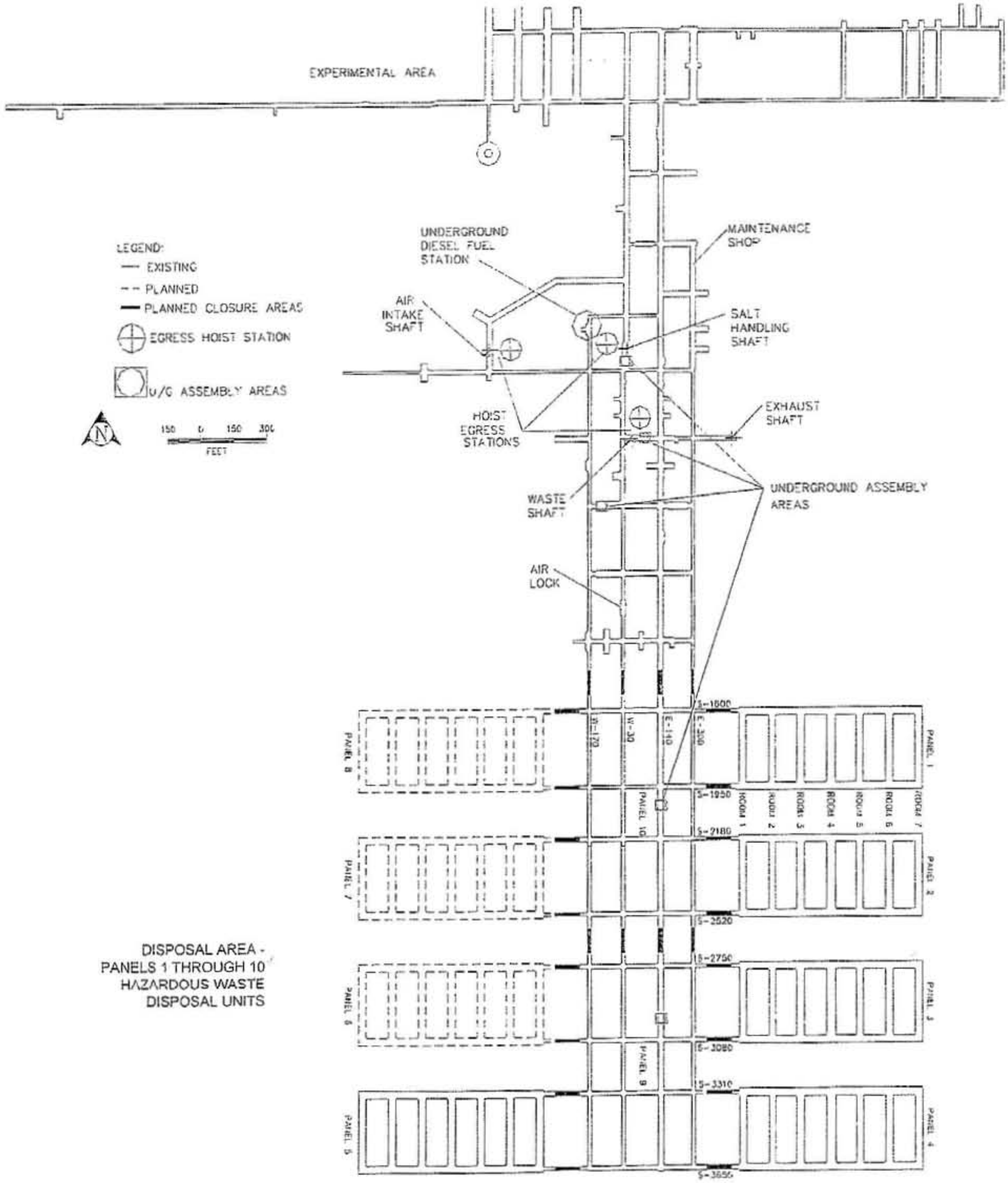
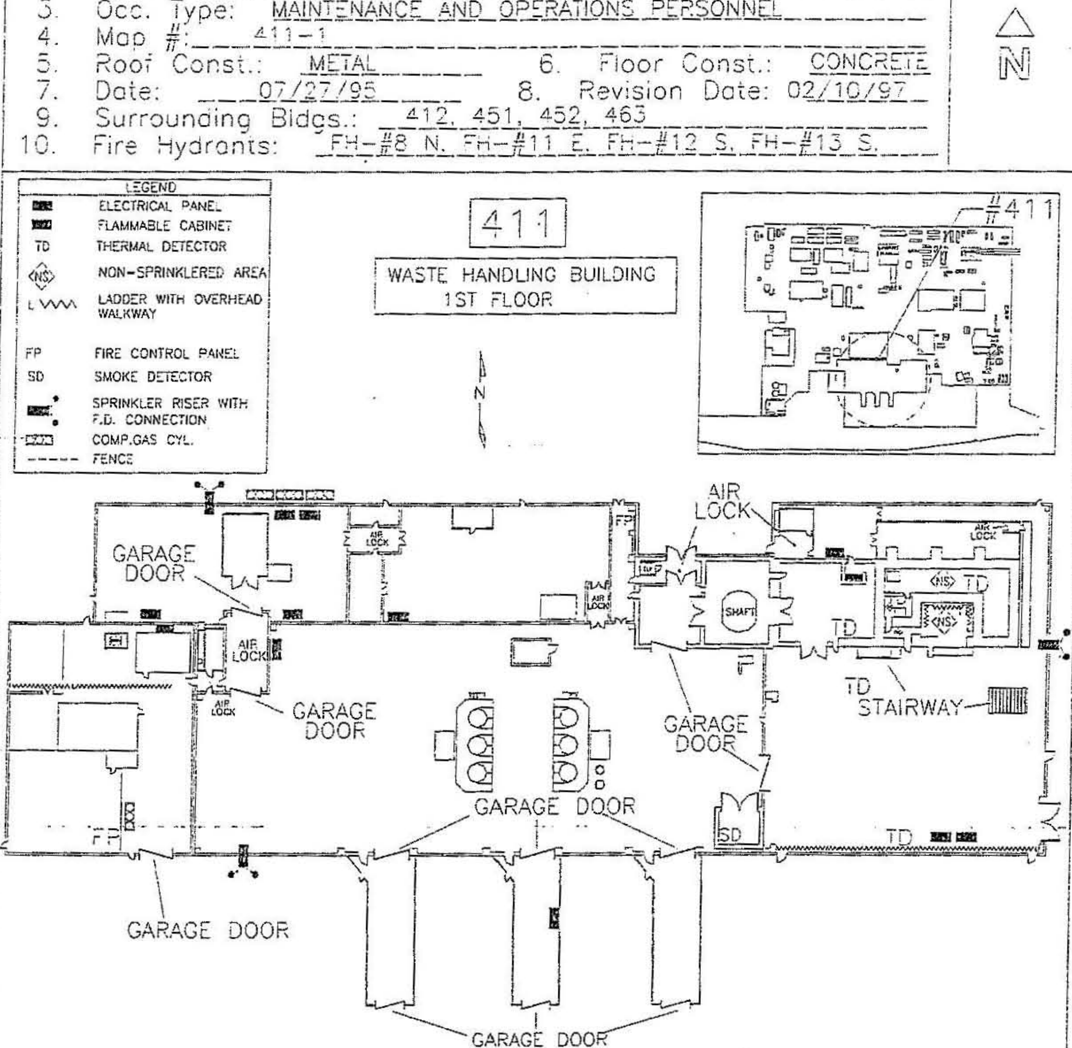


Figure F-9
Designated Underground Assembly Areas

Pre-Fire Survey

1. Bldg. Name: WASTE HANDLING BUILDING
2. Address: 411 SITE
3. Occ. Type: MAINTENANCE AND OPERATIONS PERSONNEL
4. Map #: 411-1
5. Roof Const.: METAL 6. Floor Const.: CONCRETE
7. Date: 07/27/95 8. Revision Date: 02/10/97
9. Surrounding Bldgs.: 412, 451, 452, 463
10. Fire Hydrants: FH-#8 N, FH-#11 E, FH-#12 S, FH-#13 S.



11. Comments: WATER SHUT-OFF AT PIV #8, PIV #17, PIV #19, PIV #38, PIV #39

Figure F-10
Waste Handling Building Pre-Fire Survey (First Floor)

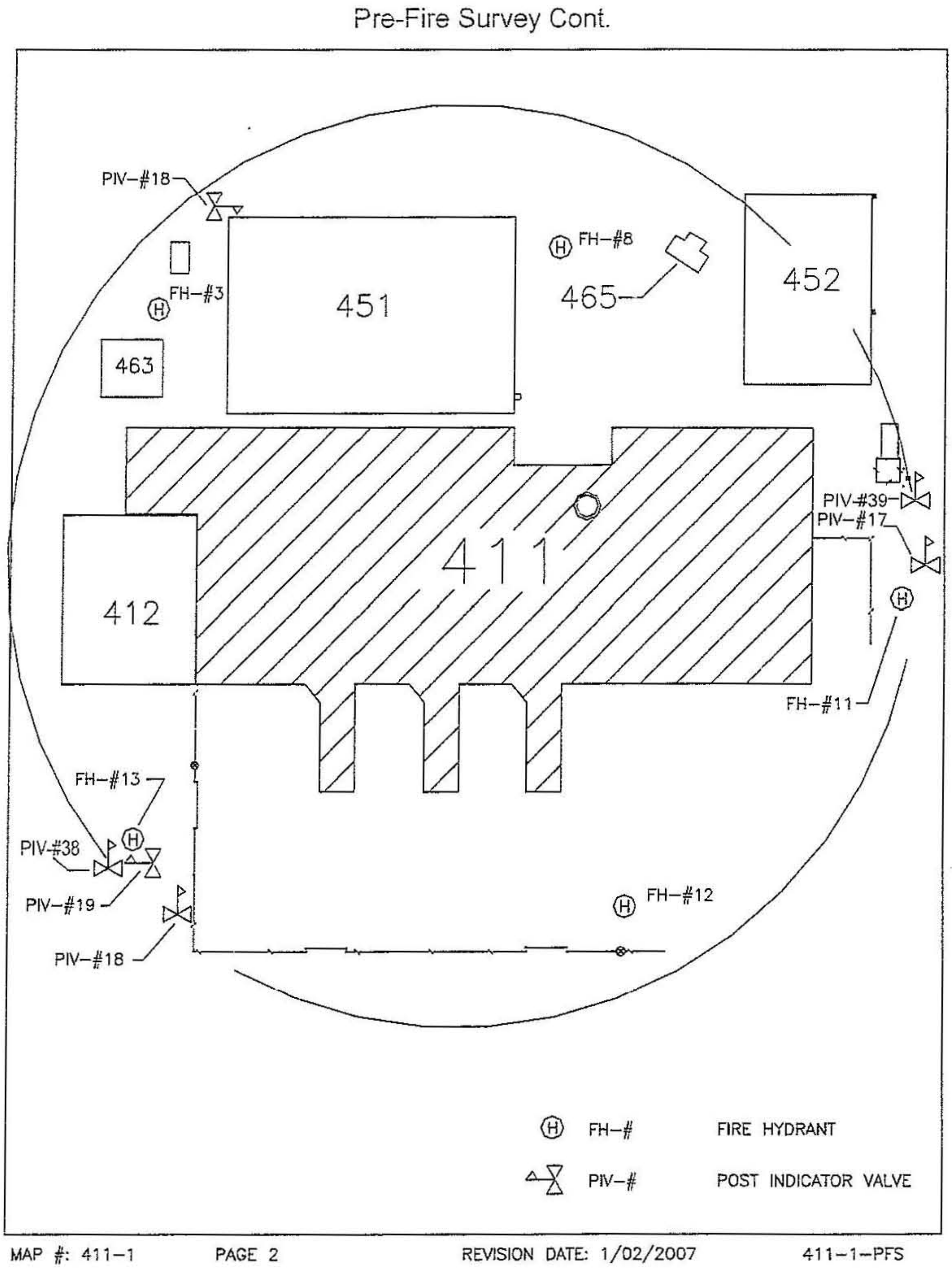
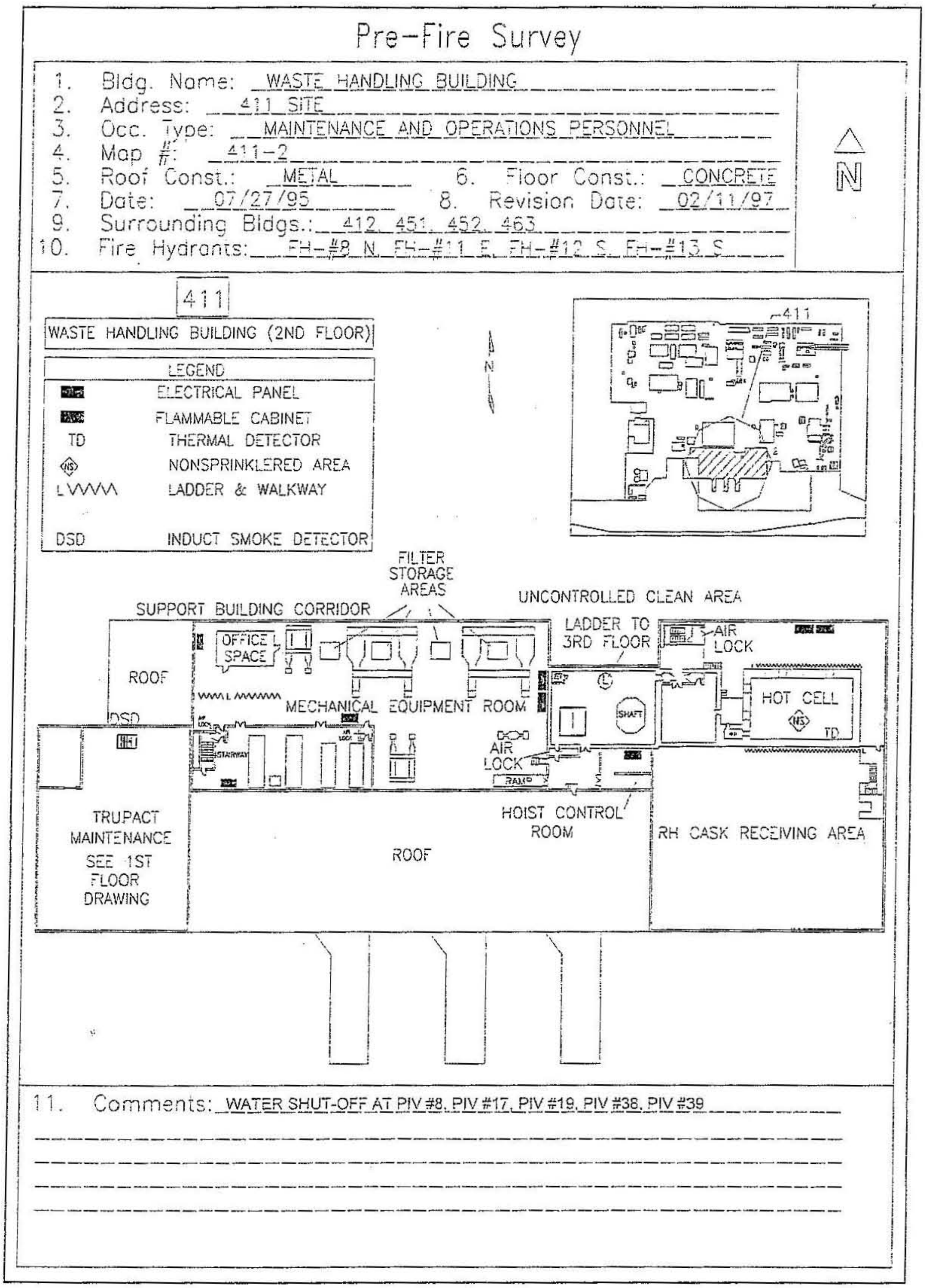


Figure F-10a
Waste Handling Building Pre-Fire Survey
(First Floor - Fire Hydrant/Post Indicator Location)



Pre-Fire Survey

1. Bldg. Name: WASTE HANDLING BUILDING
2. Address: 411 SITE
3. Occ. Type: MAINTENANCE AND OPERATIONS PERSONNEL
4. Map #: 411-2
5. Roof Const.: METAL 6. Floor Const.: CONCRETE
7. Date: 07/27/95 8. Revision Date: 02/11/97
9. Surrounding Bldgs.: 412, 451, 452, 463
10. Fire Hydrants: FH-#8 N, FH-#11 E, FH-#12 S, FH-#13 S

11. Comments: WATER SHUT-OFF AT PIV #8, PIV #17, PIV #19, PIV #38, PIV #39

Figure F-11
Waste Handling Building Pre-Fire Survey (Second Floor)

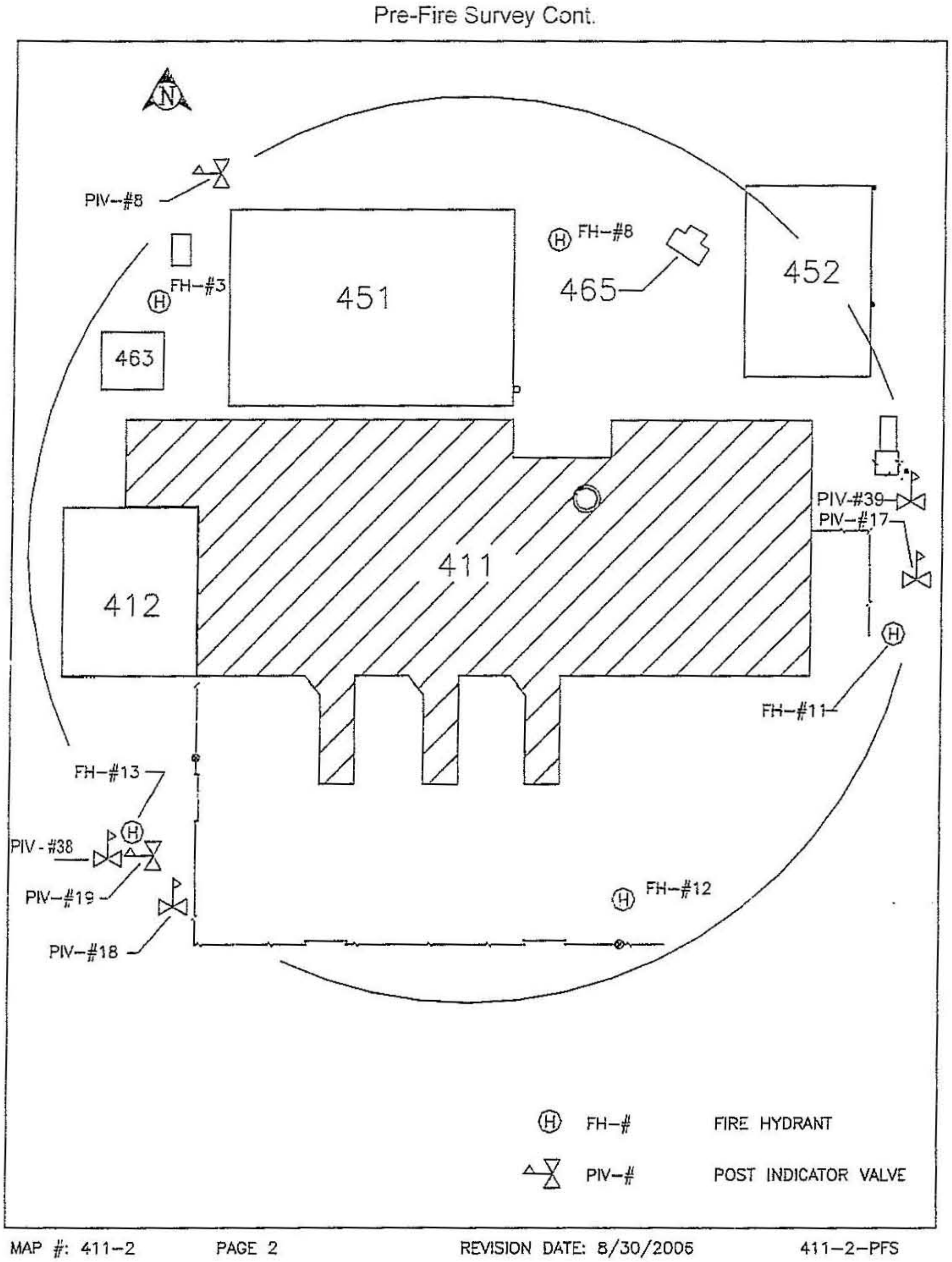


Figure F-11a
Waste Handling Building Pre-Fire Survey
(Second Floor - Fire Hydrant/Post Indicator Location)

WIPP HAZARDOUS MATERIAL INCIDENT REPORT

Date:__________ Location:______________________________

I. INITIAL INFORMATION DATE:____________________________ TIME:______________
EST:____________________________________ REPORTED LOCATION:_________________
REPORTED BY:____DEPT.:_________________
INITIALLY REPORTED TO:___________________________________DEPT.:_________________
RESPONSIBLE MANAGER:_____________________________________DEPT.:_________________

II. WEATHER CONDITIONS WIND DIRECTION_________WIND SPEED:________mph TEMP.:_______F
CONDITIONS (i.e.., icy, snowing, raining, cloudy, sunny):_______________________________________

III. TYPE OF INCIDENT (SPILL, LEAK, ETC.):______________________Fire involved: [ ]YES [ ]NO
(If fire is involved attach a copy of the fire report)

MATERIALS INVOLVED	UN/NA NO.	QUANTITY	HAZARD CLASS	NFPA CLASS

IV. PERSONNEL INVOLVED IN CLEAN-UP ACTIVITIES

PERSONNEL/DEPT	DECON METHOD/MEDICAL TREATMENT

V. PERSONNEL CONTAMINATED NOT INVOLVED IN THE CLEANUP ACTIVITIES

PERSONNEL/DEPT.	MATERIAL CONTACTED	DECON/MEDICAL TREATMENT

Figure F-12
WIPP Hazardous Materials Incident Report, Page 1 of 3

WIPP HAZARDOUS MATERIAL INCIDENT REPORT

Date:________________ Location:____________________________

VI. EQUIPMENT USED FOR CLEAN-UP AND CONTROL MEASURES

EQUIPMENT/MATERIAL/PPE	QUANTITY	DISPOSITION (decon or replacement)

VII. DESCRIPTION OF INCIDENT AND RESPONSE (including containment and control)

VIII. ENVIRONMENTAL COMPLIANCE

Date:____________________________ Time:____________________________of evaluation.

Waste Category____

Disposition____

ORGANIZATION	DATE	TIME

EC Representative:____

Print name Signature Date

Figure 12 (Continued)
WIPP Hazardous Materials Incident Report, Page 2 of 3

WIPP HAZARDOUS MATERIAL INCIDENT REPORT

Date:__________________ Location:______________________

IX. INITIAL NOTIFICATION BY CMRO

DEPARTMENT	PERSON CONTACTED	TIME	NOTIFIED BY
Facility Ops (FSM)			
Emerg. Mgmt (EST)			
EC			
Industrial Safety			
Facility Ops. (FM/FMD)			

CMRO:____
Print name Signature Date

FSM:____
Print name Signature Date

X. CONTINGENCY PLAN IMPLEMENTATION

Contingency Plan implemented [ ]YES [ ]NO

FSM:____
Print name Signature Date

XI. REVIEWS

Report submitted by:____
Print name Signature Date

Emergency Management Manger:____
Print name Signature Date

EC Manager:____
Print name Signature Date

COMMENTS:____

Figure 12 (Continued)
WIPP Hazardous Materials Incident Report, Page 3 of 3

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DRAWINGS

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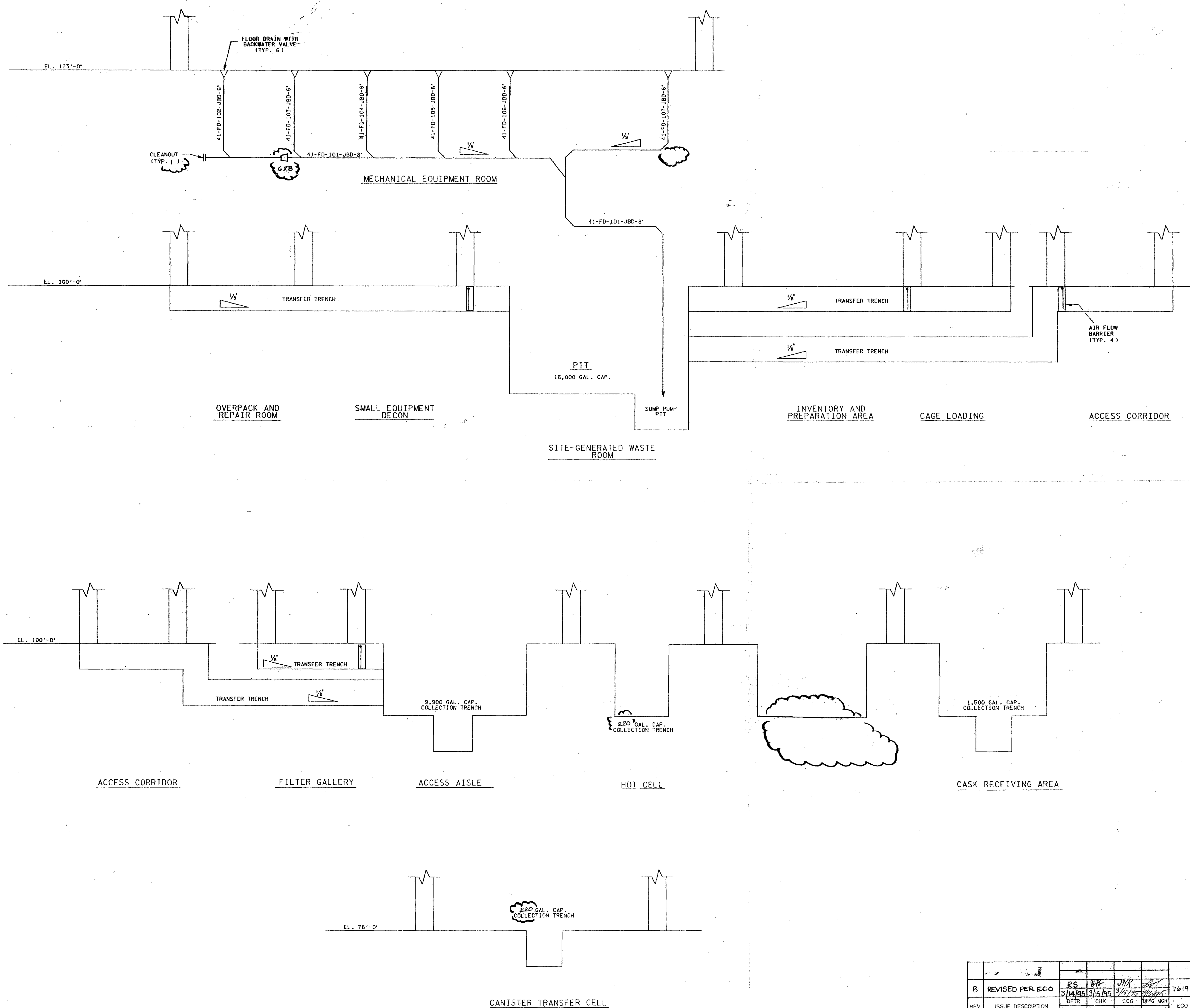
41-F-087



NOTES

1. THIS DRAWING IS A SCHEMATIC DIAGRAM AND IS NOT INTENDED TO SHOW THE PHYSICAL LOCATION OR SIZE OF THE TRENCHES.
2. THE FIRE WATER CAPACITIES AS SHOWN ON THIS DRAWING ARE APPROXIMATE. (VARIATIONS LESS THAN 3%).

REFERENCE DRAWINGS

WASTE HANDLING BUILDING 411 EQUIPMENT ARRANGEMENT PLAN EL. 100'-0" SHT 1 OF 6	41-G-501
WASTE HANDLING BUILDING 411 EQUIPMENT ARRANGEMENT PLAN EL. 100'-0" SHT 2 OF 6	41-G-502
WASTE HANDLING BUILDING 411 EQUIPMENT ARRANGEMENT PLAN EL. 122'-1" SHT 4 OF 6	41-G-504

INFORMATION ONLY

REV	DATE	ISSUE DESCRIPTION	BY	ENG	ECO	EWP
A	9/1/87	DESIGN RESPONSIBILITY TRANSFERRED TO WESTINGHOUSE	R.J.	[illegible]	2090	

CE	REV	DATE	ISSUE DESCRIPTION	BY	CK'D	SUPV	P E	PEM	DOE
NR	5	[illegible]	ISSUED FOR CONSTRUCTION	VRE	DRP	[illegible]	[illegible]		
NR	4	21OCT 1983	ISSUED FOR APPROVAL	VRE	DRP	BJW JFC	RB	HGT	
NR	3	8JUL 1983	GENERALLY REVISED AND ISSUED FOR PROGRESS REVIEW	GTA	DP	BJW	RB	RB	
NR	2	18FEB 1983	GENERALLY REVISED AND ISSUED FOR PROGRESS REVIEW	LRU	X	CT	RB	HGT	
NR	1	14OCT 1981	ISSUED FOR APPROVAL	LEM	DP	GFM	LJT	RB	
NR	0	20AUG 1981	ISSUED FOR PROGRESS REVIEW	CEM	DP	GFM	LJT	RB	

U.S. DEPARTMENT OF ENERGY
WASTE ISOLATION PILOT PLANT

SYSTEM CF02

BECHTEL
SAN FRANCISCO

WASTE HANDLING BUILDING 411
FIRE WATER COLLECTION SYSTEM
FLOW DIAGRAM

JOB NO. 12484
DOE CONTRACT NUMBER DE-AC04-79AL10751

DRAWING NO. 41-F-087-014 REV B PAGE NO. 2-205

REV	ISSUE DESCRIPTION	DFTR DATE	CHK DATE	COG DATE	DFTG MGR DATE	ECO	PWR
B	REVISED PER ECO	RS 3/14/95	[illegible] 3/15/95	JHK 3/15/95	[illegible]	7619	N/A

INDEX CODE NUMBER

SYSTEM	WBE	DWG TYPE	CL	VENDOR
CF02	41	00411	52	020

US ARMY CORPS OF ENGINEERS

DACW47-84-B-0002

41-F-087 Pg. 2-205
RCRA

CHAPTER G

TRAFFIC PATTERNS

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CHAPTER G

TRAFFIC PATTERNS

TABLE OF CONTENTS

List of Tables

List of Figures

CHAPTER G

TRAFFIC PATTERN

G-1 Traffic Information and Traffic Patterns

Access to the WIPP facility is provided by two access roads that connect with U.S. Highway 62/180, 13 mi (21 km) to the north, and NM Highway 128 (Jal Highway), 4 mi (6.4 km) to the south (Figure G-1). The northern access road, which connects the site to U.S. Highway 62/180, is an access road built specifically for the Permittees that will be used to transport TRU mixed waste from the highway to the site. The southern access road is a county highway maintained by Eddy County. Signs and pavement markings are located in accordance with the Uniform Traffic Control Devices Manual. Access-road design designation parameters, such as traffic volume, are presented in Table G-1.

G-2 Facility Access and Traffic

Access to the facility for personnel, visitors, and trucks carrying supplies and TRU mixed waste is provided through a security checkpoint (vehicle trap). After passing through the security checkpoint, TRU mixed waste transport trucks will normally turn right (south) before reaching the Support Building and then left (east) to park in the parking area HWMU just east of the air locks (Figure G-2). Outgoing trucks depart the same way they arrived, normally out of the west end of the parking area, north through the fence gate and out through the vehicle trap. An alternate inbound route is to continue straight ahead from the security checkpoint to the second road and to turn south to enter the truck parking area. The alternate outbound route is also the reverse of this route. Salt transport trucks, which remove mined salt from the Salt Handling Shaft area, will not cross paths with TRU mixed waste transporters; instead, they will proceed from the Salt Handling Shaft northward to the salt pile. Figure G-2 shows surface traffic flow at the WIPP facility.

The site speed limit for motor vehicles is 10 mph (16 kph) and 5 mph (8 kph) for rail movements. Speed limits are clearly posted at the entrance to the site and enforced by security officers. There are no traffic signals. Stop signs are located at the major intersections of roadways with the main east-west road. Safety requirements are communicated to all site personnel via General Employee Training within 30 days of their employment. Employee access to on-site facilities requires an annual refresher course to reinforce the safety requirements. Security officers monitor vehicular traffic for compliance with site restrictions, and provide instructions to off-site delivery shipments. Vehicular traffic other than the waste transporters use the same roads, but there will be no interference because there are two lanes available on the primary and alternate routes for waste shipments. Pedestrian traffic is limited to the sidewalks and prominently marked crosswalks. Site traffic is composed mostly of pickup trucks and electric carts with a frequency of perhaps 10 per hour at peak periods. Emergency vehicles are exercised periodically for maintenance and personnel training, with an average frequency of one each per day. They are used for their intended purpose on an as-required basis.

The traffic circulation system is designed in accordance with American Association of State Highway and Transportation Officials (**AASHTO**) Site Planning Guides for lane widths, lateral clearance to fixed objects, minimum pavement edge radii, and other geometric features. Objects in or near the roadway are prominently marked.

On-site roads, sidewalks, and paved areas are used for the distribution and storage of vehicles and personnel and are designed to handle all traffic generated by employees, visitors, TRU mixed waste shipments, and movements of operational and maintenance vehicles. The facility entrance and TRU mixed waste haul roads are designed for AASHTO H20-S16 wheel loading. Service roads are designed for AASHTO H10 wheel loading. Access and on-site paved roads are designed to bear the anticipated maximum load of115,000 lbs (52,163.1 kg), the maximum allowable weight of a truck/trailer carrying loaded Contact-Handled or Remote-Handled Packages. The facility is designed to handle approximately eight truck trailers per day, each carrying one or more Contact-Handled or Remote-Handled Packages. This is equivalent to 3,640 TRU mixed waste-carrying vehicles per year.

The calculations to support the anticipated maximum load of 115,000 lbs. are shown below:

Soil Resistance R (psi) - is taken directly from the WIPP Soil Report and Bechtel calculation because there is no change.

A. <u>Pavement Thickness</u>
The traffic frequency increase from 10 shipments per day to 10.15 shipments per day has only minimal impact on the Total Expanded Average Load (EAL) and the traffic index (TI) as shown below, both important parameters in pavement design.

Total EAL (TEAL):
13,780 ~ constant for 5 or more axles over 20 years, taken from Table 7-651.2A - Highway Design Manual (HDM).
TEAL = 13,780 × 25yr./20yr. = 17,225
Using 10.15 shipments per day ~ 17,225 × 10.15 = 174,834

Conversion of EAL to Traffic Index (TI).
For TEAL of 174,834 ~ TI = 7.5 - (from HDM, Table 7-651.2B)

Asphalt Concrete Thickness TAC:
GE=0.0032 × TI × (100 -R)....R=80
GE - Gravel Equivalent (Ft).
GE=0.0032 × 7.5 × 20 = 0.48′ ...GfAC = 2.01⇒ TAC = 0.48/2.01= 0.24′ ⇒ use 2½″ AC Surface Course.
(Actually used: 3″)
Gf - Gravel Equivalent Factor (constant from Table 7-651.2C from HDM).

B. Bituminous Treated Base

GE = 0.0032 × TI × (100 -R) .... R = 55 ~ caliche subbase ⇒ GE = 1.08′ GEBTB = 1.08 - 2.01 × 0.21= 0.66′

TBTB = GEBTB/GfBTB = 0.66/1.2 = 0.55′ ⇒ Use 4″ BTB

GfBTB ~ taken from table 7-651.2C

C. Caliche Subbase ~ TCSB

GE = 0.0032 × TI × (100 -R) .....R=50 - prepared subgrade

GE=1.2

GECSB=1.2 - (0.21× 2.07) - (0.33× 1.2) ⇒ 0.37′

TCBS=0.37/1.0=0.37′ ~ 4½″

Based on the results of the above calculation, the site paved roads designated for waste transportation are safe to be used by the heavier truckloads carrying shipping casks used in RH TRU mixed waste transportation to the WIPP.

G-3 Waste Handling Building Traffic

CH TRU mixed waste will arrive by tractor-trailer at the WIPP facility in sealed Contact Handled Packages. Upon receipt, security checks, radiological surveys, and shipping documentation reviews will be performed. A forklift will remove the Contact Handled Packages and transport them a short distance through an air lock that is designed to maintain differential pressure in the WHB. The forklift will place the shipping containers at one of the two TRUPACT-II unloading docks (**TRUDOCK**) inside the WHB.

The TRUPACT-II may hold up to two 55-gallon drum seven (7)-packs, two 85-gallon drum four (4)-packs, two 100-gallon drum three (3)-packs, two standard waste boxes (SWB), or one ten-drum overpack (**TDOP**). A HalfPACT may hold seven 55-gallon drums, one SWB, or four 85-gallon drums. A six-ton overhead bridge crane will be used to remove the contents of the Contact Handled Package. Waste containers will be surveyed for radioactive contamination and decontaminated or returned to the Contact Handled Package as necessary.

Each facility pallet will accommodate four seven(7)-packs of 55-gallon drums, four SWBs, four four(4)-packs of 85-gallon drums, four three(3)-packs of 100-gallon drums, two TDOPs, or any combination thereof. Waste containers will be secured to the facility pallet prior to transfer. A forklift or facility transfer vehicle will transport the loaded facility pallet the air lock at the Waste Shaft (Figure G-3). The facility transfer vehicle will be driven onto the waste shaft conveyance deck, where the loaded facility pallet will be transferred to the waste shaft conveyance and downloaded for emplacement.

RH TRU mixed waste will arrive at the WIPP facility in a payload container contained in a shielded cask loaded on a tractor-trailer. Upon arrival, radiological surveys, security checks, and shipping documentation reviews will be performed, and the trailer carrying the cask will be moved into the Parking Area or directly into the RH Bay of the Waste Handling Building Unit.

The cask is unloaded from the trailer in the RH Bay and is placed on the Cask Transfer Car. The Cask Transfer Car is used to move the cask to the Cask Unloading Room. At this point, a crane moves the waste to the Hot Cell or the Transfer Cell. Some RH TRU mixed waste may be moved to the Hot Cell for overpacking before being moved to the Transfer Cell. Once in the Transfer Cell, the Transfer Cell Shuttle Car moves the waste beneath the facility cask. A crane is used to move the waste from the Transfer Cell Shuttle Car into the facility cask. The Facility Cask Transfer Car then moves the facility cask to the underground. A more detailed description of waste handling in the WHB is included in Attachment M1. Figures G-5, G-6 and G-7 show RH TRU mixed waste transport routes.

G-4 Underground Traffic

Underground traffic, with and without TRU mixed waste, will travel on separated paths. The ventilation and traffic flow path in the TRU mixed waste handling areas underground are restricted and separate from those used for mining and haulage (construction) equipment (Figure G-4). Non-waste and non-construction traffic use the same routes as waste and construction traffic. In general, waste traffic will use the intake ventilation drift in that area. The exhaust drift in the construction area will generally be used for mining/construction equipment for maximum isolation of this activity from personnel. The exhaust drift in the waste disposal area will normally not be used for personnel access. Non-waste and non-construction traffic is generally comprised of escorted visitors only and is minimized during each of the respective operations.

Adequate clearances that exceed the mining regulations of 30 CFR §57 exist underground for safe passage of vehicles and pedestrians. Pedestrians/personnel are required to yield to vehicles in the WIPP underground facility. This condition is reinforced through the WIPP equipment operating procedures, the WIPP Safety Manual, the WIPP safety briefing required for all underground visitors, the General Employee Training annual refresher course, and the Underground annual refresher course that are mandated by 30 CFR §57, the New Mexico Mine Code, and DOE Order 5480.20A.

In addition, other physical means are utilized to safeguard pedestrians/personnel when underground such as:

- All equipment operators are required to sound the vehicle horn when approaching intersections.

- All airlock and bulkhead vehicle doors are equipped with warning bells or strobe lights to alert personnel when door opening is imminent.

- Hemispherical mirrors are used at blind intersections so that persons can see around corners.

All heavy equipment is required to have operational back-up alarms.

Heavily used intersections are well lighted.

Typically, the traffic routes during waste disposal in all Panels will use the same main access drifts.

All traffic safety is regulated and enforced by the Federal and State mine codes of regulations (30 CFR §57 and New Mexico State Mine Code). The agencies that administer these codes make regular inspection tours of the WIPP underground facilities for the purpose of enforcement.

All underground equipment is designed for off-road use since all driving surfaces are excavated in salt. No loads on the underground roadways will exceed the bearing strength of in situ halite.

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TABLES

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TABLE G-1
WASTE ISOLATION PILOT PLANT SITE DESIGN DESIGNATION
TRAFFIC PARAMETERS [a]

Traffic Parameter	North Access Road (No. of Vehicles, unless otherwise stated)	South Access Road (No. of Vehicles, unless otherwise stated)	On-Site Waste Haul Roads Contact-Handled and Remote-Handled Package Traffic)
Average Daily Traffic (ADT)[b]	800	400	8
Design Hourly Volume (DHV)[c]	144	72	NA [g]
Hourly Volume (Max. at Shift Change)	250	125	NA
Distribution (D)[d]	67%	33%	NA
Trucks (T)[e]	2%	0	100%
Design Speed [h,i]	70 mph (113 kph)	60 mph (97 kph)	25 mph (40 kph)
Control of Access [f]	None	None	Full

[a] For WIPP personnel and TRU mixed waste shipments only.
[b] ADT—Estimated number of vehicles traveling in both directions per day.
[c] DHV—A two-way traffic count with directional distribution.
[d] D—The percentage of DHV in the predominant direction of travel.
[e] T—The percentage of ADT comprised of trucks (excluding light delivery trucks).
[f] Control of Access—The extent of roadside interference or restriction of movement.
[g] NA—Not applicable.
[h] mph—miles per hour.
[i] kph—kilometers per hour.

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FIGURES

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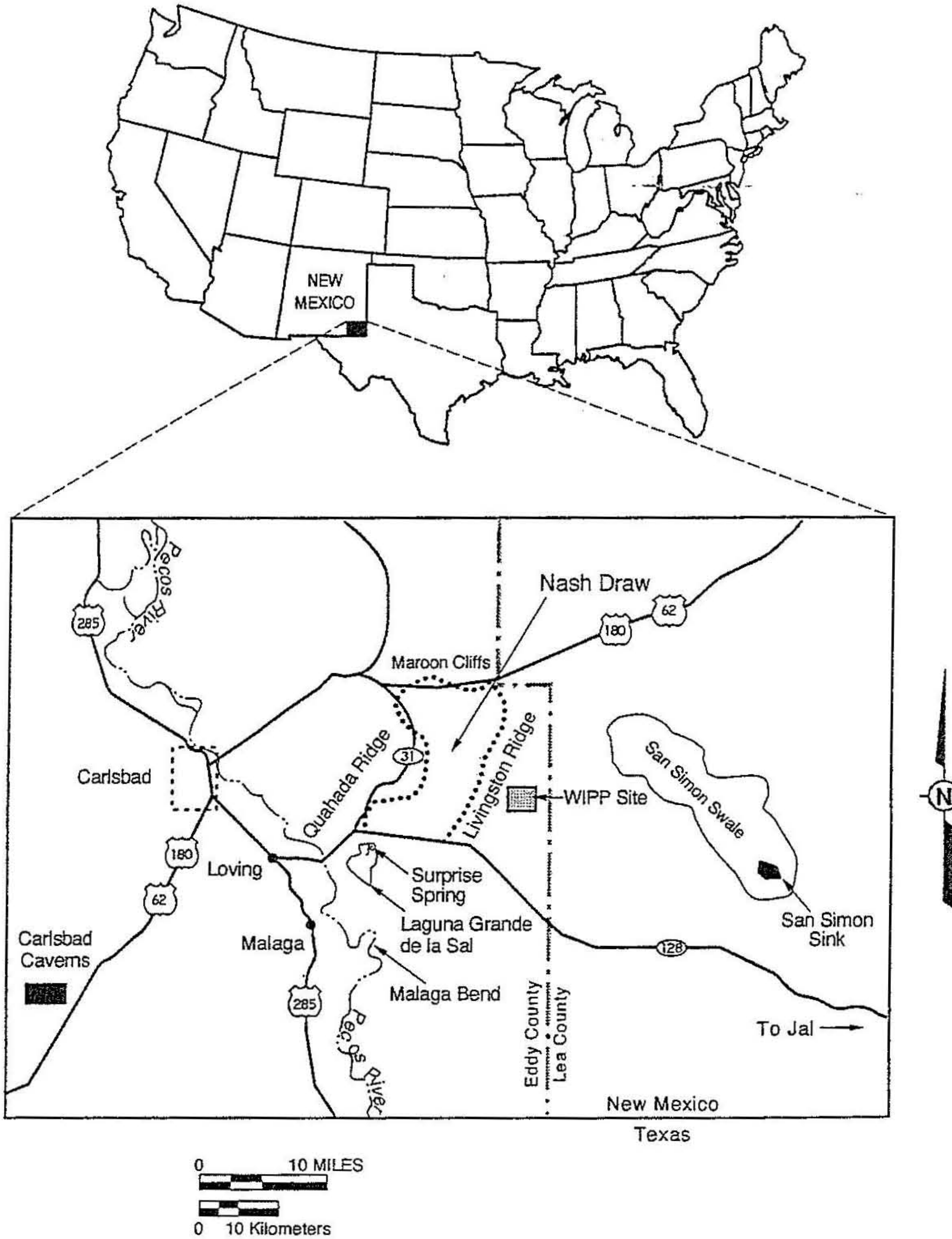
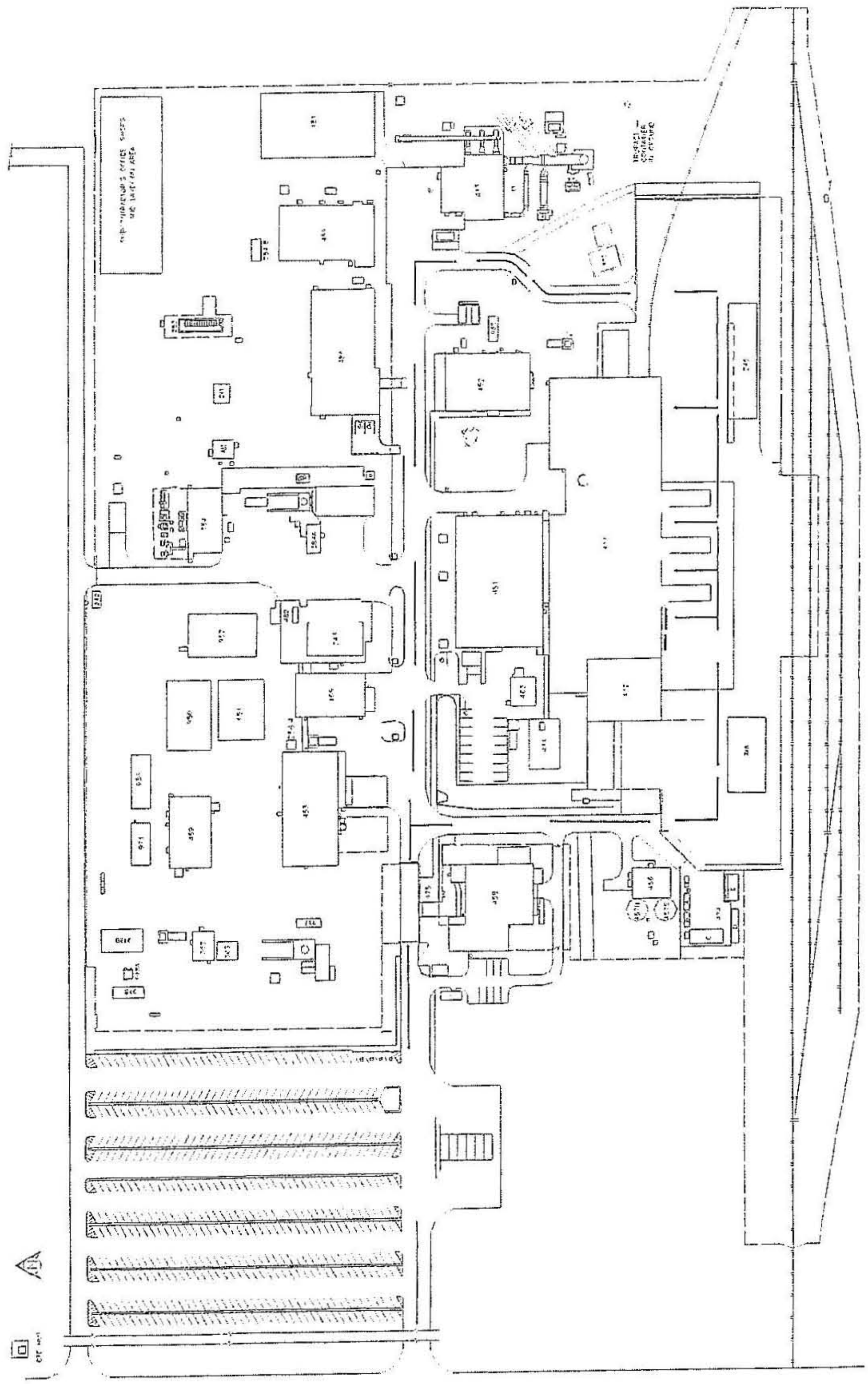


1

2 Figure G-1
3 General Location of the WIPP Facility

1



2 Figure G-2
3 WIPP Traffic Flow Diagram

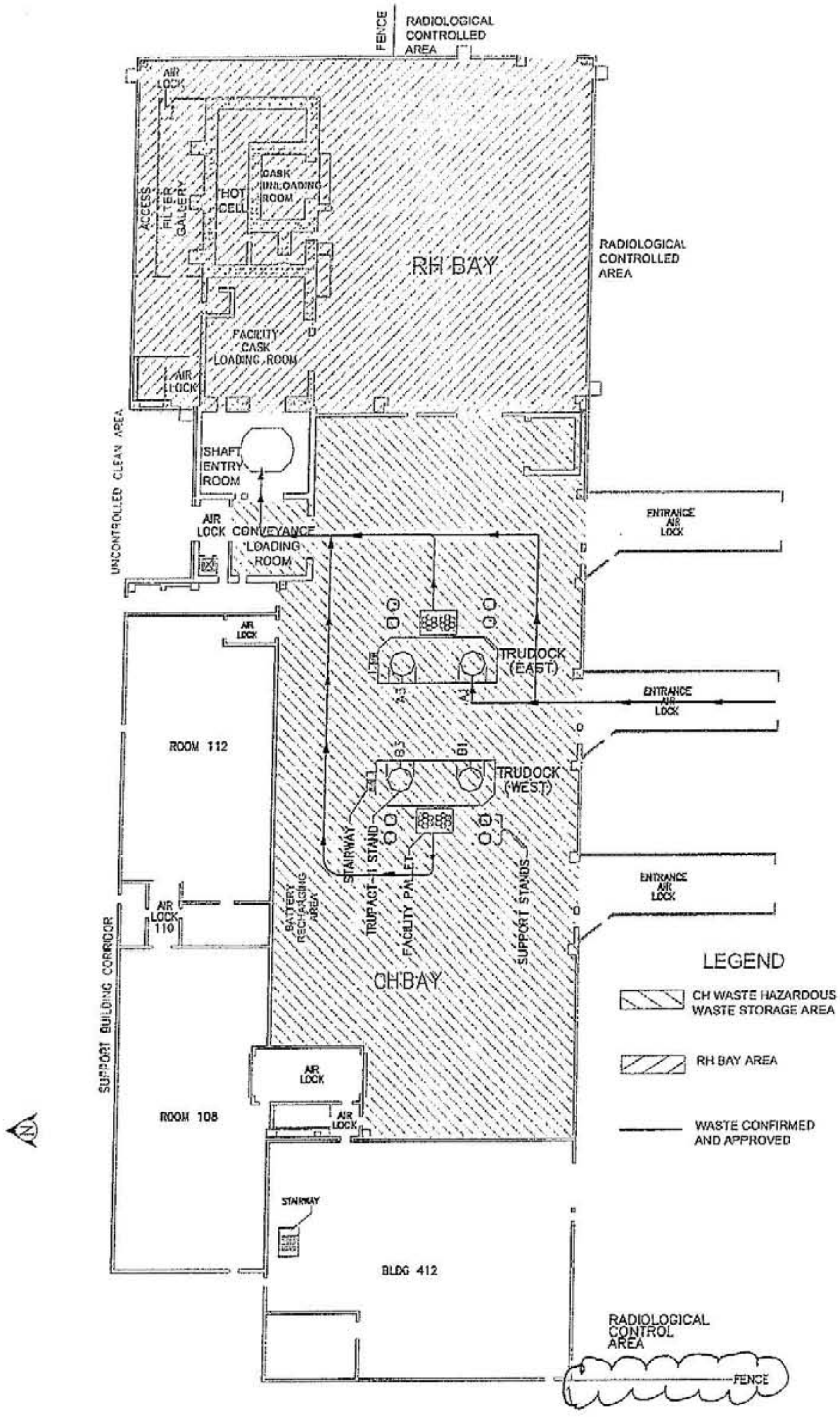


Figure G-3
Waste Transport Routes in Waste Handling Building - Container Storage Unit

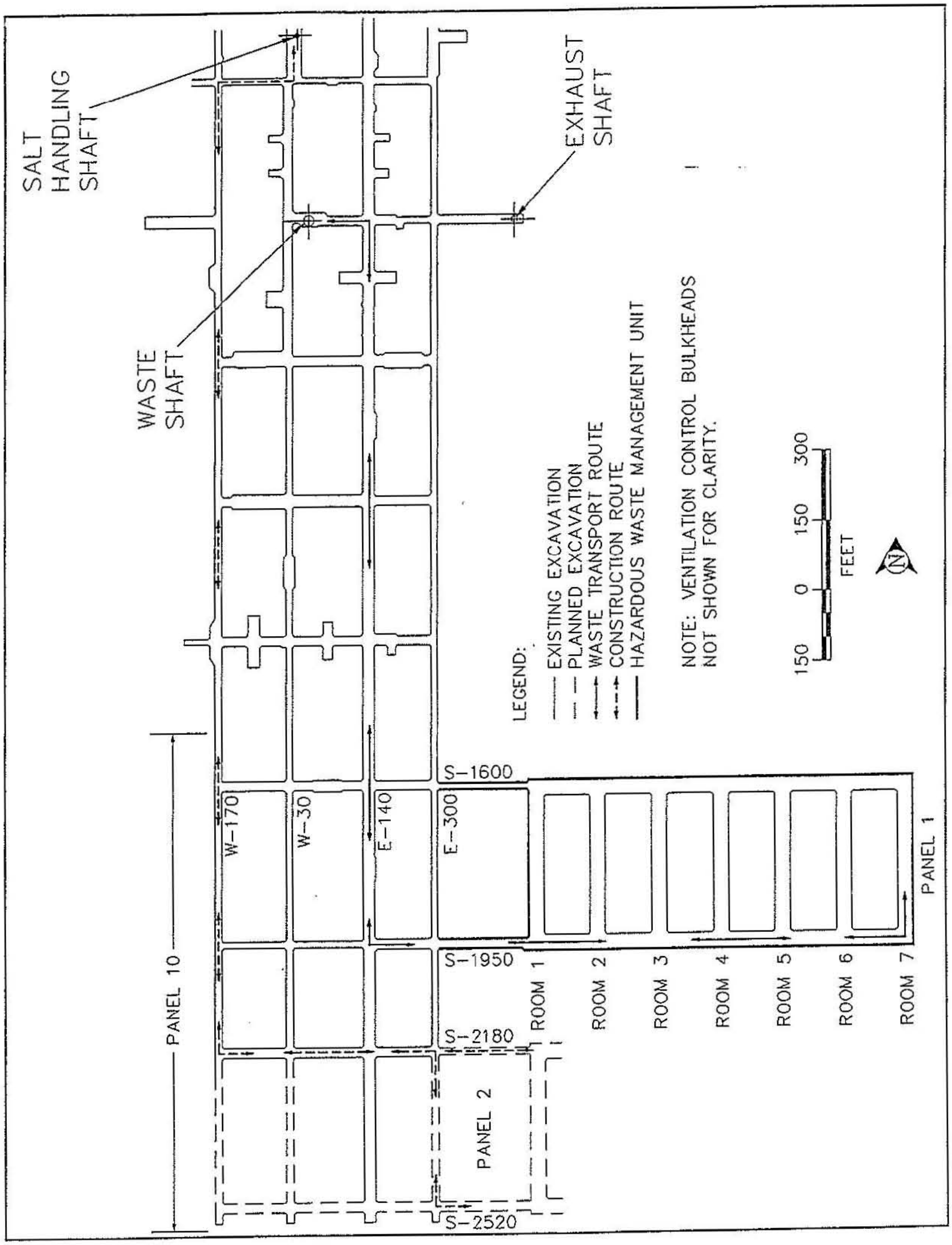


Figure G-4
Underground Transport Route

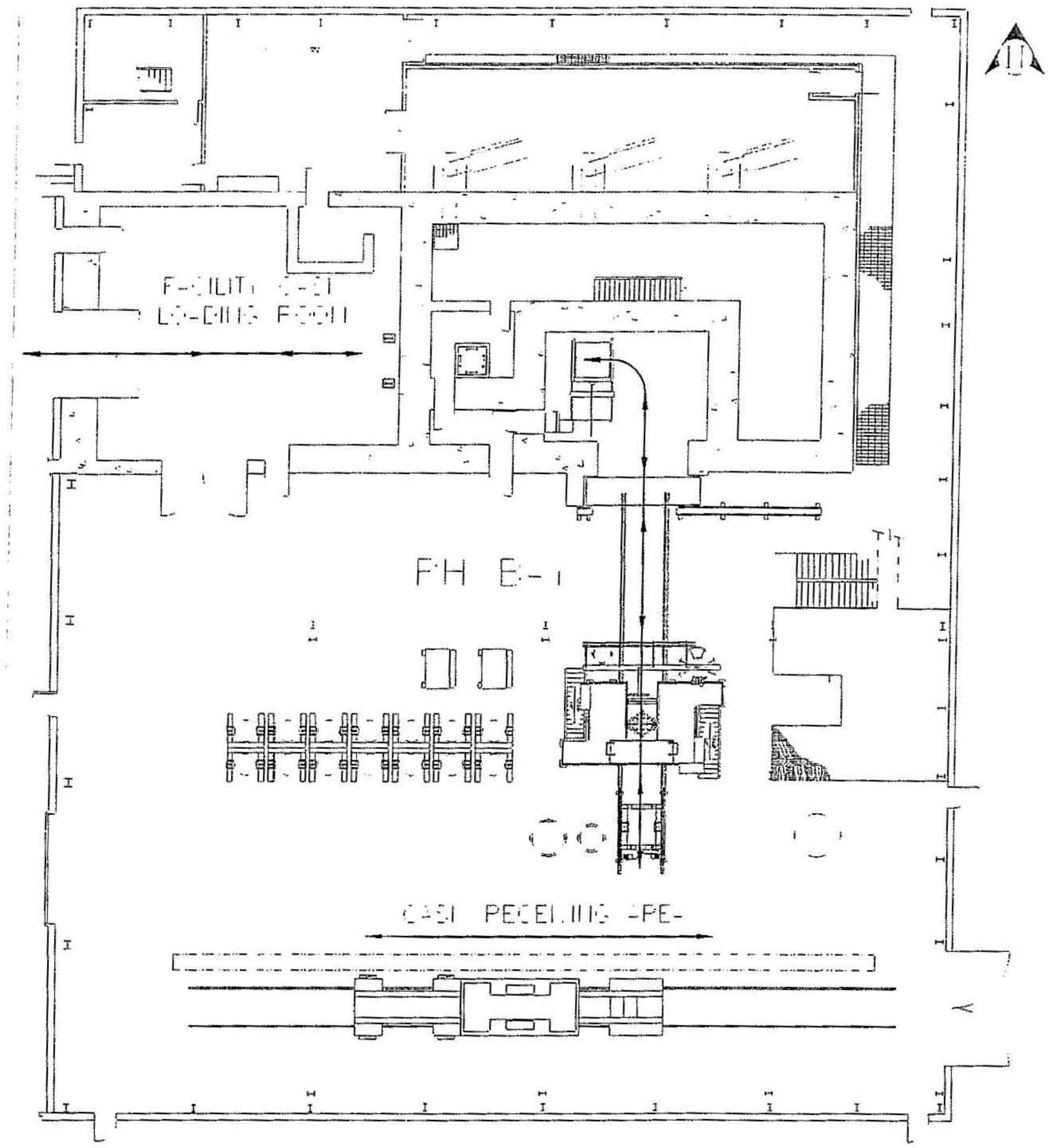


Figure G-5
RH Bay Waste Transport Routes

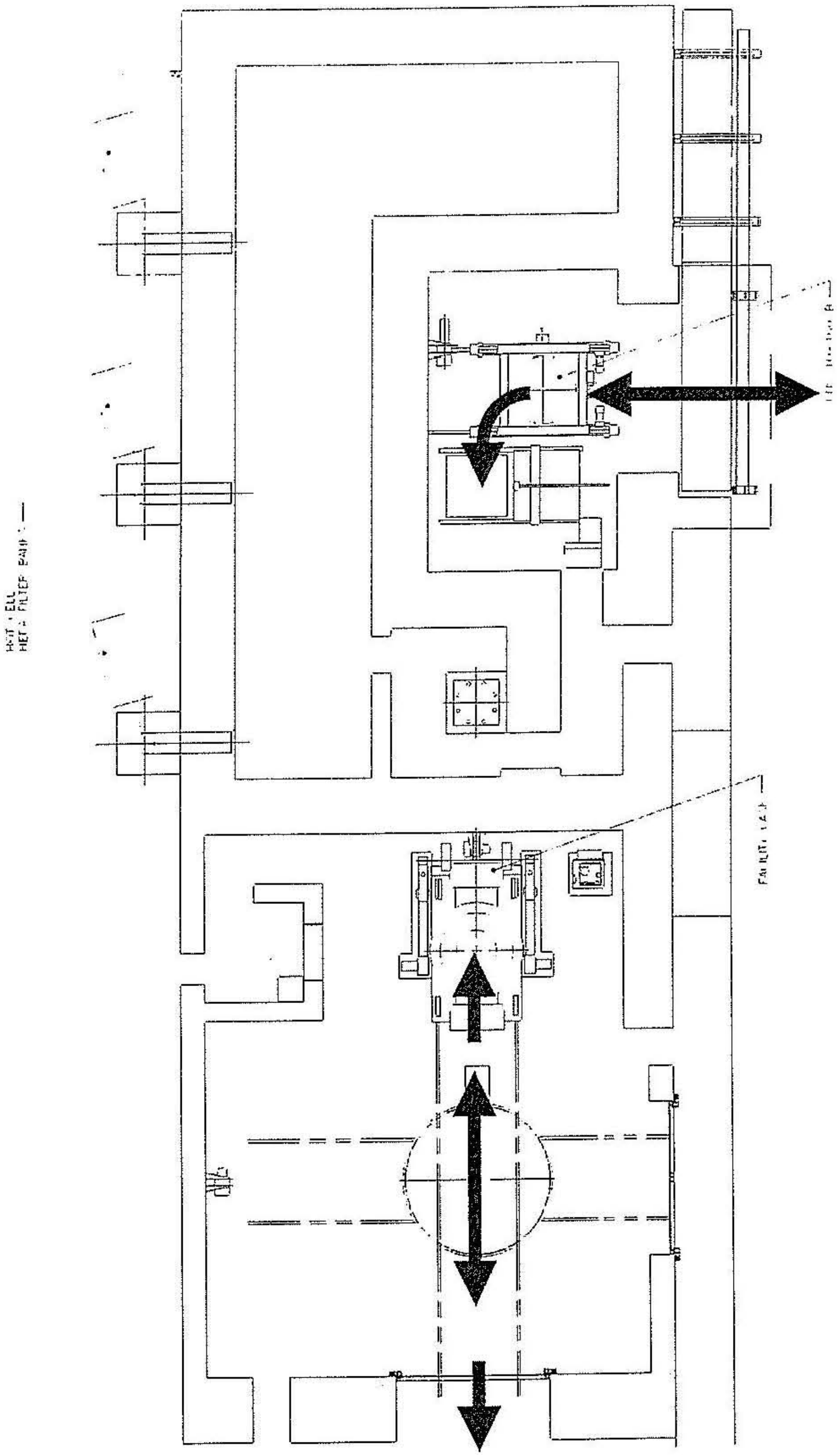


Figure G-6
RH Bay Cask Loading Room Waste Transport Route

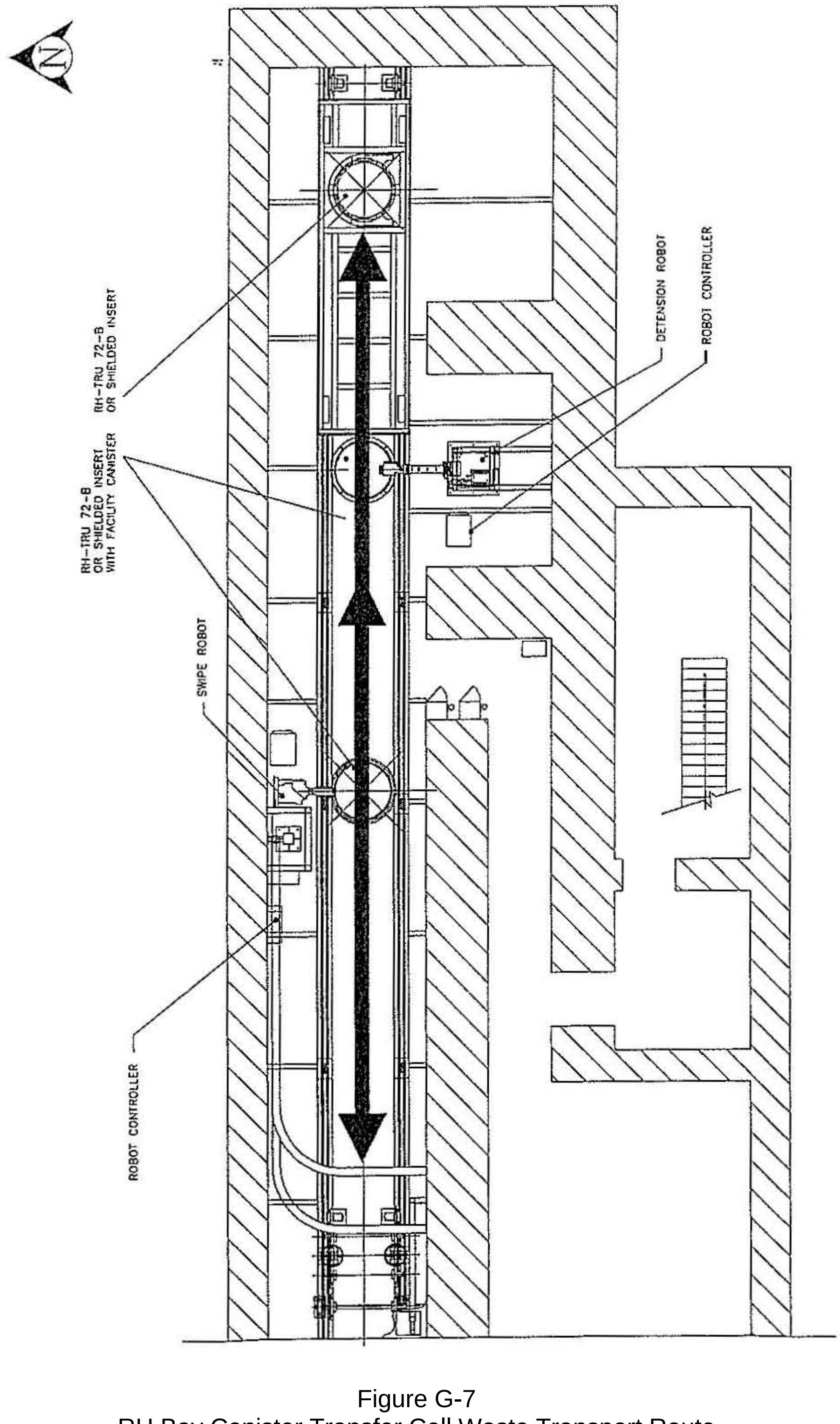


Figure G-7
RH Bay Canister Transfer Cell Waste Transport Route

CHAPTER H

PERSONNEL TRAINING

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CHAPTER H

PERSONNEL TRAINING

TABLE OF CONTENTS

List of Figures

CHAPTER H

PERSONNEL TRAINING

Introduction

This chapter describes the personnel training program for the Waste Isolation Pilot Plant (**WIPP**) in accordance with the requirements of the Resource Conservation and Recovery Act (**RCRA**) and the New Mexico Hazardous Waste Act as described in Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20.4.1.500 NMAC), (incorporating 40 CFR §264.16), and 20.4.1.900 NMAC (incorporating 40 CFR §270.14).

The primary objective of the WIPP facility training program is to prepare personnel to operate the WIPP facility in a safe and environmentally sound manner. To achieve this objective, the program provides employees with training relevant to their positions. Every WIPP facility employee, including those not directly involved in transuranic (**TRU**) mixed waste handling activities, receives an introduction to the RCRA and emergency preparedness within 30 days of employment. In this way everyone at the WIPP facility is given, at a minimum, a basic understanding of the regulatory requirements and emergency procedures. Employees in hazardous waste management positions receive additional classroom and on-the-job training designed specifically to teach them how to perform their duties safely and in conformance with regulatory requirements. Hazardous waste management personnel receive the required training before being allowed to work unsupervised, and emergency response personnel receive appropriate training before being called upon to respond to actual emergencies.

The training requirements apply to all appropriate employees of the U.S. Department of Energy (**DOE**) and contractors who regularly work at the facility that may come in contact with and/or manage hazardous waste. The WIPP Project training program is comprehensive and applies to all areas of personnel performance and development. This chapter describes the introductory and continuing training provided to personnel at the WIPP facility, with emphasis on those facility personnel and their supervisors whose jobs are such that their actions or failure to act could result in a spill or release, or the immediate threat of a spill or release of hazardous waste. These personnel are directly involved with hazardous waste management at the WIPP facility. Their training allows them to operate the facility safely and in compliance with hazardous waste regulations.

H-1 Outline of the Training Program

Employee training for the purpose of hazardous waste management at the WIPP facility is the overall responsibility of the MOC General Manager, with responsibility for implementation delegated to the manager of the Human Resources Department. The Human Resources Department Manager has established a technical training group (referred to as Technical Training) within the department to implement the requirements for training. The Technical Training Group is managed by the Technical Training Manager who has the responsibility for directing the training program. Members of the training staff are assigned to Technical Training within the Human Resources Department. The organizational structure of the Human Resources Department and its relationship to the line organizations is shown in an abbreviated organizational chart in Figure H-1. This chart also shows departments with key responsibilities for waste management and emergency response.

The WIPP facility uses a modified version of the Systematic Approach to Training (**SAT**) to analyze, design, develop, implement, and evaluate training.

This approach employs five distinct phases to develop programs. These phases are:

- Analysis
- Design
- Development
- Implementation
- Evaluation

In "analysis," technical training and line management identify job performance requirements. These requirements are derived by studying job duty areas, related tasks, and required skills and knowledge. These derived skills and knowledge, in turn, form the blueprint for the "design" phase. In "design" these requirements are translated into learning objectives, performance standards, and test items. In "development" the products of design are incorporated into new training programs or, if appropriate, incorporated into revisions of existing programs. Products of development are lesson plans, qualification cards, student materials, and examinations. Implementation of these programs then occurs. This may be through classroom instruction, on-the-job-training, self-paced study, or any combination of the three. "Evaluation" is the final phase of the SAT process. Evaluation uses feedback derived from several sources to improve or enhance the training. The WIPP utilizes extensive guidance provided within the DOE Handbook, "Training Program Handbook: A Systematic Approach to Training (DOE-HDBK-1078-94)," to direct all program analysis, design, development, implementation, or evaluation. Further details of these processes may be derived by reviewing this manual.

The Human Resources Department ensures that required RCRA-related training is conducted by qualified instructors. On-the-job training is conducted by Level I instructors. Level I instructors are subject matter experts; members of line organizations who have qualified on the related equipment and have attended the on-the-job training course. Classroom instruction is provided by Level II and Level III instructors. Level II instructors are members of Technical Training and line organizations who are qualified to conduct limited classroom training in their technical area of expertise. Level III instructors are members of Technical Training who are qualified to conduct classroom training, skills evaluation, and needs assessment. Level II and III instructors are required to attend a train-the-trainer course and periodic refresher training.

Cognizant line managers provide significant input on training requirements for the WIPP facility to qualified instructors who develop the following, as required:

- Classroom Instruction

  Objectives
  Lesson Plans
  Student Materials
  Examinations

- On-the-Job Training

  Qualification Cards

Technical training materials are approved by the Technical Training Manager and the cognizant line manager.

Following technical training, trainees must successfully complete written examinations or oral examinations conducted by boards made up of cognizant personnel (referred to as "oral boards") to demonstrate competency. The records of oral examinations are called "oral board sheets". These examinations are based on objectives and/or competency statements. Oral boards are based on knowledge learned in the on-the-job training process. Trainees also provide feedback on the content and quality of instruction, at this time, in the form of course critiques and verbal input.

Technical training documentation is maintained by the Technical Training Group located at the WIPP facility. These technical training records include:

- Course Attendance
- Completed Qualification Cards
- Off-Site Training Documentation
- Oral Board Sheets

A database is maintained which records training qualifications, and course attendance. The database is used to identify course refresher and requalification dates. Training records on current personnel are kept in the Technical Training files. Technical training records on former employees are kept by the Technical Training Group for at least three years from the date of employment termination from the WIPP facility. Training documentation for emergency response training received by personnel called out in the WIPP Contingency Plan (Permit Attachment F) is maintained by the Technical Training Group. The documents which define the process by which these training activities are managed are maintained by the Technical Training Group and are part of the Operating Record.

To ensure the safe and efficient operation of the WIPP facility, certain positions require formal qualification. Department managers identify these positions based upon safety, complexity, and involvement with hazardous waste handling operations. A document known as a “qualification card” is prepared to identify required training for each designated position. In the case of equipment and system/procedure qualification, a “qualification card” is prepared that specifies the required knowledge and practical skills needed in such areas as equipment maintenance and safety. Individual participation in the qualification card system is varied and is dependent on an incumbent’s specific job duties. A complete listing of active qualifications, as they apply to any individual position, may be determined by review of the WIPP Training Database. The list of active WIPP Qualification cards is maintained at the WIPP facility.

When the qualification card is completed, that particular qualification is recorded. Successful completion of formal classroom training is documented on the individual’s qualification card. When requirements are met, both for classroom instruction and on-the-job training, and oral board, if applicable, the qualification card is signed by the manager certifying that the employee is fully competent to perform all aspects of the associated qualification. Qualification cards are included in the training records maintained by the Technical Training Group. Qualification cards are living documents subject to change as the scope and content of training changes to meet new and revised regulatory requirements and modifications in job scope.

The hazardous waste management training program described in Section H-1b consists of a series of courses designed to ensure that hazardous waste management employees at the WIPP facility receive initial and continuing training relevant to their positions. These courses include instruction on the RCRA and Occupational Safety and Health Administration regulations, emergency procedures, and procedures for handling both site-generated hazardous waste and TRU mixed waste. Visitors, temporary personnel, and contractors are trained commensurate with the nature of their visit or duties. For visitors, this includes basic site safety and emergency notification procedures. Visitors who require unescorted access are also required to take an examination covering the material in the training they are given. Visitor records are maintained by security. Temporary or subcontract personnel, if hired to fill a hazardous waste management position, are required to complete the same training as permanent personnel. Record of this training is maintained by Technical Training.

H-1a Job Title/Job Description

Employees at the WIPP facility who are involved in hazardous waste management activities receive the same core training. A list of hazardous waste management job titles and position descriptions are provided in Permit Attachment H1. An up-to-date list of personnel assigned to these positions is maintained by the Permittees in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.16). These core hazardous waste management training courses are described briefly in Section H-1(b)(1) and outlines of the core classes, as well as other job specific training classes, are included in Permit Attachment H2. Any changes to the training plan that decrease the type or amount of training that is given to employees will be handled as a Class 2 modification, as specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.42). Other changes to the training plan will be handled as Class 1 modifications. In accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.16(d)(2)), the job descriptions include hazardous and TRU mixed waste management job duties, required skills, qualifications, and experience, as well as educational requirements. These job descriptions are approved by the cognizant staff managers. Included in the appendices are management and supervisory positions that are considered to be critical from the standpoint of hazardous waste management or emergency response. These include the following positions:

- Shift Manager, Facility Operations
- Manager, Hoisting Operations
- Manager, Radiation Control
- Manager, Waste Handling
- Team Leader, Inspection Services
- Manager, Environmental Compliance
- Manager, Technical Training

H-1b Training Content, Frequency, and Techniques

The WIPP training program includes a comprehensive combination of classroom training courses and on-the-job training. Each training course is carefully developed and periodically reevaluated to ensure relevancy to the course objectives and to ensure its support of the goal of safe and environmentally sound operations at the WIPP facility. On-the-job training is accomplished and documented through the use of qualification cards. Before an employee is considered qualified to operate certain equipment, the person must pass a prescribed set of performance standards.

H-1b(1) Training Content

WIPP facility employees who will be on site longer than 30 days, including personnel in management and supervisory positions and personnel not directly involved with hazardous waste management, receive facility-specific training in the following areas:

- General Employee Training (GET) Overview (procedures and policies)
- WIPP Facility Description
- Radiation Safety
- Emergency Preparedness (including RCRA Contingency Plan implementation)
- Security
- Fire Protection
- Quality Assurance
- Occurrence Reporting
- Industrial Safety
- RCRA
- Hazard Communication

This training is provided in GET-19X/GET-20X [1], conducted by the WIPP qualified instructors, and must be completed within 30 days of employment.

Annual refresher training on the topics taught in GET-19X/GET-20X is given in the General Employee Training Annual Refresher (GET-19XA/GET-20XA). This self-paced module provides employees with a review and update of the topics covered in GET-19X/GET-20X.

WIPP employees involved in managing site-generated, nonradioactive waste, or TRU mixed waste will receive the Hazardous Waste Worker course (HWW-101). This comprehensive course will provide job specific training required to safely receive, transfer, or handle waste at the WIPP facility. Review and update of HWW-101 topics is provided annually in the Hazardous Waste Worker refresher course (HWW-102).

Course outlines for GET-19X/GET-20X, GET-19XA/GET-20XA, HWW-101, and HWW-102 are provided in Permit Attachment H2.

H-1b(2) <u>Training Frequency</u>

Hazardous waste management courses are offered at a frequency that ensures new hires or transfers can receive relevant training within six months of assuming their new position. Employees do not work unsupervised in hazardous waste management positions until they have completed the required initial training. The Human Resources Department notifies the cognizant manager and training staff when any employee is transferred into or out of a position associated with hazardous waste management.

H-1b(3) <u>Training Techniques</u>

A variety of instructional techniques are used at the WIPP facility depending on the subject matter and the techniques that best suit the learning objectives. Many courses include a combination of lectures, demonstrations, visual aids (such as video tapes, slides, and viewgraphs), and exercises. Most equipment operation courses include hands-on practical instruction.

Written examinations are used as a technique to test and document the knowledge level of individuals participating in classroom training courses. The length and content of each exam varies according to its objective. Calculation, multiple-choice, and fill-in-the-blank, or other approved formats, may be used. If individuals fail a written examination, they must be reexamined in identified areas of weakness. Personnel filling positions requiring qualification cards to perform job functions will be requalified at least biennially in those specific areas.

On-the-job training at the WIPP facility follows a prescribed set of standards specific to the job to be performed. Typically, to become qualified to operate a piece of equipment or system,

[1] The "X" in the course number is assigned the last number of the current year (e.g., GET-19<u>5</u> is General Employee Training for 1995, GET-20<u>0</u> is for the year 2000). Course content is updated annually to provide the latest information available to students.

employees must be able to demonstrate the location and purpose of specified controls and gauges, describe proper startup and shutdown procedures, describe specific safety features and limitations of the equipment, and, in some cases, perform maintenance functions. They must also demonstrate the ability to operate the equipment or system. On-the-job training may also be function specific, such as performing a specific administrative function that is regulated.

In addition to on-the-job training, some positions require the trainee to attend an oral board. The oral board is given upon completion of on-the-job training and prior to operating any equipment unsupervised. In the oral board, the trainee is quizzed on knowledge learned in on-the-job training. The purpose of the oral board is to determine if the trainee fully understands and can apply the knowledge learned in the training process.

H-1c Training Manager

The Technical Training Manager directs the training program and is responsible for establishing technical training requirements in cooperation with the line managers. Specifically, this includes analysis, design, development, implementation, and evaluation of technical training. The Technical Training Manager is trained in hazardous waste management procedures and receives train-the-trainer and instructor training. The Technical Training Manager is also required to be knowledgeable of the applicable regulations, orders, guidelines, and the specific training process employed at the WIPP facility.

The name and qualifications of the current Technical Training Manager are documented at the WIPP facility.

H-1d Relevance of Training to Job Position

The WIPP facility training program provides employees and their supervisors with training relevant to their positions. A functional chart showing positions that receive training related to hazardous waste management or emergency response is included as Figure H-1. This figure also shows the next level manager for these positions. The SAT process mentioned in Section H-1 is a systematic method for determining the proper training for each hazardous waste management position. It compels managers and training staff to look critically at each position and determine the necessary training program for each employee to fully develop their necessary expertise.

Several training courses are determined to be so basic to the WIPP Project mission that they are considered relevant for all WIPP facility employees. The basic philosophy at the WIPP facility is that, as a RCRA-regulated facility, employees must understand the basic regulatory requirements under which the WIPP facility must operate. Therefore, all WIPP facility employees receive an introduction to the RCRA during their introductory training.

Beyond these core courses, training is designed and implemented relevant to the specific job functions being performed. For example, employees who operate key pieces of equipment necessary to manage contact-handled (**CH**) or remote-handled (**RH**) TRU mixed waste (such as forklifts, hoists, bridge cranes, cask transfer cars, etc.) must be trained to operate and inspect equipment and to recognize maintenance problems before a specific job function is performed. These employees must receive on-the-job training and demonstrate the ability to operate the equipment, as appropriate, before being qualified. This process is controlled and documented by the qualification process described in Section H-1. A complete listing of active qualification cards, along with descriptions of training courses, are on file at the WIPP facility. Summaries of qualification cards and other job specific training courses are included in Permit Attachment H2. Waste handling personnel performing CH or RH TRU mixed waste handling tasks will be qualified to the applicable specific equipment or system qualification card on file at the WIPP facility.

Managers who have direct responsibility for supervising hazardous waste management personnel receive hazardous waste management training relevant to their positions. This training will include GET-19X/GET-20X and its refresher GET-19XA/GET-20XA, which is required for all employees, and the Hazardous Waste Worker Supervisor course HWS-101 and its refresher HWS-101A. In addition, a manager may also take HWW-101 and its refresher HWW-102 if these courses are determined to be useful for his/her position. These course descriptions are included in Permit Attachment H2. Managers who do not have direct hazardous waste management supervisory responsibilities receive training sufficient to ensure their awareness of hazardous waste management requirements and procedures; however, they do not perform hazardous waste management duties and their positions are not included in the appendices. As is the case with all WIPP facility employees, all managers receive RCRA overview training in GET-19X/GET-20X.

Security personnel are an important element of the safe and secure operations at the WIPP facility; however, they do not perform hazardous waste management functions during normal operations at the WIPP facility. Security personnel who serve as members of a Fire Support Team (see Section H-1e) receive emergency response training required of that team.

H-1e Training for Emergency Response

The WIPP facility training program ensures that personnel are able to respond appropriately and effectively to emergency situations. WIPP facility employees receive GET-19X/GET-20X, which includes instruction on hazard awareness, emergency preparedness, spill control, and the WIPP RCRA Contingency Plan (Permit Attachment F). This training ensures that every employee understands how to recognize real or potential emergencies and how to report such incidents to the proper WIPP facility officials. It also ensures that employees will not endanger themselves or others by taking actions beyond their ability. Emergency response personnel receive more extensive training in emergency response procedures as described in the next paragraph.

The WIPP facility emergency response organization is capable of providing emergency response services both above ground and underground. The Emergency Response Team (**ERT**), under the supervision of the Emergency Services Technician, has primary responsibility for above ground emergency response activities, and the First Line Initial Response Team (**FLIRT**) and the Mine Rescue Team (**MRT**) are responsible for underground emergency response activities. The responsibilities of these units are described in the WIPP RCRA Contingency Plan, Permit Attachment F. Members of these teams are volunteers from the WIPP organization. These teams receive thorough emergency response training before they are called upon to perform in real emergencies. This training includes firefighting elements, such as fire behavior, ladders, fire hose, fire streams, and ventilation. The FLIRT includes current qualification for unescorted underground access, National Fire Protection Association (**NFPA**) 600 Industrial Fire Brigades requirements, and additional qualifications pertaining to the team. MRT training includes current qualification for unescorted underground access, at least one year of underground work, Mine Safety and Health Administration requirements for medical and mine rescue, and additional qualifications pertaining to the team. ERT training includes NFPA 600 Industrial Fire Brigade requirements, and additional training pertaining to the team. In addition, all teams receive lifesaving elements, such as rescue, cardiopulmonary resuscitation and first aid, and other specific elements, such as self-contained breathing apparatus. A list of required training for these positions is included in each job position description in Permit Attachment H1.

Because these response teams are used for unusual occurrences and not routine hazardous waste handling, a RCRA position title is not included. A duty description is included which summarizes basic anticipated duties of these positions. Training records for these individuals are maintained in each individual’s training file in Technical Training located at the WIPP site. These training requirements must be met prior to an individual serving in an emergency response function

Hazardous waste handling and emergency response personnel receive training that ensures their familiarity with emergency procedures, emergency equipment, and emergency systems including:

- Procedures for using and inspecting facility emergency and monitoring equipment
- Repairing and replacing facility emergency and monitoring equipment (RADCON only)
- Communications and alarm systems
- Response to fires or explosions
- Shutdown of operations.

Course outlines for emergency response training courses are provided in Permit Attachment H2.

The RCRA Emergency Coordinator receives training relevant to the RCRA Contingency Plan and must be familiar with the contents of the RCRA Contingency Plan prior to serving as RCRA Emergency Coordinator. Documentation of this training is maintained in the RCRA Emergency Coordinator’s training file. All individuals qualified to serve as RCRA Emergency Coordinators are required to complete Contingency Plan training (SAF-645). RCRA Emergency Coordinators are notified of changes to the contingency plan by a document change notice, which is distributed weekly. This notice lists all of the controlled documents that have been changed during the week. Office wardens receive Office Warden Training (SAF-632) and are required to take an annual refresher. In addition, the training requirements of the Central Monitoring Room

(**CMR**) operator are included in Permit Attachment H1. The CMR operator is listed in Permit Attachment F as an emergency response related position.

As there are no automatic waste feed systems at the WIPP facility, training on parameters for waste feed cut-off systems is not required. Similarly, as there is no potential for groundwater contamination incidents at the WIPP facility, training for responding to such incidents is not required.

H-2 Implementation of Training Program

The WIPP facility training program has been implemented to ensure that hazardous waste management and emergency response personnel employed at the WIPP facility receive the training indicated within the respective authorization cards. These authorization cards record training that the individual team members have completed. Personnel are trained on the RCRA Contingency Plan through their basic training. Newly hired employees receive the indicated training within six months of their date of hire or their transfer to a new position. Personnel do not work in unsupervised positions until they successfully complete the indicated training requirements. Hazardous waste management personnel attend annual refresher courses that review the initial training received and document knowledge transfer.

Records relating to the WIPP facility training program for hazardous waste management and emergency response personnel are maintained by the WIPP Technical Training Group located at the WIPP facility. These records include a roster of employees in hazardous waste management positions; a list of courses required for each position; course descriptions; documentation when each employee has received and completed appropriate training; and all of the backup information regarding qualification and examination. Training records of current personnel are kept by the Technical Training Group until closure of the WIPP facility. Records of former employees are kept by the Technical Training Group for at least three years from the date the employee last worked at the facility.

FIGURES

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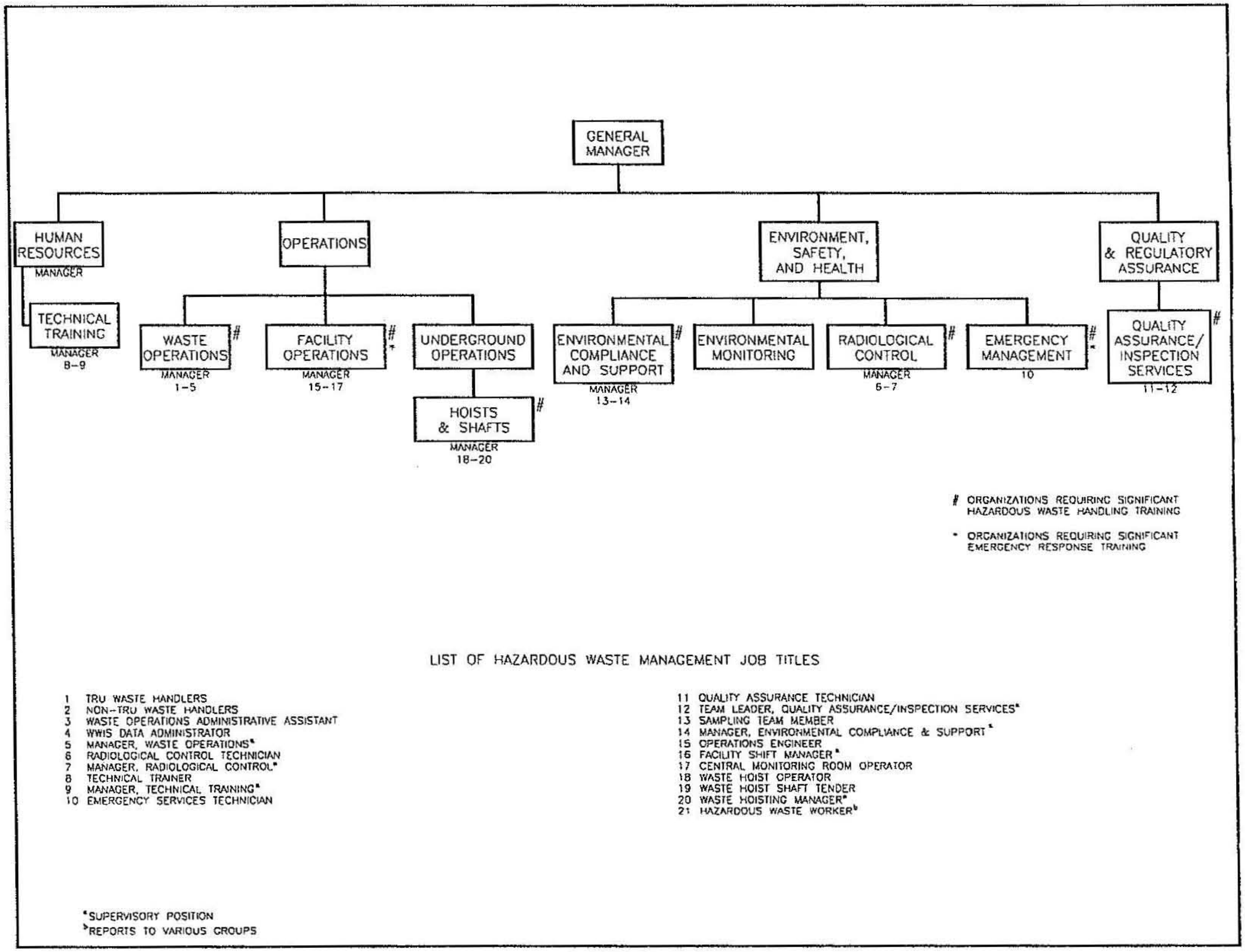

Figure H-1
Organizational Location of Training, Waste Handling, and Emergency Response Functions

APPENDIX H1

RCRA HAZARDOUS WASTE MANAGEMENT JOB TITLES AND DESCRIPTIONS

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APPENDIX H1

RCRA HAZARDOUS WASTE MANAGEMENT JOB TITLES AND DESCRIPTIONS

TABLE OF CONTENTS

APPENDIX H1

RCRA HAZARDOUS WASTE MANAGEMENT JOB TITLES AND DESCRIPTIONS

RCRA Hazardous Management Job Titles
Hazardous Waste Worker TRU Mixed Waste Handlers Underground Hazardous Waste Worker Site-Generated Waste Handlers Transportation Engineer WWIS Data Administrator Manager, Waste Handling Manager, Shipping Coordination
Radiological Control Technician Manager, Radiation Control
Technical Trainer Manager, Technical Training
Emergency Services Technician
Quality Assurance Technician Team Leader, Inspection Services Facility Inspection, Repair, and Service Team (FIRST) Leader Facility Inspection, Repair, and Service Team (FIRST)
Sampling Team Member Sampling Team Assistant Manager, Environmental Compliance
Facility Shift Engineer Facility Shift Manager Central Monitoring Room Operator
Waste Hoist Operator Waste Hoist Shaft Tender Waste Hoisting Manager
Chief Office Warden Assistant Chief Office Warden
Mine Rescue Team Member First Line Initial Response Team member Emergency Response Team Fire Brigade Fire Protection Technician
Radiographer (Radiography Independent Technical Reviewer) Visual Examination Operator/Expert (VE Independent Technical Reviewer) Permittees’ Management Representative

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RCRA Hazardous Waste Management Job Descriptions

Position Title: Hazardous Waste Worker

Duties:

- Performs hazardous waste operations in accordance with WIPP procedures

Requisite Skills, Experience and Education:

Academic or vocational high school diploma or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X) (Annual)
- Hazardous Waste Worker (HWW-101/102) (Annual)

RCRA Hazardous Waste Management Job Descriptions

Position Title: TRU Mixed Waste Handlers

Duties:

- Operates waste handling equipment and support systems to unload, handle and emplace TRU mixed waste and backfill into the repository
- Performs functional and operational checks of waste handling equipment and support systems as well as conduct waste container storage area inspections
- Performs spot decontamination of shipping casks, waste containers, and waste handling equipment
- Perform waste container overpacking operations

Requisite Skills, Experience and Education:

Academic or vocational high school graduate with courses in algebra and physics or chemistry, or equivalent, plus two years of college-level technical study with courses in nuclear waste management and health physics, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Waste Handling Operations Qualification Card Signature
    - CH TRU Mixed Waste Handler - (WH-01A Backfill Technician, Floor, Yard, and Emplacement Technician, and WH-01B Waste Handling Technician or WH-02 Waste Handling Engineers) and Waste Handling Operations Guidebook (WH-GUIDE-1)
    - RH TRU Mixed Waste Handler - (RH-01A, RH-01B, RH-01C) RH Waste Handling Technician Qualification Card or (RH-02) RH Waste Handling Engineer Qualification Card and Waste Handling Operations Guidebooks
- Radworker II (RAD-201)
- Hazardous Waste Worker (HWW-101/102)
- Respiratory Protection (SAF-630/631)
- Hazardous Waste Responder (HWR-101, 101A)
- Hazardous Waste Transportation (HMT-102)
- Forklift Safety (EQP 402) (Once)
- Conduct of Shift Operations (OPS 115) (Once)
- Technical Safety Requirements (OPS 122) (Once)
- Incident Rigger (OPS 402) (Biennial)
- 40-Hour Inexperienced Miner (SAF 501/502) (Annual)
- Subject Matter Expert/On the Job Trainer (TRG 293/298) (Biennial)
- Waste Handling Systems (STC-003/STC-015) (Once)

NOTE: Waste Handling Technicians will not participate in TRU waste handling activities and integrated system functions unsupervised until full qualification is acquired.

RCRA Hazardous Waste Management Job Descriptions

<u>Position Title:</u> Underground Hazardous Waste Worker

<u>Duties:</u>

- Move waste from generation point to waste shaft conveyance
- Containerize waste generated at the wash bay and exhaust shaft catchment basin

<u>Requisite Skills, Experience and Education:</u>

High school diploma or equivalent.

<u>Training (Type/Amount):</u>

- General Employee Training (GET-19X/GET-20X) (Annual)
- Hazardous Waste Worker (HWW-101/102) (Annual)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Site-Generated Waste Handlers

Duties:

- Inspects and inventories site-generated hazardous waste staging areas
- Assists the transfer of site-generated hazardous waste to on-site staging areas
- Directs storage of site-generated hazardous waste in the hazardous waste staging areas
- Conducts inspections of Satellite Accumulation Areas

Requisite Skills, Experience and Education:

High school diploma.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Transportation of Hazardous Material (HMT-102)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Transportation Engineer

Duties:

- Supervise/oversee the preparation of hazardous waste shipments
- Review hazardous waste manifests and accompanying land disposal restriction notification forms for compliance
- Resolve manifest discrepancies
- Prepare hazardous waste manifests and supporting documentation for outgoing shipments of TRU mixed waste
- Provide generator sites with a signed copy of the hazardous waste manifest

Requisite Skills, Experience and Education:

Bachelors degree in engineering, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Transportation of Hazardous Material (HMT-102)
- Hazardous Waste Worker (HWW-101/102)
- Radioactive Transportation Qualification Card (TE-01)
- Federal Motor Carrier Safety Regulations Qualification Card (TE-02)
- Hazardous Materials Qualification Card (TE-03)
- Hazardous Waste Shipments by Public Highway Qualification Card (TE-05)

RCRA Hazardous Waste Management Job Descriptions

Position Title: WWIS Data Administrator

Duties:

- Supervise the day to day operation of the WWIS
- Review and approve waste characterization, certification, and shipping data
- Manage the WWIS, including data change control, archival of the database, and reporting functions
- Review Waste Stream Profile Forms (WSPF) and compare with WWIS data on specific containers. Make approval/rejection recommendations to the WSPF review team

Requisite Skills, Experience and Education:

Bachelor of Science degree with technical courses in nuclear waste management, chemistry and health physics, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- Subject Matter Expert/On-The-Job Training (TRG-293/298)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Manager, Waste Handling

Duties:

- Oversee all TRU waste and non-TRU waste handling activities conducted by Waste Operations personnel

Requisite Skills, Experience and Education:

B.S. degree, or equivalent, in nuclear-related field.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Manager, Transportation Operations

Duties:

- Oversee all TRU waste and non-TRU handling activities conducted by Transportation Operations

Requisite Skills, Experience and Education:

B.S. degree, or equivalent, in nuclear-related field.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Radiological Control Technician

Duties:

- Conducts routine surveys of all incoming shipping containers for radiation, contamination, and damage
- Conducts routine radiological surveys (monitoring for surface and airborne contamination and radiation exposure) of various areas at the WIPP site
- Serves as emergency response personnel for any event involving radiation and radioactive materials
- Oversees any radiological work at the facility. This duty involves writing radiological work permits (RWPs), issuing radiological protective clothing and supplemental dosimetry, conducting radiological monitoring of the job (including personnel, equipment, and areas involved), as well as providing any other radiological safety oversight function
- Monitors TRU waste handling and related operations, as well as any other radiological work, to determine compliance with radiological control documents and procedures
- Performs operational and functional checks of radiological detection and monitoring equipment
- In the unlikely event of personnel radiological contamination, the RadCon Tech is qualified to perform personnel decontamination and provide radiological oversight to medical personnel if an injury is contaminated
- Posts radiological areas with applicable signs and barriers
- Controls radioactive sources (including leak testing) used in the performance/functional checks and calibrations of radiological instrumentation
- Operates some non-radiological measurement equipment associated with radiological monitoring (gravimetric scale, chart recorders, data loggers, etc.)

Requisite Skills, Experience and Education:

Academic or vocational high school graduate, or equivalent, with courses in chemistry, physics, geometry, or trigonometry, or equivalent; associate degree in radiation safety or health physics preferred.

RCRA Hazardous Waste Management Job Descriptions (continued)

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Health Physics Technician Qualification (RCT-01/02)
- Radiological Worker II (RAD-201)
- Respiratory Protection (SAF-630/631)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Responder (HWR-101/101A)
- Conduct of Shift Operations (OPS-115)
- First Aid/CPR (MED-101 or 101A)
- Electrical Safety (ELC 103) (Annual)
- Hazardous Material Transportation (HMT 102/103) (Biennial)
- 40-Hour Inexperienced Miner (SAF 501/502) (Annual
- compressed Gas Cylinder Safety (SAF 619) (Once)
- Fundamental Academic Lessons
- Site-Specific Academic Lessons

RCRA Hazardous Waste Management Job Descriptions

Position Title: Manager, Radiation Control

Duties:

- Supervises/oversees hazardous waste management duties performed by personnel in the Radiation Control section

Requisite Skills, Experience and Education:

B.S. degree in engineering, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Technical Trainer

Duties:

- Conduct Hazardous Waste Management training

Requisite Skills, Experience and Education:

High school graduate with knowledge in areas of skills taught.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Level II Trainer (TRG-300)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Manager, Technical Training

Duties:

- Directs hazardous waste management training

Requisite Skills, Experience and Education:

B.S. degree and 5 years nuclear experience, or seven years nuclear training experience, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Level II Trainer (TRG-300)
- Subject Matter Expert/On-the-Job Training (TRG-293/298)
- Hazardous Waste Supervisor ((HWS-101)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Emergency Services Technician

Duties:

- Responds to hazardous waste spills in emergency situations
- Provides emergency fire-response services
- Conducts routine inspections and maintains all response equipment on site
- Directs emergency teams to control hazardous situations

Requisite Skills, Experience and Education:

Vocational or commercial high school graduate, or equivalent, plus additional training in emergency fire and medical response, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- EST Qualification Card (EST-01)
- Subject Matter Expert/On-The-Job Training (TRG-293/298)
- Hazardous Waste Worker (HWW-101/102)
- Respiratory Protection (SAF-630/ 631)
- Firefighter I (SAF-621)
- Hazardous Waste Responder (HWR-101/101A)
- Incident Command Structure (ERT 113) (Once)
- Radiological Worker II (RAD 201) (Annual)
- 40-Hour Inexperienced Miner (SAF 501/502) (Annual)
- Heated Environment/Confined Space (SAF 515/515A) (Annual)
- Compressed Gas Cylinder Safety (SAF 619) (Once)

NOTE: The trainee may perform duties prior to qualification only for those evolutions and/or operations for which training has been completed.

RCRA Hazardous Waste Management Job Descriptions

Position Title: Quality Assurance Technician

Duties:

- Observes waste handling operations and verifies adherence with hazardous waste handling procedures

Requisite Skills, Experience and Education:

Vocational, technical or high school graduate, or equivalent, plus two years of technical training with courses in inspection techniques, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Quality Assurance Inspector Qualification Card

RCRA Hazardous Waste Management Job Descriptions

Position Title: Team Leader, Inspection Services

Duties:

- Ensures that items or services that do not conform with specified quality requirements are controlled to prevent use until disposition and corrective action, where applicable, are implemented
- Provides technical supervision for Quality Assessment Technicians inspecting and verifying waste handling operations

Requisite Skills, Experience and Education:

Associate of science degree in a technical field, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Facility Inspection, Repair, and Service Team (FIRST) Leader

Duties:

- Oversee the packaging and shipment of hazardous and non-hazardous waste

Requisite Skills, Experience and Education:

High school graduate, or equivalent, supervisory experience and one year maintenance-related experience.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)
- Hazardous Materials and Waste Transportation (HMT-102, 103)

RCRA Hazardous Waste Management Job Descriptions

<u>Position Title:</u> Facility Inspection, Repair, and Service Team (FIRST)

<u>Duties:</u>

- Support hazardous and non-hazardous waste packaging and shipments

<u>Requisite Skills, Experience and Education:</u>

High school graduate, or equivalent, and one year maintenance-related experience.
Maintain CDL Driver's License

<u>Training (Type/Amount):</u>

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102) (Annual)
- Hazardous Materials and Waste Transportation (HMT-102, 103) (Biennial)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Sampling Team Member

Duties:

- Collects samples of waste for characterization and environmental media for determination of possible releases

Requisite Skills, Experience and Education:

Academic or vocational high school graduate, or equivalent, with courses in algebra and chemistry or biology, plus Associate degree in engineering or science with courses in computer science, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Responder (HWR-101/101A)
- Sampling Team Qualification (ST-001)
- Respiratory Protection (SAF 630/631) (Annual)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Sampling Team Assistant

Duties:

- Assists sampling team members in the collection of waste samples for characterization and environmental media for determination of possible releases. Sampling Team Assistant will not respond to hazardous material spills.

Requisite Skills, Experience and Education:

Academic or vocational high school graduate, or equivalent, with courses in algebra and chemistry or biology, plus Associate degree in engineering or science with courses in computer science, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Sampling Team Assistant Qualification (STA-001)
- Respiratory Protection (SAF 630/631) (Annual)

RCRA Hazardous Waste Management Job Descriptions

<u>Position Title:</u> Manager, Environmental Compliance

<u>Duties:</u>

- Supervises/oversees hazardous duties performed by Sampling Team members

<u>Requisite Skills, Experience and Education:</u>

B.S. degree in an environmental science, or equivalent.

<u>Training (Type/Amount):</u>

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Supervisor (HWS-101/101A)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Facility Shift Engineer

Duties:

- Notifies emergency response personnel and on-call facility manager during emergency occurrences
- Serves as backup RCRA Emergency Coordinator

Requisite Skills, Experience and Education:

Associate degree in engineering or scientific discipline, or equivalent, and five years related practical experience, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Facility Operations Shift Supervisor Qualification Card (FO-FOSE-3 or FO-FOSE-3R)
- Roving Watch Qualification (FO-RW-1)
- Central Monitoring Room Operator Qualification (FO-CMRO-2)
- Conduct of Shift Operations (OPS-115)
- Hazardous Materials Emergency Response (HMT-104)
- Root Cause Analysis (TRG-296)
- WIPP Occurrence Reporting for Facility Managers (OPS-110)
- WIPP Contingency Plan Procedure (SAF-645)
- Hazardous Waste Worker (HWW-101)

NOTE: Full Qualification must be completed prior to the candidate operating any equipment or performing any operating evolutions without the direct supervision of a qualified operator.

RCRA Hazardous Waste Management Job Descriptions

Position Title: Facility Shift Manager

Duties:

- Serves as RCRA Emergency Coordinator
- Notifies emergency response personnel and on-call facility manager during emergency occurrences

Requisite Skills, Experience and Education:

Academic or vocational high school (mechanical/electrical) graduate and eight years of nuclear plant operating experience, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Facility Operations Shift Engineer Qualification Card (FO-FOSE-3 or FO-FOSE-3R)
- Roving Watch Qualification (FO-RW-1)
- Central Monitoring Room Operator Qualification (FO-CMRO-2)
- Conduct of Shift Operations (OPS-115)
- Hazardous Materials Emergency Response (HMT-104)
- Root Cause Analysis (TRG-296)
- WIPP Occurrence Reporting for Facility Managers (OPS-110)
- WIPP Contingency Plan Procedure (SAF-645)
- Hazardous Waste Worker (HWW-101)

NOTE: Full Qualification must be completed prior to the candidate operating any equipment or performing any operating evolutions without the direct supervision of a qualified operator.

RCRA Hazardous Waste Management Job Descriptions

Position Title: Central Monitoring Room Operator

Duties:

- Notifies emergency response personnel
- Documents emergency actions

Requisite Skills, Experience and Education:

Vocational or academic high school graduate, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Roving Watch Qualification (FO-RW-1)
- Central Monitoring Room Operator (FO-CMRO-2 or FO-CMRO-2R)
- Hazardous Materials Emergency Response (HMT-104)
- Conduct of Shift Operations (OPS-115)

NOTE: Full Qualification must be completed prior to the candidate operating any equipment or performing any operating evolutions without the direct supervision of a qualified operator.

RCRA Hazardous Waste Management Job Descriptions

Position Title: Waste Hoist Operator

Duties:

- Operates waste shaft hoist in accordance with established procedures
- Maintains daily hoist operations log
- Performs routine inspections of the Waste Shaft hoisting equipment

Requisite Skills, Experience and Education:

Vocational or academic high school graduate, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Waste Hoist Qualification (M-30)

1 **RCRA Hazardous Waste Management Job Descriptions**

Position Title: Waste Hoist Shaft Tender

Duties:

- Oversees and directs loading and unloading of the Waste Shaft Conveyance above and below ground

Requisite Skills, Experience and Education:

Vocational or academic high school graduate, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Waste Hoist Shaft Tender (M-31)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Waste Hoisting Manager

Duties:

- Coordinate and direct the daily operations and maintenance of the operating hoist and shaft
- Supervise/oversee hazardous waste management duties performed by hoisting personnel

Requisite Skills, Experience and Education:

B.S. degree, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Chief Office Warden

Duties:

- Cooperate, participate, and comply with the provisions of WIPP Emergency Plan
- Primary function is to coordinate personnel accountability in the event of an evacuation
- Responsible for surface accountability at staging areas in the event of an evacuation

Requisite skills, Experience and Education:

High School Diploma or equivalent, approval from employee’s manager, compliance with the requirements of the WIPP Emergency Plan, and current knowledge of emergency evacuations, staging and assembly areas, and the site notification system.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Office Warden Training (SAF-632)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Assistant Chief Office Warden

Duties:

- Cooperate, participate, and comply with the provisions of WIPP Emergency Plan
- Primary function is to coordinate personnel accountability in the event of an evacuation
- Responsible for surface accountability at staging areas in the event of an evacuation

Requisite skills, Experience and Education:

High School Diploma or equivalent, approval from employee's manager, compliance with the requirements of the WIPP Emergency Plan, and current knowledge of emergency evacuations, staging and assembly areas, and the site notification system.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Office Warden Training (SAF-632)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Mine Rescue Team Member

Duties:

- Cooperate, participate, and comply with provisions of the WIPP Emergency Management Program (WP 12-9)
- Trained in accordance with 30 CFR to respond to mine emergencies beyond that of the FLIRT
- Responsible for underground reentry and rescue after an underground evacuation

Requisite Skills, Experience and Education:

High School Diploma or equivalent, written approval from employee’s manager (Authorization Card MRT-01), compliance with health and physical requirements, 1) Initial examination and clearance by the Occupational Medical Director, 2) Examined and cleared annually by the Occupational Medical Director, 3) Additional tests: pulmonary function test, cardiac stress test every five years, drug screen, 4) Encouraged to maintain good medical and physical condition, Compliance with requirements of the SERP, current knowledge regarding rescue and recovery of personnel involved in mine emergencies according to 30 CFR. At least one year verifiable underground work.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- First Aid and CPR (MED-101)
- Respiratory Protection (SAF-630/SAF-631 D)
- Radiological Worker II (RAD-201)
- Mine Rescue Team Initial training (EOC-101)
- Inexperienced Miner Training (SAF-501/502)
- Compressed Gas Cylinder Safety (SAF 619) (Once)

RCRA Hazardous Waste Management Job Descriptions

Position Title: First Line Initial Response Team member

Duties:

- Cooperate, participate, and comply with provisions of the Supplemental Emergency Response Program Plan (SERP)
- Primary function is to provide medical and hazardous material response to the WIPP underground

Requisite Skills, Experience, and Education:

High School Diploma or equivalent, written approval from employee’s manager (Authorization Card FLIRT-01), compliance with health and physical requirements, 1) Initial examination and clearance by the Occupational Medical Director, 2) Examined and cleared annually by the Occupational Medical Director, 3) Additional tests: pulmonary function test, cardiac stress test every five years, drug screen, 4) Encouraged to maintain good medical and physical condition, compliance with requirements of the SERP, current knowledge regarding medical response and hazardous materials response.

Training (Type/Amount):

The following training must be completed and current prior to participation during an emergency response:

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA)
- Inexperienced miner (SAF 501/502)
- Confined Space Training (SAF-515)
- Hazardous Waste Worker (HWW-101)
- Respiratory Protection (SAF-630 and SAF-631 D)
- First Aid and CPR (MED-101)
- Radiological Worker II (RAD-201)
- Confined Space Rescue (ERT 102/102A) (Annual)
- Annual Live Fires Practical (ERT 107) (Annual)
- Introduction to Firefighting (ERT 117) (Once)
- Eight hours of training quarterly
- Hazardous Waste Responder (HWR 101/101A)(Annual)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Emergency Response Team

Duties:

- Responding to hazardous waste incidents or releases due to fires, HAZMAT, and medical emergencies
- Operating as part of the WIPP Supplemental Emergency Response Program

Requisite Skills, Experience, and Education:

High School Diploma or equivalent, written approval from employee's manager (Authorization Card ERT-01), compliance with health and physical requirements:
1) Initial examination and clearance by the Occupational Medical Director
2) Examined and cleared annually by the Occupational Medical Director
3) Additional tests: pulmonary function test, cardiac stress test every five years, drug screening.

Training (Type/Amount):

- Emergency Response Team (ERT-102/102A) (Annual)
- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA) (Annual)
- Hazardous Waste Worker (HWW-101/102) (Annual)
- Hazardous Waste Responder (HWR-101/101A) (Annual)
- Respiratory Protection (SAF-630/ SAF-631C/ SAF-631 D) (Annual)
- First Aid and CPR (MED-101/101A) (Annual)
- Radiological Worker (RAD-201/202) (Annual)
- Confined Space/Heated Environment (SAF-515/515A)
- Emergency Response Team Member Authorization Card (ERT-01)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Fire Brigade

Duties:

- Fight fires

Requisite Skills, Experience, and Education:

High School Diploma or equivalent, fire fighting training, compliance with health and physical requirements:
1) Initial examination and clearance by the Occupational Medical Director.
2) Examined and cleared annually by the Occupational Medical Director.
3) Encouraged to maintain good medical and physical condition.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA) (Annual)
- Hazardous Waste Worker (HWW-101/102) (Annual)
- Hazardous Waste Responder (HWR-101/101A) (Annual)
- Radiological Worker (RAD-201/202) (Annual)
- Respiratory Protection (SAF-630/ SAF-631D) (Annual)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Fire Protection Technician

Duties:

- Responds to hazardous waste spills in emergency situations
- Provides emergency fire-response service
- Conducts routine inspections and maintains all response equipment on site
- Serves as incident commander
- Directs emergency teams to control hazardous situations

Requisite Skills, Experience, and Education:

Vocational or commercial high school graduate, or equivalent, plus additional training in emergency fire and medical response, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-19XA/GET-20XA) (Annual)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Responder (HWR-101/101A)
- Radiological Worker (RAD-201/202)
- Respiratory Protection (SAF-630/ SAF-631D)
- Fire Protection Technician Qualification Card (FTP-01)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Radiographer Level 1 (Radiography Independent Technical Reviewer)

Duties:

- Reviews radiography record performed by another radiographer

Requisite Skills, Experience and Education:

Academic or vocational high school diploma or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-20XA)
- Conduct of Shift Operations (OPS 115) (Once)
- Radiography Training (Level 1)

RCRA Hazardous Waste Management Job Descriptions

<u>Position Title:</u> Radiographer Level 2 (Radiography Independent Technical Reviewer)

<u>Duties:</u>

- Performs confirmation of waste using radiography
- Reviews radiography record performed by another radiographer

<u>Requisite Skills, Experience and Education:</u>

Academic or vocational high school diploma or equivalent.

<u>Training (Type/Amount):</u>

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-20XA)
- Radworker II (RAD-201)
- Hazardous Waste Worker (HWW-101/102)
- Respiratory Protection (SAF-630/631)
- Conduct of Shift Operations (OPS 115) (Once)
- Technical Safety Requirements (OPS 122) (Once)
- Subject Matter Expert/On the Job Trainer (TRG 293/298) (Biennial)
- Waste Handling Systems (STC-003) (Once)
- Radiography Training (Level 2)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Visual Examination Operator/Expert Level 1 (VE Independent Technical Reviewer)

Duties:

- Reviews visual examination or visual examination record review performed by another Visual Examination Expert.

Requisite Skills, Experience and Education:

Academic or vocational high school diploma or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-20XA)
- Conduct of Shift Operations (OPS 115) (Once)
- Visual Examination (Level 1)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Visual Examination Operator/Expert Level 2 (VE Independent Technical Reviewer)

Duties:

- Performs confirmation of waste using visual examination or review of visual examination records
- Reviews visual examination or visual examination record review performed by another Visual Examination Expert.

Requisite Skills, Experience and Education:

Academic or vocational high school diploma or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-20XA)
- Radworker II (RAD-201)
- Hazardous Waste Worker (HWW-101/102)
- Respiratory Protection (SAF-630/631)
- Conduct of Shift Operations (OPS 115) (Once)
- Technical Safety Requirements (OPS 122) (Once)
- Subject Matter Expert/On the Job Trainer (TRG 293/298) (Biennial)
- Waste Handling Systems (STC-003) (Once)
- Visual Examination (Level 2)

RCRA Hazardous Waste Management Job Descriptions

Position Title: Permittees' Management Representative

Duties:

- Reviews radiography and/or visual examination to certify that waste confirmation is complete and that waste contains no ignitable, corrosive, or reactive waste

Requisite Skills, Experience and Education:

Academic or vocational high school diploma or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X/GET-20X)
- General Employee Training Refresher (GET-20XA)
- Radworker II (RAD-201)
- Hazardous Waste Worker (HWW-101/102)
- Respiratory Protection (SAF-630/631)
- Conduct of Shift Operations (OPS 115) (Once)
- Technical Safety Requirements (OPS 122) (Once)
- Subject Matter Expert/On the Job Trainer (TRG 293/298) (Biennial)
- Waste Handling Systems (STC-003) (Once)
- Radiography Training
- Visual Examination Training

APPENDIX H2

TRAINING COURSE AND QUALIFICATION CARD OUTLINES

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APPENDIX H2

TRAINING COURSE AND QUALIFICATION CARD OUTLINES

TABLE OF CONTENTS

Course Outlines

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COURSE: GET-19X/GET-20X - General Employee Training

DURATION: ≈ 16 Hours

PREREQUISITES: None

SCOPE:

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to perform their job in a safe manner and will have an overview of the site organization and description.

Mastery of the terminal objectives will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: GET-19XA/GET-20XA annually

COURSE DESCRIPTION (by module)

1. Site Overview & WIPP Description
   ≈1 hour
   - a. Mission of DOE and CBFO
   - b. Relationship of WIPP organizations
   - c. Surface structures
   - d. WIPP shafts
   - e. Underground area

2. Emergency Preparedness (includes Occurrence Reporting)
   ≈1 hour
   - a. Definition of occurrence
   - b. DOE Order 5000.3B
   - c. WP 12-ES3918
   - d. Occurrence reporting process
   - e. Employee involvement with Emergency Preparedness
   - f. Types of emergencies
   - g. Emergency response by WIPP groups
   - h. Off-site response groups
   - i. WIPP emergency procedures
   - j. Emergency equipment
   - k. Employee actions during emergencies

3. General Safety ≈1 hour	a. Personal Protective Equipment b. Requirements for PPE c. Warning Tags d. WIPP safety hazards e. Medical assistance f. Actions to take for injuries g. Reporting injuries/accidents h. Employee concerns

4. Computer Security
≈1 hour
	a. Department to contact
	b. WIPP policies and procedures for:
	  1. Personally owned software
	  2. Computer games
	  3. Passwords/password protection
	c. Computer virus prevention

5. Fire Protection ≈1 hour	a. WIPP Fire Protection Program b. Fire sources at WIPP c. Fire Tetrahedron d. Classes of fires e. Fire extinguisher f. Office Warden Program g. Employee responsibilities during a fire
6. RCRA & Storm Water Management ≈2 hours	a. RCRA history b. RCRA goals c. WIPP goals and relation to RCRA d. Definition of RCRA wastes e. Site generated waste program f. Training requirements for treatment storage and disposal facilities g. Contingency Plan h. Waste Minimization Program i. RCRA regulatory agencies j. RCRA enforcement options k. Application of Storm Water Management policy in relation to the general employee

8. Work Policies and Procedures
   ≈1 hour
   a. DOE Orders and MOC Procedures
   b. Teamwork
   c. Conduct of Operations Policy
      1. Elements of Conduct of Ops
   d. Quality Assurance Program
   e. Responsibility for following procedures
   f. Resuming work after stoppage
   g. Stopping work for unsafe acts
   h. Purpose and uses of "Hold Tag"
   i. Quality records and requirements
   j. Correcting errors on QA Records
   k. Configuration Management and affected departments

9. Electrical Safety
   ≈1 hour
   a. Variables of electrical circuits
   b. Severity of electrical shock
   c. Areas where electrical accidents occur
   d. WIPP policy on using damaged electrical equipment
   e. WIPP policy for modifying electrical protective devices
   f. Requirements for use of Ground Fault Interrupters.
   g. Purpose of GFI's
   h. WIPP policy for resetting breakers
   i. WIPP policy for using extension cords, plug-in devices, and other equipment exposed to energized electrical circuits

10. Hazard Communications
    ≈1 hour
    a. Description of Haz Comm Std.
    b. Health and Safety hazards
    c. Protection from workplace hazards
       1. PPE
       2. Preparedness/Prevention
       3. Employee responsibilities
    d. Emergency procedures
    e. WIPP Hazard Communication Prog.
       1. Training
       2. Container labels
       3. Chemical transfers
       4. Material Safety Data Sheets
    f. Other information sources

11. Personal Protective Equipment ≈1 hour	a. Requirements for head protection b. Requirements for hearing conservation c. Requirements for face/eye protection d. Requirements for foot protection
12. Bloodborne Pathogens ≈1 hour	a. Def. of Bloodborne Pathogens b. Def. of Hepatitis B and Human Immunodeficiency Virus c. Bloodborne Pathogen transmission d. Prevention of bloodborne pathogen infection e. WIPP Exposure Control Plan
13. Ergonomics ≈2 hours	a. Cumulative Trauma Disorder b. Risk factors for CTD c. Prevention of CTD d. Recognition of CTD e. Steps to take when CTD develops
14. Security ≈1 hour	a. Security Mission b. Def. of Security Officer c. Security Officer Tasks d. Access and Property Control at WIPP e. Badge accountability f. Property Pass system g. Physical security h. Telephone threat list i. Employee responsibilities during demonstration j. Fitness for duty k. Computer security l. Parking requirements

15. General Employee Radiological Training (GERT)
≈1 hour

This program will be implemented prior to declaration of site readiness for all site employees. The standardized core materials for GERT include the following topics:

Sources of Radiation
Non-ionizing and Ionizing Radiation
Risk in Perspective
ALARA Concept
Radiological Controls
Monitoring/Dosimetry
Emergency Procedures
Employee Responsibilities

All times are approximate and do not reflect time spent on additional topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: GET-19XA/GET-20XA - General Employee Training Refresher

DURATION: Self-paced Course

PREREQUISITES: None

SCOPE:

TYPE: Self-paced Module

OBJECTIVES: Objectives are stated at the beginning of each module, including security, radiological basics, general safety, hazard communications, bloodborne pathogens, hearing protection, and OSHA/RCRA.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the module examination.

REFRESHER: Annually

COURSE DESCRIPTION (by module)

1. Introduction
    - a. Self Paced Course
    - b. Information about WIPP organizations
    - c. Appendix Information
        1. Storm Water Management
        2. WIPP Land Withdrawal Act
        3. DOE Mission
    - d. Exam Guidelines
2. General Security
    - a. Prohibited Articles
    - b. Primary responding agencies
    - c. Wearing your badge
    - d. Escort Responsibility
    - e. Number of visitors an employee may escort
    - f. When to turn off your computer
    - g. Personal Property Passes
3. Computer Security
    - a. Point of contact
    - b. WIPP policies and procedures for:
        1. Personally owned software
        2. Computer games
        3. Passwords/password protection
    - c. Computer virus prevention

4. Fitness for Duty	a. Reasons for the Fitness for Duty Program b. General Employee Responsibilities
5. RCRA	a. Types of waste disposed b. Waste Identification
6. Storm Water Management	a. Application of Storm Water Management policy in relation to the general employee
7. Bloodborne Pathogens	a. Transmission Identification of Bloodborne Pathogens b. Prevention of Hepatitis B and Human Immunodeficiency Virus c. Actions to take if exposed
8. Hazard Communications	a. Purpose of MSDS b. Responsibilities when transferring hazardous materials c. WIPP Hazard Communication Prog. 1. Training 2. Container labels 3. Chemical transfers 4. Material Safety Data Sheets
9. Ergonomics	a. Identification of CTD b. Ways to prevent CTD c. Required actions
10. Personal Protective Equipment	a. Requirements for head protection b. Requirements for hearing conservation c. Requirements for face/eye protection d. Requirements for foot protection
11. General Safety	a. Requirements for obeying signs and tags b. Requirements for reporting an occurrence c. Actions for emergency situations d. Resolving employee concerns e. Proper uses of extension cords f. WIPP Circuit Breaker Policy g. Steps to take when responding to fire h. Responsibilities when fighting a fire i. When to use the sign-out board

12. Conduct of Operations	a. Goals of In-House Management Program b. Required actions before posting information c. Correcting a written record d. Point of Contact for Records Management

COURSE: HWW-101 - Hazardous Waste Worker

DURATION: ≈24 hours

PREREQUISITES: None

SCOPE:

REFRESHER: HWW-102 Annually

COURSE DESCRIPTION (by module)

1. Course and Regulatory Overview ≈1 hour	a. OSHA regulations and their applicability to RCRA facilities and operations b. RCRA standards for generator facilities and for TSDFs c. DOT/EPA regulations and applicability to hazardous waste transportation
2. Hazard Communications ≈1 hour	a. Purpose of the Hazard Communication standard (29 CFR 1910.1200) b. Locations of Material Safety Data Sheets (MSDS) c. Labeling of containers d. Other resources for information on hazardous materials/waste including NFPA 704 hazard warning symbol, DOT United Nations Identification System, DOT Emergency Response Guidebook, NIOSH Pocket Guide to Chemical Hazards. Student exercises are included in this section on the use of these references.
3. Principles of Toxicology ≈3 hours	a. Dose-response relationship with regard to exposures to hazardous materials b. Immediate and delayed effects (acute and chronic effects) c. Different ways substances enter the human body d. Effects of substances on the human body including target organ effects, systemic effects, carcinogens, and genetic effects

	e. Exposure limits including Threshold Limit Value (TLV), Permissible Exposure Limit (PEL), Lethal Dose 50% (LD_{50}), Lethal Concentration 50%(LC_{50}) f. Effects of temperature extremes on the human body including signs and symptom heat stress and cold stress g. Effects of ionizing radiation
4. Hazards ≈3 hours	a. Safety and health hazards when conducting hazardous waste operations including fire, explosion, oxygen deficiency, ionizing radiation, biological, electrical, heat and cold stress b. Hazard classification including chemical, physical, mechanical, biological, and radiological c. Airborne hazards including gases, vapors, and particulates d. Properties of materials including corrosivity, pH, flammability, explosivity, (upper and lower explosive limits), specific gravity, vapor density, boiling point, solubility, and reactivity e. Protection from hazards f. Confined space hazards g. Causes and prevention of accidents
5. Personal Protective Equipment ≈3 hours	a. Description and examples of Personal Protective Equipment (PPE) b. Factors in the selection of PPE c. Non-radiological and radiological hazards d. Selection process for PPE e. Ways substances enter PPE including permeation, degradation, penetration f. Equipment included in each of the four levels of PPE adopted by the EPA (Levels A, B, C, and D), capabilities and limitations of each level g. PPE inspection h. Job scope planning

	i. Human factors that limit the use of PPE j. Demonstration on donning and removal of Level D PPE. Students perform a Level D dress out sequence and are evaluated by a Job Performance Measure.
6. Satellite Accumulation Areas ≈2 hours	a. Purpose of hazardous waste satellite accumulation areas (proper accumulation of hazardous waste to protect human health and the environment) b. Key elements of satellite accumulation areas including maintenance of containers, labeling, maximum quantities allowed, and transfers to storage area c. Inspection criteria including aisle space, stacking of containers, closing of containers, labeling requirements, containment structures, housekeeping, warning signs, alarms, fire extinguisher, spill control materials, and ignition sources
7. Decontamination ≈2 hours	a. Purpose of decontamination (prevent the spreading of contamination, prevention of exposure to workers, protection of the environment) b. Causes and prevention of worker contamination c. Decontamination planning including methods for decontaminating d. Layout of decontamination stations e. Emergency decontamination procedures

All times are approximate and do not reflect time spent on additional topics that arise due to class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: HWW-102 - Hazardous Waste Worker Refresher

DURATION: 8 hours

PREREQUISITES: HWW-101

SCOPE: This course reviews precautions for safe handling and use of a hazardous material and the management of any hazardous waste generated during the these activities. This is accomplished by reviewing the concepts presented in HWW-101 and the application to a particular hazardous material by the use of a Material Safety Data Sheet (MSDS). Also included in this course is an overview of mixed waste.

TYPE: Classroom and Practical

COURSE DESCRIPTION (by lesson)

1. Material or Waste Information ≈2 hours
   a. Definition of TRU mixed waste
   b. Emergency actions in the event of a spill or leaking or punctured container of TRU mixed waste
   c. This module describes the information found in the supplier information section of a Material Safety Data Sheet (MSDS)
   d. This information is used in the event the user of the material needs more information than what is included in the particular MSDS
   e. Information
      1. This module describes the product's individual ingredients, relative concentration, and the exposure limit for each ingredient
   f. Physical/Chemical Data
      1. This module describes the chemical and physical properties of the material including; boiling point, specific gravity, melting point, vapor pressure, vapor density, evaporation rate, solubility, pH, and volatility

2. Hazard Data ≈2 hours	a. This module describes the fire and explosion hazards of the particular material including; flash point, lower explosive limit, upper explosive limit, auto-ignition temperature, NFPA 704M Hazard Classification Rating, fire extinguishing media, special fire fighting procedures, unusual fire and explosion hazards, toxic gases produced, and explosion data b. Reactive Data Module 1. This module describes the material's reactivity characteristics including stability, incompatibility, decomposition, and polymerization c. Health Hazards Data Module 1. This module describes the different ways the user may be exposed to the material and the adverse effects the material may have on the body including; lethal dose 50% (LD_{50}), lethal concentration 50 % (LC_{50}), target organ effects, carcinogenicity, acute and chronic effects, and emergency first aid procedures

3. Safety
   ≈2 hours
   a. This module describes the precautions for the safe handling of the material including steps to take in the event the material is spilled, waste disposal method (EPA hazardous waste numbers), regulatory requirements (SARA Title III hazard categories/lists and CERCLA Hazardous Substance classification), labeling of containers, protective equipment, and site specific requirements
   b. Control Measures Module
      1. This module describes safety control measures to take when using the material including respiratory protection, ventilation requirements, work/hygiene practices and site specific requirements
   c. Personal Protective Equipment Module
      1. This module describes the purpose of personal protective equipment (PPE), the categories of protection, EPA Levels of Protection (A,B,C,D), PPE material and chemical resistance. In this module the donning and doffing of Level D PPE is demonstrated. The students are given an opportunity to practice and then are evaluated by completion of a Job Performance Measure.

4. Demonstration
   ≈1 hour
   a. The effects the hazardous material has on various types of PPE material (degradation, permeation, and penetration effects), other common materials and neutralization effects are demonstrated

All times are approximate and do not reflect additional time spent on topics that arise due to class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE:	HWR-101 - Hazardous Waste Responder
DURATION:	20 hours
PREREQUISITES:	GET-19X/GET-20X Medical Physical SAF 630/631- Respiratory Protection HWW 101 - Hazardous Waste Worker
SCOPE:	The instructor will present updated information needed for personnel who respond to hazardous material and/or hazardous waste emergencies at the WIPP site.
TYPE:	Classroom and Field Exam
OBJECTIVES:	Upon completion of this course, the student will be able to respond to hazardous materials emergencies at the WIPP site. Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the post course examination, satisfactory performance on the job performance measure for donning and doffing Personal Protective Equipment, and participate as a team in the final practical.
REFRESHER:	HWR-101A Annually

COURSE DESCRIPTION

1. Regulatory Requirements ≈1 hour	a. 29 CFR 1910.120
2. Evaluation of Incident ≈3 hours	
A. (Types of Information)	a. Physical data 1. color 2. odor 3. sound b. Cognitive c. Technical
B. Dispatch and Initial Response Phase	a. Primary focus information b. CMR information c. During a response

C. Product Information
- a. Product identification
- b. Primary and secondary hazards

D. Incident Elements
- a. Spill
- b. Leak
- c. Fire

E. Incident Priorities

3. Response Operations
≈1 hour

A. Size-up, Strategy, and Tactics
- a. Size-up
  1. Monitoring atmospheric conditions near the release
     - a. Weather conditions
     - b. Organic vapors, gases, particulates
     - c. Oxygen deficiency
     - d. Specific materials
     - e. Combustible gases
     - f. Inorganic vapors, gases, particulates
     - g. Radiation
  2. Visual observations
  3. Unusual odors
  4. Off-site samples
  5. Entry team procedures
     - a. Monitoring on-site ambient air
     - b. Types of containers and impoundments
     - c. Physical condition of material
     - d. Leaks or discharges
     - e. Labels and markings
  6. Additional considerations
     - a. Type, condition, and behavior of container
     - b. Resources and control measures
  7. Summary of size-up

b. Strategy and tactics
   1. Definitions
   2. Strategy
   3. Tactics
   4. Rescue
   5. Prevent container failure
   6. Containment
   7. Confinement
   8. Remove ignition sources
   9. Extinguish fires
   10. Tactical withdrawal

B. Incident Command System and Mitigation Plan at the WIPP
≈1 hour

a. Key elements required
b. Key personnel and functions
   1. Incident commander
   2. Science officer
   3. Safety officer
   4. Records keeper
   5. Medical officer
   6. Resource officer
   7. Operations officer
c. Implementing response operations
   1. Organize
   2. Evaluate the situation
   3. Develop a plan of action

4. Safety
≈5 hours

A. Responder Protection

a. Pre-entry evaluation
b. Deny entry
c. Hydration
d. Pre-entry briefing
e. Post-exit evaluation
f. Support location
g. Environmental temperature monitoring

B. Personal Protective Equipment
   a. Selection of appropriate PPE
      1. Levels
         a. Level A
         b. Level B
         c. Level C
         d. Level D
      2. Optional equipment
      3. Manufacturer recommendations/testing
         a. Gloves

C. Donning and Doffing Level A PPE

D. Job Performance Measures
   a. Students will Don and Doff Level A PPE with a partner

E. Decontamination

F. Emergency Medical Services

5. Table-top Drill
   ≈2 hours

6. Course Review

7. Written Examination

8. Practical
   ≈5 hours
   a. Objective
   b. Demonstration
   c. Equipment needed
   d. Have students develop Incident Commander and System
   e. Evaluation

All times are approximate and do not reflect time spent on additional topics that arise due to class participation, student breaks, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: HWR-101A - Hazardous Waste Responder, Refresher

DURATION: ≈8 hours

PREREQUISITES: HWR-101

OBJECTIVES: Upon Completion of this course, the student will be able to respond to hazardous materials emergencies at the WIPP site.

Mastery of the terminal objective will be demonstrated by satisfactory performance on the job performance measure for donning and doffing Personal Protective Equipment (PPE), and successfully participate as a team in the final practical

REFRESHER: Annually

COURSE DESCRIPTION

1. Review of HWR-101
   ≈2 hours

2. Changes in Regulations, procedures, and polices
   ≈2 hours

3. Lessons Learned
   ≈2 hours

4. Conclusion and Exam
   ≈2 hours

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size and/or practical exercises (i.e., Job Performance Measures)

COURSE: HWS-101 - Hazardous Waste Worker Supervisor

DURATION: ≈8 hours

SCOPE: This course will provide the students with the knowledge necessary to identify factors affecting individual and corporate liability under applicable hazardous waste laws and regulations. Students will be able to state the stages of criminal and civil litigation, identify the types of behavior that leads to criminal prosecution, and identify appropriate actions to ensure compliance with applicable hazardous waste operations.

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student shall be able to perform supervisory functions in compliance with policies, procedures, and regulations, with regard to hazardous waste management.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: HWS 101A annually

COURSE DESCRIPTION (by lesson)

1. Liability and Responsibility
   ≈3 hours

   a. General requirements
   b. Definitions and key liability concepts
   c. Mental element in criminal litigation
   d. Typical litigation chronology
   e. Civil and criminal penalties under OSHA
   f. Criminal penalties under environmental laws
   g. Federal sentencing guidelines
   h. Mitigation credit under Federal Sentencing Guidelines
   i. Who will be defendants
      1. Direct involvement
      2. Direct supervisory involvement
      3. Indirect involvement and Responsible Corporate Officer doctrine
   j. Representation
   k. Indemnification
   l. Scope of employment
   m. Types of criminal cases being pursued
   n. Recommended actions

	o. Illustrative cases 1. Knowledge 2. Sovereignty 3. Multiple prosecutions 4. Pervasiveness of liability 5. Potential for catastrophic corporate consequences p. Conclusions
2. Health and Safety Program ≈3 hours	a. Purpose b. Authority c. Supervisor responsibilities 1. Hazard control 2. Hazardous waste management 3. Hazardous materials management a. Training b. Storage and handling c. Labeling containers d. General precautions and practices d. Personal protective equipment
A. Industrial Hygiene	a. Exposure limits b. Conversion and comparison of PPM
B. Spill Containment (Emergency Response)	a. Spill response plan
C. Site Control	a. Zoning
D. Decontamination	
E. Reporting Requirements	
3. Conclusion ≈1 hour	

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises (i.e. Job Performance Measures)

COURSE: HWS-101A - Hazardous Waste Worker Supervisor-Refresher

DURATION: ≈8 Hours

PREREQUISITES: HWS-101

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to perform supervisory functions in compliance with policies, procedures, and regulations with regard to hazardous waste management

Mastery of the terminal objective will be demonstrated by scoring 80% or higher on the course examination.

REFRESHER: Annually

COURSE DESCRIPTION (by lesson)

1. Review of HWS-101
   ≈2 hours
   a. Liability and Responsibility
   b. Health and Safety Program

2. Changes in regulations, procedures, policies
   ≈2 hours

3. Lessons Learned
   ≈2 hours

4. Conclusion and Exam
   ≈1 hour

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises (i.e. Job Performance Measures)

1

COURSE: SAF-630/631 - Respiratory Protection

DURATION: ≈8 hours

PREREQUISITES: Medical physical

TYPE: Classroom and Practical

SCOPE: This program contains the requirements of respiratory protection as outlined in 29 CFR 1910.134, 10 CFR 20, ANSI, Z88.2-1980 and applicable WIPP procedures.

OBJECTIVES: Upon completion of this course the trainee will demonstrate a knowledge of the WIPP respiratory protection program; respiratory health hazards; and types of respiratory protection devices, their proper use and limitations.

Mastery of the terminal objective will be demonstrated by scoring 80% or higher on a closed book lesson examination.

COURSE DESCRIPTION (by lesson)

1. Introduction
   ≈2 hours
   A. Basic Requirements
      a. Regulations
      b. DOE Orders
      c. Industry Standards
      d. WIPP Procedures
         1. Physical exam
         2. Pulmonary test
         3. Training
         4. Fit Testing
         5. Identification of potential respirator activities
         6. Selection of Respirators
         7. Respirator usage, storage and sanitation

B. Nature, Extent, and Effects of Respiratory Hazards and the Need for Protection
- a. Human Respiratory System
- b. Respiratory Hazards
- c. Contaminants (Identification)
  1. Physical Properties
  2. Chemical Properties
  3. Concentration
  4. Warning Properties
  5. MSDS
  6. Toxicology
     - a. Gases/Vapors
     - b. Particulates

C. Engineering and Administrative Controls
- a. Hazard Control
  1. Engineering Controls
  2. Administrative Controls
- b. ALARA

2. Use of Respirators at WIPP
≈2 hours

A. Selection of Respirators
- a. Medical Verification
  1. Physical Exam
  2. Spirometer Testing
- b. Training
- c. Qualitative/Quantitative Fit Testing
- d. Selection Factors
  1. User Acceptance
  2. Psychological/Physiological Complications

B. Air Purifying Respirators
- a. Operation
- b. Limitations/Capabilities
  1. Particulate Air Filters
  2. Chemical Cartridge Respirators

C. Atmosphere Supplying Respirators
- a. Operation
- b. Limitations/Capabilities

D. Respirator Cleaning/Storage
- a. Cleaning Frequency
- b. Maintenance
- c. Storage

E. Respiratory Emergencies
- a. Actions for Air Purifying Respirators
- b. Self Contained Breathing Apparatus (SCBA) Emergency Actions
    1. Buddy System
    2. Regulator Failure
    3. Insufficient Air Flow
    4. Hyperventilation

3. Practical Session
≈2 hours
- a. Half-Facepiece, Air Purifying Regulators
    1. Types
    2. Mode of Operation
    3. Protection Factors
    4. Inspection
    5. Donning
    6. Qualitative Test
    7. Cartridge Type
    8. Removal
- b. Full Facepiece, Air Purifying Regulator
    1. Types
    2. Mode of Operation
    3. Protection Factor
    4. Inspection
    5. Donning
    6. Qualitative Test
    7. Removal
- c. Full Facepiece, SCBA
    1. Types
    2. Mode of Operation
    3. Protection Factor
    4. Inspection
    5. Donning
    6. Qualitative Test
    7. Removal

All time are approximate and do not reflect time spent on additional topics that arise due to class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: SAF-515 - Confined Space

DURATION: ≈12 hours

PREREQUISITES: GET-19X/GET-20X initial training
Medical physical
SAF-630/631 Respiratory Protection
Current OPS-08 Qual Card

SCOPE: The instructor will present hazards, personal protective equipment requirements, emergency action, and compliance with regulatory and WIPP procedures involving confined space. Students will learn emergency retrieval techniques for removal of personnel from confined spaces.

Students will enter a simulated confined space using Personal Protective Equipment (PPE)

TYPE: Classroom and practical

OBJECTIVES: Upon completion of this course, the student will be able to state the requirements for entry into confined spaces, identify hazards which may exist, provide proper monitoring of the environmental conditions of spaces, and provide proper emergency response actions involving employees in distress.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: SAF-515A Annually

COURSE: SAF-515A - Confined Space

DURATION: 4 Hours

PREREQUISITES: SAF-515 - Confined Space Initial Training
SAF-630/631 - Respiratory Protection
Current OPS-08 Qual Card

SCOPE: The instructor will present hazards, personal protective equipment requirements, emergency action, and compliance with regulatory and WIPP procedures involving confined space. The course will also review several confined space fatalities lessons learned.

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to describe the WIPP's Confined Space Program

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination

REFRESHER: Annually

COURSE: RAD-101 - Radiological Worker I

DURATION: ≈16 hours

PREREQUISITES: Radiation Manager Approval

SCOPE: The instructor will present radiological theory and practical information necessary to allow unescorted entry into a controlled area, radioactive materials area, radiological buffer area, and radiation area as required by the WIPP Radiation Safety Manual.

TYPE: Classroom and Practical

OBJECTIVES: Upon completion of this course, the student will have the knowledge to work safely in areas controlled for radiological purposes.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination.

Completion of the course meets the training requirements necessary for Radiological Worker -I (RWT-I).

REFRESHER: Retraining every two years with an alternate year refresher.

COURSE DESCRIPTION (by lesson)

1. Radiological Fundamentals
   ≈2 hours
   - a. Introduction
     1. DOE Safety Policy
     2. Course Overview
     3. Radiological Worker (core academics)
        - a. Radiological Worker II (RW II) training
        - b. Course outline
        - c. Successful completion
   - b. Atomic Structure
     1. Basic Units of Matter
        - a. Protons
        - b. Neutrons
        - c. Electrons
     2. Stable and Unstable atoms
     3. Charge of the atom

c. Definitions
    1. Ionization
    2. Ionizing radiation
    3. Non-ionizing radiation
    4. Radioactivity
    5. Radioactive material
    6. Radioactive Contamination
    7. Radioactive decay
    8. Radioactive half-life
d. Four Basic Types of Ionizing Radiation
    1. Alpha particles
        a. Physical characteristics
        b. Range
        c. Shielding
        d. Biological hazard
        e. Sources
    2. Beta particles
        a. Physical characteristics
        b. Range
        c. Shielding
        d. Biological hazard
        e. Sources
    3. Gamma rays/x rays
        a. Physical characteristics
        b. Range
        c. Shielding
        d. Biological hazard
        e. Sources
    4. Neutron particles
        a. Physical characteristics
        b. Range
        c. Shielding
        d. Biological hazard
        e. Sources
e. Units of Measure
    1. Radiation
        a. Roentgen
        b. RAD (Radiation Absorbed Dose)
        c. Rem (Roentgen Equivalent Man)
        d. Radiation dose and dose rate
    2. Contamination/Radioactivity
f. 10 CFR Part 835, “Occupational Radiation Protection”

2. Biological Effects
   ≈1 hour

a. Introduction
b. Sources of Radiation
   1. Natural sources
      a. Cosmic radiation
      b. Sources in earth's crust (terrestrial)
      c. Internal
      d. Radon
   2. Man-made sources
      a. Medical radiation sources
         1. X-rays
         2. Diagnosis and therapy
      b. Atmospheric testing of nuclear weapons
      c. consumer products
      d. Industrial uses
c. Effects of Radiation on Cells
   1. Biological effects
   2. Cell sensitivity
   3. Possible effects of radiation on cells
      a. No damage
      b. Cells repair damage and operate normally
      c. Cells are damaged and operate abnormally
      d. Cells die as a result of damage
d. Acute and Chronic Radiation Dose
   1. Acute radiation doses
   2. Chronic radiation doses
   3. Genetic effects
   4. Factors affecting biological damage due to exposure to radiation
      a. Total dose
      b. Dose rate
      c. Types of radiation
      d. Area of the body which receives a dose
      e. Cell sensitivity
      f. Individual sensitivity
e. Prenatal Radiation Exposure
   1. Sensitivity to the unborn
   2. Potential effects associated with prenatal exposures

f. Risks in Perspective
   1. Risk from exposures to ionizing radiation
   2. Comparison or risks
g. Summary

3. Radiation Limits
≈1 hour

a. Basis and Purposes for Radiation Dose Limits and Administrative Control levels for radiological workers
   1. Bases for DOE dose limits
   2. WIPP administrative control levels
b. Dose Limits and Administrative
   1. Whole body Control Levels
      a. Definition
      b. Limit and control levels
   2. Extremities
      a. Definition
      b. Limit and control levels
   3. Skin and other organs
      a. Definition
      b. Limit and control levels
   4. Lens of the eye
      a. Definition
      b. Limit and control levels
   5. Declared pregnant worker: Embryo/fetus
      a. DOE policy
      b. DOE limit
      c. Site policy
      d. WIPP administrative control level
   6. Visitors and public
c. Worker Responsibilities Regarding Dose Limits
d. Summary

4. ALARA Program
≈1 hour

a. ALARA Program
   1. ALARA Concept
   2. DOE Management Policy for the ALARA program
   3. Site policy
b. Responsibilities for the ALARA
   1. Management Program
   2. Radiological control organization
   3. Radiological workers

- c. External and internal radiation
  1. Basic protective measures used to Dose Reduction reduce external doses
     - a. Time
     - b. Distance
     - c. Shielding
  2. Additional methods to reduce dose
  3. Lessons learned
- d. Internal Radiation Dose Reduction
  1. Pathways
     - a. Inhalation
     - b. Ingestion
     - c. Absorption through the skin
     - d. Absorption through wounds
  2. Methods to reduce internal radiation dose
- e. Radioactive Waste Minimization
  1. Methods to minimize radioactive waste
  2. Separate radioactive waste from nonradioactive waste
  3. Separate compactable material from noncompactable material
  4. Minimize the amount of waste generated
  5. Use good housekeeping techniques
- f. Summary

5. Personnel Monitoring Programs ≈1 hour

- a. External Dosimetry
  1. Thermoluminescent dosimeters
  2. Direct reading dosimeters
  3. Alarming dosimeters
  4. Worker responsibility for external dosimetry
- b. External Monitoring
- c. Worker Dose Records
- d. Summary

6. Radiological Postings and Controls ≈2 hours	a. Radiological Work Permits 1. Use 2. Types a. General radiological work permit b. Job specific radiological work permit 3. Information to be included on the permit 4. Worker responsibilities b. Radiological postings 1. Uses 2. Requirements 3. Responsibilities of the worker associated with postings, signs, and labels 4. Consequences of disregarding radiological postings, signs, and labels 5. Requirements for entry, exit, and area working in radiologically posted areas c. Radiological areas 1. Radiological buffer areas a. Posting requirements b. Minimum requirements for unescorted entry c. Requirements for working in RBA's d. Requirements for exit 2. Radiation areas a. Posting requirements b. Minimum requirements for unescorted entry c. Requirements for working in area d. Requirements for exit 3. Contamination areas a. Posting requirements b. Require special training 4. High contamination areas a. Posting requirements b. Require special training 5. Airborne radioactivity areas a. Posting requirements b. Require special training

6. Radioactive materials areas
    a. Posting requirements
    b. Minimum requirements for unescorted entry
    c. Requirements for working in area
    d. Requirements for exit
7. Fixed contamination area
    a. Posting requirements
    b. Contact radiological control for entry requirements
8. Soil contamination area
    a. Posting requirements
    b. contact radiological control for entry requirements
9. Underground radioactive materials area
    a. Posting requirements
    b. General requirements
10. Hot spots
    a. Posting requirements

d. Summary

6. Radiological Emergencies ≈1 hour

a. Emergency alarms and responses
    1. Area radiation monitors (ARMs)
    2. Continuous Airborne Monitors (CAMs)
b. Disregard for radiological alarms
c. Radiological emergency situations
d. Considerations in Rescue and Recovery Operations
e. Summary

7. High/very High Radiation Area Training ≈1 hour
   a. Definitions
      1. High radiation area
      2. Very high radiation area
   b. Signs and postings
   c. General entry, work, exit
      1. Entry requirements
      2. Working requirements
      3. Exit requirements
   d. Access controls
      1. Administrative controls
      2. Physical controls
      3. Consequences for violating radiological signs or postings or bypassing physical access controls
   e. Response to area radiation alarms and unusual conditions
   f. Considerations in Rescue and Recovery Operations
   g. Summary

8. Written Examination and Review ≈1 hour

9. JPM Review and JPM Evaluations ≈4 hours

All times are approximate and do not reflect time spent on additional topics that arise from class participation, student breaks, class size and/or practical exercises. (i.e. Job Performance Measures)

COURSE: RAD-201 - Radiological Worker II

DURATION: ≈8 hours

PREREQUISITES: Radiation Manager Approval

SCOPE: The instructor will present an intensive course intended for the radiological workers whose job assignments involve unescorted entry to high and very high radiation areas, contamination areas, high contamination areas, and airborne activity areas.

TYPE: Classroom and Practical

OBJECTIVES: Demonstrate the ability to work safely in radiologically controlled areas, use ALARA techniques in accordance with WIPP radiation protection procedures

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination

REFRESHER: Retraining every two years with an alternate year refresher

COURSE DESCRIPTION (by lesson)

1. Radioactive Contamination
   ≈3 hours
   - a. Plutonium
   - b. Comparison of ionizing radiation
     1. Ionizing radiation and radioactive contamination
     2. Radioactive contamination
     3. Radiation is energy, contamination is material
   - c. Types of contamination
   - d. Sources of radioactive contamination
     1. Sources
     2. Indicators of possible area contamination
     3. Employee response to a spill
   - e. Contamination control methods
     1. Preventable methods
     2. Engineering control methods
     3. Personal protective measures
        - a. Protective clothing

f. Contamination monitoring equipment
    1. Purpose
    2. Types and uses
    3. Frisking
g. Decontamination
    1. Personnel decontamination
    2. Material decontamination
        a. General considerations
        b. Methods available
        c. Techniques
h. Contamination control requirements
    1. Posting requirements
    2. Requirements for entering
    3. Donning double PC's
    4. Exit requirements
    5. Method for removing items from contamination areas
i. Unusual events involving radioactive materials
    1. Unusual events
    2. Use of the incident command system
    3. Actions of emergency responders
    4. Response techniques
j. Identification of radiation hazards
    1. Placards
    2. Labels
    3. Shipping papers
k. Field operation protocol for radiation accidents

2. Practical Examination and review
   ≈1 hour

3. JPM Review and JPM Evaluations
   ≈4 hours

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: TRG-293/298 - Subject Matter Expert and On-the-Job Training

DURATION: ≈4 hours

PREREQUISITES: Manager Approval

TYPE: Classroom

SCOPE: The instructor will provide the training skills and knowledge necessary to perform the role of subject matter expert (SME)/on-the-job trainer (OJT).

OBJECTIVES: Upon completion of this course the student will be able to perform the instructional duties of a Level I Instructor (SME/OJT trainer) In compliance with WIPP training policies.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: Every Two Years

COURSE DESCRIPTION (by lesson)

1. Requirements for Qualification
   ≈.5 hour
   - a. Qualification card
   - b. Designation letter to training
   - c. Training course
   - d. SME Qualification Board
   - e. Arranging the SME Board
   - f. Conduct of the Board
   - g. Maintaining qualification
   - h. Lapses in qualification

2. Role of the Level I Instructor
   ≈1 hour
   - a. Conduct formal OJT
   - b. Develop/revise qualification cards
   - c. Maintaining files related to area of expertise
   - d. Limitations of Level I Instructors

3. On-The-Job (OJT) Training ≈1 hour	a. Definition b. Formal training vs. informal training c. Process for OJT 1. Introduction phase 2. Explanation phase 3. Knowledge evaluation phase 4. Demonstration phase 5. Practice phase 6. Practical evaluation phase 7. Rules d. Trainee failures or slow learners e. Good OJT practices f. Common OJT instructor errors
4. Qualification Cards ≈1 hour	a. Purpose b. Elements c. Writing competency statements d. Selecting competency statements for requalification e. Reviewing qualification cards
5. Qualification Guide ≈.5	

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: TRG-300 - Classroom Instructor - Level II

DURATION: ≈40 hours

PREREQUISITES: Manager’s approval

SCOPE: The Instructor will present the student with the information and skills necessary to develop and preform classroom instruction based on DOE guideline “Good Practice For Training And Qualification of Instructors” DOE-HDBK-1001-96.

TYPE: Classroom and Practical

OBJECTIVES: Upon completion of this course the student will be able to develop, conduct, and document formal classroom training in compliance with current WIPP training policies.

Mastery of the terminal objective will be demonstrated by satisfactory performance on all practical sessions and maintaining 80 percent or higher for an overall course Average. No score less than 70 percent may be scored on any daily examination.

REFRESHER: TRG-292 Every six months

COURSE DESCRIPTION (by lesson)

1. Introduction
   ≈1 hour
   - a. Course title
   - b. Course terminal objective
     1. Part I
     2. Part II
   - c. Course topics
     1. Qualities of a competent instructor
     2. Adult learning principles
     3. PBT
     4. Training settings
     5. Learning objectives
     6. Test development
     7. Development of lesson plans
     8. Use of instructional aids
     9. Presentation and facilitation skills
     10. Effective questioning techniques
     11. Behavioral problems
     12. Demonstration method
     13. Evaluations

	14. Administration 15. Final practical examination a. Subject choices b. Time limit c. Requirements in the lecture d. Evaluation method e. Video taped d. Summary
2. Competencies of a Competent Instructor ≈1 hour	a. Motivator b. Role of the Instructor c. Role of the Level II Instructor 1. Develop instructional materials 2. Conduct formal classroom instruction in their technical area 3. Administer examinations 4. Document formal training d. Reasons for Qualified Instructors e. Categories of Instructor Qualities f. Qualities of competent instructor g. Common pitfalls to an instructor's success h. Summary

3. Adult Learning Principles
   ≈2 hours

a. Motivator
b. Learning defined
   1. Learning based on experience
   2. Learning as an experience retained by the learner and produces a measurable change in behavior
   3. How change can occur
   4. Categories of learning
c. Learning style
d. Instructor learning principles
   1. Learning principles and information processing
   2. Learning principle equals motivation
   3. Learning principle equals digestible chunks
   4. Learning principle equals experience
   5. Learning principle equals attention
   6. Learning principle equals reinforcement
   7. Learning principle equals retention
   8. Learning principle equals retrieval
   9. Learning principle equals transfer
   10. Summarize concepts
e. Adults as Learners
   1. Four adult learning principles
   2. Concept of the learner
   3. Role of experience
   4. Readiness to learn
   5. Orientation to learning
   6. Internal summary
f. Barriers to learning in adults
   1. Physical barriers
   2. Emotional barriers
   3. Intellectual barriers
   4. Learning style barriers
g. Summary

4. Overview of PBT/TAP
   ≈1 hour

a. Motivator
b. Performance Based Training
   1. Definition
c. Five Phases of PBT System
   1. Analysis
   2. Design
   3. Development
   4. Implementation
   5. Evaluation
d. Reasons for using the PBT process
e. Definitions of five phases
   1. Analysis
      a. Purpose
      b. Process/products
         1. Job analysis
         2. Task analysis
   2. Design
      a. Purpose
      b. Process/products
   3. Development
      a. Purpose
      b. Process/products
   4. Implementation
      a. Purpose
      b. Process/products
   5. Evaluation
      a. Purpose
      b. Process/products
f. DOE Order
   1. DOE Order 5480.18
h. Summary

5. Methods of Instruction
≈1 hour
	a. Motivator
	b. Training sessions
	  1. Definition
	  2. Training sessions common to DOE
	  3. Classroom setting
	  4. On-the-Job
	  5. Laboratory setting
	  6. Self-paced instruction setting
	  7. Simulator setting
	c. Setting selection criteria
	  1. Setting criteria
	d. Training methods
	  1. Lecture
	  2. Discussion
	  3. Role-play
	  4. Self-study
	  5. Walk-through
	  6. Case study
	e. Summary

6. Development of Learning Objectives ≈1 hour	a. Motivator b. Definition of learning objective 1. Definition 2. Why write objectives 3. When to write objectives 4. Basic assumptions c. Component parts of learning objectives 1. Action statement 2. Conditions 3. Standard 4. Implied conditions and standards d. Definition of Terminal Objective 1. Definition 2. First sentence 3. Second sentence e. Source of Information for Terminal Objectives f. Definition of Enabling Objective 1. Definition g. Information source for enabling objectives h. Exercise 1. Terminal objective 2. Enabling objective i. Summary

7. Methods of Testing
   ≈2 hours

a. Motivator
b. Purpose of testing
   1. Purpose of testing
   2. Selection and placement
   3. Feedback to trainers and trainees
   4. Motivation
   5. Improvement to training programs
c. When are tests developed?
   1. Analysis phase
   2. Design phase
      a. Training settings
      b. Learning objectives
      c. Entry-level skills
      d. Design
      e. Written tests
      f. Oral tests
   3. Development phase
   4. Implementation phase
   5. Evaluation phase
d. Guidelines for question development
   1. Approved test question formats at the WIPP
      a. True/false
      b. Multiple choice
      c. Matching
      d. Completion/short answer
      e. Draw/label
   2. General guidelines
   3. True/false format
   4. Multiple choice
   5. Matching
   6. Completion/short answer
   7. Draw/label
e. Approved examination format
   1. Two items per objective
   2. Meet the intent of the objective
   3. Use acceptable format
f. Examination format
   1. Version vs. multiple exam
   2. Required formats
   3. Approval

g. Control of examinations
   1. Examination preparation
   2. Administering the examination
   3. Grading examination
h. Examination failure
i. Summary

8. Developing Lesson Plans
   ≈2 hours

a. Motivator
b. Function of a Lesson Plan
   1. Defined as TAP
   2. Accomplish objective
   3. Promote consistency
   4. Serve as guide
c. Elements of Lesson Plan format
   1. Cover page
   2. Instructor pages
d. Definition of "Introduction"
   1. Goal of introduction
   2. Preliminaries
      a. Instructor name and background
      b. Lesson title
      c. Trainee comfort
      d. Solicit participation for questions and comments
   3. Learning objectives
   4. Overview
e. Development of the Body
   1. Outline content
   2. Topics sequence
   3. Detail of content
f. Definition of Summary
g. Summary

9. Development of Instructional Aids ≈2 hours

a. Motivator
b. Definition of instructional aid
c. Purpose of instructional aids
d. General guidelines for instructional aids
    1. Design and development guidelines
    2. Utilization guidelines
e. Guidelines for the use of visual aids
f. Writing boards (white and chalk)
    1. Introduction
    2. Development tips
    3. Utilization tips
g. Flip charts
    1. Introduction
    2. Development tips
    3. Utilization tips
h. Overhead transparencies
    1. Introduction
    2. Development tips
    3. Utilization tips
i. Handout materials and study guides/workbooks
    1. Introduction
    2. Purpose
    3. Development tips
    4. Utilization tips
j. Videos/films
    1. Introduction
    2. Development tips
    3. Introduce video
    4. Utilization tips
k. Training aids
    1. Transition
    2. Types of training aids
    3. Purpose
l. Consideration for selecting training aids
m. Summary

10. Use of Presentation and Facilitation Skills
≈2 hours
	a. Motivator
	b. Understanding speaking fears
	c. Presentation skills
	  1. Personal space
	  2. Body movements/ gestures/eye contact/voice
	  3. Exercise
	d. Communications model
	e. Facilitation skills
	  1. Transition
	  2. Attending skills
	  3. Observing skills
	    a. Exercise
	  4. Listening skills
	f. Summary

11. Effective Questioning Techniques
≈2 hours
	a. Motivator
	  1. Why trainers do not ask questions
	    a. Control
	    b. Time
	    c. Discomfort for self and trainees
	    d. Other
	b. Advantages of questioning
	c. Characteristics of effective questions
	d. Difference between comprehension and interaction questions
	e. Types of questions
	  1. Overhead question
	  2. Rhetorical question
	  3. Direct question
	  4. Relay questions
	  5. Reverse question
	  6. Pointed question
	  7. Offensive question
	f. Asking questions
	g. Responding to answers
	h. Summary

12. Handling Behavioral Problems ≈1 hour	a. Motivator b. Characteristics of behavioral problems 1. Argumentative 2. Belligerent 3. Bored 4. Chronic questioner 5. Clown 6. Late to class 7. Monopolizer 8. Preoccupied 9. Shy 10. Slow learner 11. Superior learner 12. Exercise c. Guidelines for determining 1. Determining need a personal conference d. Guidelines for personal conference 1. Planning the conference a. State the problem b. Describe your reaction to the problem c. Ask for the trainee view of the situation d. Ask the trainee for recommendations e. Present your alternatives f. Select the best solution from alternatives and develop an action plan g. Set specific follow up review dates 2. Physical arrangement for the conference 3. Conducting the conference 4. Strategies for active listening e. Methods for correcting behavioral problems f. Summary

13. Use of Demonstration Methods
≈1 hour
	a. Motivator
	b. Purpose of the demonstration method
	c. Effective areas of demonstration method
	  1. Concepts
	  2. Manipulative skills
	  3. Attitudes
	  4. Practice
	d. Training aids
	e. Advantages and disadvantages
	  1. Advantages
	  2. Disadvantages
	f. Preparing for the lesson
	g. Steps in the demonstration method
	  1. Introduction
	  2. Presentation
	  3. Practice
	  4. Summary
	h. Actual presentation
	i. Exercise
	j. Summary

14. Purpose of Evaluations
≈1 hour
	a. Motivator
	b. Definition of evaluation
	c. Purposes of evaluation
	d. Sections of evaluation process
	e. Evaluations performed
	  1. Trainee questionnaire
	  2. Post training survey (trainee)
	  3. Post training survey (supervisor)
	  4. Annual instructor observation form
	f. Results of the evaluation
	g. Summary

15. Training Administration
    ≈1 hour

    a. Motivator
    b. Course package
        1. Lesson plan
        2. Exam, quizzes, and JPM's
        3. Trainee handouts
        4. Overheads
        5. Approval
            a. Training records
            b. Cognizant manager
            c. Training manager
            d. Material given back to instructor
    c. Course preparation
        1. Lesson plan
        2. Exams and quizzes
        3. Trainee handouts
        4. Overheads
        5. Paperwork
    d. Training attendance sheet
    e. Post class activities
    f. Summary

16. Final Practical
    ≈6 hours

17. Examinations
    ≈2 hours

18. Work Time
    ≈8 hours

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: MED-101 - First Aid and CPR

DURATION: 12 hours

PREREQUISITES: None

SCOPE: The instructor will provide CPR training including one-rescuer CPR, the Heimlich maneuver, and first aid techniques.

TYPE: Classroom and CPR Practical

OBJECTIVES: Upon completion of this course, the student will be able to administer basic first aid and one-rescuer CPR in accordance with the national safety council. Identify heart disease factors, signs, and symptoms of a heart attack and perform one-rescuer CPR and the Heimlich maneuver.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination.

REFRESHER: MED 101A Annually

COURSE DESCRIPTION (by lesson)

1. Definitions and Legal Aspects
   ≈1 hour
   a. Duty to act
   b. Consent for treatment
   c. Abandonment
   d. Good Samaritan law
   e. Confidentiality

2. Assessment
   ≈1 hour
   a. Purpose
   b. Systematic approach considerations
   c. Parts
   d. Scene assessment
   e. Primary survey
   f. Secondary survey

3. Cardiopulmonary Resuscitation (CPR) ≈1 hour	a. Anatomy of cardiovascular system
	b. Physiology of the heart
	c. Anatomy of the respiratory system
	  1. Upper airway
	  2. Lower airway
	  3. Alveoli
	  4. Pulmonary arteries, veins, capillaries
	d. Physiology of the respiratory system
	e. Heart disease

Treatment of Various Conditions
≈4 hours

4. Shock	a. Hypovolemic shock b. Fainting c. Anaphylactic shock
5. Bleeding	a. Types b. Control c. Treatment d. AIDS and HBV
6. Head Injury	a. General information b. Scalp lacerations c. Skull fractures d. Spinal injuries 1. Treatment
7. Burns	a. Classifications b. Causes c. Treatment

9. Heat Related Injuries/Illnesses	a. Types
	  1. Heat cramps
	    a. Treatment
	  2. Heat exhaustion
	    a. Signs and symptoms
	    b. Treatment
	  3. Heat stroke
	    a. Signs and symptoms
	    b. Treatment

10. Bone and Joint Injuries
    a. General information
    b. Signs and symptoms
    c. Treatment

11. Summary

12. Written examination

13. Practical
    ≈3 hours

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: MED-101A - First Aid and CPR Refresher

DURATION: ≈8 Hours

PREREQUISITES: MED-101

SCOPE: The instructor will provide refresher training Basic CPR (one-rescuer) and basic first aid techniques

TYPE: Classroom and practical

OBJECTIVES: Upon completion of this course, the student will able to administer basic first aid and one-rescuer CPR

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination

REFRESHER: Annually

COURSE: HMT-102 - Hazardous Materials and Waste Transportation

DURATION: ≈16 Hours

PREREQUISITES: Manager approval and/or assignment to transportation duties in accordance with 49 CFR

SCOPE: Instruction meeting 49 CFR 172 Subpart H provided in a modular format. This course covers: awareness, the hazards material table, packaging, marking, labeling, placarding, material separation and segregation, special or unique transportation moves, safety, and site specific transportation issues.

TYPE: Classroom lecture including exercises to enhance trainee learning and retention

OBJECTIVES: Upon completion of the course, the trainee will be able to define, locate, apply and maintain compliance with the DOT regulations involving the transportation and/or offering for transportation of a hazardous material or waste.

Mastery of this objective will be demonstrated by scoring a minimum of 80 percent on the course examinations using "approved course" reference material.

REFRESHER: Biennially

COURSE DESCRIPTION (by lesson)

1. Awareness/familiarization
   ≈1 hour
   - a. Introduction
     1. Instructor
     2. Lesson
     3. Course content
     4. Lesson objectives
   - b. Lesson materials
     1. Department of Transportation (DOT) Regulations
        - a. Brief history
        - b. Purpose
        - c. Scope
        - d. Terminology
        - e. Application of regulations

	2. Training programs
	    a. Module assignments
	        1. Basic modules
	        2. Additional modules
	c. Training program objectives
	d. Training requirements
	e. General transportation responsibility
	f. General transportation liability
	g. Potential exposures
	    1. Number of shipments
	    2. Events leading to exposures
	    3. Causes for events
	h. Compliance mandate
	    1. Regulator responsibility
	    2. Penalties
	    3. Trends
	i. DOE guidance
	    1. DOE Orders
	    2. Interaction of DOE Orders and Federal Regulations
	j. Enforcement
	k. Application of DOT Regulations at DOE facility
	l. Introduction to Title 49 CFR
	    1. Overview transportation regulations
	    2. Navigating within the code book
	m. Shippers acronym
	n. Standardized DOT communications
	o. Summary
	p. Review
	q. Questions and answer

2. The Hazardous Materials Table
≈3 hours
	a. Introduction
	b. Lesson body
	    1. Lesson objectives
	c. Shipper’s Star
	d. Definition
	    1. Hazardous material
	    2. Hazardous waste
	    3. Hazardous substance

	e. Hazard classes 1. 9 classes 2. Special cases 3. Class system 4. Identification 5. Shipper's responsibility 6. Material identification f. The Hazardous Materials Table 1. 10 columns 2. Navigating the hazardous materials table g. Summary h. Review i. Questions and answers
3. Packaging ≈1.5 hours	a. Introduction 1. Lesson b. Lesson body 1. Lesson objectives c. Terminology 1. Packaging vs. package a. Packaging b. Package d. Identifying packaging by code 1. Recognition types 2. Code interpretation for UN packaging a. Packaging type b. Packaging group e. Limited quantity packing exemptions 1. Describe "Limited Quantity" 2. General criteria f. Package Acceptance Criteria 1. Acceptable packaging 2. Unacceptable packaging g. Summary h. Review i. Questions and answers

4. Marking
   ≈1.5 hours

   a. Introduction
   b. Lesson body
      1. Lesson objectives
      2. Purpose
      3. Material identification
         a. The PSN
         b. UN/UA number
         c. Shipments containing multiple materials
      4. Physical markings
         a. Location
         b. Marking format
         c. PIH
         d. Arrows
         e. Reportable quantities
         f. Consignor/consignee information
      5. Exemptions
   c. Summary
   d. Review
   e. Questions and answers

5. Labeling
   ≈1.5 hours

   a. Introduction
   b. Lesson body
      1. Lesson objective
      2. Purpose
      3. Label selection
         a. HMT table
      4. General placement of labeling
      5. Primary vs. secondary labeling
         a. Primary label
         b. Secondary
      6. Specific labeling requirements
         a. Gas cylinders
         b. Alterative labeling
      7. Mixed shipment in one package
         a. Special requirements
      8. Combination package in one
         a. Special requirements of outer package
   c. Summary
   d. Review
   e. Questions and answers

6. Shipping Papers
   ≈1.5 hours
   - a. Introduction
     1. Lesson
   - b. Lesson body
     1. Lesson objectives
   - c. Types of shipping documents
     1. Standard bill of lading
     2. Waste manifest
   - d. Basic components of a proper shipping paper
   - e. Specific shipping paper
     1. Shipper information
     2. Quantity of packages
     3. Hazardous materials
     4. Quantity of material
     5. Emergency response information
     6. Certification statement signature
   - f. Shipping paper format
   - g. Additional information
     1. Hazardous and non-hazardous shipping paper
   - h. Emergency information
   - i. Summary
   - j. Review
   - k. Questions and answers

7. Placarding
   ≈1.5 hours
   - a. Introduction
   - b. Lesson material
   - c. Lesson objectives
   - d. Purpose
     1. Hazardous material identification
     2. Materials with certain exemptions
   - e. Application
     1. Placards should not be used
     2. Selection criteria
        - a. Table application
        - b. Aggregate gross weight
     3. Authorized placards
        - a. Displaying requirements
        - b. Placard identification
   - f. Shipper's requirements

	g. Other placards 1. Explosives 2. Residue 3. Spontaneously combustible 4. Organic peroxide 5. Harmful 6. Class 9 h. Displaying of subsidiary placards 1. Criteria j. Displaying placards 1. Single trailer or bobtail type truck 2. Multiple trailers k. Summary l. Review m. Questions and answers
8. Separation and Segregation ≈1 hour	a. Introduction b. Lesson material 1. Lesson objectives 2. Purpose c. The table 1. Layout 2. Symbols d. Summary e. Review f. Questions and answers
9. Special and Unique Moves ≈1 hour	a. Introduction b. Lesson material 1. Lesson objectives 2. Terminology a. Empty b. Residue c. Treatment of “empty” shipments d. Overpack and salvage drums 1. Overpack drums a. Intended use b. Use requirements 2. Salvage drums a. Intended use b. Package requirements

- e. Shipment of samples
  1. Material identification
  2. Unknown material
- f. Summary
- g. Review
- h. Questions and answers

10. Safety
≈1 hour

- a. Introduction
- b. Lesson material
  1. Lesson objectives
  2. Emergency response information
     - a. Transportation
     - b. Resources
- c. Emergency Response Guide
  1. Purpose
  2. Emergency Response Guidebook layout and overview
- d. Using the emergency
  1. Locate chemical identity in Response Guidebook
  2. Review concerns and response recommendations
- e. Potential risk and actions
  1. Risk
  2. Actions
- f. Response principles
  1. "Never"
  2. Consider
- g. Documentation
  1. DOT Form F5800.1
  2. When to document
- h. Summary
- i. Review
- j. Questions and answers

11. Site Specific Transportation
≈1 hour
	a. Introduction
	b. Lesson material
	  1. Lesson objectives
	  2. Department/sect/individual
	    a. Employee involvement for shipment from the WIPP
	    b. Material control
	    c Procurement
	    d. Health physics
	    e. Hazardous waste operations (HWO)
	c. The shipping process
	d. Additional information requirements by HWO
	e. Hazardous waste shipments
	f. Summary
	g. Review
	h. Questions and answers

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: HMT-104 - DOT Emergency Response Information

DURATION: ≈3 hours

PREREQUISITES: None

SCOPE: This course is designed to instruct the trainee in the basic concepts of applying DOT Transportation regulations involving shipments from the WIPP site. This course will inform the trainee of information that may be required when responding to an emergency involving transportation of hazardous materials and hazardous waste from the WIPP site.

TYPE: Classroom

OBJECTIVES: Upon completion of this lesson, the trainee will be able to respond to phone request from emergency personnel when hazardous materials or hazardous waste are in transit from the WIPP site that may have been involved in a transportation accident.

Mastery of the terminal objective will be demonstrated by scoring a minimum of 80 percent on the course examination.

REFRESHER: None

COURSE DESCRIPTION (by lesson)

1. Regulations ≈.5 hour	a. Emergency response information b. Applicability c. Availability

2. Logistics of an Emergency Response
≈2.5 hours
	a. Central Monitoring Room Operator response to a request for emergency
	  1. Request received at CMR
	  2. Requestor need further information
	b. Organization of Emergency Response Guidebook
	  1. By placard
	  2. By shipping papers
	  3. By package hazardous waste label
	  4. Highlighted entries
	  5. No available reference Information
	c. Log entries
	d. Summary

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: SAF-501 - Inexperienced Miner Training

DURATION: 40 Hours

PREREQUISITES: None (Steel-toe shoes/boots required for underground tour)

SCOPE: The instructor will present the required information to allow unescorted underground access

OBJECTIVES: Fulfill all requirements of 30 CFR part 48 for underground access.

Mastery of the terminal objective will be demonstrated by satisfactory performance on all practical sessions and by scoring 80 percent or higher on the daily exams with no score less than 70 percent with post course examination.

REFRESHER: SAF-502 Annually

COURSE DESCRIPTION (by lesson)

1. Introduction
≈.5 hour
	a. Paperwork
	b. Course attendance
	  1. Required attendance
	  2. Special instructions
	c. Overview of the WIPP Underground Operations
	  1. Similarity to other mining operations
	    a. Potash mining
	  2. Differences to other mining operations
	    a. Potash mining
	    b. Coal mining
	d. Summary

2. Act of 1977
≈1 hour
	a. Creation of the Federal Mine Safety and Health Act of 1977
	  1. Congressional Act
	b. Purpose
	c. Coverage under the Act of 1977
	  1. Mandatory safety and health standards
	  2. Inspection rights
	  3. Accident investigations
	  4. Record keeping
	  5. Guidelines for correcting dangerous conditions
	  6. Mandatory posing of violations and warnings
	  7. Required training
	d. Summary

3. Miner's Representative ≈1 hour	a. Definition b. The miner's representative under the Act of 1977 c. The miner's representative system at WIPP d. Protection of the employee e. Need for employee participation in the inspection of the site f. Summary

4. Reporting of Hazards/Lines of Authority
≈1 hour
	a. Hazards
	b. Reporting of hazards
	  1. Responsibilities
	    a. Miner operator
	    b. Supervisor
	    c. Employee
	c. Method of reporting
	  1. Potential minor hazard
	  2. Hazards involving possible imminent dangers
	d. Disciplinary actions and the employee
	e. Need for employee involvement
	f. Summary

5. Self-Rescuer/Respiratory Devices
   ≈1.5 hour
   a. Purpose
   b. Service life
   c. Inspection/Color code
   d. Mine operator quarterly inspection
   e. The self-rescuer
      1. Features
      2. The assembly
   f. Operation
   g. Demonstration
   h. Practical application
   i. Respiratory protection
      1. The WIPP program
      2. Requirements
   j. Summary

6. Entering and Leaving the Mine
   ≈1 hour
   a. Access requirements
      1. Miner training
   b. Qualification period
   c. Lamproom location
      1. Proper safety equipment
      2. Sign-in procedure
      3. Brass tag
   d. Summary

7. Transportation
   ≈1 hour
   a. General
      1. Surface
      2. Underground
   b. Hazards
   c. Hazard preventive equipment
      1. Lighting
      2. Alarms
   d. Personnel warning systems
   e. Interaction with pedestrians
      1. Normal travel patterns
      2. Variations
   f. Samples of hazards
      1. Conveyance
      2. Electric carts
      3. Haulage trucks
      4. Fork lift trucks
   g. Summary

8. Communications
   ≈1.5 hours

   a. WIPP communications systems overview
      1. Personnel
      2. Artificial
   b. System breakdown
      1. Personnel communication
         a. Lamp signals
         b. Hand signals
         c. Appropriate uses
      2. Artificial communications
         a. Commercial telephone
         b. Mine phone
         c. Gia-tronics
         d. Alarms systems
         e. Alarm warning lights
   c. Summary

9. Mine Map
   ≈1 hour

   a. Definitions
   b. Map legends
   c. Directions and locations
      1. Underground reference point
      2. Boundary limits
   d. Primary drifts
      1. North/South
      2. East/West
   e. Drifts by area name
      1. North
         a. East/West
         b. North/South
      2. Other North area drifts
      3. South construction area
      4. South disposal area
   f. Assembly areas
   g. Summary

10. Ventilation ≈1.5 hours	a. Ventilation 1. General requirements b. Intake volume c. Intake points 1. Air Intake Shaft 2. Salt Handling Shaft 3. Waste Shaft d. Exhaust volume e. Primary air-flow routes 1. North mine area air flow (intake) 2. North mine area air flow (exhaust) 3. South mine area air flow (intake) 4. South mine area air flow (exhaust) f. Air quality g. Air flow balancing 1. The plan 2. Adjustments 3. Unapproved adjustments h. Escapeways i. Summary
11. Evacuation and Escape Routes ≈2 hours	a. WIPP underground evacuation procedures 1. Authorization for evacuation 2. Notifications 3. Initial actions b. Escapes 1. Purpose 2. Primary 3. Secondary c. Non-routine egress 1. Combination usage 2. Blocked access d. Define a barricade e. Function of barricades f. Permanent barricades g. Temporary barricades h. Methods of erecting a temporary barricade i. Barricades in relationship with WIPP design j. Summary

12. Ground Control
    ≈2.5 hours

a. Evaluation of ground control
b. Federal regulations
c. State mining regulations
d. WIPP procedures
e. Introduction to ground control and ventilation
f. Introduction to barring down and scaling
g. Demonstration of bar down and scaling techniques
h. Geological formation at WIPP
i. Review of class room instruction
j. Field activities
   1. Identification of bad back or rib
   2. Bar down operations
   3. Scaling down operations
   4. Safety issues
k. Summary/exam

13. Hazard Recognition
    ≈6 hour

a. General hazard recognition
   1. Mining as a whole
   2. Comparing WIPP with general mining industry
b. Mobile equipment
   1. Size
   2. Construction
   3. Other hazards
c. Ground control
   1. Over confidence in work place
   2. Barriers
   3. Improper installation of control devices
d. Electrical hazards
   1. Cables
   2. Substations and switch racks
   3. Unauthorized personal equipment
e. Loss of ventilation
   1. Air quality
   2. Radiation
f. Housekeeping
   1. General
   2. Risk to personnel
g. Laser operations
h. Seismic activity
i. Summary

14. Health
    ≈1 hour

- a. Air quality
    1. Dust
    2. Other vapors
    3. Personal protective equipment
- b. Noise
    1. Acceptable working levels
        - a. 8 hour shift
        - b. Short term
    2. Protection against damage
        - a. In-ear protection
        - b. Over-the-ear protection
- c. Chemicals
    1. Use
    2. Personal protective equipment
    3. Training
    4. Health effects
    5. Pre-event planning
- d. Potable water
- e. Toilet facilities
    1. Chemical toilets
- f. Waste receptacles
    1. General
- g. Food consumption
    1. Restriction
- h. Radiation exposure
    1. ALARA
    2. External
    3. Internal
    4. Through wounds
- i. Summary

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: SAF-502 - Mine Safety-Experienced Miner Refresher

DURATION: ≈8 Hours

PREREQUISITES: SAF-501

SCOPE: The instructor will update personnel of any change or modification in the underground

TYPE: Classroom

OBJECTIVES: Fulfill requirements of 30 CFR part 48, for annual experienced miner refresher training

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination

REFRESHER: Annually

COURSE DESCRIPTION (by lesson)

1. Introduction
≈.5 hour
	a. Hand out 5000-23 MSHA Forms
	b. Workplace overview
	  1. Ground control
	  2. Electrical
	  3. Air quality
	  4. Equipment
	    a. Accidents
	    b. Fires
	    c. Noise
	c. Summary

2. Authority and Responsibility of Supervisors, Miner's Representatives
≈.5 hour
	a. Miner's representative
	b. Miner's rights and responsibilities
	c. Normal reporting of safety issues
	d. Safety issues with eminent danger
	  1. Verbal notification
	  2. Protection from reporting safety issues
	  3. Work refusal
	e. Summary

3. Ventilation ≈1 hour	a. Intake volume b. Intake points 1. Air Intake Shaft 2. Salt Handling Shaft 3. Waste Shaft c. Exhaust volume 1. Exhaust Shaft 2. EFB capabilities d. Primary air-flow routes 1. North mine area air flow (intake) 2. North mine area air flow (exhaust) 3. South construction air flow (intake) 4. South construction air flow (exhaust) 5. South disposal area air flow (intake) 6. Waste Shaft station area e. Air quality 1. Required testing 2. Ventilation failure 3. Adjustments 4. Unapproved adjustments f. Summary
4. Ground Control ≈1 hour	a. Ground control 1. General employee responsibility 2. Typical ground failures 3. Ground control practices b. Summary
5. Entering and Leaving the Mine Transportation and Controls ≈.5 hour	a. Underground access procedure 1. General employee responsibility 2. Violation of restricted areas b. Personal protective equipment c. Transportation 1. The conveyance 2. Mobile equipment 3. Airlocks and doors d. Summary
6. Communication, Warning Alarms and signals ≈.5 hour	a. Communication systems 1. GTE telephone 2. Mine telephone 3. Public address system b. Alarm systems 1. Fire

	c. Emergency staging areas 1. Assembly areas 2. Station areas d. Alarm notification actions 1. Escapeways 2. Retreat to station for evacuation 3. Retreat to assembly areas e. Summary
7. Mine Map, Escapeway, Emergency Evacuation and Barricades ≈1 hour	a. Escapeways b. Assembly areas 1. Purpose 2. Locations 3. Personnel duties during emergencies c. Barricade equipment d. Summary
8. Accident Prevention ≈.5 hour	a. Event happenings b. Changing events c. Pre-event recognition d. Lessons learned e. Summary
9. Self-Rescuer ≈.5 hour	a. Definition b. Purpose c. Inspections d. Methods of conversion - catalytic conversion e. Protection from deadly gas f. Conversion to what compound? g. Effect time limit h. Compounds and operation i. Practical applications j. Summary
10. First Aid ≈1 hour	a. Basic principles

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: RIG-001 - Incidental Rigger

DURATION: ≈16 Hours

PREREQUISITES: None

SCOPE: The instructor will present types of rigging, how to size up the load to be lifted, and the mechanical lifting devices.

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to perform incidental rigger duties in compliance with the DOE Standard Hoisting and Rigging Manual DOE-STD-1090-96.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: None

COURSE DESCRIPTION (by lesson)

1. Identifying Rigging Components
≈4 hours
	a. Qualifications
	b. Definitions
	c. Wire rope components
	  1. Core
	  2. Strand
	  3. Wire
	d. Core
	  1. Strand
	  2. Wire
	  3. Lay of the rope
	  4. Length of the rope lay
	  5. Inspection
	e. Web slings
	f. Polyester slings
	g. Wire rope slings
	  1. Inspection
	  2. Hooks
	  3. Spreader beam
	  4. Eyebolts
	  5. Shackles - anchor and chain
	  6. Wire rope clips - U bolt and twin base
	  7. Turnbuckles

2. Inspection and Storage - Weight Calculation
≈4 hours
	a. Rigging inspection
	  1. Improper sling use
	  2. Inspection techniques
	  3. Rigging storage
	  4. Load weight determination
	  5. Calculations
	  6. Center of gravity
	  7. Slings and hitches
	  8. Load angle
	  9. Choker hitch rated capacity adjustment
	  10. Load cell

3. Identity Lifts/Long Term Check-Out Hand Signals
   ≈4 hours

   a. Load indicating devices
      1. Ordinary lift
   b. Critical lifts
      1. Determination
      2. Requirements
   c. Pre-engineered production lift
   d. Rigging check-out
   e. Long-term checkout
   f. Standard signals and signaler identification

4. Identify rigging Attachments, Accessories and Uses
   ≈4 hours

   a. Beam Clamps
      1. Types
      2. Inspection
      3. Hand operated hoists
         a. Chain hoist
         b. Lever operated hoist
            1. Link chain
            2. Roller chain
            3. Wire rope
   b. Jacks
   c. Using jacks
   d. Cribbing
   e. Cribbing assembly

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: OPS-115 - Conduct of Shift Operations

DURATION: ≈8 hours

PREREQUISITES: None

SCOPE: The instructor will describe how shift operation will be conducted at the site.

OBJECTIVES: Upon completion of this course, the student will be able to perform their job in accordance with Operations Department “Conduct of Operations” WP 04-CO.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: NONE

COURSE DESCRIPTION (by lesson)

1. DOE Guidance for Conduct of Operations and Basic Requirements ≈1 hour
    a. DOE Policy
    b. DOE Orders
    c. Conduct of operations sections
        1. Operations organization and administration
        2. Shift routines and operating practices
        3. Control area activities for the WIPP
        4. Communications
        5. Control of on-shift training
        6. Investigation of abnormal events
        7. Notifications
        8. Control of equipment and system status
        9. Tagouts and lockouts
        10. Independent verification
        11. Logkeeping
        12. Operations turnover
        13. Operations aspects of facility unique processes
        14. Required reading
        15. Timely orders to operators
        16. Operations procedures
        17. Operator aid posting
        18. Equipment and piping labeling

	d. Operations organization and administration 1. Operations Policies 2. Resources 3. Monitoring of operating performance 4. Accountability 5. Planning for safety e. Procedures 1. Use of procedures 2. Working copies
2. Sections of Conduct of Operations ≈5 hours	
A. Communications	a. Emergency communications b. Public address system usage c. Contacting operators d. Radios e. Abbreviations and acronyms f. Oral instructions and informational communications
B. Control Area Activities	a. Control area access b. Professional behavior c. Monitoring the main control panels d. Control operator ancillary duties e. Operation of control area equipment
C. Control of Equipment and System Status	a. Status change authorization and reporting b. Equipment and systems alignment c. Equipment locking and tagging d. Equipment deficiency identification and documentation e. Work authorization and documentation f. Equipment post-maintenance testing and return to service g. Alarm status h. Temporary modification control i. Distribution and control of equipment and system documents
D. Independent Verification	a. Components requiring independent verification b. Occasions requiring independent verification c. Verification techniques

E. Operator Aid Postings

F. Equipment and Piping Labeling
   a. Requirements
   b. Identifying labeling deficiencies

G. Shift Requirements
   a. Routines and operating practices
      1. Status practices
      2. Safety practices
      3. Operator inspection tours
      4. Round/tour inspection sheets
      5. Personnel protection
      6. Response to indications
      7. Resetting protective devices
      8. Load changes
      9. Authority to operate equipment
      10. Shift operating bases

H. Control of On-Shift Training
   a. Adherence to training programs
   b. On-shift instructor qualification
   c. Supervision and control of trainees
   d. Operator qualification program approval
   e. Training documentation
   f. Suspension of training
   g. Maximum number of trainees

I. Logkeeping
   a. Establishment of operating logs
   b. Timeliness of recordings
   c. Information to be recorded
   d. Legibility
   e. Corrections
   f. Log review
   g. Care and keeping of logbooks

J. Operations Turnover
   a. Turnover checklists
   b. Document review
   c. Control panel walk-down
   d. Discussion and exchange of responsibility
   e. Shift crew briefing
   f. Reliefs occurring during the shift

K. Operations Aspects of Facility Unique Processes	a. Operator responsibilities b. Operator knowledge c. Operator response to process problems d. Communications between operations and process personnel
L. Required Reading	a. File Index b. Reading assignments c. Required dates for completion of reading d. Documentation e. Review
M. Timely Orders to Operators	a. Content and format b. Issuing, segregating, and reviewing orders c. Removal of orders

3. Summary

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: TRG-296 - Root Cause Analysis

DURATION: ≈8 hours

PREREQUISITES: None

SCOPE: The instructor will provide personnel with the knowledge and skills necessary to identify the root cause of unplanned plant events, in accordance with DOE standards. Students will analyze incidents to identify corrective action necessary to prevent the incidents from recurring. This training is recommended for all operators, technicians, supervisors, and managers.

TYPE: Classroom And Practical

OBJECTIVES: Upon completion of this course, the student will be able to perform root cause analysis in accordance with DOE Order 232.1.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination.

REFRESHER: None

COURSE DESCRIPTION (by lesson)

1. Introduction to Root Cause Analysis
   ≈2 hours
   - a. Case study
   - b. Root cause
   - c. Other causes
   - d. Event
   - e. Event/cause relationship
   - f. Root cause analysis
   - g. Reason for root cause analysis
     1. Overview
     2. Specifics
     3. Concern - employees
     4. Concern - facility
     5. Concern - company permanent image
     6. Concern - public and environment
     7. Concern - economic
     8. Concern - legal

2. Root Cause Analysis Process
   ≈4 hours
   a. Phases and sub-phases
      1. Collect data
      2. Correct
      3. Inform
      4. Follow-up
   b. Phase one - collect data
      1. What to collect
      2. How to collect
      3. Data review
   c. Phase two - assess
      1. Purpose
      2. Methods
      3. Use, advantages, and disadvantages
      4. Event and casual factor charting
      5. Consists of two phases
      6. Cause and effect
      7. Cause and effect charting
   d. Phase three - correct
   e. Phase four - communications
      1. Internal
      2. External
   f. Phase five - follow-up

3. Root Cause Analysis at the WIPP
   ≈1 hour
   a. Investigations
   b. Reportable and non-reportable events
   c. Root cause analysis team report
   d. Reportable events
   e. Non-reportable events
   f. Follow-up

4. Summary
   ≈1 hour

5. Homework

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: SAF-645 - RCRA Emergency Coordinator (WIPP Contingency Plan Procedure)

DURATION: N/A

PREREQUISITES: None

SCOPE: This self-paced lesson describes the responsibilities and actions to be taken by the RCRA Emergency coordinator and other emergency response personnel whenever the WIPP Contingency Plan is implemented.

TYPE: Self-paced

OBJECTIVES: Upon completion of this course, the student will be able to perform the duties of RCRA Emergency Coordinator in accordance with established requirements.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: None

1. State the purpose of the RCRA Contingency Plan.
2. Describe the general responsibilities of the RCRA Emergency Coordinator.
3. Identify the emergency response groups and their responsibilities.
4. State when the Contingency Plan is to be implemented.
5. Describe the criteria for Incident Levels I, II, and III.
6. Describe the types of events that do not implement the Contingency Plan.
7. Describe the activities regarding initial response and notification of emergency response personnel.
8. Describe the actions to be taken when a surface evacuation is declared.
9. Describe the action to be taken when an underground evacuation is declared.
10. State the information that is included in notifications to public safety and regulatory safety agencies.

11. Describe the various means of identifying hazardous materials.
12. Describe the information that is initially provided to the Emergency Coordinator by the EST.
13. Describe the additional information that is collected to conduct a more thorough assessment.
14. Define the 4 criteria that are evacuated in the assessment stage of an incident.
15. State when the RCRA Emergency Coordinator would request assistance from off-site agencies.
16. Describe the actions involved in the control, containment, and correction of an incident.
17. Describe physical and chemical methods of mitigation.
18. Describe the actions that are implemented in the event of a fire.
19. Describe the actions to be taken in the event of an explosion.
20. Describe the actions to be taken in the event of a spill.
21. Describe the actions to be taken in the event of container spills or leakage.
22. State who is responsible for the radiological decontamination of personnel.
23. Describe the response actions to spills, or leaking, or punctured CH and RH TRU mixed waste containers.
24. Describe the actions to be taken in the event of a natural emergency (earthquake, lightning strike, etc.) involving hazardous waste or materials.
25. Describe the response efforts in the event of spalling of ground in the underground.
26. Describe the response efforts in the event of a roof fall in the underground.
27. Describe the events to be completed during the emergency termination phase.
28. Describe the reporting requirements in the event the Contingency Plan is implemented.

COURSE: SAF-632 - Office Warden

DURATION: ≈ 2 Hours

PREREQUISITES: None

SCOPE:

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to state the responsibilities and duties of the Office Warden, in accordance with established guidelines, policies, and regulations.

REFRESHER: SAF-632 annually

1. Objectives ≈ 10 minutes	a. Define role of Office Warden b. List responsibilities c. Describe emergency notification system d. Describe purpose of assembly/staging areas

2. Presentation
≈ 90 minutes
	a. Role of Office Warden
	b. Office Warden responsibilities
	  1. Day-to-day
	  2. Emergency situations
	  3. Bomb threats
	  4. Inclement weather
	  5. Personnel accountability w/no assembly
	c. Emergency Notification System
	  1. Different evacuation notifications
	  2. Reporting emergencies
	d. Assembly/staging areas
	  1. Purpose
	  2. Locations

3. Review and Exam ≈ 20 minutes	

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises (i.e. Job Performance Measures)

COURSE: SAF-621 - Firefighter I

DURATION: ≈40 hours

PREREQUISITES: None

SCOPE: This class prepares the student to respond to fires. This class is taught by the New Mexico Fire Academy

OBJECTIVES:

REFRESHER: Training is conducted 8 hours quarterly

COURSE DESCRIPTION (by lesson)

1. Inspection
   ≈.5 hour classroom
   a. Common causes of fires and their prevention
   b. Fire protection procedures
   c. Define importance of public relations
   d. Define dwelling inspection procedures

2. Sprinklers
   ≈.5 hour classroom
   a. Identify a fire department sprinkler connection and water motor alarm
   b. Connect hose lines to a fire department connection of a sprinkler or standpipe system
   c. Define how automatic sprinkler heads open and release water
   d. Temporarily stop flow of water from a sprinkler head

3. Overhaul
   ≈2 hours classroom
   a. Demonstrate searching for hidden fires
   b. Demonstrate exposure of hidden fires by opening ceilings, walls, floors, and pulling apart burned material
   c. Demonstrate how to separate and remove charred materials from unburned material
   d. Define duties of fire fighters left at the scene for fire and security surveillance
   e. Identify the purpose of overhaul

4. Salvage ≈1.5 hours classroom ≈.5 hours practical	a. Identify the purpose of salvage and its value b. Demonstrate folds and rolls of salvage covers c. Demonstrate salvage cover throws d. Demonstrate the techniques of inspection, cleaning, and maintaining salvage equipment
5. Fire Streams ≈1.5 hours classroom ≈2.5 hours practical	a. Define a fire stream b. Manipulate a nozzle so as to attack Class A and Class B fires c. Define water hammer and at least one method for its prevention d. Demonstrate how to open and close a nozzle
6. Fire Hoses, Nozzles, and Appliances ≈2.5 hours classroom ≈3.5 hours practical	a. Identify the sizes, types, amounts, and uses of hose carried on a pumper b. Demonstrate the use of nozzles, hose adapters, and hose appliances carried on a pumper c. Advance dry hose lines of two different sizes from a pumper: 1. Into a structure 2. Up a ladder into an upper floor window 3. Up an inside stairway to an upper floor 4. Up an outside stairway to an upper floor 5. Down an inside stairway to a lower floor 6. Down an outside stairway to a lower floor 7. To an upper floor by hoisting

d. Advance charged hose lines of two different sizes from a pumper
   1. Into a structure
   2. Up a ladder into an upper floor window
   3. Up an inside stairway to an upper floor
   4. Up an outside stairway to an upper floor
   5. Down an inside stairway to a lower floor
   6. Down an outside stairway to a lower floor
   7. To an upper floor by hoisting
e. Demonstrate the techniques for cleaning fire hose, couplings, and nozzles and inspecting for damage
f. Connect a fire hose to a hydrant and fully open and close the hydrant
g. Demonstrate the loading of fire hose on a fire apparatus and identify the purpose of at least three types of hose loads and finishes
h. Demonstrate three types of hose rolls
i. Demonstrate two types of hose carries
j. Demonstrate coupling and uncoupling of the fire hose
k. Work from a ladder with a charged attack line which shall be 1.5" or larger
l. Demonstrate carrying hose into a building to be connected to a standpipe
m. Demonstrate the methods for extending a hose line
n. Demonstrate replacing a burst section of hose line

7. Forcible Entry
   ≈3 hours classroom
   ≈1 hour practical

a. Identify and demonstrate each type of manual forcible entry tool
b. Identify the method and procedure of properly cleaning, maintaining, and inspecting each type of forcible entry tool and equipment

8. Ladders ≈1.5 hours classroom ≈2.5 hours practical	a. Identify each type of ladder and its intended use b. Demonstrate the following ladder carries: 1. One person carry 2. Two person carry 3. Three person carry 4. Four person carry 5. Five person carry 6. Six person carry c. Raise each type and size of ground ladder d. Climb the full length of every type e. Climb the full length of each type of ground and aerial ladder carrying fire fighting tools or equipment while ascending and descending f. Climb down the full length of a ground and aerial ladder carrying an injured person g. Demonstrate the techniques of working from ground and aerial ladders with tools and appliances h. Demonstrate the techniques of cleaning ladders
9. Rescue ≈5 hour classroom ≈1.25 hours practical	a. Demonstrate the removal of injured persons from immediate hazards practical by use of carries, drags, and stretchers b. Demonstrate searching for victims in burning, smokefilled buildings, or other hostile environments c. Define the use of a life belt d. Define safety procedures as they apply to rescue

10. Self-Contained Breathing Apparatus ≈2 hours classroom ≈2 hours practical	a. Identify at least four hazardous respiratory environments encountered in fire fighting b. Demonstrate the use of all types of self-contained breathing apparatus in a dense smoke environment c. Identify the physical requirements of the wearer, the limitations of the self-contained breathing apparatus, and the safety features of all types of self-contained breathing apparatus d. Demonstrate donning self-contained breathing apparatus while wearing protective clothing e. Demonstrate that the self-contained breathing apparatus is in a safe condition for safe use f. Identify the procedure for cleaning and sanitizing the self-contained breathing apparatus for future use
11. Ropes ≈2 hours class room and practical	a. Identify and describe the purpose for specific knots b. Identify the construction characteristics and appropriate uses of natural and synthetic fiber rope c. Demonstrate tying a bowline knot, a clove hitch, rescue knot, figure of eight knot, a becket or sheep bend, and an overhand safety knot d. Demonstrate the bight, loop, round turn, and half hitch as used in tying knots and hitches e. Using an overhand knot, hoist any selected forcible entry tool, ground ladder, or appliance to a height of 20 feet f. Demonstrate the techniques of inspecting, cleaning, maintaining, and storing rope

12. Ventilation ≈5 hours classroom	a. Define the principals of ventilation, and identify the advantages and effects of ventilation b. Identify the dangers present and precautions to be taken when performing ventilation c. Demonstrate opening various types of windows from inside and outside, with and without tools d. Demonstrate breaking window and door glass and its removal e. Using an ax, demonstrate the ventilation of a room and a floor f. Define the theory of a back draft explosion
13. Safety ≈1 hour classroom	a. Identify dangerous building conditions created by fire b. Demonstrate techniques for action when trapped or disoriented in a fire situation c. Define procedures to be used in electrical emergencies d. Define fire service lighting equipment e. Identify safety procedures when using fire services lighting equipment f. Demonstrate the use of portable power plants, lights, cords, and connectors g. Define safety procedures as they apply to emergency operations, specifically: 1. Protective equipment 2. Team concept 3. Portable tools and equipment 4. Riding and apparatus 5. Hazardous materials incidents

14. Fire Behavior ≈3 hours	a. Define fire b. Define the fire triangle and fire tetrahedron c. Identify two chemical, mechanical, and electrical energy sources d. Define the following stages of fire: 1. Incipient 2. Flame spread 3. Hot smoldering 4. Flash over 5. Steady state 6. Clear burning e. Define the three methods of heat transfer f. Define the three physical stages of matter in which fuels are commonly found g. Define the hazard of finely divided fuels as they relate to the combustion process h. Define flash point, fire point, and ignition temperature i. Define concentrations in air as it affects combustion j. Identify three products of combustion found in structural fires which create a life hazard

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises (i.e., Job Performance Measures)

COURSE: EOC-101 - Initial Mine Rescue

DURATION: 20 Hours

PREREQUISITES: Physical, underground experience

SCOPE:

TYPE: Classroom, field, hands-on

OBJECTIVES: Upon completion of this training, the student will be able to wear and maintain a Drager self-contained breathing apparatus, and perform all the functions required as a member of a mine rescue team.

REFRESHER: 48 hours of refresher training is required annually

COURSE DESCRIPTION (by lesson)

1. MSHA 2004 (Drager BG 174-A)
   ≈8 hours
   - a. Description
   - b. Major parts
   - c. Wearing and testing
   - d. Limitations
   - e. Maintenance

2. MSHA 2202 (Mine Gases)
   ≈2 hours
   - a. Meaning of terms
     1. Specific gravity
     2. Explosive range
     3. Toxicity
     4. Asphyxiate
     5. Solubility
   - b. Physical properties and characteristics
     1. Normal air
     2. Oxygen
     3. Nitrogen
     4. Carbon dioxide
     5. Carbon monoxide
     6. Oxides of nitrogen
     7. Hydrogen
     8. Hydrogen sulfide
     9. Sulfur dioxide
     10. Methane
   - c. Composition, physical properties, and characteristics
     1. Smoke

	2. Rock strata gases 3. Damps
3. MSHA 2203 (Mine Ventilation) ≈2 hours	a. Purpose and methods b. Ventilation controls c. Proper chain-of-command when altering ventilation d. Air measurement devices e. Construction of ventilation controls
4. MSHA 2204 (Mine Exploration) ≈2 hours	a. Examination of mine openings b. Barefaced exploration c. The fresh air base d. Apparatus teams e. Briefing f. Going underground g. Exploration procedures h. Traveling procedures i. Ground testing j. Debriefing
5. MSHA 2205 (Firefighting) ≈2 hours	a. Classification of fires b. Firefighting equipment c. Firefighting techniques 1. Indirect 2. Direct d. Explosions
6. MSHA 2206 (Rescue of Survivors) ≈2 hours	a. Rescuing survivors 1. Rescue techniques 2. First aid b. Recovery of bodies
7. MSHA 2207 (Mine Recovery) ≈2 hours	a. Assessing conditions b. Reestablishing ventilation c. Clearing and rehabilitating

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size and/or practical exercises (i.e., Job Performance Measures)

1

COURSE: Radiological Control Technician Fundamental Academic Lessons

DURATION: ~52 hours
Students may elect to test out of these courses with Radiological Control Manager approval

PREREQUISITES: Lesson specific

SCOPE: Lesson specific

REFRESHER: Requalification every two years

COURSE DESCRIPTION (by module)

1. Basic Mathematics and Algebra (CL1.01) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson is a review of arithmetic and algebraic methods used to perform various radiological control calculations required by the RCT to perform his/her daily duties. These calculations include scientific notation, unit analysis and conversion, radioactive decay calculations, dose rate/distance calculations, shielding calculations, and stay-time calculations.
c. Outline - Introduction
  - Basic math operations with fractions
  - Basic math operations with decimals
  - Convert fractions to decimals and vice-versa
  - Convert percent to decimal and vice-versa
  - Basic math operations with signed numbers
  - Basic math operations with exponents
  - Find rational square roots
  - Convert scientific notation to standard form and vice-versa
  - Basic math with scientific notation
  - Solving equations using the “Order of Mathematical Operations”
  - Performing algebraic functions
  - Solving equations with common and natural logarithms
  - Exam

2. Unit Analysis and Conversion (CL1.02) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson is a review of the unit analysis and conversion process necessary for the RCT to perform air and water sample activity calculations, contamination calculations, and many other applications.

c. Outline - Introduction
   - Unit systems of measurement and base units for mass, length and time
   - SI prefix values and abbreviations
   - Using conversion factors/tables
   - Using formulas
   - Exam

3. Physical Sciences (CL1.03) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson is a review of basic physics since the RCT may work in environments where materials can undergo changes in state, resulting in changes in the radiological work environment.
c. Outline - Introduction -
   - Work/force/energy in relation to physics
   - Identify and describe four forms of energy
   - State the Law of Conservation of Energy
   - Solid/liquid/gas in regards to shape and volume
   - Basic atom structure
   - Defining physical science terms
   - Identifying symbols
   - Periodic Table element arrangement
   - Identifying Periodic Table layout
   - Defining terms relative to atomic structure
   - Exam

4. Nuclear Physics (CL1.04) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson is designed to provide an understanding of the forces present within an atom.
c. Outline - Introduction
   - Definitions: Nucleon, Nuclide, Isotope
   - Mass-Energy Equivalence Concept
   - Definitions: Mass Defect, Binding Energy
   - Definitions: Fission, Criticality, Fusion
   - Exam

5. Sources of Radiation (CL1.05) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding that radiation sources are not limited to nuclear facilities. The study of radiation sources provides data for:
   - The basis for occupational exposure
   - Showing the effects from high source exposures
   - Assessing the impact on radiation background from nuclear facilities
   - Determining the use of building materials
c. Outline - Introduction
   - Identifying natural background radiation sources
   - Identifying artificially produced radiation sources and dose magnitudes from each source
   - Exam

6. Radioactivity and Radioactive Decay (CL1.06) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding of the radioactive decay processes from different types of radionuclides.
c. Outline - Introduction
   - Neutron to proton ratio
   - Definitions: radioactivity, radioactive decay
   - Characteristics of alpha, beta, and gamma
   - Identifying radioactive decay modes
   - Decay of radioactive nuclides
   - Differences: natural and artificial radioactivity
   - Unstable fission products
   - Three naturally-occurring radioactive families and their end products
   - Identify nuclide attributes with Nuclide Chart
   - Tracing nuclide decay and stable end-product
   - Definitions: curie, Becquerel
   - Definitions: specific activity, half-life
   - Calculate activity using the decay formula
   - Defining exposure, absorbed dose, dose equivalent, and quality factor
   - Defining roentgen, rad/gray, and rem/sievert
   - Exam

7. Interaction of Radiation with Matter (CL1.07) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding of how different types of radiation interacts with different types of matter.

c. Outline - Introduction
   - Define ionization, excitation, bremsstrahlung
   - Defining specific ionization, linear energy transfer (LET), stopping power, range, and W-value
   - Alpha particle energy transfer
   - Energy transfer for beta particulate radiation
   - Gamma photon interaction with matter
   - Kinetic energies of various types of neutrons
   - Slow neutron capture
   - Scattering interactions for fast neutrons
   - Characteristics of materials shielding alpha, beta, gamma and neutron radiations
   - Exam

8. Biological Effects of Radiation (CL-1.08) ≈ 4 hours

a. Prerequisites - None
b. Scope -This lesson provides a basic understanding of the methods in which radiation may cause biological damage so that the RCT may protect themselves and the workers from unnecessary exposure to ionizing radiation.
c. Outline - Introduction
   - Function of various cell structures
   - Effects of radiation on cell structures
   - Law of Bergonie and Tribondeau
   - Factors affecting radiosensitivity of cells
   - Most and least radiosensitive cells
   - Reactions on cells from ionizing radiation
   - Definitions: stochastic, non-stochastic effect
   - LD 50/30 value for humans
   - Somatic effects of chronic radiation exposure
   - Three types of acute radiation syndromes and associated exposure levels and symptoms
   - Radiation exposure risks to embryo and fetus
   - Somatic and heritable effects
   - Exam

9. Radiological Protection Standards (CL1.09) ≈ 4 hours

a. Prerequisites - None
b. Scope -This lesson provides an understanding of the history of the development of the limits to show why the current limits of exposure are imposed. This lesson also provides an awareness of the current CFRs and DOE Orders that may affect the RCTs at the work place.

c. Outline - Introduction
   - Role of advisory agencies in developing radcon recommendations
   - Role of regulatory agencies in developing standards and regulations
   - DOE RCM purpose and scope
   - DOE RCM use of “shall” and “should”
   - Exam

10. ALARA (CL1.10) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding of the ALARA philosophy and shows the methods for the RCT to establish and maintain the commitment to ALARA that all personnel at the facility must have for a safe radiological work place.
c. Outline - Introduction
   - Base assumptions for ALARA philosophy
   - Collective personnel and individual exposure
   - Effective radiological ALARA program
   - Purposes of pre- and post-job reviews
   - RCT responsibilities for implementation
   - Exam

11. External Exposure Control (CL1.11) ≈ 4 hours

a. Prerequisites - None
b. Scope -This lesson provides an understanding of external exposure reduction and control measures available to the RCT to provide the best coverage and support at the radiological work site.
c. Outline - Introduction
   - Four basic methods for minimization
   - Calculating gamma exposure rates
   - Source reduction techniques
   - Time-saving techniques
   - Calculating remaining allowable dose equivalent or stay time
   - “Distance to radiation sources” techniques
   - Calculating exposure rate or distance for a point source of radiation
   - Calculating exposure rate or distance for a line source of radiation
   - Effects of distance on exposure rates from a plane source
   - Mass and linear attenuation coefficients
   - Defining “density thickness”
   - Density-thickness values for skin, lens of the eye, and the whole body
   - Using equations to calculate shielding thickness and exposure rates for gamma/x-ray radiation
   - Exam

12. Internal Exposure Control (CL1.12) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson is designed to familiarize the technician with those actions necessary as a result of the entry of radioactive materials into the body and the basis for those actions.
c. Outline - Introduction
   - Four ways radioactive material enters the body
   - Methods to prevent/minimize entry of radioactive material
   - Defining and distinguishing ALI and DAC
   - Determining basis for ALI
   - Defining "reference man"
   - Using DACs to minimize internal exposure
   - Behavior of radioactive materials in the body
   - Natural reductions of radionuclides in body
   - Relationship between physical, biological and effective half lives
   - Calculating effective half life
   - Medical elimination methods
   - Exam

13. Radiation Detector Theory (CL1.13) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson provides a good theoretical understanding of radiological instrumentation to help RCTs understand the data obtained by that instrumentation.
c. Outline - Introduction
   - Fundamental laws of electrical charges
   - Defining current, voltage, resistance, and their respective units
   - Functions of detector and readout circuitry components in radiation measurement system
   - Parameters affecting ion pair numbers in a gas-filled detector
   - Regions of gas amplification curves
   - Characteristics of a detector used in gas amplification curve regions
   - Defining resolving time, dead time, and recovery time
   - Discriminating between various types of radiation and various radiation energies
   - Operation of scintillation detector and associated components
   - Operation of neutron detector
   - Principles of GeLi and HPGe detectors
   - Exam

COURSE: Radiological Control Technician Site-Specific Academic Lessons

DURATION: ≈88 hours

PREREQUISITES: Lesson specific

SCOPE: Lesson specific

1. Counting Errors and Statistics (CL2.03) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson provides a basic knowledge of the random process of detecting and measuring radioactivity and the associated counting errors involved with that process. The RCTs will use this knowledge when obtaining the radioactivity measurements to make decisions that may affect the health and safety of workers at the facility and its surrounding environments
c. Outline - Introduction
   - Analyzing errors and their effect on sample measurements
   - Sample analysis statistics applications
   - Defining mean, median, and mode
   - Determining mean, median, and mode
   - Defining variance and standard deviation
   - Calculating the standard deviation
   - Purpose of Chi-squared test
   - Criteria for acceptable Chi-squared values at the WIPP
   - Purpose of creating quality control charts
   - WIPP QC chart maintenance and review requirements
   - Purpose of warning and control limits
   - Purpose of efficiencies and correction factors
   - Calculating efficiencies and correction factors
   - Meaning of counting data reported as "x±y"
   - Reporting results to desired confidence level
   - Purpose of determining background
   - WIPP methods and requirements for determining background
   - Purpose of performing sample planchet maintenance
   - WIPP method and requirements of performing planchet maintenance for counting systems
   - Methods to improve statistical validity of sample measurements
   - Defining and explaining "detection limits"
   - Calculate detection limit values at WIPP
   - Purpose, method, and criteria for acceptable values of determining crosstalk at the WIPP
   - Purpose and method of performing voltage plateau
   - Exam

2. Dosimetry (CL2.04) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson introduces the types of dosimeters used to measure external radiation to people at the facility. The material presented in this lesson is valuable to RCTs since dosimeters are the only direct method to measure and document personnel radiation exposure and ensure regulatory compliance with applicable limits.
c. Outline - Introduction
   - DOE occupational worker external exposure limits
   - DOE established limits for embryo/fetus
   - WIPP administrative exposure control guidelines for radiation/non-radiation workers, incidents and emergencies, and unborn children
   - Requirements for pregnant worker
   - Theory of operation of a TLD
   - Theory of operation of a TLD reader
   - Advantages and disadvantages of a TLD
   - WIPP beta-gamma TLDs
   - WIPP neutron TLDs
   - WIPP TLD use requirements
   - WIPP personnel neutron dosimeter types and principle of operation
   - WIPP self-reading dosimetry (SRD) principle of operation
   - WIPP alarming dosimeter use guidelines and principle of operation
   - WIPP bioassay monitoring methods
   - Exam

3. Contamination Control (CL2.05) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson shows that contamination control is probably one of the most difficult and challenging tasks the RCTs will encounter. This lesson covers the methods to prevent personnel contaminations and releases of radioactive material into the environment which is the ultimate purpose of a radiological control organization.
c. Outline - Introduction
   - Removable and fixed surface contamination
   - Components of the radiation monitoring program
   - Basic goal of the program
   - Basic principles
   - Possible engineering control methods
   - Use of protective clothing
   - Basic factors which determine protective clothing requirements
   - Exam

4. Airborne Sampling Program/Methods (CL2.06) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson provides an overview of the air sampling program and the methods for obtaining airborne radioactivity concentration in an area to ensure that the control measures assigned are effective and continue to be effective.
c. Outline - Introduction
   - Primary objectives of air monitoring program
   - Three physical states of radiation contaminants
   - Ensuring a representative air sample
   - Defining "isokinetic sampling"
   - Six methods for obtaining samples and their principle of operation
   - Selection of air monitoring methods
   - Purpose of five types of samplers/monitors
   - Factors affecting accuracy of measurements
   - WIPP air monitoring program
   - Exam

5. Airborne Sampling Laboratory (CL2.06A) ≈ 4 hours

a. Prerequisites - None
b. Scope - This training laboratory provides the initial on-the-job training for the job performance measures (JPMs) pertaining to the Airborne Sampling Program/Methods.
c. Outline - Introduction
   - Collecting FAS filters
   - Analyzing air sample for radioactivity
   - Changing 'Station A' FAS filters
   - Determining appropriate respiratory equipment based on air activity

6. Radiological Source Control (CL2.08) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding of the purposes, uses, methods to control radioactive sources that are necessary at a nuclear facility.
c. Outline - Introduction
   - N41.1 requirements for radioactive sources
   - WIPP sources that must be controlled
   - Packaging, marking and labeling requests
   - Storage area approval and posting requests
   - WIPP procedures for storage and accountability of radioactive sources
   - Exam

7. Access Control and Work Area Setup (CL2.10) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson presents instruction in Radiological Work Permits, various types of postings used in radiological areas, setting up radiological areas, access controls, and releasing of material from radiological areas.
c. Outline - Introduction
   - Purpose and information on Radiological Work Permit (RWP) including WIPP classifications
   - Responsibilities in using or initiating RWP
   - WIPP document that governs our ALARA program
   - WIPP establishment of exposure/performance goals
   - WIPP conditions requiring a pre-job ALARA review
   - WIPP conditions requiring a post-job ALARA review
   - Purpose of postings, signs, labels and barricades; and RCTs responsibilities for them
   - WIPP postings, requirements for postings/barriers, and entry requests for various radiological areas
   - Setting up radiological areas
   - Containment device discrepancies
   - Setting up portable ventilation systems and count rate meters
   - Requirements while working in RBAs
   - Requirements for removing or releasing materials from any radiological area
   - Exam

8. Radiological Work Coverage (CL2.11) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson covers the methods of job coverage by RCTs to assist radiological workers in keeping their radiation exposures ALARA.
c. Outline - Introduction
   - Three purposes of job coverage
   - Continuous and intermittent job coverage
   - Conditions that require job coverage
   - Planning job coverage
   - Pre-job briefing discussions
   - Worker and technician exposure control techniques
   - WIPP in-progress radiological surveys
   - WIPP documentation of in-progress surveys
   - Actions taken for unexpected survey results
   - Contamination control techniques
   - Preventative job coverage techniques
   - Overall job control techniques
   - WP 12-5 reasons to stop radiological work activities
   - Exam

9. Shipment/Receipt of Radioactive Material (CL2.12) ≈ 4 hours

a. Prerequisites - None
b. Scope -
c. Outline - Introduction
   - Regulatory agencies for radioactive material transport
   - Defining the DOT terms: LSA, Limited Quantity, Transport Index, Exclusive Use, and Closed Transport Vehicle
     Determining radionuclide contents of a package
   - Radiation and contamination surveys and applicable limits performed on packages
   - Radiation and contamination surveys and applicable limits performed on exclusive use vehicles
   - Placement of placards on transport vehicles
   - WIPP shipment release inspection criteria
   - WIPP procedures for receipt and shipment
   - WIPP procedures for shipments exceeding limits
   - WIPP procedures for opening packages
   - Exam

10. Radiological Incidents and Emergencies (CL2.13) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson covers the necessary immediate and supplementary actions for responding to radiological emergencies and abnormal events. This lesson also reveals that, although most people do not take incident response planning seriously because they do not expect the unexpected, incidents do occur, and experience has shown that best response comes from workers who have prepared themselves with a plan for dealing with incidents.
c. Outline - Introduction
   - RCT general response and responsibilities
   - Emergency equipment and facilities, including location and contents of emergency equipment kits
   - RCT response to CAM alarm
   - RCT response to personnel contamination monitor alarm
   - RCT response to off scale or lost dosimetry
   - RCT response to radiation levels or area alarm
   - RCT response to dry or liquid spill
   - RCT response to fire in a radiological area or involving radioactive materials
   - RCT response to other incidents
   - Emergency response levels
   - Incident documentation procedures
   - Emergency response team structure

- Offsite incident support groups
- Plant incidents, including cause, prevention, and response
- Exam

11. Personnel Decontamination (CL2.14) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lessons outlines the best methods available to control or oversee the decontamination of a contaminated individual.
c. Outline - Introduction
   - Three factors in personnel decontamination
   - Required RCT preliminary actions and notifications for contaminated individual
   - RCT response to clothing contamination
   - RCT response to skin contamination
   - Using decontamination reagents to decontaminate personnel
   - Exam

12. Radiological Considerations for First Aid (CL2.15) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson introduces the special considerations for injuries in radiological areas. It is incumbent on the RCT to use his/her knowledge and training to make judgement calls based on available facts and conditions. Often there is more than one "right way" to handle the situation, with many alternatives which may all work equally well.
c. Outline - Introduction
   - Treatment of minor radiation injuries
   - Treatment of major radiation illness/injury
   - RCT's responsibility at scene of major radiation injury after arrival of medical personnel
   - WIPP treatment and transport of contaminated injured personnel
   - Exam

13. Radiation Survey Instrumentation (CL2.16) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding of radiation survey instruments to ensure the data obtained is accurate and appropriate for the source of radiation. This lesson contains information about widely used portable radiation survey instruments.
c. Outline - Introduction
   - Appropriate external radiation survey instruments and their selection
   - WIPP ion chamber instrument features and specifications
   - WIPP high range instrument features and specifications
   - WIPP neutron detection and measurement instrument features and specifications
   - Exam

14. Contamination Monitoring Instrumentation (CL2.17) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding of contamination monitoring (count rate) instruments to provide the basis for assignment of practical contamination and internal exposure controls, to establish the proper controls, and to identify personnel contamination prior to exiting radiological areas at the facility.
c. Outline - Introduction
   - Portable contamination monitoring equipment selection
   - WIPP beta/gamma and/or alpha survey count rate meter probe features and specifications
   - WIPP count rate instrument features and specifications
   - WIPP personnel contamination monitor features and specifications
   - WIPP contamination monitor (tool, bag, laundry monitors) features and specifications
   - Exam

15. Air Sampling Equipment (CL2.18) ≈ 4 hours

a. Prerequisites - None
b. Scope
c. Outline - Introduction
   - WIPP portable air sampler (PAS) selection
   - Physical and operating characteristics and limitation(s) of WIPP portable air samplers
   - Physical and operating characteristics and limitation(s) of WIPP motor air pumps
   - Pre-operational checkout of WIPP PASs
   - Physical and operating characteristics and limitation(s) of WIPP beta-gamma CAMs
   - Physical and operating characteristics and limitation(s) of WIPP alpha CAMs
   - Exam

16. Counting Room Equipment (CL2.19) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson covers counting room equipment in relation to types used, purpose for, radiation monitored, operational requirements, and specific limitations and characteristics. The RCT uses information from these counting instruments to identify and assess the hazards presented by contamination and airborne radioactivity and establish protective requirements for work performed in radiological areas.
c. Outline - Introduction
   - WIPP Scintillation Alpha and Beta laboratory counter/scalers' features and specifications
   - WIPP low background auto alpha/beta proportional counting system features and specifications
   - Exam

COURSE: Radiography (Level 1)

TYPE: Classroom/OJT

OBJECTIVES: Upon completion of this course and obtaining a grade of at least 80% on a comprehensive examination, the student will be able to review radiography records performed by another radiographer. Level 1 radiographers will perform a practical capability demonstration in the presence of an experienced, qualified radiography operator or trainer.

REFRESHER: Biennially

COURSE DESCRIPTION

Level 1 radiography operators shall be instructed in the specific waste generating practices and typical packaging configurations expected to be found in each Waste Matrix Code at each site shipping waste to WIPP. The OJT and apprenticeship shall be conducted by an experienced, qualified radiography operator or trainer prior to qualification of the training candidate.

The Permittees' Level 1 radiography training program includes:

Formal Training

- Project Requirements
- State and Federal Regulations
- Basic Principles of Radiography
- Radiography of Waste Forms (including the ability to identify liquids and compressed gases which will be verified by a radiography subject matter expert)
- Waste Stream-Specific Instruction (e.g., specific waste generating processes, typical packaging configurations, waste material parameters)

On-the-Job Training

- System Operation (equipment and procedures used by Level 1 radiographers)
- Identification of Packaging Configurations
- Identification of Waste Material Parameters/Waste Matrix Codes
- Identification of excess residual liquids as defined in the TSDF-WAC, and compressed gases
- Verification of waste stream description

COURSE:	Radiography (Level 2)
TYPE:	Classroom/OJT
OBJECTIVES:	Upon completion of this course, the student will be able to perform radiography in a safe manner and will be able to confirm whether waste contains ignitable, corrosive, or reactive waste. Successfully pass a comprehensive exam based upon training enabling objectives. The comprehensive exam will address the radiography operation, documentation, and procedural elements stipulated in this WAP. Perform practical capability demonstration in the presence of appointed site Permittee radiography subject matter expert.
REFRESHER:	Biennially

COURSE DESCRIPTION

Level 2 radiography operators shall be instructed in the specific waste generating practices and typical packaging configurations expected to be found in each Waste Matrix Code at each site shipping waste to WIPP. The OJT and apprenticeship shall be conducted by an experienced, qualified radiography operator prior to qualification of the training candidate.

The Permittees' Level 2 radiography training program includes:

<u>Formal Training</u>

- Project Requirements
- State and Federal Regulations
- Basic Principles of Radiography
- Radiographic Image Quality
- Radiographic Scanning Techniques
- Application Techniques
- Radiography of Waste Forms
- Standards, Codes, and Procedures for Radiography
- Waste Stream-Specific Instruction

<u>On-the-Job Training</u>

- System Operation
- Identification of Packaging Configurations
- Identification of Waste Material Parameters/Waste Matrix Codes
- Identification of excess residual liquids as defined in the TSDF-WAC and compressed gases
- Verification of waste stream description

A radiography training drum shall include items common to the waste streams to be confirmed by the Permittees. The training drums shall be divided into layers with varying packing densities or different drums may be used to represent different situations that may occur during radiography examination by the Permittees. The following elements will be in a radiography training drum(s):

- Aerosol can with puncture
- Horsetail bag
- Pair of coveralls
- Empty bottle
- Irregular shaped pieces of wood
- Empty one gallon paint can
- Full container
- Aerosol can with fluid
- One gallon bottle with three tablespoons of fluid
- One gallon bottle with one cup of fluid (upside down)
- Leaded glove or leaded apron
- Wrench

These items shall be successfully identified by the operator as part of the qualification process.

Requalification of operators shall be based upon evidence of continued satisfactory performance (primarily video/audio reviews) and shall be done at least every two years. Unsatisfactory performance will result in disqualification. Unsatisfactory performance is defined as the misidentification of excess residual liquids (as defined in the TSDF-WAC) or compressed gases in a training drum or a score of less than eighty percent (80%) on the comprehensive exam. Retraining and demonstration of satisfactory performance are required before a disqualified operator is again allowed to operate the radiography system for the Permittees.

COURSE: Visual Examination (Level 1)

TYPE: Classroom/OJT

OBJECTIVES: Upon completion of this course and obtaining a grade of at least 80% on a comprehensive examination, the student will be able to perform a review of visual examination records and will be able to confirm the Summary Category Group, Waste Matrix Code and whether waste contains ignitable, corrosive, or reactive waste. Level 1 visual examination personnel will perform a practical capability demonstration in the presence of an experienced, qualified visual examination expert or trainer.

REFRESHER: Biennially

COURSE DESCRIPTION

Level 1 visual examination personnel shall be instructed in the specific waste generating processes, typical packaging configurations, and waste material parameters expected to be found in each Waste Matrix Code in the waste stream being confirmed using visual examination.

The OJT and apprenticeship shall be conducted by an operator experienced and qualified in visual examination or a qualified trainer prior to qualification of the candidate. The training shall be site waste stream specific to include the various waste configurations being confirmed. For example, the particular physical forms and packaging configurations at each site will vary and operators shall be trained on types of waste that are generated, stored, and/or characterized at that particular site.

Visual examination personnel shall be requalified once every two years.

The Level 1 visual examination training program includes:

<u>Formal Training</u>

- Project Requirements
- State and Federal Regulations
- Batch Data Report Forms
- Waste Stream-Specific Instruction (e.g., waste generating processes, typical packaging configurations, waste material parameters)

On-the-Job Training

- System Operation (equipment and procedures used by Level 1 visual examination personnel)
- Identification of Packaging Configurations
- Identification of Waste Material Parameters/Waste Matrix Codes
- Identification of excess residual liquids as defined in the TSDF-WAC and compressed gases
- Verification of waste stream description

COURSE: Visual Examination (Level 2)

TYPE: Classroom/OJT

OBJECTIVES: Upon completion of this course, the student will be able to perform visual examination or a review of visual examination records in a safe manner and will be able to confirm whether waste contains ignitable, corrosive, or reactive waste.

Successfully pass a comprehensive exam based upon training enabling objectives. The comprehensive exam will address the visual examination operation, documentation, and procedural elements stipulated in this WAP.

Perform practical capability demonstration in the presence of appointed site Permittee visual examination subject matter expert.

REFRESHER: Biennially

COURSE DESCRIPTION

Level 2 visual examination operators shall be instructed in the specific waste generating processes, typical packaging configurations, and waste material parameters expected to be found in each Waste Matrix Code in the waste stream being confirmed using visual examination.

The OJT and apprenticeship shall be conducted by an operator experienced and qualified in visual examination prior to qualification of the candidate. The training shall be site waste stream specific to include the various waste configurations being confirmed. For example, the particular physical forms and packaging configurations at each site will vary so operators shall be trained on types of waste that are generated, stored, and/or characterized at that particular site.

Visual examination personnel shall be requalified once every two years.

The Level 2 visual examination training program includes:

<u>Formal Training</u>

- Project Requirements
- State and Federal Regulations
- Batch Data Report Forms
- Application Techniques
- Waste Stream-Specific Instruction (e.g., specific waste generating processes, typical packaging configurations, waste material parameters)

On-the-Job Training

- Identification of Packaging Configurations
- Identification of Waste Material Parameters/Waste Matrix Code
- Identification of Prohibited Items liquids as defined in the TSDF-WAC and compressed gases
- Verification of waste stream description

Qualification Cards

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QUALIFICATION CARD: CH Waste Handling Technician (WH-01A, WH-01B)
CH Waste Handling Engineer (WH-02)

DURATION: Nine to twelve months

CLASSROOM TRAINING: Various classroom courses are utilized to provide operators the requisite training as part of the qualification process. The candidate must satisfactorily complete the classroom training courses prior to completion of the qualification card.

SCOPE: The CH Waste Handling Technician Qualification Card (WH-01A Backfill Technician, and Emplacement Technician, and WH-01B Waste Handling Technician) and CH Waste Handling Engineer Qualification Card (WH-02 Waste Handling Operations Qualification Card Guide Book [WH-GUIDE-1]).

REFERENCES: CH Waste Handling Technician Qualification Card (WH-01)
CH Waste Handling Engineer Qualification Card (WH-02)
Waste Handling Operations Qualification Card Guide Book (WH-GUIDE-1)

QUALIFICATION CARD DESCRIPTION (by category)

1. Equipment Knowledge Requirements

Demonstrate knowledge of the following for the various pieces of CH waste handling equipment and systems:

- General principle of equipment operation
- Understanding of alarms, indications, and readings
- Proper response to abnormal equipment conditions
- Precautions, administrative requirements, and technical specification requirements
- Basic safety requirements for equipment operation

2. Equipment Operation Practical Requirements

Demonstrate competency in conducting CH waste handling equipment and system functional and operational inspections.

Demonstrate competency in standard operation of CH waste handling equipment and systems.

3. Integrated Process Knowledge Requirements

Demonstrate knowledge of the following for the various integrated support functions.

- Administrative activities for equipment/system isolation, modification and control
- Management of site derived waste
- Proper response to abnormal facility conditions
- Container storage area inspections
- Facility support systems

4. Integrated Process Practical Requirements

Demonstrate competency in performing administrative duties for equipment/system isolation and control.

Demonstrate competency in management of site derived waste.

Demonstrate competency in performing container storage area inspections.

Walkdown the various facility support systems that affect waste handling.

QUALIFICATION CARD: RH Waste Handling Technician (RH-01A, RH-01B, RH-01C)
RH Waste Handling Engineer (RH-02)

DURATION: Nine to twelve months

CLASSROOM TRAINING: Various classroom courses are utilized to provide operators the requisite training as part of the qualification process. The candidate must satisfactorily complete the classroom training courses prior to completion of the qualification card

SCOPE: The RH Waste Handling Technician Qualification Card (RH-01A, RH-01B, RH-01C) and RH Waste Handling Engineer Qualification Card (RH-02).

REFERENCES: RH Waste Handling Technician Qualification Card
RH Waste Handling Engineer Qualification Card
Waste Handling Operations Qualification Card Guide Book

QUALIFICATION CARD DESCRIPTION (by category)

1. Equipment Knowledge Requirements

Demonstrate knowledge of the following for the various pieces of RH waste handling equipment and systems:

- General principle of equipment operation
- Understanding of alarms, indications, and readings
- Proper response to abnormal equipment conditions
- Precautions, administrative requirements, and technical specification requirements
- Basic safety requirements for equipment operation

2. Equipment Operation Practical Requirements

Demonstrate competency in conducting RH waste handling equipment and system functional and operational inspections.

Demonstrate competency in standard operation of RH waste handling equipment and systems.

3. Integrated Process Knowledge Requirements

Demonstrate knowledge of the following for the various integrated support functions.

- Administrative activities for equipment/system isolation, modification and control
- Management of site derived waste
- Proper response to abnormal facility conditions
- Container storage area inspections
- Facility support systems

4. Integrated Process Practical Requirements

Demonstrate competency in performing administrative duties for equipment/system isolation and control.

Demonstrate competency in management of site derived waste.

Demonstrate competency in performing container storage area inspections.

Walkdown the various facility support systems that affect waste handling.

QUALIFICATION CARD: Radiological Control Technician (RCT)

DURATION: ≈9 working months

CLASSROOM TRAINING: Various classroom courses are utilized to reinforce the training received as part of the qualification card. The candidate is required to complete

SCOPE:

REFERENCES: WP 12-5, WIPP Radiological Control Manual
WP 12-HP, WIPP OHP Procedures Manual
WP 12-RE, Rad Engineering Procedures Manual

QUALIFICATION CARD DESCRIPTION (by category)

1. Academics Training

There are 13 lessons associated with the core academics program and 15 lessons associated with the site academics program.

2. Practical Training

There are 33 job performance measures associated with the practical training element of the RCT qualification program covering the following areas:

Demonstrate generation of a Radiological Work Permit.

Demonstrate how a radiological area should be posted.

Demonstrate applicable emergency response to various events.

Demonstrate competency in operating various types of monitoring equipment.

3. Written Examination

This exam is administered after successful completion of academic lessons and practical lessons. Successful completion of the comprehensive written exam is necessary prior to participation in the oral examinations.

4. Oral Examination Board

The oral board consists of members of Radiation Safety, Operational Health Physics, Facility Operations, and Technical Training. This board will assess the candidate's response to normal and emergency situations encountered by a Radiation Control Technician

QUALIFICATION CARD: EST-01 Emergency Services Technician

DURATION: 2 Years

PREREQUISITIES: The candidate must be current in CPR and possess an EMT-I License.

CLASSROOM TRAINING: Additional classroom training courses are required prior to completion of this qualification card.

SCOPE: This qualification card must be completed by all candidates prior to standing a watch unsupervised. Qualification is a six month process. The individual may perform duties without direct supervision only for those evolutions and/or operations for which training has been completed.

All signatures must be made by an approved Subject Matter Expert. The signatures indicate that the trainee has demonstrated satisfactory knowledge and performance of the task(s) indicated.

REFERENCES:
Emergency Services Technician Qualification Card Guide Book (EST-01G)
WIPP Emergency Management Program (WP 12-9)
Emergency Fire Pump (WP 04-FP2202)
Inspection and Testing of Sprinkler Systems
1. Wet Pipe Fire Sprinkler System Testing (PM000025)
2. NFPA 13, Installation of Sprinkler Systems

QUALIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

Demonstrate basic knowledge of emergency management procedures and protocols such as:

- The purpose and types of dry chemicals utilized in large and portable dry chemical systems.
- Inspection and testing principles of sprinkler systems, buildings, pull boxes, and fire detection systems.
- The general operation and hazards of fixed halon systems.
- Principles and procedures for operation of various fire and rescue apparatus.
- Selection and use of personal protective equipment.
- Selection and use of hazardous material equipment and supplies for control and mitigation.

2. Practical Requirements

Demonstrate competency in the following areas:

- Use of fire suppression apparatus and equipment.
- Use of rescue apparatus and equipment.
- Inspection and testing techniques and completion of corresponding forms.
- Operation of ambulance and operation and application of all ambulance equipment and supplies.
- Application of all hazardous materials equipment and supplies for control and mitigation.

QUALIFICATION CARD: FPT-01 Fire Protection Technician

DURATION: 2 Years

PREREQUISITES: The candidate must be currently certified in CPR and possess an EMT-B License.

CLASSROOM TRAINING: Additional classroom training courses are required prior to completion of this qualification card.

SCOPE: This qualification card must be completed by all candidates prior to standing a watch unsupervised. Qualification is a six month process. The individual may perform duties without direct supervision only for those evolutions and/or operations for which training has been completed.

All signatures must be made by an approved Subject Matter Expert. The signatures indicate that the trainee has demonstrated satisfactory knowledge and performance of the task (s) indicated.

REFERENCES: Emergency Services Technician Qualification Card Guide Book (EST-01G)
WIPP Emergency Management Program (WP 12-9)

QUALIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

Demonstrate basic knowledge of emergency management procedures and protocols such as:

- The purpose and types of dry chemicals utilized in large and portable dry chemical systems.
- Inspection and testing principles of sprinkler systems, buildings, pull boxes, and fire detection systems.
- The general operation and hazards of fixed halon systems.
- Principles and procedures for operation of various fire and rescue apparatus.
- Selection and use of personal protective equipment.
- Selection and use of hazardous material equipment and supplies for control and mitigation.

2. Practical Requirements

Demonstrate competency in the following areas:

- Use of fire suppression apparatus and equipment.
- Use of rescue apparatus and equipment.
- Inspection and testing techniques and completion of corresponding forms.
- Operation of ambulance and operation and application of all ambulance equipment and supplies.
- Application of all hazardous materials equipment and supplies for control and mitigation.

QUALIFICATION CARD: Quality Assurance Inspector

DURATION: Six to nine months

CLASSROOM TRAINING: Various formal classroom courses are utilized to support the training received as part of the qualification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the qualification card.

SCOPE: The Quality Assurance Qualification card establishes the minimum education, skill, training, knowledge, and experience requirements for Quality Assurance personnel who perform inspection activities.

REFERENCES: WP 13-1, Quality Assurance Program Description
QAI PD2-3, Qualification of Inspection Personnel

QUALIFICATION CARD DESCRIPTION (by category)

1. General Knowledge

Demonstrate knowledge of the minimum site specific procedures:

- ASME NQA-1
- Quality Assurance Program Description
- Safety Manual
- Hoisting and Rigging Procedures
- Work Authorization Procedures
- Document Control Procedures

2. On-the-Job Training

Perform at least 20 hours of the following activities while supervised by a qualified inspector:

- Receiving inspection
- Dimensional inspection
- Mechanical inspection
- Electrical inspection
- Civil inspection

3. Qualification Card

Perform the following tasks:

- Receipt inspection
- Conduct an inspection
- Hold/witness point inspection
- Issuance of a corrective action request
- Hold tag issuance
- Verification of corrective action
- Conduct a corrective action receipt inspection

QUALIFICATION CARD: Facility Operations Roving Watch

DURATION: Six to nine months

CLASSROOM TRAINING: Various classroom courses are utilized to reinforce the training received as part of the qualification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the qualification card.

SCOPE: The Facility Operations Roving Watch qualification is the foundation for all of the Facility Operations qualifications. The qualifications developed utilizing the Facility Operations Roving Watch qualification are the Central Monitoring Room Operator Qualification (FO-CMRO-2) and the Facility Operations Shift Engineer Qualification (FO-FOSE-3) (for FSM). This qualification is used by all Facility Operations personnel qualifying. All of the requirements of the applicable qualifications must be completed by the candidate before operating any equipment or performing any operating evolutions without direct supervision of a qualified operator.

REFERENCES: Facility Operations Roving Watch Qualification Card (FO-RW-1)
WIPP Operations Watchstation Qualification Card Guide Book (FO-GUIDE-1)

QUALIFICATION CARD DESCRIPTION (by category)

1. System Knowledge

Demonstrate knowledge of the critical facility operating systems, such as:

- Theory of the system and equipment
- System design
- Differences in the various building systems around the facility
- Alarms and sequence of actions that follow alarms

The systems covered include:

- Facility electrical and backup electrical systems
- Heating, air conditioning, and ventilation systems
- Underground ventilation systems
- Domestic water and fire protection systems

2. System Operation Practical Evaluation

Demonstrate system startup/shutdown for the various facility systems according to procedures.

Demonstrate maintenance of applicable records pertaining to the operation of facility systems.

Demonstrate ability to conduct periodic required testing of facility systems.

Demonstrate competency to respond to alarms and emergency situations according to procedures.

3. Integrated Plant Knowledge

Discuss the site policies on equipment lockout/tagout.

Discuss the process of notifications and authorizations that is involved in making temporary plant modifications.

Discuss the site process for work authorization.

Discuss the role and responsibilities of Facility Operations on the site.

Discuss Conduct of Operations as it applies to Facility Operations.

4. Integrated Plant Practical Evaluation

Demonstrate the lockout/tagout process.

Prepare paperwork associated with a temporary plant modification.

Demonstrate ability to maintain the Facility Operations logs.

Demonstrate the actions that are taken in various facility emergencies.

Demonstrate ability to stand watch as RW during various shifts.

5. Oral Qualification Exam

This final portion of the qualification consists of an oral board exam conducted by board members who are knowledgeable in the qualification program areas.

QUALIFICATION CARD: Central Monitoring Room Operator

DURATION: Three to five months

CLASSROOM TRAINING: Various classroom courses are utilized to reinforce the training received as part of the qualification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the qualification card.

SCOPE: The Facility Operations Central Monitoring Room Operator Qualification (FO-CMRO-2) in conjunction with the Roving Watch qualification make up the support for the Facility Operations Shift Engineer Qualification (FO-FOSE-3). This qualification is used by Facility Operations personnel qualifying as CMR operators or Facility Operations Shift Supervisors. All of the requirements of the applicable qualifications must be completed by the candidate prior to operating any equipment or performing any operating evolutions without direct supervision of a qualified operator. Qualification are valid for two years.

REFERENCES: Central Monitoring Room Operator Qualification Card (FO-CMR-2)
WIPP Operations Watchstation Qualification Card Guide Book (FO-GUIDE-1)

QUALIFICATION CARD DESCRIPTION (by category)

1. System Knowledge

Demonstrate knowledge of the following for the various systems in the Central Monitoring Room:

- Theory of the system and equipment
- System design
- Alarms and sequence of actions that follow the alarms

2. System Operation Practical Evaluation

Demonstrate competency in standard operation of the systems in the Central Monitoring Room including obtaining various pieces of information such as:

- System status
- Alarm Status
- Meteorological data

Demonstrate what actions are to take place in the event of an alarm.

Demonstrate storage of information and subsequent retrieval.

3. Integrated Plant Knowledge

State the actions that must be taken to remove a CMS point scan/alarm check.

Discuss the sequence of events that must occur during a facility emergency.

4. Integrated Plant Practical Evaluation

Demonstrate how the CMR log is maintained.

Demonstrate the sequence of events that are involved in CMS point scan/alarm check removal.

Demonstrate ability to stand watch as CMRO during different shifts.

Demonstrate the sequence of events involved in a facility emergency.

5. Oral Qualification Exam

This final portion of the qualification consists of an oral board exam conducted by board members who are knowledgeable in the qualification program areas.

QUALIFICATION CARD: Facility Operations Shift Supervisor

DURATION: Three to five months

CLASSROOM TRAINING: Various classroom courses are utilized to reinforce the training received as part of the qualification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the qualification card

SCOPE: The Facility Operations Shift Engineer Qualification (FO-FOSE-3) is the final qualification developed from the Central Monitoring Room Operator Qualification and Roving Watch Qualification. This qualification is used by Facility Operations personnel, Facility Operations Engineer, and Facility Shift Manager. The candidate must be recommended by the Facility Operations Manager to perform this qualification. All of the requirements of the applicable qualifications must be completed by the candidate prior to operating any equipment or performing any operating evolutions without direct supervision of a qualified operator. Qualifications are valid for two years.

REFERENCES: Facility Operations Shift Engineer (FO-FOSE-3)
WIPP Operations Watchstation Qualification Card Guide Book (FO-GUIDE-1)

QUALIFICATION CARD DESCRIPTION (by category)

1. System Knowledge

Completed qualification through Central Monitoring Room Operator Qualification and Roving Watch Qualification

2. System Operation Practical Evaluation

Completed qualification through Central Monitoring Room Operator Qualification and Roving Watch Qualification

3. Integrated Plant Knowledge

Discuss the site work authorization process and the role of the FSM.

Discuss the use of operator aids.

Discuss the responsibilities of the FSM.

Discuss the use of shift instructions.

Discuss the role of the FSM in facility emergencies and the actions that are to be taken by the FSM.

Discuss the role of the Quality Assurance and Safety programs on the site.

Discuss the Contingency Plan and its implementation.

Discuss site regulatory compliance as it applies to hazardous waste and hazardous materials.

4. Integrated Plant Knowledge Evaluation

Complete the required documentation for a lockout/tagout.

Complete the proper documentation relating to temporary plant modifications.

Perform various work authorization actions.

Demonstrate a review of the Facility Operations logs.

Demonstrate the response required for various facility emergencies.

Demonstrate ability to stand watch as FSM during different shifts.

5. Oral Qualification Exam

This final portion of the qualification consists of an oral board exam conducted by board members who are knowledgeable in the qualification program areas.

QUALIFICATION CARD: WWIS Data Administrator

DURATION: Two years

CLASSROOM TRAINING: Various classroom courses are utilized to provide the WWIS Data Administrator with the knowledge and background on the WIPP waste operations. OJT connected with the everyday operation of the database will be provided by the WWIS SME. The candidate must satisfactorily complete the classroom training courses and the OJT prior to qualification.

SCOPE: The WWIS Qualification Card provides the minimum knowledge and competency requirements for qualification. The requirements of the qualification must be completed to the satisfaction of the current WWIS SME prior to the candidate performing any of the WWIS data functions without direct supervision by a qualified WWIS DA.

REFERENCES: WWIS Data Administrator Qualification Card

QUALIFICATION CARD DESCRIPTION (by category)

1. Equipment Knowledge Requirements

Demonstrate knowledge of the following WWIS hardware and software systems:

- General computer operation principles and communication terminal techniques
- IBM PC and Internet techniques
- Bar Code Reader System operation

2. Equipment Operation Practical

- Obtain and maintain local and Internet IDs
- Access WWIS and produce reports
- Demonstrate operation of bar code reader interface to WWIS

3. Integrated Process Knowledge Requirements

Demonstrate knowledge of the following project document data requirements:

- WIPP Waste Acceptance Criteria
- WIPP Quality Assurance Program Plan
- Waste Analysis Plan

Demonstrate knowledge of the following WWIS Specific documentation:

- WWIS Software Requirements Specification
- WWIS Software Configuration Management Plan
- WWIS Software Quality Assurance Plan
- WWIS Software Design Description

4. Integrated Process Practical Requirements

Demonstrate competency in performing the administrative duties of the WWIS DA

Demonstrate competency in accessing the local area network (LAN) and the Internet.

Demonstrate the WIPP data interface to the WWIS via a walkdown of the receipt and emplacement operations that provide data to the database.

QUALIFICATION CARD: Radioactive Transportation (TE-01)
Federal Motor Carrier Safety Regulations (TE-02)
Hazardous Materials (TE-03)
Hazardous Waste Shipments by Public Highway (TE-05)

DURATION: Six to twelve months

CLASSROOM TRAINING: Various classroom courses are utilized to provide candidates the requisite training as part of the qualification process. The candidate must satisfactorily complete the classroom training courses listed on the individual qualification card as a prerequisite to beginning that process.

SCOPE: The Transportation Engineer qualification cards (TE-01 through TE-05) provide the minimum knowledge and competency requirements for qualification. The requirements of the individual qualification cards must be completed by the candidate prior to performing those duties without direct supervision.

REFERENCES: Radioactive Transportation (TE-01)
Federal Motor Carrier Safety Regulations (TE-02)
Hazardous Materials (TE-03)
Hazardous Waste Shipments by Public Highway (TE-05)

QUALIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

Demonstrate knowledge of the following regulatory arenas:

- Radioactive Material Transportation
- Federal Motor Carrier Safety Regulations
- Hazardous Materials
- Hazardous Waste Shipments by Public Highway

2. Practical Requirements

Demonstrate competency in performing the following for a given shipment:

- Determine the proper shipping name
- Determine the proper labeling and placement requirements
- Determine the proper application and marking requirements
- Prepare the proper shipping documents (i.e., Hazardous Waste Manifest, Bill of Lading, LDR notification form, etc.)

QUALIFICATION CARD:	Sampling Team (ST-01)
DURATION:	1 month
CLASSROOM TRAINING:	HWW-101 - Hazardous Waste Worker/Hazardous Waste Responder
SCOPE:	This qualification card must be completed by all candidates prior to performing sampling tasks without the direct supervision of a qualified person. This qualification ensures that the sampler will collect samples in a way that will protect the sampler and the integrity of the sample collected.
REFERENCES:	WIPP Sampling Team Qualification Guide ST-01G WP 02-EC.05 Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling WP 02-EC.06 WIPP Site Effluent and Hazardous Materials Sampling Plan

QUALIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

Demonstrate basic knowledge of hazardous waste sampling protocol such as:

- Preventing cross-contamination of samples and equipment
- Importance of the a chain-of-custody
- Purpose of the field logbook and documentation
- Labeling and sealing procedures
- Methods of obtaining various sample types (i.e. TCLP organics, volatile organic compounds, TCLP metals)

2. Safety Requirements

Demonstrate knowledge of the safety requirements for sampling activities such as:

- Level of personal protective equipment (PPE) needed for various sampling situations
- Actions to take when encountering damaged or bulging containers
- Importance of the “Buddy System”

3. Practical Requirements

- Correct and safe use of sampling equipment
- Collection of a given sample preventing cross-contamination
- Labeling and sealing sampling containers
- Completion of the Chain-of-Custody form

QUALIFICATION CARD:	Sampling Team Assistant (STA-01)
DURATION:	1 month
PREREQUISITES:	HWW-101 - Hazardous Waste Worker/Hazardous Waste Responder
SCOPE:	This qualification card must be completed by all candidates prior to performing sampling tasks without the direct supervision of a qualified person. This qualification ensures that the sampler will collect samples in a way that will protect the sampler and the integrity of the sample collected.
REFERENCES:	WIPP Sampling Team Qualification Guide ST-01G WP 02-EC.05 Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling WP 02-EC.06 WIPP Site Effluent and Hazardous Materials Sampling Plan

QUALIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

Demonstrate basic knowledge of hazardous waste sampling protocol such as:

- Preventing cross-contamination of samples and equipment
- Importance of the chain-of-custody
- Purpose of the field logbook and documentation
- Labeling and sealing procedures
- Methods of obtaining various sample types (i.e., TCLP organics, volatile organic compounds, TCLP metals)

2. Safety Requirements

Demonstrate knowledge of the safety requirements for sampling activities such as:

- Level of personal protective equipment (PPE) needed for various sampling situations
- Actions to take when encountering damaged or bulging containers
- Importance of the “Buddy System”

3. Practical Requirements

- Correct and safe use of sampling equipment
- Collection of a given sample preventing cross-contamination
- Labeling and sealing sampling containers
- Completion of the Chain-of-Custody form

QUALIFICATION CARD: Waste Handling Hoist Equipment Operator

DURATION: Approximately 12 to 15 months

SCOPE: The Waste Handling Hoist Equipment Operator Qualification (M-30) prepares the candidate to be a qualified man-hoist operator. All of the requirements for the applicable qualification must be completed prior to operating the Waste Handling Hoist unless under the direct supervision of a qualified operator.

REFERENCES: Waste Handling Hoist Equipment Operator Qualification Card Guide (M-30G)
Waste Handling Shaft Operation Procedure

QUALIFICATION CARD DESCRIPTION (by category)

1. Equipment Knowledge

Demonstrate knowledge of the following systems associated with the Waste Hoist:

- Major components of the Waste Hoist in the headframe and collar areas
- Major components of the Waste Hoist electrical systems
- Be able to describe the correct operations of all Waste Hoist systems and their interrelationships

2. Equipment Safety

Demonstrate knowledge of all safety systems associated with the Waste Hoist and how their functions affect hoist operation.

Describe the correct response of the operator when safety features are actuated.

3. Equipment Practical

Perform normal startup and shutdown of all Waste Hoist systems.

Perform normal hoisting operations for material and personnel in all modes of operation.

4. Classroom Training

Receive formal training in electrical safety.

5. Required Reading

Read the appropriate related procedures for waste hoist operation.

QUALIFICATION CARD:	Waste Handling Shaft Tender Operator
DURATION:	Approximately 7 months
SCOPE:	The Waste Handling Shaft Tender Operator Qualification (M-31) prepares the candidate to operate controls and systems located at both the collar area (surface) and the station area (underground) at the Waste Shaft. All the requirements for this qualification must be completed prior to operation of Waste Shaft systems unless under the direct supervision of a qualified operator.
REFERENCES:	Waste Handling Shaft Tender Qualification Guide (M-31G) Waste Handling Shaft Operation Procedure

QUALIFICATION CARD DESCRIPTION (by category)

1. Equipment Knowledge

Demonstrate knowledge of the following Waste Shaft equipment at the collar and station:

- Waste Shaft controls
- Communication systems
- Conveyance control panels
- Cage and its capacity

2. Equipment Safety

Demonstrate knowledge of all safety systems and devices associated with the Waste Hoist.

Describe the position responsibilities with regard to shaft safety and who to contact during abnormal conditions

3. Personnel Safety

Demonstrate knowledge of the requirements for all personnel who wish to enter the underground via the Waste Shaft.

Demonstrate knowledge of actions required during all work in and around the Waste Shaft or surrounding areas.

4. Equipment Maintenance

Describe the maintenance and inspection duties of both the collar and station tender.

5. Equipment Practical

Perform pre-shift inspections of the collar and station areas.

Perform all record keeping duties of the shaft tender.

Demonstrate proper operation of the Local Control Stations, Pivot Rail System, and Bell Systems.

CHAPTER I

CLOSURE PLAN

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CHAPTER I

CLOSURE PLAN

TABLE OF CONTENTS

List of Tables

List of Figures

CHAPTER I

CLOSURE PLAN

Introduction

This Permit Attachment contains the Closure Plan that describes the activities necessary to close the Waste Isolation Pilot Plant (**WIPP**) individual units and facility. Since the current plans for operations extend over several decades, the Permittees will periodically reapply for an operating permit in accordance with Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (**20.4.1 NMAC**), Subpart 900 (incorporating 40 CFR §270.10(h)). Consequently, this Closure Plan describes several types of closures. The first type is panel closure, which involves constructing closures in each of the underground hazardous waste disposal units (**HWDUs**) after they are filled. The second type is partial closure, which can be less than the entire facility and therefore less than an entire unit as described herein for the Waste Handling Building (**WHB**) Unit and the Parking Area Unit (**PAU**). The third type of closure is final facility closure at the end of the Disposal Phase, which will entail "clean" closure of all remaining surface storage units and construction of the four shaft seal systems. Finally, in the event a new permit is not issued prior to expiration of an existing permit, a modification to this Closure Plan will be sought to perform contingency closure. Contingency closure defers the final closure of waste management facilities such as the Waste Handling Building Container Storage Unit (**WHB Unit**), the conveyances, the shafts, and the haulage ways because these will be needed to continue operations with non-mixed Transuranic (**TRU**) waste.

The hazardous waste management units (**HWMUs**) addressed in this Closure Plan include the aboveground HWMU in the WHB, the parking area HWMU, and Panels 1 through ~~7~~8, each consisting of seven rooms.

This plan was submitted to the New Mexico Environment Department (**NMED**) and the U.S. Environmental Protection Agency (**EPA**) in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(13)). Closure at the panel level will include the construction of barriers to limit the emission of hazardous waste constituents from the panel into the mine ventilation air stream below levels that meet environmental performance standards[1] and to mitigate the impacts of methane buildup and deflagration that may be postulated for some closed panels. The Post-

[1] The mechanism for air emissions prior to closure is different than the mechanism after closure. Prior to closure, volatile organic compounds (VOC) will diffuse through drum filters based on the concentration gradient between the disposal room and the drum headspace. These VOCs are swept away by the ventilation system, thereby maintaining a concentration gradient that is assumed to be constant. Hence, the VOCs in the ventilation stream are a function of the number of containers only. After closure, the panel air will reach an equilibrium concentration with the drum headspace and no more diffusion will occur. The only mechanism for release into the mine ventilation system is due to pressure that builds up in the closed panel. This pressure arises from the creep closure mechanism that is reducing the volume of the rooms and from the postulated generation of gas as the result of microbial degradation of organic matter in the waste. Consequently, the emissions after panel closure are a direct function of pressurization processes and rates within the panel.

Closure Plan (Permit Attachment J) includes the implementation of institutional controls to limit access and groundwater monitoring to assess disposal system performance. Until final closure is complete and has been certified in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.115), a copy of the approved Closure Plan and all approved revisions will be on file at the WIPP facility and will be available to the Secretary of the NMED or the EPA Region VI Administrator upon request.

I-1 Closure Plan

This Closure Plan is prepared in accordance with the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264 Subparts G, I, and X), Closure and Post-Closure, Use and Management of Containers, and Miscellaneous Units. The WIPP underground HWDUs, including Panels 1 through ~~7~~8 on Figure I-1, will be closed under this permit to meet the performance standards in 20.4.1.500 NMAC (incorporating 40 CFR §264.601). The WIPP surface facilities, including Waste Handling Building Container Storage Unit and the Parking Area Container Storage Unit, will be closed in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.178). The Permittees may perform partial closure of the WHB and PAU HWMUs prior to final facility closure and certification. For final facility closure, this plan also includes closure of future waste disposal areas including Panels ~~8 through~~ 9 and10 and closure and sealing of the facility shafts in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.601).

Following completion of waste emplacement in each underground HWDU, the HWDU will be closed. The Permittees will notify the NMED of the closure of each underground HWDU as specified in the schedule in Figure I-2. For the purpose of this Closure Plan, panel closure is defined as the process of rendering underground HWDUs in the repository inactive and closed according to the facility Closure Plan. The Post-Closure Plan (Permit Attachment J) addresses requirements for future monitoring that are deemed necessary for the post-closure period, including monitoring closed panels prior to final facility closure.

For the purposes of this Closure Plan, final facility closure is defined as closure that will occur when all waste disposal areas are filled or when the WIPP achieves its capacity of 6.2 million cubic feet (ft^3) (175,600 cubic meters (m^3)) of TRU waste. At final facility closure, the surface container storage areas will be closed, and equipment that can be decontaminated and used at other facilities will be cleaned and sent off site. Equipment that cannot be decontaminated plus any derived waste resulting from decontamination will be placed in the last open underground HWDU. Stockpiled salt may be placed in the underground; it may be used as the core material for the berm component of the permanent marker system; or it must be otherwise disposed of in accordance with Sections 2 and 3 of the Minerals Act of 1947 (30 U.S.C. §§602 and 603). In addition, shafts and boreholes which lie within the WIPP Site Boundary and penetrate the Salado will be plugged and sealed, and surface and subsurface facilities and equipment will be decontaminated and removed. Final facility closure will be completed to demonstrate compliance with the Closure Performance Standards contained in 20.4.1.500 NMAC (incorporating 40 CFR §264.111, 178, and 601).

In the event the Permittees fail to obtain an extension of the hazardous waste permit in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.51) or fail to obtain a new permit in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.10(h)), the Permittees will seek a modification to this Closure Plan in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.42) to accommodate a contingency closure. Under contingency closure, storage units will undergo clean closure in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.178); waste handling equipment, shafts, and haulage ways will be inspected for hazardous waste residues (using, among other techniques, radiological surveys to indicate potential hazardous waste releases as described in Permit Attachment I3) and decontaminated as necessary; and underground HWDUs that contain radioactive mixed waste will be closed in accordance with the panel closure design described in this Closure Plan. Final facility closure, however, will be redefined and a request for a time extension for final closure will be requested. A copy of this Closure Plan will be maintained by the Permittees at the WIPP facility and at the Department of Energy (**DOE**) Carlsbad Field Office. The primary contact person at the WIPP facility is:

Manager, Carlsbad Field Office
U.S. Department of Energy
Waste Isolation Pilot Plant
P. O. Box 3090
Carlsbad, New Mexico 88221-3090
(~~505~~575) 234-7300

I-1a Closure Performance Standard

The closure performance standard specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.111), states that the closure shall be performed in a manner that minimizes the need for further maintenance; that minimizes, controls, or eliminates the escape of hazardous waste; and that conforms to the closure requirements of §264.178 and §264.601. These standards are discussed in the following paragraphs.

I-1a(1) Container Storage Units

Final or partial closure of the permitted container storage units (the Waste Handling Building Unit and Parking Area Unit) will be accomplished by removing all waste and waste residues. Indication of waste contamination will be based, among other techniques, on the use of radiological surveys as described in Permit Attachment I3. Radiological surveys use very sensitive radiation detection equipment to indicate if there has been a potential release of TRU mixed waste, including hazardous waste components, from a container. This allows the Permittees to indicate potential releases that are not detectable from visible evidence such as stains or discoloration. Visual inspection and operating records will also be used to identify areas where decontamination is necessary. Contaminated surfaces will be decontaminated until radioactivity is below free release limits[2]. Once surfaces are determined to be free of radioactive waste constituents, they will be tested for hazardous waste contamination. These surface decontamination activities will ensure the removal of waste residues to levels protective of human health and the environment. The facility is expected to require no decontamination at closure because any waste spilled or released during operations will be contained and removed immediately. Solid waste management units associated described in Permit Module VII will be subject to closure. In the event portions of these units which require decontamination cannot be decontaminated, these portions will be removed and the resultant wastes will be managed as appropriately.

Once the container storage units are decontaminated and certified by the Permittees to be clean, no further maintenance is required. The facilities and equipment in these units will be reused for other purposes as needed.

I-1a(2) Miscellaneous Unit

Post-closure migration of hazardous waste or hazardous waste constituents to ground or surface waters or to the atmosphere, above levels that will harm human health or the environment, will not occur due to facility engineering and the geological isolation of the unit. The engineering aspects of closure are centered on the use of panel closures on each of the underground HWDUs and final facility seals placed in the shafts. The design of the panel closure system is based on the criteria that the closure system for closed underground HWDUs will prevent migration of hazardous waste constituents in the air pathway in concentrations above health-based levels beyond the WIPP land withdrawal boundary during the thirty-five (35) year operational and facility closure period and to withstand any flammable gas deflagration that may occur prior to final facility closure.

Consistent with the definitions in 20.4.1.101 NMAC (incorporating 40 CFR §260.10), the process of panel closure is considered partial closure because it is a process of rendering a part of the repository inactive and closed according to the approved underground HWDU partial closure plan. Panel closure will be complete when the panel closure system is emplaced and operational, when that underground HWDU and related equipment and structures have been decontaminated (if necessary), and when the NMED has been notified of the closure.

Shaft seals are designed to provide effective barriers to the inward migration of ground water and the outward migration of gas and contaminated brine over two discrete time periods. Several components become effective immediately and are expected to function for one hundred (100) years. Other components become effective more slowly, but provide permanent isolation of the waste. The final shaft seal design is specified in Permit Attachment I2.

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[2] The free release criteria for items, equipment, and areas is < 20 dpm/100 cm^2 for alpha radioactivity and < 200 dpm/100 cm^2 for beta-gamma radioactivity.

The facility will be finally closed (i.e., decontaminated and decommissioned) to minimize the need for continued maintenance. Protection of human health and the environment includes, but is not limited to:

- Prevention of any releases that may have adverse effects on human health or the environment due to the migration of waste constituents in the groundwater or in the subsurface environment [20.4.1.500 NMAC, incorporating 40 CFR §264.601(a)].
- Prevention of any releases that may have adverse effects on human health or the environment due to migration of waste constituents in surface water, in wetlands, or on the soil surface [20.4.1.500 NMAC, incorporating 40 CFR §264.601(b)].
- Prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in the air [20.4.1.500 NMAC, incorporating 40 CFR §264.601(c)].

As part of final facility closure, surface recontouring and reclamation will establish a stable vegetative cover, and further surface maintenance will not be necessary to protect human health and the environment. Prior to cessation of active controls, monuments will be emplaced to serve as long-term site markers to discourage activities that would penetrate the facility or impair the ability of the salt formation to isolate the waste from the surface environment for at least 10,000 years. The Federal government will maintain administrative responsibility for the repository site in perpetuity and will limit future use of the area.

If, during panel or final facility closure activities, unexpected events require modification of this Closure Plan to demonstrate compliance with closure performance standards, a Closure Plan amendment will be submitted in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.42).

I-1a(3) Post-Closure Care

The post-closure care period will begin after completion of the first panel closure and will continue for thirty (30) years after final facility closure. The post-closure care period may be shortened or lengthened at the discretion of the regulatory agency based on evidence that human health and the environment are being protected or that they are at risk. During the post-closure period, the WIPP shall be maintained in a manner that complies with the environmental performance standards in 20.4.1.500 NMAC (incorporating 40 CFR §264.601). Post-closure activities are described in Permit Attachment J.

I-1b Requirements

The Permit specifies a sequential process for the closure of individual HWMUs at the WIPP. Each underground HWDU will undergo panel closure when waste emplacement in that panel is complete. Following waste emplacement in each underground HWDU, construction-side ventilation will be terminated and waste-disposal-side ventilation will be established in the next underground HWDU to be used, and the underground HWDU containing the waste will be closed. The Permittees will notify the NMED of the closure of each of the underground HWDUs as they are sequentially filled on a HWDU-by-HWDU basis. The HWMUs in the WHB and in the parking area will be closed as part of final facility closure of the WIPP facility.

The Permittees will notify the Secretary of the NMED in writing at least sixty (60) days prior to the date on which closure activities are scheduled to begin.

I-1c Maximum Waste Inventory

The WIPP will receive no more than 6.2 million ft^3 (175,600 m^3) of TRU mixed waste, which may include up to 250,000 ft^3 (7,080 m^3) of remote-handled (**RH**) TRU mixed waste. Excavations are mined as permitted when needed during operations to maintain a reserve of disposal areas. The amount of waste placed in each room is limited by structural and physical considerations of equipment and design. Waste volumes include waste received from off-site generator locations as well as derived waste from disposal and decontamination operations. The maximum volume of TRU mixed waste in a disposal panel is established in Module IV, Table IV.A.1 For closure planning purposes, a maximum achievable volume of 685,100 ft^3 (19,400 m^3) of TRU mixed waste per panel is used. This equates to 662,150 ft^3 (18,750 m^3) of contact-handled (**CH**) TRU mixed waste and 22,950 ft^3 (650 m^3) of RH TRU mixed waste per panel.

The maximum extent of operations during the term of this permit is expected to be Panels 1 through ~~7~~8 as shown on Figure I-1, the WHB Container Storage Unit, and the Parking Area Container Storage Unit. Note that panels 8, 9, and 10 are scheduled for excavation only under the initial term of this permit. If other waste management units are permitted during the Disposal Phase, this Closure Plan will be revised to include the additional waste management units. At any given time during disposal operations, it is possible that multiple rooms may be receiving TRU mixed waste for disposal at the same time. Underground HWDUs in which disposal has been completed (i.e., in which CH and RH TRU mixed waste emplacement activities have ceased) will undergo panel closure.

I-1d Schedule for Closure

For the purpose of establishing a schedule for closure, an operating and closure period of no more than thirty-five (35) years (twenty-five (25) years for disposal operations and ten (10) years for closure) is assumed. This operating period may be extended or shortened depending on a number of factors, including the rate of waste approved for shipment to the WIPP facility and the schedules of TRU mixed waste generator sites, and future decommissioning activities.

I-1d(1) Schedule for Panel Closure

The anticipated schedule for the closure of the underground HWDUs known as Panels 3 through 8 is shown in Figure I-2. This schedule assumes there will be little contamination within the exhaust drift of the panel. Underground HWDUs should be ready for closure according to the schedule in Table I-1. These dates are estimates for planning and permitting purposes. Actual dates may vary depending on the availability of waste from the generator sites.

In the schedule in Figure I-2, notification of intent to close occurs thirty (30) days before placing the final waste in a panel. Once a panel is full, the Permittees will initially block ventilation through the panel as described in Permit Attachment M2 and then will assess the closure area for ground conditions and contamination so that a definitive schedule and closure design can be determined. If as the result of this assessment the Permittees determine that a panel closure cannot be emplaced in accordance with the schedule in this Closure Plan, a modification will be submitted requesting an extension to the time for closure.

The Permittees will initially block ventilation through Panel 2 as described in Permit Attachment M2 once Panel 2 is full to ensure continued protection of human health and the environment. The Permittees will then install the explosion-isolation wall portion of the panel closure system that is described in Permit Attachment I1, Section 3.3.2, Explosion- and Construction-Isolation Walls. Construction of the explosion-isolation wall will not exceed 180 days after the last receipt of waste in Panel 2. Final closure of Panels 1 and 2 will be completed as specified in this Permit no later than January 31, 2016.

To ensure continued protection of human health and the environment, the Permittees will initially block ventilation through Panel 3 as described in Permit Attachment M2, Section M2-2a(3), after waste disposal in Panel 3 has been completed. The Permittees shall continue VOC monitoring in Panel 3 until final panel closure. If the measured concentration, as confirmed by a second sample, of any VOC in Panel 3 exceeds the "95% Action Level" in Module IV, Table IV.F.3.b, the Permittees will initiate closure of Panel 3 by installing the 12-foot explosion-isolation wall as described in Section I-1e(1) and submit a Class 1* permit modification request to extend Panel 3 closure, if necessary. Regardless of the outcome of disposal room VOC monitoring , final closure of Panel 3 will be completed as specified in this Permit no later than January 31, 2016.

I-1d(2) Schedule for Final Facility Closure

The Disposal Phase for the WIPP facility is expected to require a period of twenty-five (25) years beginning with the first receipt of TRU waste at the WIPP facility and followed by a period ranging from seven to ten (7-10) years for decontamination, decommissioning, and final closure. Assuming the first waste receipt occurs in July 1998, the Disposal Phase may extend until 2023, and so the latest expected year of final closure of the WIPP facility (i.e., date of final closure certification) would be 2033. If, as is currently projected, the WIPP facility is dismantled at closure, all surface and subsurface facilities (except the hot cell portion of the WHB, which will remain as an artifact of the Permanent Marker System [**PMS**]) will be disassembled and either salvaged or disposed in accordance with applicable standards. In addition, asphalt and crushed caliche that was used for paving will be removed, and the area will be recontoured and revegetated in accordance with a land management plan. A detailed closure schedule will be submitted in writing to the Secretary of the NMED, along with the notification of closure. Throughout the closure period, all necessary steps will be taken to prevent threats to human health and the environment in compliance with all applicable Resource Conservation and Recovery Act (**RCRA**) permit requirements. Figure I-3 presents the best estimate of a final facility closure schedule.

The schedule for final facility closure is considered to be a best estimate because closure of the facility is driven by policies and practices established for the decontamination, if necessary, and decommissioning of radioactively contaminated facilities. These required activities include extensive radiological contamination surveys and hazardous constituent surveys using, among other techniques, radiological surveys to indicate potential hazardous waste releases. Both types of surveys will be performed at all areas of the WIPP site where hazardous waste were managed. These surveys, along with historical radiological survey records, will provide the basis for release of structures, equipment, and components for disposal or decontamination for release off site. Specifications will be developed for each structure to be removed. A cost benefit analysis will be needed to evaluate decontamination options if extensive decontamination is necessary. Individual equipment surveys, structure surveys, and debris surveys will be required prior to disposition. Size-reduction techniques may be required to dispose of mixed or radioactive waste at the WIPP site. Current DOE policy, as reflected in the WIPP facility Safety Analysis Report (**SAR**) (DOE 1997), requires the preparation of a final decommissioning and decontamination (**D&D**) plan immediately prior to final facility closure. In this way, the specific conditions of the facility at the time D&D is initiated will be addressed. Section I-1e(2) provides a more detailed discussion of final facility closure activities.

Figure I-3 shows the schedule for the final facility closure consisting of decontamination, as needed, of the TRU waste-handling equipment, and of the aboveground equipment and facilities, including closure of surface HWMUs; decontamination of the shaft and haulage ways; disposal of decontamination derived wastes in the last open underground HWDU; and subsequent closure of this underground HWDU. Subsequent activities will include installation of repository shaft seals.

An overall schedule for final facility closure, showing currently scheduled dates for the start and end of final facility closure activities is shown in Table I-2. The dates assume a start up date of March 1999 and hazardous waste permit effective dates of September 1999, September 2009, and September 2019. Details for panel closures are shown on Table I-1.

I-1d(3) Extension for Closure Time

As indicated by the closure schedule presented in Figure I-3, the activities necessary to perform facility closure of the WIPP facility will require more than one hundred eighty (180) days to complete because of additional stringent requirements for managing radioactive materials. Therefore, the Permit provides an extension of the 180-day final closure requirement in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.113). During the extended closure period, the Permittees will continue to demonstrate compliance with applicable permit requirements and will take all steps necessary to prevent threats to human health and the environment as a result of TRU mixed waste management at the WIPP facility including all of the applicable measures in Permit Attachment E (Preparedness and Prevention).

In addition, according to the schedules in Figure I-3, the final derived wastes that are generated as the result of decontamination activities will not be disposed of for sixteen (16) months after the initiation of final facility closure. In accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.113(a)), the Permit provides an extension of the 90-day limit to dispose of final derived waste resulting from the closure process. This provision is necessitated by the fact that the radioactive nature of the derived waste makes placement in the WIPP the best disposition, and the removal of these wastes will, by necessity, take longer than ninety (90) days in accordance with the closure schedules. During this extended period of time, the Permittees will take all steps necessary to prevent threats to human health and the environment, including compliance with all applicable permit requirements. These steps include all of the applicable preparedness and prevention measures in Permit Attachment E.

Finally, in the event the hazardous waste permit is not renewed as assumed in the schedule, the Permittees will submit a modification to the Closure Plan to implement a contingency closure that will allow the Permittees to continue to operate for the disposal of non-mixed TRU waste. This modification will include a request for an extension of the time for final facility closure. This modified Closure Plan will be submitted to the NMED for approval.

I-1d(4) Amendment of the Closure Plan

If it becomes necessary to amend the Closure Plan for the WIPP facility, the Permittees will submit, in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.42), a written notification of or request for a permit modification describing any change in operation or facility design that affects the Closure Plan. The written notification or request will include a copy of the amended Closure Plan for approval by the NMED. The Permittees will submit a written notification of or request for a permit modification to authorize a change in the approved plan, if:

- There are changes in operating plans or in the waste management unit facility design that affect the Closure Plan
- There is a change in the expected year of closure
- Unexpected events occur during panel or final facility closure that require modification of the approved Closure Plan
- Changes in State or Federal laws affect the Closure Plan
- Permittees fail to obtain permits for continued operations as discussed above

The Permittees will submit a written request for a permit modification with a copy of the amended Closure Plan at least sixty (60) days prior to the proposed change in facility design or operation or within sixty (60) days of the occurrence of an unexpected event that affects the Closure Plan. If the unexpected event occurs during final closure, the permit modification will be requested within thirty (30) days of the occurrence. If the Secretary of the NMED requests a modification of the Closure Plan, a plan modified in accordance with the request will be submitted within sixty (60) days of notification or within thirty (30) days, if the change in facility condition occurs during final closure.

I-1e Closure Activities

Closure activities include those instituted for panel closure (i.e., closure of filled underground HWDUs), contingency closure (i.e., closure of surface HWMUs and decontamination of other waste handling areas), and final facility closure (i.e., closure of surface HWMUs, D&D of surface facilities and the areas surrounding the WHB, and placement of repository shaft seals). Panel closure systems will be emplaced to separate areas of the facility and to isolate panels. Permit Attachments I1 and I2 provide panel closure system and shaft seal designs. All closure activities will meet the applicable quality assurance (**QA**)/quality control (**QC**) program standards in place at the WIPP facility. Facility monitoring procedures in place during operations will remain in place through final closure, as applicable.

I-1e(1) Panel Closure

Following completion of waste emplacement in each underground HWDU, disposal-side ventilation will be established in the next panel to be used, and the panel containing the waste will be closed. A panel closure system will be emplaced in the panel access drifts, in accordance with the design in Permit Attachment I1 and the schedule in Figure I-2 and Table I-1. The panel closure system is designed to meet the following requirements that were established by the DOE for the design to comply with 20.4.1.500 NMAC (incorporating 40 CFR §264.601(a)):

- the panel closure system shall limit the migration of VOCs to the compliance point so that compliance is achieved by at least one order of magnitude
- the panel closure system shall consider potential flow of VOCs through the disturbed rock zone (**DRZ**) in addition to flow through closure components
- the panel closure system shall perform its intended functions under loads generated by creep closure of the tunnels
- the panel closure system shall perform its intended function under the conditions of a postulated methane explosion
- the nominal operational life of the closure system is thirty-five (35) years
- the panel closure system for each individual panel shall not require routine maintenance during its operational life
- the panel closure system shall address the most severe ground conditions expected in the waste disposal area

- the design class of the panel closure system shall be IIIb (which means that it is to be built to generally accepted national design and construction standards)
- the design and construction shall follow conventional mining practices
- structural analysis shall use data acquired from the WIPP underground
- materials shall be compatible with their emplacement environment and function
- treatment of surfaces in the closure areas shall be considered in the design
- thermal cracking of concrete shall be addressed
- during construction, a QA/QC program shall be established to verify material properties and construction practices
- construction of the panel closure system shall consider shaft and underground access and services for materials handling

The performance standard for air emissions from the WIPP facility is established in Module IV and Permit Attachment M2. Releases shall be below these limits for the facility to remain in compliance with standards to protect human health and the environment. The following panel closure design has been shown, through analysis, to meet these standards, if emplaced in accordance with the specifications in Permit Attachment I1.

The approved design for the panel closure system calls for a composite panel barrier system consisting of a rigid concrete plug with removal of the DRZ, and an explosion-isolation wall. The design basis for this closure is such that the migration of hazardous waste constituents from closed panels during the operational and closure period would result in concentrations well below health-based standards. The source term used as the design basis included the average concentrations of VOCs from CH waste containers as measured in headspace gases through January 1995. The VOCs are assumed to have been released by diffusion through the container vents and are assumed to be in equilibrium with the air in the panel. Emissions from the closed panel occur at a rate determined by gas generation within the waste and creep closure of the panel.

Figures I-4 and I-5 show a diagram of the panel closure design and installation envelopes. Permit Attachment I1 provides the detailed design and the design analysis for the panel closure system. Although the permit application proposed several panel closure design options, depending on the gas generated by wastes and the age of the mined openings, the NMED and EPA determined that only the most robust design option (D) would be approved. This decision does not prevent the Permittees from continuing to collect data on the behavior of the wastes and mined openings, or proposing a modification to the Closure Plan in the future, using the available data to support a request for reconsideration of one or more of the original design options. If a design different from Option D as defined in Permit Attachment I1 is proposed, the appropriate permit modification will be sought.

I-1e(2) Decontamination and Decommissioning

Decontamination is defined as those activities which are performed to remove contamination from surfaces and equipment that are not intended to be disposed of at the WIPP facility. The policy at the WIPP will be to decontaminate as many areas as possible, consistent with radiation protection policy. Decontamination is part of all closure activities and is a necessary activity in the clean closure of the surface container management units. Decontamination determinations are based upon radiological and hazardous constituent surveys.

Decommissioning is the process of removing equipment, facilities, or surface areas from further use and closing the facility. Decommissioning is part of final facility closure only and will involve the removal of equipment, buildings, closure of the shafts, and establishing active and passive institutional controls for the facility. Passive institutional controls are not included in the Permit.

The objective of D&D activities at the WIPP facility is to return the surface to as close to the preconstruction condition as reasonably possible, while protecting the health and safety of the public and the environment. Major activities required to accomplish this objective include, but are not limited to the following:

1. Review of operational records for historical information on releases
2. Visual examination of surface structures for evidence of spills or releases
3. Performance of site contamination surveys
4. Decontamination, if necessary, of usable equipment, materials, and structures including surface facilities and areas surrounding the WHB.
5. Disposal of equipment/materials that cannot be decontaminated but that meet the treatment, storage, and disposal facility waste acceptance criteria (**TSDF-WAC**) in an underground HWDU
6. Emplacement of final panel closure system
7. Emplacement of shaft seals[3]

[3] For the purposes of planning, the conclusion of shaft sealing is used by the DOE as the end of closure activities and the beginning of the Post-Closure Care Period.

8. Regrading the surface to approximately original contours

9. Initiation of active controls

This Closure Plan will be amended prior to the initiation of closure activities to specify the methods to be used.

Health and Safety

Before final closure activities begin, health physics personnel will conduct a hazards survey of the unit(s) being closed. A release of radionuclides could also indicate a release of hazardous constituents. If radionuclides are not detected, sampling for hazardous constituents will still be performed if there is documentation or visible evidence that a spill or release has occurred. The purpose of the hazards survey will be to identify potential contamination concerns that may present hazards to workers during the closure activities and to specify any control measures necessary to reduce worker risk. This survey will provide the information necessary for the health physics personnel to identify worker qualifications, personal protective equipment (**PPE**), safety awareness, work permits, exposure control programs, and emergency coordination that will be required to perform closure related activities.

I-1e(2)(a) Determine the Extent of Contamination

The first activities performed as part of decontamination include those needed to determine the extent of any contamination that needs to be removed prior to decommissioning a facility. This includes activities 1 to 3 above and, as can be seen by the schedules in Figures I-3 and I-4 (Items B and C), these surveys are anticipated to take ten (10) months to perform, including obtaining the results of any sample analyses. The process of identifying areas that require decontamination include three sources of information. First, operating records will be reviewed to determine where contamination has previously been found as the result of historical releases and spills. Even though releases and spills will have been cleaned up at the time of occurrence, newer equipment and technology may allow further cleaning. Second, surfaces of facilities and structures will be examined visually for evidence of spills or releases. Finally, extensive detailed contamination surveys will be performed to document the level of cleanliness for all surface structures and equipment. If equipment or areas are identified as contaminated, the Permittees will notify NMED as specified in Permit Module I, and a plan and procedure(s) will be developed and implemented to address decontamination-related questions, including:

- Should the component be decontaminated or disposed of as waste?
- What is the most cost-effective method of decontaminating the component?
- Will the decontamination procedures adequately contain the contamination?

Radiological and hazardous constituent surveys will be used in determining the presence of hazardous waste and hazardous waste residues in areas where spills or releases have occurred.

Radiological surveys are described in Permit Attachment I3. Once cleanup of the radioactivity has been completed, the surface will be sampled for hazardous constituents specified in Permit Attachment O to determine that they, too, have been cleaned up. Sampling and analysis protocols will be consistent with EPA's document SW-846 (EPA, 1996).

I-1e(2)(b) Decontamination Activities

Once the extent of contamination is known, decontamination activities will be planned and performed. Radiological control and the control of hazardous waste residues are the primary criteria used in the design of decontamination activities. Radiation control procedures require that careful planning and execution be used in decontamination activities to prevent the exposure of workers beyond applicable standards and to prevent the further spread of contamination. Careful control of entry, cleanup, and ventilation are vital components of radiation decontamination. The level of care mandated by DOE orders and occupational protection requirements results in closure activities that will exceed the one hundred eighty (180) days allowed in 20.4.1.500 NMAC (incorporating 40 CFR §264.113(b)). Decontamination activities are included as item 4 above and are shown on the schedules for contingency closure and final facility closure (Figures I-3 and I-4) as activities D, E, and F. These activities are anticipated to have a duration of twenty (20) months for both contingency closure and for final facility closure. The result of these activities is the clean closure of the surface container management units. Under contingency closure, the other areas that have been decontaminated will not be closed. Instead they will remain in use for continued waste management activities involving non-mixed waste. Under final facility closure, other areas that are decontaminated are eligible for closure.

The "Start Clean—Stay Clean" operating philosophy of the WIPP Project will provide for minimum need for decontamination. However, the need for decontamination techniques may arise.

Decontamination activities will be coordinated with closure activities so that areas that have been decontaminated will not be recontaminated. All waste resulting from decontamination activities will be surveyed and analyzed for the presence of radioactive contamination and hazardous constituents specified in Permit Attachment O. The waste will be characterized as hazardous, mixed, or radioactive and will be packaged and handled appropriately. Mixed and radioactive waste will be classified as TRU mixed waste managed in accordance with the applicable Permit requirements. Derived mixed waste collected during decontamination activities that are generated before repository shafts have been sealed will be emplaced in the facility, if appropriate, or will be managed together with decontamination derived waste collected after the underground is closed. This waste will be classified and shipped off site to an appropriate, permitted facility for treatment, if necessary, and for disposal.

Removal of Hazardous Waste Residues

Because of the type of waste management activities that will occur at the WIPP facility, waste residues that may be encountered during the operation of the facility and at closure may include derived waste. Derived wastes result from the management of the waste containers or may be collected as part of the closure activities (such as those during which wipes were used to sample the containers and equipment for potential radioactive contamination or those involving solidified decontamination solutions, the handling of equipment designated for disposal, and the handling of residues collected as a result of spill cleanup). Derived wastes collected during the operation and closure of the WIPP facility will be identified and managed as TRU mixed wastes. These wastes will be disposed in the active underground HWDU. D&D derived wastes and equipment designated for disposal will be placed in the last underground HWDU panel before closure of that unit.

Surface Container Storage Units

The procedures employed for waste receipt at the WIPP facility minimize the likelihood for any waste spillage to occur outside the WHB. TRU mixed waste is shipped to the WIPP facility in approved shipping containers (i.e., Contact-Handled or Remote-Handled Packages) that are not opened until they are inside the WHB. Therefore, it is unlikely that soil in the Parking Area Unit or elsewhere in the vicinity of the WHB will become contaminated with TRU mixed waste constituents as a result of TRU mixed waste management activities. An evaluation of the soils in the vicinity of the WHB will only be necessary if a documented event resulting in a release has occurred outside the WHB.

The "Start Clean—Stay Clean" operating philosophy of the WIPP Project will minimize the need for decontamination of the WHB during decommissioning and closure. Procedures for opening shipping containers in the WHB limit the opportunity for waste spillage.

Should the need for decontamination of the WHB arise, the following methods may be employed, as appropriate, for the hazardous constituent/contaminant type and extent:

- Chemical cleaning (e.g., water, mild detergent cleanser, and polyvinyl alcohol)
- Nonchemical cleaning (e.g., sandblasting, grinding, high-pressure water spray, scabbler pistons and needle scalers, ice-blast technology, dry-ice blasting)
- Removal of contaminated components such as pipe and ductwork

Waste generated as a result of WHB decontamination activities will be managed as derived waste in accordance with applicable permit requirements and will be emplaced in the last open underground HWDU for disposal.

Waste Handling Equipment and

The waste shaft conveyance and associated waste handling equipment will be decontaminated to background or be disposed as derived waste as part of both contingency and final facility closure. Procedures for detection and sampling will be as described above. Equipment cleanup will be as above using chemical or nonchemical techniques.

Personnel Decontamination

PPE worn by personnel performing closure activities in areas determined to be contaminated will be disposed of appropriately. Disposable PPE used in such areas will be placed into containers and managed as TRU mixed waste. Non-disposable PPE will be decontaminated, if possible. Non-disposable PPE that cannot be decontaminated will be managed as TRU mixed waste.

In accordance with DOE policy, TRU mixed waste PPE will be considered to be contaminated with all of the hazardous waste constituents contained in the containers that have been managed within the unit being closed. Wastes collected as a result of closure activities and that may be contaminated with radioactive and hazardous constituents will be considered TRU mixed wastes. These wastes will be managed as derived wastes, as described in Permit Attachment M2. Such waste, collected as the result of closure of the WIPP facility, will be disposed of in the final open underground HWDU.

Cleanup Criteria

Radiation decontamination will be less than or equal to the following levels, or to whatever lesser levels that may be established by DOE Order at the time of cleanup:

Contamination Type	Loose[4]
	Fixed plus removable
alpha contamination (α)	20 dpm/100 cm^2
	500 dpm/100 cm^2
beta-gamma contamination (β-γ)	200 dpm/100 cm^2
	1000 dpm/100 cm^2

Hazardous waste decontamination will be conducted in accordance with standards in 20.4.1.500 NMAC (incorporating 40 CFR §264) or as incorporated into the Permit.

Final Contamination Sampling and Quality Assurance

Verification samples will be analyzed by an approved laboratory that has been qualified by the DOE according to a written program with strict criteria. The QA requirements of EPA/SW-846, "Test Methods for Evaluating Solid Waste" (EPA, 1986), will be met for hazardous constituent sampling and analyses.

[4] The unit "dpm" stands for "disintegration per minute" and is the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

Quality Assurance/Quality Control

Because decisions about closure activities may be based, in part, on analyses of samples of potentially contaminated surfaces and media, a program to ensure reliability of analytical data is essential. Data reliability will be ensured by following a QA/QC program that mandates adequate precision and accuracy of laboratory analyses. Field documentation will be used to document the conditions under which each sample is collected. The documented QA/QC program in place at the WIPP facility will meet applicable RCRA QA requirements.

Field blanks and duplicate samples will be collected in the field to determine potential errors introduced in the data from sample collection and handling activities. To determine the potential for cross-contamination, rinsate blanks (consisting of rinsate from decontaminated sampling equipment) will be collected and analyzed. At least one rinsate blank will be collected for every 20 field samples. Duplicate samples will be collected at a frequency of one duplicate sample for every ten field samples. In no case will less than one rinsate blank or duplicate sample be collected for a field-sampling effort. These blank and duplicate samples will be identified and treated as separate samples. Acceptance criteria for QA/QC hazardous constituent sample analyses will adhere to the most recent version of EPA SW-846 or other applicable EPA guidance.

I-1e(2)(c) Dismantling

Final facility closure will include dismantling of structures on the surface and in the underground. These are items 6 and 7 above and are represented as Activity G in the final facility closure schedule in Figure I-4. During dismantling, priority will be given to contaminated structures and equipment that cannot be decontaminated to assure these are properly disposed of in the remaining open underground HWDU in a timely manner. All such facilities and equipment are expected to be removed and disposed of sixteen (16) months after the initiation of closure. Dismantling of the balance of the facility, including those structures and equipment that are not included in the application and are not used for TRU mixed waste management, is anticipated to take an additional sixty-six (66) months. It should be noted that the placement of D&D waste into the final underground HWDU may, by necessity, involve the placement of uncontainerized bulk materials such as concrete components, building framing, structural members, disassembled or partially disassembled equipment, or containerized materials in non-standard waste boxes. Such placement will only occur if it can be shown that it is protective of human health and the environment and all items are described in an amendment to the Closure Plan. Identification of bulk items is not possible at this time since their size and quantity will depend on the extent of non-removable contamination.

I-1e(2)(d) Closure of Open Underground HWDU

The closure of the final underground HWDU is shown by Activity H in Figure I-3. This closure will be consistent with the description in Section I-1e(1) and the design in Permit Attachment I1. Detailed closure schedules for underground HWDUs are given in Figure I-2 and Table I-1.

I-1e(2)(e) Final Facility Closure

Final facility closure includes several activities designed to assure both the short-term isolation of the waste and the long-term integrity of the disposal system. These include the placement of plugs in boreholes that penetrate the salt and the placement of the repository sealing system. In addition, the surface will be returned to as near its original condition as practicable, and will be readied for the construction of markers and monuments that will provide permanent marking of the repository location and contents.

Figure I-6 identifies where ten existing boreholes overlie the proximate area of the repository footprint. Of these identified boreholes in Figure I-6, all but ERDA-9 are terminated hundreds of feet above the repository horizon. Only ERDA-9, which is accounted for in long-term performance modeling, is drilled through the repository horizon, near the WIPP excavations.

To mitigate the potential for migration beyond the repository horizon, the DOE has specified that borehole seals be designed to limit the volume of water that could be introduced to the repository from the overlying water-bearing zones and to limit the volume of contaminated brine released from the repository to the surface or water-bearing zones.

Borehole plugging activities have been underway since the 1970s, from the early days of the development of the WIPP facility. Early in the exploratory phase of the project, a number of boreholes were sunk in Lea and Eddy counties. After the WIPP site was situated in its current location, an evaluation of all vertical penetrations was made by Christensen and Peterson (1981).

As an initial criterion, any borehole that connects a fluid-producing zone with the repository horizon becomes a plugging candidate.

Grout plugging procedures are routinely performed in standard oil-field operations; however, quantitative measurements of plug performance are rarely obtained. The Bell Canyon Test reported by Christensen and Peterson (1981) was a field test demonstration of the use of cementitious plugging materials and modification of existing industrial emplacement techniques to suit repository plugging requirements. Cement emplacement technology was found to be "generally adequate to satisfy repository plugging requirements." Christensen and Peterson (1981) also report "that grouts can be effective in sealing boreholes, if proper care is exercised in matching physical properties of the local rock with grout mixtures. Further, the reduction in fluid flow provided by even limited length plugs is far in excess of that required by bounding safety assessments for the WIPP." The governing regulations for plugging and/or abandonment of boreholes are summarized in Table I-3.

The proposed repository sealing system design will prevent water from entering the repository and will prevent gases or brines from migrating out of the repository. The proposed design includes the following subsystems and associated principal functions:

- Near-surface: to prevent subsidence at and around the shafts
- Rustler Formation: to prevent subsidence at and around the shafts and to ensure compliance with Federal and State of New Mexico groundwater protection requirements
- Salado Formation: to prevent transporting hazardous waste constituents beyond the point of compliance specified in Permit Module V

The repository sealing system will consist of natural and engineered barriers within the WIPP repository that will withstand forces expected to be present because of rock creep, hydraulic pressure, and probable collapses in the repository and will meet the closure requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.601 and §264.111). Permit Attachment I2 presents the final repository sealing system design.

Once shaft sealing is completed, the Permittees will consider closure complete and will provide the NMED with a certification of such within sixty (60) days.

I-1e(2)(f) <u>Final Contouring and Revegetation</u>

In the preparation of its Final Environmental Impact Statement (DOE, 1980), the DOE committed to restore the site to as near to its original condition as is practicable. This involves removal of access roads, unneeded utilities, fences, and any other structures built by the DOE to support WIPP operations. Provisions would be left for active post-closure controls of the site and for the installation of long-term markers and monuments for the purpose of permanently marking the location of the repository and waste. Permit Attachment J-1a(1) discusses the active and long-term controls proposed for the WIPP. Installation of borehole seals are anticipated to take twelve (12) months, shaft seals fifty-two (52) months, and final surface contouring eight (8) months.

I-1e(2)(g) <u>Closure, Monuments, and Records</u>

A record of the WIPP Project shall be listed in the public domain in accordance with the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.116). Active access controls will be employed for at least the first one hundred (100) years after final facility closure. In addition, a passive control system consisting of monuments or markers will be erected at the site to inform future generations of the location of the WIPP repository (see "Permanent Marker Conceptual Design Report" [DOE, 1995b]).

This Permit requires only a thirty (30) year post-closure period. This is the maximum post-closure time frame allowed in an initial Permit for any facility, as specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.117(a)). The Secretary of the NMED may shorten or extend the post-closure care period at any time in the future prior to completion of the original post-closure period (30 years after the completion of construction of the shaft seals). The Permanent Marker Conceptual Design Report and other provisions during the first 100 years after closure are addressed under another Federal regulatory program.

Closure of the WIPP facility will contribute to the following:

- Prevention of the intrusion of fluids into the repository by sealing the shafts
- Prevention of human intrusion after closure
- Minimization of future physical and environmental surveillance

Detailed records shall be filed with local, State, and Federal government agencies to ensure that the location of the WIPP facility is easily determined and that appropriate notifications and restrictions are given to anyone who applies to drill in the area. This information, together with land survey data, will be on record with the U.S. Geological Survey and other agencies. The Federal government will maintain permanent administrative authority over those aspects of land management assigned by law. Details of post-closure activities are in Permit Attachment J.

I-1e(3) Performance of the Closed Facility

20.4.1.500 NMAC (incorporating 40 CFR §264.601) requires that a miscellaneous unit be closed in a manner that protects human health and the environment. The RCRA Part B permit application addressed the expected performance of the closed facility during the thirty (30) year post closure period. Groundwater monitoring will provide information on the performance of the closed facility during the post-closure care period, as specified in Section J-1a(2) (Monitoring) of Permit Attachment J.

The principal barriers to the movement of hazardous constituents from the facility or the movement of waters into the facility are the halite of the Salado Formation (natural barrier) and the repository seals (engineered barrier). Data and calculations that support this discussion were presented in the permit application. The majority of the calculations performed for the repository are focused on long-term performance and making predictions of performance over 10,000 years. In the short term, the repository is reaching a steady state configuration where the hypothetical brine inflow rate is affected by the increasing pressure in the repository due to gas generation and creep closure. These three phenomena are related in the numerical modeling performed to support the permit application. The modeling parameters, assumptions and methodology were described in detail in the permit application.

I-2 Notices Required for Disposal Facilities

I-2a Certification of Closure

Within sixty (60) days after completion of closure activities for a HWMU (i.e., for each storage unit and each disposal unit), the Permittees will submit to the Secretary of the NMED a certification that the unit (and, after completion of final closure, the facility) has been closed in accordance with the specifications of this Closure Plan. The certification will be signed by the Permittees and by an independent New Mexico registered professional engineer. Documentation supporting the independent registered engineer's certification will be furnished to the Secretary of the NMED with the certification.

I-2b Survey Plat

Within sixty (60) days of completion of closure activities for each underground HWDU, and no later than the submission of the certification of closure of each underground HWDU, the Permittees will submit to the Secretary of the NMED a survey plat indicating the location and dimensions of hazardous waste disposal units with respect to permanently surveyed benchmarks. The plat will be prepared and certified by a professional land surveyor and will contain a prominently displayed note that states the Permittees' obligation to restrict disturbance of the hazardous waste disposal unit. In addition, the land records in the Eddy County Courthouse, Carlsbad, New Mexico, will be updated through filing of the final survey plats.

References

Christensen, C. L., and Peterson, E. W. 1981. "Field-Test Programs of Borehole Plugs in Southeastern New Mexico." In The *Technology of High-Level Nuclear Waste Disposal Advances in the Science and Engineering of the Management of High-Level Nuclear Wastes*, P. L. Hofman and J. J. Breslin, eds., SAND79-1634C, DOE/TIC-4621, Vol. 1, pp. 354–369. Technical Information Center of the U.S. Department of Energy, Oak Ridge, TN.

DOE, see U.S. Department of Energy

EPA, see U.S. Environmental Protection Agency

U.S. Department of Energy, 1980, "Final Environmental Impact Statement, Waste Isolation Pilot Plant," DOE/EIS 0026, U.S. Department of Energy, Washington, D.C.

U.S. Department of Energy, 1995b, "Permanent Marker Conceptual Design Report," from Appendix PMR of the *Draft Compliance Certification Application*, Draft-DOE/CAO-2056, U.S. Department of Energy, Carlsbad, NM.

U.S. Department of Energy, 1997, "WIPP Safety Analysis Report," DOE/WIPP-95-2065, Revision 1, U.S. Department of Energy, Carlsbad, NM.

U.S. Environmental Protection Agency, 1996, "Test Methods for Evaluating Solid Waste," SW-846, U.S. Environmental Protection Agency, Washington, D.C.

TABLES

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TABLE I-1
ANTICIPATED EARLIEST CLOSURE DATES FOR THE UNDERGROUND HWDUS

HWDU	OPERATIONS START	OPERATIONS END	CLOSURE START	CLOSURE END
PANEL 1	3/99*	3/03*	3/03*	7/03* SEE NOTE 5
PANEL 2	3/03*	10/05*	10/05*	3/06* SEE NOTE 5
PANEL 3	4/05*	2/07*	2/07*	2/07* SEE NOTE 6
PANEL 4	1/07*	1/09	2/09	8/09 SEE NOTE 6
PANEL 5	1/09	1/11	2/11	8/11 SEE NOTE 6
PANEL 6	1/11	1/13	2/13	8/13 SEE NOTE 6
PANEL 7	1/13	1/15	2/15	8/15 SEE NOTE 6
PANEL 8	1/15	1/17	2/17	8/17
PANEL 9	1/17	1/28	2/28	SEE NOTE 4
PANEL 10	1/28	9/30	10/30	SEE NOTE 4

* Actual date

NOTE 1: Only Panels 1 to 4 will be closed under the initial term of this permit. Closure schedules for Panels 5 through 10 are projected assuming new permits will be issued in 2009 and 2019.

NOTE 2: The point of closure start is defined as sixty (60) days following notification to the NMED of closure.

NOTE 3: The point of closure end is defined as one hundred eighty (180) days following placement of final waste in the panel.

NOTE 4: The time to close these areas may be extended depending on the nature and extent of the disturbed rock zone. The excavations that constitute these panels will have been opened for as many as forty (40) years so that the preparation for closure may take longer than the time allotted in Figure I-2. If this extension is needed, it will be requested as an amendment to the Closure Plan.

NOTE 5: The anticipated closure end date for Panels 1 and 2 is for installation of the 12-foot explosion-isolation wall. Final closure of Panels 1 and 2 will be completed as specified in this Permit no later than January 31, 2016.

NOTE 6: The anticipated closure end date for Panels 3 through 7 is for initially blocking ventilation through the filled panel. Final closure of Panels 3 through 7 will be completed as specified in this Permit no later than January 31, 2016.

TABLE I-2
ANTICIPATED OVERALL SCHEDULE FOR CLOSURE ACTIVITIES

ACTIVITY	FINAL FACILITY CLOSURE	
	START	STOP
Notify NMED of Intent to Close WIPP (or to Implement Contingency Closure)	October 2030	N/A
Perform Contamination Surveys in both Surface Storage Areas	October 2030	April 2031
Sample Analysis	December 2030	July 2031
Decontamination as Necessary of both Surface Storage Areas	June 2031	January 2032
Final Contamination Surveys of both Surface Storage Areas	February 2032	September 2032
Sample Analysis	June 2032	January 2033
Prepare and Submit Container Management Unit Closure Certification	February 2033	May 2033
Dispose of Closure-Derived Waste	November 2030	January 2032
Closure of Open Underground HWDU panel	February 2032*	September 2032
Install Borehole Seals	October 2032	September 2033
Install Repository Seals	June 2033	September 2037
Recontour and Revegetate	October 2037	May 2038
Prepare and Submit Final (Contingency) Closure Certification	October 2037	May 2038
Post-closure Monitoring	July 2038	N/A

N/A--Not Applicable
Refer to Figures I-3 and I-4 for precise activity titles.

*This assumes the final waste is placed in this unit in January 2032 and notification of closure for this HWDU is submitted to the NMED in December 2031.

TABLE I-3
GOVERNING REGULATIONS FOR BOREHOLE ABANDONMENT

Federal or State Land	Type of Well or Borehole	Governing Regulation	Summary of Requirements
Both	Groundwater Surveillance	State and Federal regulation in effect at time of abandonment	Monitor wells no longer in use shall be plugged in such a manner as to preclude migration of surface runoff or groundwater along the length of the well. Where possible, this shall be accomplished by removing the well casing and pumping expanding cement from the bottom to the top of the well. If the casing cannot be removed, the casing shall be ripped or perforated along its entire length if possible, and grouted. Filling with bentonite pellets from the bottom to the top is an acceptable alternative to pressure grouting.
Federal	Oil and Gas Wells	43 CFR Part 3160, §§ 3162.3-4	The operator shall promptly plug and abandon, in accordance with a plan first approved in writing or prescribed by the authorized officer.
Federal	Potash	43 CFR Part 3590, § 3593.1	(b) Surface boreholes for development or holes for prospecting shall be abandoned to the satisfaction of the authorizing officer by cementing and/or casing or by other methods approved in advance by the authorized officer. The holes shall also be abandoned in a manner to protect the surface and not endanger any present or future underground operation, any deposit of oil, gas, or other mineral substances, or any aquifer.
State	Oil and Gas Well Outside the Oil-Potash Area	State of New Mexico, Oil Conservation Division, Rule 202 (eff. 3-1-91)	B. Plugging (1) Prior to abandonment, the well shall be plugged in a manner to permanently confine all oil, gas, and water in the separate strata where they were originally found. This can be accomplished by using mud-laden fluid, cement, and plugs singly or in combination as approved by the Division on the notice of intention to plug. (2) The exact location of plugged and abandoned wells shall be marked by the operator with a steel marker not less than four inches (4") in diameter, set in cement, and extending at least four feet (4') above mean ground level. The metal of the marker shall be permanently engraved, welded, or stamped with the operator name, lease name, and well number and location, including unit letter, section, township, and range.
State	Oil and Gas Wells Inside the Oil-Potash Area	State of New Mexico, Oil Conservation Division, Order No. R-111-P (eff. 4-21-88)	F. Plugging and Abandonment of Wells (1) All existing and future wells that are drilled within the potash area, shall be plugged in accordance with the general rules established by the Division. A solid cement plug shall be provided through the salt section and any water-bearing horizon to prevent liquids or gases from entering the hole above or below the salt selection. It shall have suitable proportions—but no greater than three (3) percent of calcium chloride by weight—of cement considered to be the desired mixture when possible.

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FIGURES

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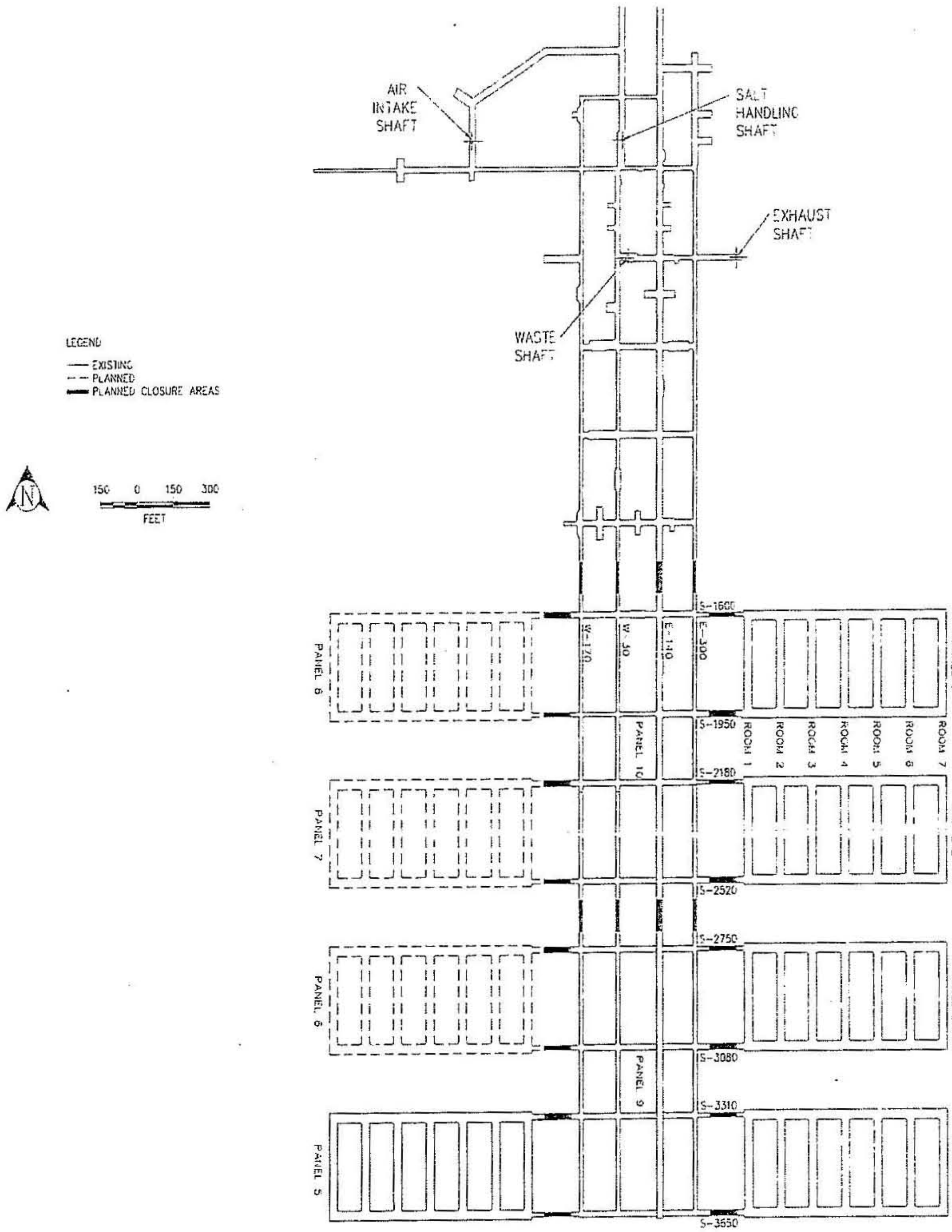

Figure I-1
Location of Underground HWDUs and Anticipated Closure Locations

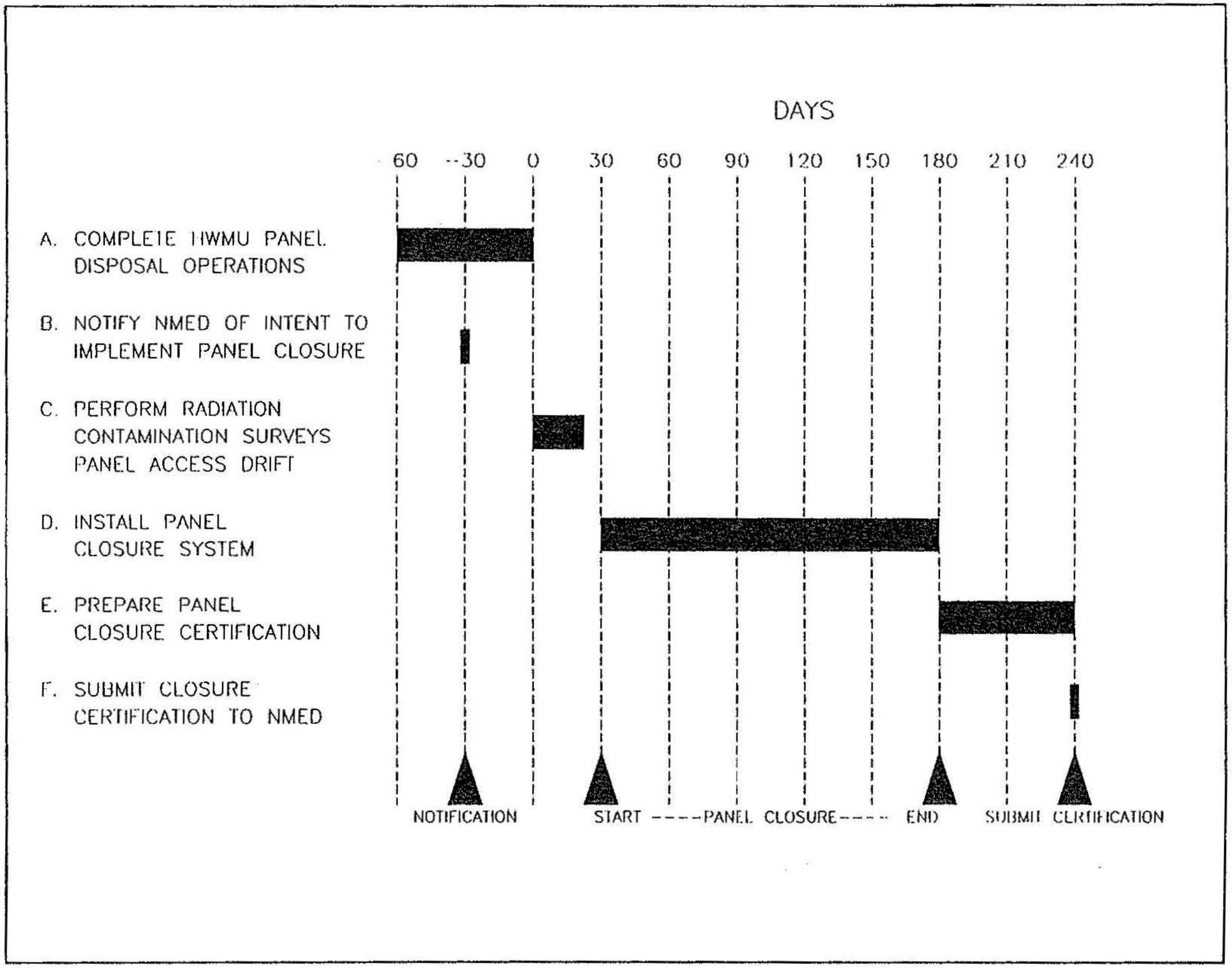

Figure I-2
WIPP Panel Closure Schedule

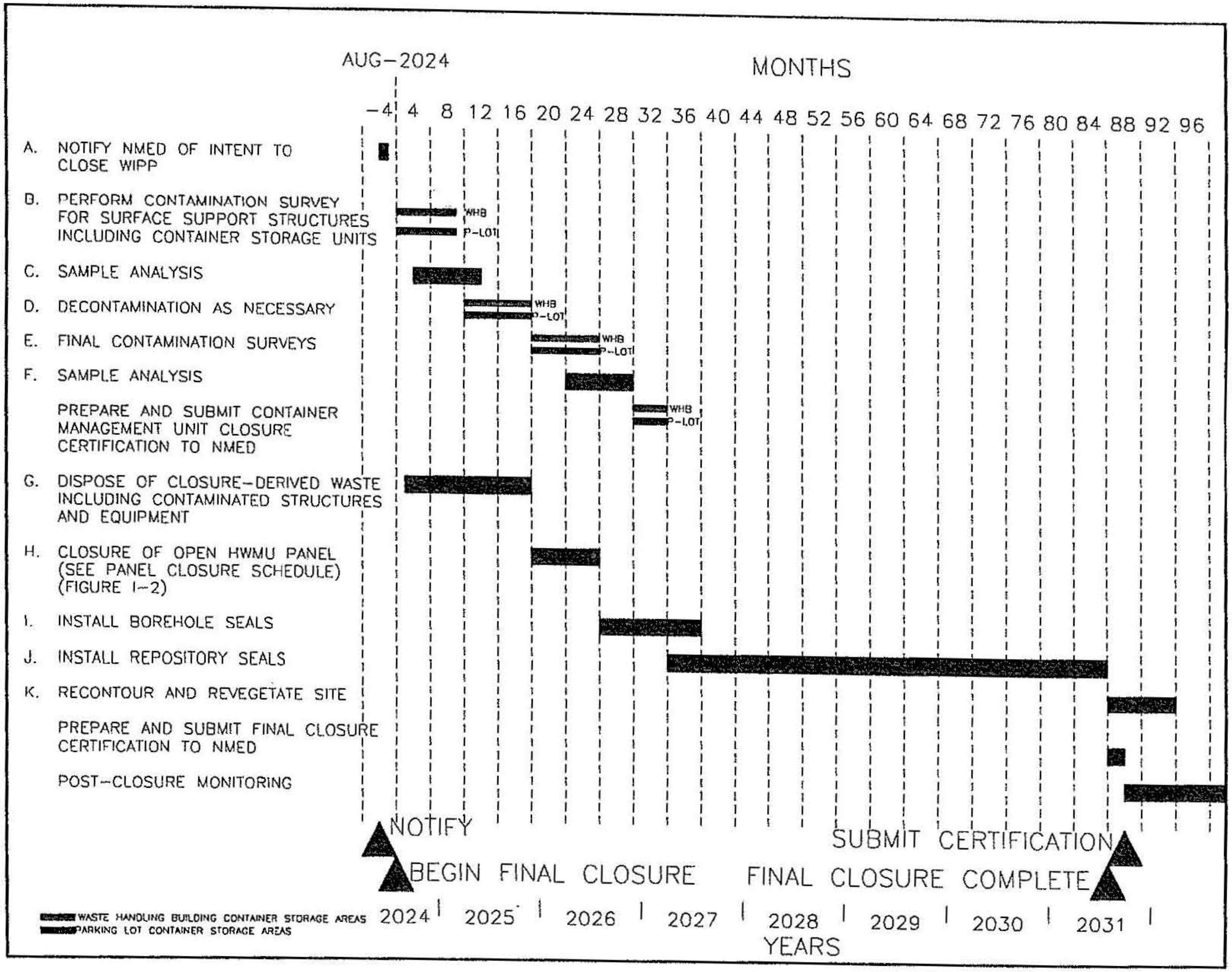

Figure I-3
WIPP Facility Final Closure Schedule

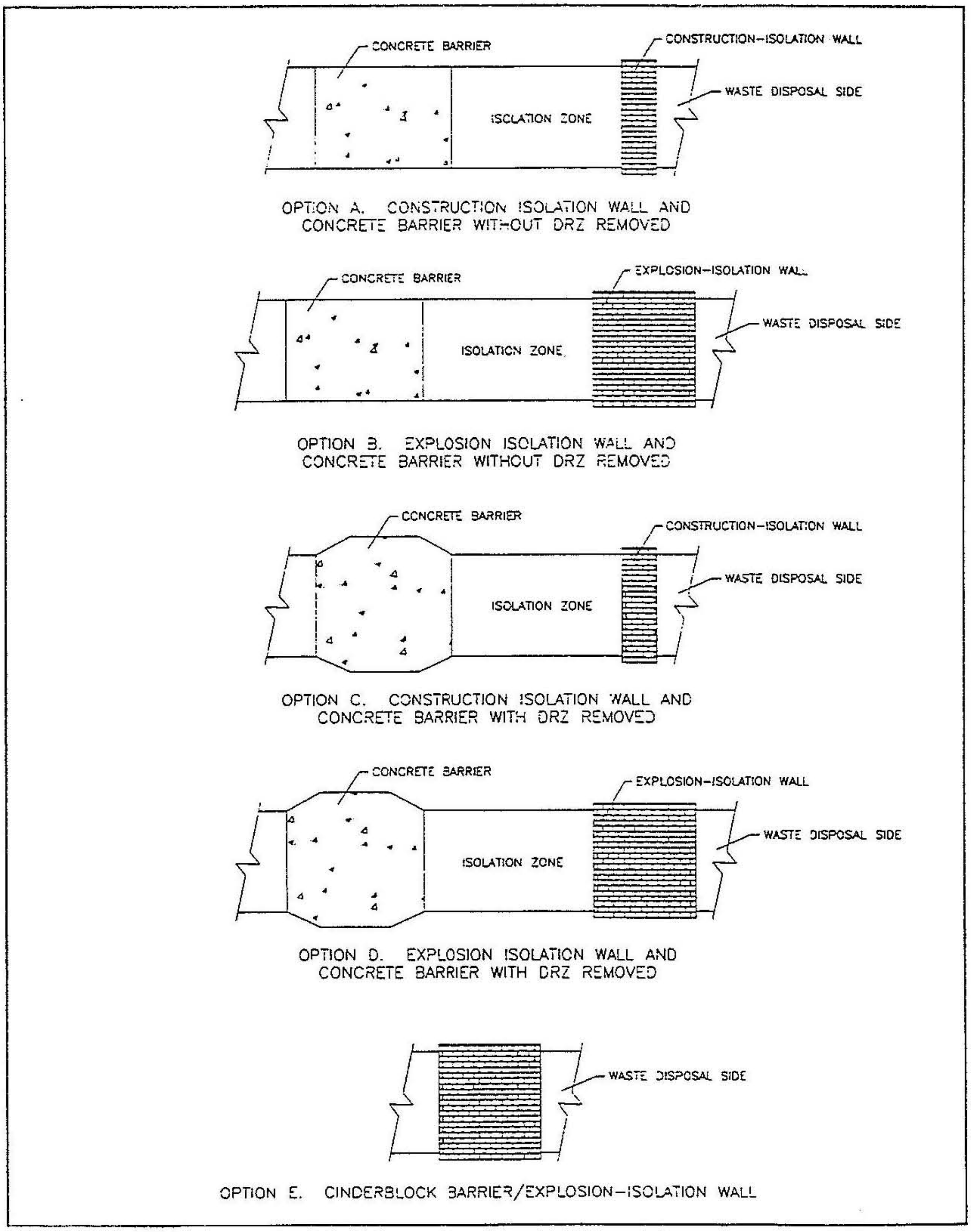

Figure I-4
Design of a Panel Closure System

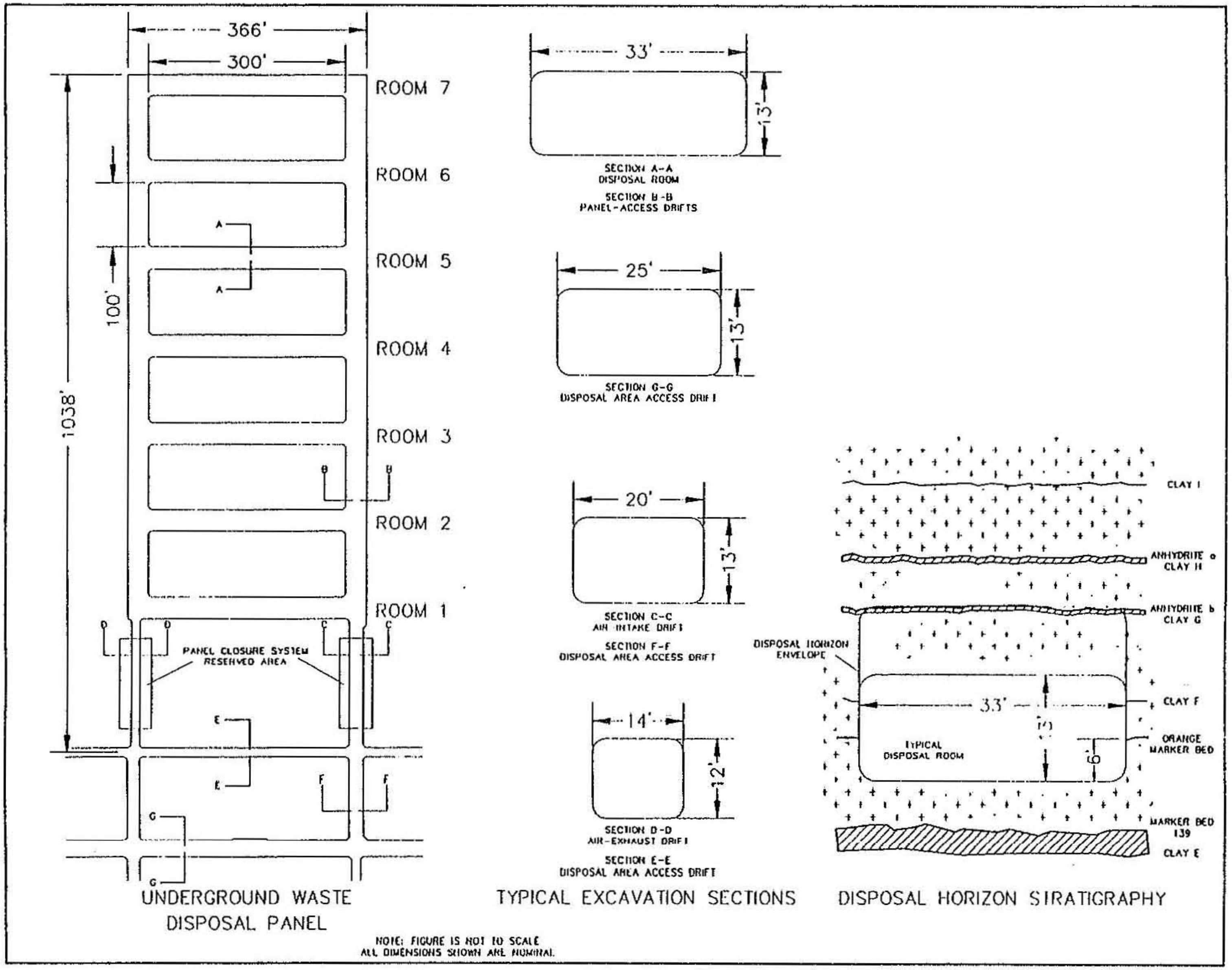

Figure I-5
Typical Disposal Panel

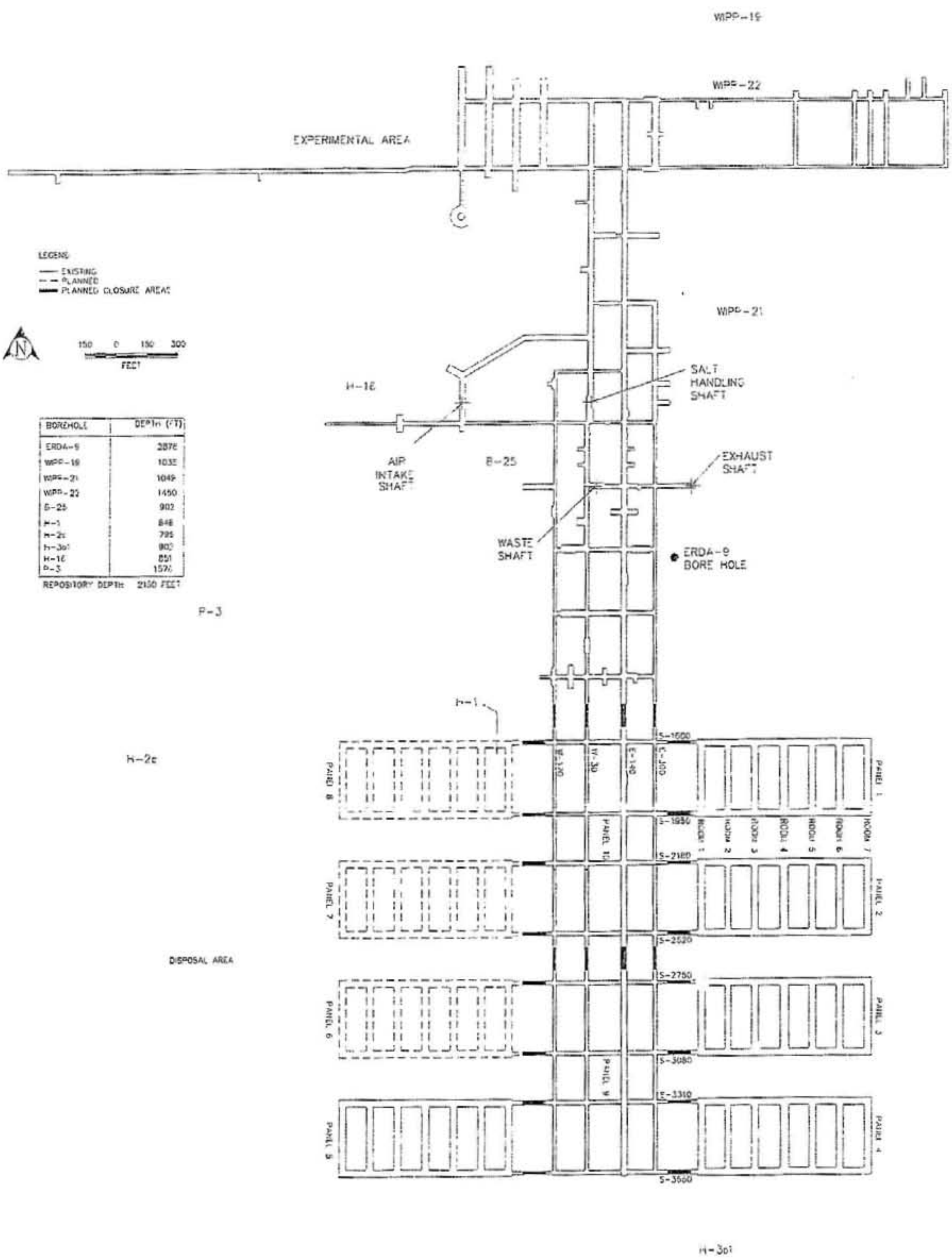

Figure I-6
Approximate Locations of Boreholes in Relation to the WIPP Underground

APPENDIX I1

DETAILED DESIGN REPORT FOR AN OPERATION PHASE PANEL CLOSURE SYSTEM

Adapted from DOE/WIPP 96-2150

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APPENDIX I1

DETAILED DESIGN REPORT FOR AN OPERATION PHASE PANEL CLOSURE SYSTEM

TABLE OF CONTENTS

*Appendices A through F are not included in the Permit.

List of Tables

List of Figures

List of Abbreviations/Acronyms

ACI	American Concrete Institute
AISC	American Institute for Steel Construction
*CFR	Code of Federal Regulations
cm	centimeter
°C	degrees celsius
°F	degrees Fahrenheit
DOE	U.S. Department of Energy
DRZ	disturbed rock zone
EEP	Excavation Effects Program
ESC	expansive salt-saturated concrete
FLAC	Fast Lagrangian Analysis of Continua
ft	foot (feet)
GPR	ground-penetrating radar
Kips	1,000 pounds
m	meter(s)
MB 139	Marker Bed 139
MOC	Management and Operating Contractor (Permit Condition I.D.3)
MPa	megapascal(s)
MSHA	Mine Safety and Health Administration
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NaCl	sodium chloride
NMVP	no-migration variance petition
psi	pound(s) per square inch
RCRA	Resource Conservation and Recovery Act
SMC	Salado Mass Concrete
TRU	transuranic
VOC	volatile organic compound(s)
WIPP	Waste Isolation Pilot Plant

APPENDIX I1

DETAILED DESIGN REPORT FOR AN OPERATION PHASE PANEL CLOSURE SYSTEM

Executive Summary

Scope. Under contract to the Management and Operating Contractor (**MOC**), IT Corporation has prepared a detailed design of a panel-closure system for the Waste Isolation Pilot Plant (**WIPP**). Preparation of this detailed design of an operational-phase closure system is required to support a Resource Conservation and Recovery Act (**RCRA**) Part B permit application. This report describes the detailed design for a panel-closure system specific to the WIPP site. The recommended panel-closure system will adequately isolate the waste-emplacement panels for at least 35 years.

The report was modified to make it a part of the RCRA Permit issued by the New Mexico Environment Department. The primary change required in the original report was to specify that Panel Closure Design Options A, B, C and E are not approved as part of the facility Permit. Option D is the most robust of the original group of options, and it was specified in the Permit as the design to be constructed for all panel closures. The concrete to be used for panel closures is salt-saturated Salado Mass Concrete as specified in Permit Attachment I1, Appendix G, instead of the proposed plain concrete. The Permittees may submit proposals to modify the Permit (Module II), the Closure Plan (Permit Attachment I) and this Appendix (identified as Permit Attachment I1) in the future, as specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.42).

Other changes included in this version of the report revised for the permit are minor edits to regulatory citations, deletion of references to the No Migration Variance Petition (no longer required under 40 CFR 268.6), and movement of all figures to the end of the document. Appendices A through F in the original document are not included in this Permit Attachment. Although those Appendices were important in demonstrating that the panel closures will meet the performance standards in the hazardous waste regulations, they do not provide design details or plans to be implemented as Permit requirements. References to these original Appendices were modified to indicate that they were part of the permit application, but are not included in the Permit. In contrast, Appendix G (Technical Specifications) and Appendix H (Design Drawings) are necessary components of future activities and are retained as parts of this Permit Attachment.

Purpose. This report provides detailed design and material engineering specifications for the construction, emplacement, and interface-grouting associated with a panel-closure system at the WIPP repository, which would ensure that an effective panel-closure system is in place for at least 35 years. The panel-closure system provides assurance that the limit for the migration of volatile organic compounds (**VOC**) will be met at the point of compliance, the WIPP site boundary. This assurance is obtained through the inherent flexibility of the panel-closure system. The panel-closure system will be located in the air-intake and air-exhaust drifts (Figure I1-1). The system components have been designed to maintain their intended functional requirements under loads generated from salt creep, internal pressure, and a postulated methane explosion. The design complies with regulatory requirements for a panel-closure system promulgated by RCRA and the Mine Health and Safety Administration (**MSHA**). The design uses common construction practices according to existing standards.

Background. The engineering design considers a range of expected subsurface conditions at the location of a panel-closure system. The geology is predominantly halite with interbedded anhydrite at the repository horizon. During the operational period, the panel-closure system would be subject to creep from the surrounding host rock that contains trace amounts of brine.

During the conceptual design stage, two air-flow models were evaluated: (1) unrestricted flow and (2) restricted flow through the panel-closure system. The “unrestricted” air flow model is defined as a model in which the gas pressure that develops is at or very near atmospheric pressure such that there exists no back pressure in the disposal areas. Flow is unrestricted in this model. The “restricted” air flow model is defined as a model in which the back pressure in the waste emplacement panels develops due to the restriction of flow through the barrier, and the surrounding disturbed rock zone. The analysis was based on an assumed gas generation rate of 8,200 moles per panel per year (0.1 moles per drum per year) due to microbial degradation, an expected volumetric closure rate of 28,000 cubic feet (800 cubic meters) per year due to salt creep, the expected headspace concentration for a series of nine VOCs, and the expected air dispersion from the exhaust shaft to the WIPP site boundary. The analysis indicated that the panel-closure system would limit the concentration of each VOC at the WIPP site boundary to a small fraction of the health-based exposure limits during the operational period.

Alternate Designs. Various options were evaluated considering active systems, passive systems, and composite systems. Consideration of the aforementioned factors led to the selection of a passive panel-closure system consisting of an enlarged tapered concrete barrier which will be grouted at the interface and an explosion-isolation wall. This system provides flexibility for a range of ground conditions likely to be encountered in the underground repository. No other special requirements for engineered components beyond the normal requirements for fire suppression and methane explosion or deflagration containment exist for the panel-closure system during the operational period.

The panel-closure system design incorporates mitigative measures to address the treatment of fractures and therefore minimizes the potential migration of contaminants. The design includes excavating the disturbed rock zone (**DRZ**) and emplacing an enlarged concrete barrier.

To be effective, the excavation and installation of the panel-closure system must be completed within a short time frame to minimize disturbance to the surrounding salt. A rigid concrete barrier will promote interface stress buildup, as fractures are expected to heal with time. For this purpose, the main concrete barrier would be tapered to reduce shear stress and to increase compressive stress along the interface zone.

Design Classification. Procedure WP 09-CN3023 (Westinghouse, 1995a) was used to establish a design classification for the panel-closure system. It uses a decision-flow-logic process to designate the panel-closure system as a Class IIIB structure. This is because during the methane explosion the concrete barrier would not fail.

Design Evaluations. To investigate several key design issues, design evaluations were performed. These design evaluations can be divided into those that satisfy (1) the operational requirements of the system and (2) the structural and material requirements of the system.

The conclusions reached from the evaluations addressing the operational requirements are as follows:

- Based on an air-flow model used to predict the mass flow rate of carbon tetrachloride through the panel-closure system for the alternatives, the air-flow analysis suggests that the fully enlarged barrier provides the highest protection for restricting VOCs during the operational period of 35 years.
- Results of the Fast Lagrangian Analysis of Continua (**FLAC**) analyses show that the recommended enlarged configuration is a circular rib-segment excavated to Clay G and under MB 139. Interface grouting would be performed at the upper boundary of the concrete barrier.
- The results of the transverse plane-strain models show that higher stresses would form in MB 139 following excavation, but that after installation of the panel-closure system, the barrier confinement will result in an increase in barrier-confining stress and a reduction in shear stress. The main concrete barrier would provide substantial uniform confining stresses as the barrier is subjected to secondary salt creep.
- The removal of the fractured salt prior to installation of the main concrete barrier would reduce the potential for flexure. The fracturing of MB 139 and the attendant fracturing of the floor could reduce structural load resistance (structural stiffness), which could initially result in barrier flexure and shear. With the removal of MB 139, the fractured salt stiffens the surrounding rock and results in the development of more uniform compression.
- The trade-off study also showed that a panel-closure system with an enlarged concrete barrier with the removal of the fractured salt roof and anhydrite in the floor was found to be the most protective.

The conclusions reached from the design evaluations addressing the structural and material requirements of the panel-closure system are as follows:

- Existing information on the heat of hydration of the concrete supports placing concrete with a low cement content to reduce the temperature rise associated with hydration. Plasticizers might be used to achieve the required slump at the required strength. A thermal analysis, coupled with a salt creep analysis, suggests installation of the enlarged barrier at or below ambient temperatures to adequately control hydration temperatures.

- In addition to installation at or below ambient temperatures, the concrete used in the main barrier would exhibit the following:
  - An 8 inch (0.2 meter) slump after 3 hours of intermittent mixing
  - A less-than-25-degree Fahrenheit heat rise prior to installation
  - An unconfined compressive strength of 4,000 pounds per square inch (psi) (28 megapascals [MPa]) after 28 days
  - Volume stability
  - Minimal entrained air.
- The trace amounts of brine from the salt at the repository horizon will not degrade the main concrete barrier for at least 35 years.
- In 20 years, the open passage above the waste stack would be reduced in size. Further, rooms with bulkheads at each end would be isolated in the panel. It is unlikely that a long passage with an open geometry would exist; therefore, the dynamic analysis considered a deflagration with a peak explosive pressure of 240 psi (1.7 MPa).
- The heat-transfer analysis shows that elevated temperatures would occur within the salt and the explosion-isolation wall; however, the elevated temperatures will be isolated by the panel-closure system. Temperature gradients will not significantly affect the stability of the wall.
- The fractures in the roof and floor could be affected by expanding gas products reaching pressures on the order of 240 psi (1.7 MPa). Because the peak internal pressure from the deflagration is only one fifth of the pressure, fractures could not propagate beyond the barrier.

A composite system is selected for the design with various components to provide flexibility. These design options are described below.

Design Options. Figure I1-2 illustrates the options developed to satisfy the requirements for the panel-closure system. The basis for selecting an option depends on conditions at the panel-closure system locations as would be documented by future subsurface investigations. As noted earlier, Option D is the only option approved for construction as part of the facility permit issued by the NMED.

While no specific requirements exist for barricading inactive waste areas under the MSHA, their intent is to safely isolate these abandoned areas from active workings using barricades of “substantial construction.” A previous analysis (DOE, 1995) examined the issue of methane gas generation from transuranic waste and the potential consequence in closed areas. The principal concern is whether an explosive mixture of methane with an ignition source would result in deflagration. A concrete block wall of sufficient thickness will be used to resist dynamic and salt creep loads.

It was shown (DOE, 1995) that an explosive atmosphere may exist after approximately 20 years.

Design Components. The enlarged concrete barrier location within the air-intake and air-exhaust drifts will be determined following observation of subsurface conditions. The enlarged concrete barrier will be composed of salt-saturated Salado Mass Concrete with sufficient unconfined compressive strength. The barrier will consist of a circular rib segment excavated into the surrounding salt where the central portion of the barrier will extend just beyond Clay G and MB 139. FLAC analyses showed that plain concrete will develop adequate confined compressive strength.

The enlarged concrete barrier will be placed in four cells, with construction joints formed perpendicular to the direction of potential air flow. The concrete will be placed through 6-inch (15.2 centimeter) diameter steel pipes and will be vibrated from outside the formwork. The formwork is designed to withstand the hydrostatic loads that would occur during installation with minimal bracing onto exposed salt surfaces. This will be accomplished by a series of steel plates that are stiffened by angle iron, with load reactions carried by spacer rods. Some exterior bracing will be required when the concrete is poured into the first cell at the location for the enlarged concrete barrier. All structural steel will be American Society of Testing and Materials [grade] A36 in conformance with the latest standards specified by the American Institute for Steel Construction. After concrete placement, the formwork will be left in place and will stiffen the enlarged concrete barrier if nonuniform reactive loadings should occur after panel closure.

After completion of the enlarged concrete barrier installation, it will be grouted through a series of grout supply and air return lines that terminate in grout boxes. The boxes will be mounted near the top of the barrier. The grout will be injected through one set of lines and returned through a second set of air lines.

An explosion-isolation wall, constructed with concrete-blocks, will mitigate the effects of a methane explosion. The explosion-isolation wall would consist of 3,500 psi (24 MPa) concrete blocks mortared together with a bonding agent. The concrete-block wall design complies with MSHA requirements, because it consists of noncombustible materials of “substantial construction.” The concrete-block walls will be keyed into the salt. For the WIPP, an explosion-isolation wall is designed to resist loading from salt creep.

The compliance of the detailed design was evaluated against the design requirements established for the panel-closure system. The design complies with all aspects of the design basis established for the panel-closure system.

1.0 Introduction

The Waste Isolation Pilot Plant (**WIPP**) repository, a U.S. Department of Energy (**DOE**) research facility located near Carlsbad, New Mexico, is approximately 2,150 feet (ft) (655 meters [m]) below the surface, in the Salado Formation. The WIPP facility consists of a northern experimental area, a shaft-pillar area, and a waste-emplacement area. The WIPP facility will be used to dispose transuranic (**TRU**) mixed waste.

One important aspect of future repository operations at the WIPP is the activities associated with closure of waste-emplacement panels. Each panel consists of air-intake and air-exhaust drifts, panel-access drifts, and seven rooms (Figure I1-1). After completion of waste-emplacement activities, each panel will be closed, while waste emplacement may be occurring in the other panel(s). The closure of individual panels during the operational period will be conducted in compliance with project-specific health, safety, and environmental performance criteria.

1.1 Scope

This report provides information on the detailed design and material engineering specifications for the construction, installation, and interface grouting associated with a panel-closure system for a minimum operational period of 35 years. The panel-closure system design provides assurance that the limit for the migration of volatile organic compounds (**VOC**) will be met at the point of compliance, the WIPP site boundary. This assurance is obtained through the inherent flexibility of the panel closure system. The panel-closure system will be located in the air-intake and air-exhaust drifts to each panel (Figure I1-1). The panel-closure system design maintains its intended functional requirements under loads generated from salt creep, internal panel pressure, and a postulated methane explosion. The design complies with regulatory requirements for a panel-closure system promulgated by the Resource Conservation and Recovery Act (**RCRA**) and Mine Safety and Health Administration (**MSHA**) (see citations in Section 1.3 below).

Figure I1-3 illustrates the design process used for preparing the detailed design. The design process commenced with the evaluation of the performance requirements of the panel-closure system through review of the work performed in developing the conceptual design and the “Underground Hazardous Waste Management Unit Closure Criteria for the Waste Isolation Pilot Plant Operation Phase” (Westinghouse, 1995b). The various design evaluations were performed to address specific design-implementation issues identified by the project. The results of these design evaluations are presented in this report.

1.2 Design Classification

Procedure WP 09-CN3023 (Westinghouse, 1995a) was used to establish a design classification for the panel-closure system. The design classification for the panel-closure system evolved from addressing the short-term operational issues regarding the reduction of VOC migration. Figure I1-4 shows the decision flow logic process used to designate the panel-closure system as a Class IIIB structure.

1.3 Regulatory Requirements

The following subsections discuss the regulatory requirements specified in RCRA and MSHA for the panel-closure system.

1.3.1 Resource Conservation and Recovery Act (40 CFR 264 and 270)

In accordance with 20.4.1.500 NMAC, incorporating Title 40, Code of Federal Regulations (**CFR**), Part 264, Subpart X (40 CFR 264, Subpart X), "Miscellaneous Units," and 20.4.1.900 NMAC, incorporating 40 CFR 270.23, "Specific Part B Information Requirements for Miscellaneous Units," a RCRA Part B permit application has been submitted for the WIPP facility.

1.3.2 Protection of the Environment and Human Health

The WIPP RCRA Part B permit application indicates that VOCs must not exceed health-based standards beyond the WIPP site boundary. Worker exposure to VOCs, and VOC emissions to non-waste workers or to the nearest resident will not pose greater than a 10^{-6} excess cancer risk in order to meet health-based standards. The panel-closure system design incorporates measures to mitigate VOC migration for compliance with these standards.

1.3.3 Closure Requirements (20 New Mexico Administrative Code 4.1, Subpart V)

The Permittees will notify the Secretary of the New Mexico Environment Department in writing at least 60 days prior to the date on which partial and final closure activities are scheduled to begin.

1.3.4 Mining Safety and Health Administration

The significance of small natural-gas occurrences within the WIPP repository is within the classification of Category IV for natural gas under the MSHA (30 CFR 57, Subpart T) (MSHA, 1987). These regulations include the hazards of methane gas and volatile dust. Category IV "applies to mines in which non-combustible ore is extracted and which liberate a concentration of methane that is not explosive nor capable of forming explosive mixtures with air based on the history of the mine or the geological area in which the mine is located." For "barriers and stoppings," the regulations provide for noncombustible materials (where appropriate) for the specific mine category and require that "barriers and stoppings" be of "substantial construction." Substantial construction implies construction of such strength, material, and workmanship that the barrier could withstand air blasts, methane detonation or deflagration, blasting shock, and ground movement expected in the mining environment.

1.4 Report Organization

This report presents the engineering package for the detailed design of the panel-closure system. Chapter 2.0 presents the design evaluations. Chapter 3.0 describes the design and Chapter 4.0

presents the Constructability Design Calculations Index. Chapter 5.0 shows the technical specifications. Chapter 6.0 presents the design drawings. The conclusions are presented in Chapter 7.0 and the references presented in Chapter 8.0. Appendices to this report provide detailed information to support the information contained in Chapters 2.0 through 7.0 of this report.

2.0 Design Evaluations

This chapter in the Part B permit application presented the results of the various design evaluations that support the panel-closure system: (1) analyses addressing the operational requirements, and (2) analyses addressing the structural and material requirements. These evaluations were important in demonstrating that the panel closures will adequately restrict releases of VOCs and will be structurally stable during the operations phase of the WIPP. However, these evaluations are not necessary as part of the facility permit and have been deleted from this edited document.

3.0 Design Description

This chapter presents the final design selected from the evaluations performed in the previous chapter. It presents design modifications to cover a range of conditions that may be encountered in the underground and describes the design components for the panel-closure system. Finally, information is presented on the proposed construction for the panel-closure system.

3.1 Design Concept

The composite panel-closure system proposed in the permit application included (1) a standard concrete barrier, rectangular in shape, or (2) an enlarged tapered concrete barrier. Options (1) and (2) were both proposed to be grouted along the interface and may contain explosion- or construction-isolation walls. Figure I1-2 illustrates these design components. The construction methods and materials to be used to implement the design have been proven in previous mining and construction projects. The standard concrete barrier without DRZ removal was intended to apply to future panel air-intake and air-exhaust drifts where the time duration between excavation and barrier emplacement is short. The enlarged concrete barrier with DRZ removal and explosion-isolation wall is the only option approved in the RCRA facility Permit. The design concept for the enlarged concrete barrier incorporates:

- A concrete barrier that is tapered to promote the rapid stress buildup on the host rock. The stiffness was selected to provide rapid buildup of compressive stress and reduction in shear stress in the host rock.

- The enlarged barrier requires DRZ removal just beyond Clay G and MB 139, and to a corresponding distance in the ribs to keep the tapered shape approximately spherical. The design includes DRZ removal and thereby limits VOC flow through the panel-closure system.

- The design of the approved panel-closure system includes an explosion-isolation wall designed to provide strength and deformational serviceability during the operational period. The length was selected to assure that uniform compression develops over a substantial portion of the structure and that end-shear loading that might result in fracturing of salt into the back is reduced.

3.2 Design Options

The design options consist of the following:

- An enlarged concrete barrier with the DRZ removed and a construction-isolation wall

- An enlarged concrete barrier with the DRZ removed and an explosion-isolation wall (This is the only option approved in the RCRA facility Permit.)

- A rectangular concrete barrier without the DRZ removed and a construction-isolation wall

- A rectangular concrete barrier without the DRZ removed and an explosion-isolation wall.

In each case, interface grouting will be used for the upper barrier/salt interface to compensate for any void space between the top of the barrier and the salt. The process for selecting these options was proposed to depend on the subsurface conditions at the panel-closure system locations described in the following subsections.

Observation boreholes will be drilled into the roof or floor of the new air-intake and air-exhaust drifts and will be used for observation of fractures and bed separation. Observations can be made in the boreholes using a small video camera, or a scratch rod. A scratch rod survey will be performed in accordance with the current Excavation Effects Program (**EEP**) procedure.

The EEP was initiated in 1986 with the occurrence of fractures in Site and Preliminary Design Validation Room 3. The purpose of the EEP is to study fractures that develop as a result of underground excavation at the WIPP and to monitor those fractures. Borehole inspections have been successful for determining the fracturing and bed separation in the host rock. These inspections have been performed since 1983 (Francke and Terrill, 1993). This technique in addition to the above will be used to determine the optimum location for the panel-closure system.

Since the enlarged barrier is required to be constructed for all panel closures, the proposed DRZ investigations are not required as part of the RCRA facility Permit.

3.3 Design Components

The following subsections present system and components design features.

3.3.1 Concrete Barrier

The enlarged concrete barrier consists of Salado Mass Concrete, with sufficient unconfined compressive strength and with an approximately circular cross-section excavated into the salt over the central portion of the barrier (Figure I1-5). The enlarged concrete barrier will be located at the optimum locations in the air-intake and air-exhaust drifts with the central portion extending just beyond Clay G and MB 139.

The enlarged concrete barrier will be placed in four cells, with construction joints perpendicular to the direction of potential air flow. The concrete strength will be selected according to the standards specified by the latest edition of the ACI code for plain concrete. The concrete will be placed through 6-inch- (15-cm)-diameter steel pipes and vibrated from outside the formwork. The formwork is designed to withstand the hydrostatic loads during construction, with minimal bracing onto exposed salt surfaces. This will be accomplished by placing a series of steel plates that are stiffened by angle iron, with load reactions carried by spacer rods. The spacer rods will be staggered to reduce potential flow along the rod surfaces through the barrier. Some exterior bracing will be required when the first cell is poured. All structural steel will be ASTM A36, with detailing, fabrication, and erection of structural steel in conformance with the latest edition of the AISC steel manual (AISC, 1989). After concrete placement, the formwork will be left in place.

The above design is for the most severe conditions expected to be encountered at the WIPP.

3.3.2 Explosion- and Construction-Isolation Walls

An explosion-isolation wall, consisting of concrete-blocks, will mitigate the effects of a postulated methane explosion. The explosion-isolation wall consists of 3,500-psi (24-MPa) concrete blocks mortared together with cement (Figure I1-6).

The concrete block wall design complies with MSHA requirements (MSHA, 1987) because it uses incombustible materials of substantial construction. The explosion-isolation wall will be placed into the salt for support. The explosion-isolation walls are designed to resist creep loading from salt deformation. In the absence of the postulated methane explosion, the design was proposed to be simplified to a construction-isolation wall. The construction-isolation wall design provides temporary isolation during the time the main concrete barrier is being constructed. The construction-isolation wall was not approved as part of the RCRA facility Permit.

3.3.3 Interface Grouting

After construction of the main concrete barrier, the interface between the main concrete barrier and the salt will be grouted through a series of grout-supply and air-return lines that will terminate in grout distribution collection boxes. The openings in these boxes will be protected during concrete placement (Figure I1-7). The grout boxes will be mounted near the top of the barrier. The grout will be injected through one distribution system, with air and return grout flowing through a second distribution system.

3.4 Panel-Closure System Construction

The construction methods and materials to be used to implement the design have been proven in previous mining and construction projects. The design uses common construction practices according to existing standards. The proposed construction sequence follows completion of the waste-emplacement activities in each panel: (1) Perform subsurface exploration to determine the optimum location for the panel closure system, (2) select the appropriate design option for the location, (3) prepare surfaces for the construction- or explosion-isolation walls, (4) install these walls, (5) excavate for the enlarged concrete barrier (if required), (6) install concrete formwork, (7) emplace concrete for the first cell, (8) grout the completed cell, and (9) install subsequent formwork, concrete and grout until completion of the enlarged concrete barrier. (Step 2 above is not required as part of the RCRA facility Permit, because there are no design options to choose between.)

The explosion-isolation wall will be located approximately 30 feet from the main concrete barrier. The host rock will be excavated 6 inches (15 cms) around the entire perimeter prior to installing the explosion-isolation wall. The surface preparation will produce a level surface for placing the first layer of concrete blocks. Excavation may be performed by either mechanical or manual means.

Excavation for the enlarged concrete barrier will be performed using mechanical means, such as a cutting head on a suitable boom. The existing roadheader at the main barrier location in each drift is capable of excavating the back and the portions of the ribs above the floor level. Some manual excavation may be required in this situation as well. If mechanical means are not available, drilling boreholes and an expansive agent can be used to fragment the rock (Fernandez et al., 1989). Excavation will follow the lines and grades established for the design. The roof will be excavated to just above Clay G and then the floor to just below MB 139 to remove the DRZ. The tolerances for the enlarged concrete-barrier excavation are +6 to 0 inches (+15 to 0 cm). In addition, loose or spalling rock from the excavation surface will be removed to provide an appropriate surface abutting the enlarged concrete barrier. The excavations will be performed according to approved ground control plans.

Following completion of the roof excavation for the enlarged barrier, the floor will be excavated. If mechanical means are not available, drilling boreholes and using an expansive agent to fragment the rock (Fernandez et al., 1989) is a method that can be used. Expansive agents would load the rock salt and anhydrite, producing localized tensile fracturing in a controlled manner, to produce a sound surface.

A batch plant at the surface or underground will be prepared for batching, mixing, and delivering the concrete to the underground in sufficient quantity to complete placement of the concrete within one form cell. The placement of concrete will be continuous until completion, with a time for completing one section not to exceed 10 hours, allowing an additional 2 hours for cleanup of equipment.

Pumping equipment suitable for placing the concrete into the forms will be provided at the main concrete barrier location. After transporting, and prior to pumping, the concrete will be remixed to compensate for segregation of aggregate during transport. Batch concrete will be checked at the surface at the time of mixing and again at the point of transfer to the pump for slump and temperature. Admixtures may be added at the remix stage in accordance with the batch design.

4.0 Design Calculations

Table I1-1 summarizes calculations to support the construction details for an explosion-isolation

Table I1-1
Constructability Design Calculations Index

Section	Design Area	Category
1.0	Explosion-isolation wall	W
2.0	Explosion-isolation wall seismic check	S
3.0	Formwork design	F

wall, construction-isolation wall, and structural steel formwork for concrete barriers up to 29-ft high. The codes for the explosion-isolation and construction-isolation wall are specified by the Uniform Building Code (International Conference of Building Officials, 1994), with related seismic design requirements. The external loads for the solid block wall are as developed in the methane-explosion and fracture propagation design evaluations.

The structural formwork for all cells is designed in accordance with the AISC guidelines on allowable stress (AISC, 1989). Lateral pressures are developed using ACI 347R-88, using a standard concrete weighing 150 pounds per cubic foot (2,410 kg/m^3) with a slump of 8 inches (20 cm) or less. Design loadings reflect full hydrostatic head of concrete, with lifts spaced at 4 ft (1.2 m) intervals from bottom to top through portals, with no external vibration. All forms will remain in place.

5.0 Technical Specifications

The specifications are in the engineering file room at the WIPP and are the property of the MOC. These specifications are included as an attachment in Appendix G and summarized in Table I1-2.

Table I1-2
Technical Specifications for the WIPP Panel-Closure System

Division 1 - General Requirements	
Section 01010	Summary of Work
Section 01090	Reference Standards
Section 01400	Contractor Quality Control
Section 01600	Material and Equipment
Division 2 - Site Work	
Section 02010	Mobilization and Demobilization
Section 02222	Excavation
Section 02722	Grouting
Division 3 - Concrete	
Section 03100	Concrete Formwork
Section 03300	Cast-in-Place Concrete
Division 4 - Masonry	
Section 04100	Mortar
Section 04300	Unit Masonry System

6.0 Drawings

The drawings (Appendix H) are in the engineering file room at the WIPP and are the property of the MOC and summarized in Table I1-3.

Table I1-3
Panel-Closure System Drawings

Drawing Number	Title
762447-E1	Title Sheet
762447-E2	Underground Waste Disposal Plan
762447-E3	Air Intake Drift Construction Details
762447-E4	Air Exhaust Drift Construction Details
762447-E5	Construction and Explosion Barrier Construction Details
762447-E6	Grouting and Miscellaneous Details

7.0 Conclusions

This chapter presents the conclusions for the detailed design activities of the panel-closure system. A design basis, including the operational requirements, the structural and material requirements, and the construction requirements, was developed that addresses the governing regulations for the panel-closure system. Table I1-4 summarizes the design basis for the panel-closure system and the compliance with the design basis. The panel-closure system design incorporates mitigative measures to address the treatment of fractures and therefore counter the potential migration of VOCs. Several alternatives were evaluated for the treatment of fractures. These included excavation and emplacement of a fully enlarged barrier with removal of the DRZ, excavation of the roof and emplacement of a partially enlarged barrier, and emplacement of a standard barrier with formation grouting.

To investigate several key design issues and to implement the design, design evaluations were performed. These design evaluations can be divided into evaluations satisfying the operational requirements of the system and evaluations satisfying the structural and materials requirements of the system. The conclusions reached from the evaluations addressing the operational requirements are as follows:

- Based on an air-flow model used to predict the mass flow rate of carbon tetrachloride through the panel-closure system for the alternatives, the air-flow analysis suggests that the fully enlarged barrier is the most protective for restricting VOCs during the operational period of 35 years.

- Results of the FLAC analyses show that the recommended enlarged configuration is a circular rib-segment excavated to Clay G and under MB 139. Interface grouting would be performed at the upper boundary of the concrete barrier.

- The results of the transverse plane-strain models show that high stresses would form in MB 139 following excavation, but that after installation of the panel-closure system, an increase in barrier-confining stress and a reduction in shear stress would result. The concrete barrier would provide substantial uniform confining stresses as the barrier is subjected to secondary salt creep.

- The removal of the fractured salt prior to installation of the main concrete barrier would reduce the potential for flexure. With the removal of MB 139, the fractured salt stiffens the surrounding rock and results in the development of more uniform compression.

- The trade-off study also showed that a panel-closure system with an enlarged concrete barrier with the removal of the fractured salt roof and anhydrite in the floor was found to be the most protective.

1 Table I1-4
2 Compliance of the Design with the Design Requirements

Type of Requirement	Requirement	Section	Compliance with Requirement	Notes on Compliance
Operational	Individual panels shall be closed in accordance with the schedule of actual waste emplacement.	2.1.1	Complies	Gas-flow models used for design are based on the waste-emplacement operational schedule.
	The panel-closure system shall provide assurance that the limit for the migration of volatile organic compounds (**VOC**) of concern will be met at the point of compliance. To achieve this assurance, the design shall consider the potential flow of VOCs through the several components of the disturbed rock zone and the panel-closure system.	2.1.1, 2.1.2	Complies	Gas-flow modeling shows that the VOC flow is less than the design migration limit.
	The panel-closure system shall comply with its intended functional requirements under loads generated from creep closure and any internal pressure that might develop in the disposal panel under reasonably anticipated conditions.	2.1.2, 4.0	Complies	Stress analyses and design calculations show that the panel-closure system performs as intended.
	The panel-closure system shall comply with its intended functional requirements under a postulated methane explosion.	2.2.3, 2.2.4, 4.0	Complies	The methane explosion studies, fracture propagation studies, and supporting design calculations show that the panel-closure system performs as intended.
	The operational life of the panel-closure system shall be at least 35 years.	2.1.1	Complies	Gas-flow modeling and analyses shows satisfactory performance for at least 35 years.
	The panel-closure system for each individual panel shall not require routine maintenance during its operational life.	3.2	Complies	Passive design components require no routine maintenance.

Type of Requirement	Requirement	Section	Compliance with Requirement	Notes on Compliance
	The panel-closure system shall address the most severe ground conditions expected in the panel entries. If actual conditions are found to be more favorable, this design can be simplified and still satisfy the operational requirements of the system.	2.1.1 2.1.3 3.2	Complies	Design is based upon flow and structural analyses for the most severe expected ground conditions. If conditions are less severe, simpler design options are used. The various design options accommodate all expected conditions.
Design configuration and essential features	The panel-closure system shall be emplaced in the air-intake and air-exhaust drifts identified by Westinghouse (1995c)	3.2	Complies	The design shows placement in the designated areas for panel closure.
	The panel-closure system shall consist of a concrete barrier and construction-isolation and explosion-isolation walls with dimensions to satisfy the operational requirements of the system.	3.2, 3.3	Complies	The panel-closure system design uses the identified components with dimensions to satisfy the operational requirements of the system.
Safety	The design class for the panel-closure system shall be IIIb. Design and construction shall follow conventional mining and construction practices.	3.4	Complies	Components are designed according to Class IIIb. The construction sequence for the design followed conventional mining practices.
	The structural analysis for the underground shall use the empirical data acquired from the WIPP Excavation Effects Program.	2.1.2	Complies	The structural analysis uses properties that model creep closure for stress analyses from data acquired in the WIPP Excavation Effects Program.
Structural and material	The panel-closure system materials shall be compatible with their emplacement environment and function. Surface treatment between the host rock and the panel-closure system shall be considered in the design.	2.2.1	Complies	The material compatibility studies showed no degradation of materials and no need for surface treatment.
	The selection and placement of concrete in the concrete barrier shall address potential thermal cracking due to the heat of hydration.	2.2.2	Complies	The heat generation studies show that hydration temperatures are controlled by appropriate selection of cement type and placement temperature.

Type of Requirement	Requirement	Section	Compliance with Requirement	Notes on Compliance
	The panel-closure system shall sustain the dynamic pressure and subsequent temperature generated by a postulated methane explosion.	2.2.3, 2.2.4, 4.0	Complies	The methane explosion study shows that the explosion-isolation wall protects the concrete barrier from pressure loading and thermal loading. The fracture propagation study shows that the system performs as intended.
Construction	The panel-closure system shall use to the extent possible normal construction practices according to existing standards.	3.4	Complies	The specifications include normal construction practices used in the underground at WIPP and according to the most current steel and concrete specifications.
	During construction of the panel-closure system, a quality assurance/quality control program shall be established to verify material properties and construction practices.	3.4	Complies	The specifications include materials testing to verify material properties and construction practices.
	The construction specification shall take into account the shaft and underground access capacities and services for materials handling.	3.4	Complies	The specifications allow construction within the capacities of underground access.

The conclusions reached from the design evaluations addressing the structural and material requirements of the panel-closure system are as follows:

- Existing information on the heat of hydration of the concrete supports placing concrete with a low cement content to reduce the temperature rise associated with hydration. The slump at the required strength would be achieved through the use of plasticizers. A thermal analysis coupled with a salt creep analysis suggest installation of the enlarged barrier at or below ambient temperatures to adequately control hydration temperatures.

- In addition to installation at or below ambient temperatures, the concrete used in the main concrete barrier would exhibit the following:

  - An 8 inch (0.2 meter) slump after 3 hours of intermittent mixing
  - A less-than-25-degree Fahrenheit heat rise prior to installation
  - An unconfined compressive strength of 4,000 psi (28 MPa) after 28 days
  - Volume stability
  - Minimal entrained air.

- The trace amounts of brine from the salt at the repository horizon should not degrade the main concrete barrier for at least 35 years.

- In 20 years, the open passage above the waste stack would be reduced in size. Further, rooms with bulkheads at each end would be isolated in the panel. It is unlikely that a long passage with an open geometry would exist; therefore, the dynamic analysis considered a deflagration with a peak explosive pressure of 240 psi (1.7 MPa).

- The heat-transfer analysis shows that elevated temperatures would occur within the salt and the explosion-isolation wall; however, the elevated temperatures will be isolated by the panel-closure system. Temperature gradients will not significantly affect the stability of the wall.

- The fractures in the roof and floor could be affected by expanding gas products reaching pressures of the order of 240 psi (1.7 MPa). Because the peak internal pressure from the deflagration is only one fifth of the pressure, fractures could not propagate beyond the wall.

The design options proposed to satisfy the design requirements for the panel-closure system include (1) a standard barrier, rectangular in shape, or (2) an enlarged concrete barrier, approximately spherical in shape. Options (1) and (2) will be grouted at the interface and may contain explosion- or construction-isolation walls. Only the enlarged barrier with an explosion-isolation wall is approved as part of the RCRA facility Permit.

The design provides flexibility to satisfy the design migration limit for the flow of VOCs out of the panels. An enlarged concrete barrier would be selected where the air-intake and air-exhaust drifts have aged and where there is fracturing resulting in significant flow of VOCs. These conditions apply to the most severe ground conditions in the air-intake and air-exhaust drifts of

Panel 1. If ground conditions are more favorable, such as might be the case for future panel entries, the design was proposed to be simplified to a standard concrete barrier rectangular in shape, with a construction isolation wall. GPR and observation boreholes are available for detecting the location and extent of fractures in the DRZ. These methods may be used to select the optimum location within each entry and exhaust drift for the enlarged barrier panel-closure system.

The design is presented in this report as a series of calculations, engineering drawings, and technical performance specifications. The drawings illustrate the construction details for the system. The technical performance specifications cover the general requirements of the system, site work, concrete, and masonry. Information on the proposed construction method is also presented.

The design complies with all aspects of the design basis established for the WIPP panel-closure system. The design can be constructed in the underground environment with no special requirements at the WIPP.

8.0 References

American Institute of Steel Construction (AISC), 1989, "Specification for the Design of Structural Steel Buildings," *AISC Manual of Steel Construction*, American Institute of Steel Construction, Inc., New York, New York.

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IT Corporation (IT), 1993, "Ground-Penetrating Radar Surveys at the WIPP Site," January 1991 to February 1992, contractor report for Westinghouse Electric Corporation, Carlsbad, New Mexico.

Mine Safety and Health Administration (MSHA), 1987, "Safety Standards for Methane in Metal and Nonmetal Mines," *Title 30, Code of Federal Regulations (CFR), Part 57 (30 CFR 57)*, U.S. Department of Labor, Mine Safety and Health Administration, Washington, D.C.

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Westinghouse Electric Corporation (Westinghouse), 1995a, "Design Classification Determination," *WP 09-CN3023,* Rev. 0, Westinghouse Electric Corporation, Waste Isolation Division, Carlsbad, New Mexico.

Westinghouse Electric Corporation (Westinghouse), 1995b, "Underground Hazardous Waste Management Unit Closure Criteria for the Waste Isolation Pilot Plant Operational Phase, Predecisional Draft," *WID/WIPP-Draft-2038*, February 1995, Westinghouse Electric Corporation, Waste Isolation Division, Carlsbad, New Mexico.

Westinghouse Electric Corporation (Westinghouse), 1995c, "Underground Facilities Typical Disposal Panel," *WID/WIPP-DWG 51-W-214-W*, Revision 0, Westinghouse Electric Corporation, Waste Isolation Division, Carlsbad, New Mexico.

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FIGURES

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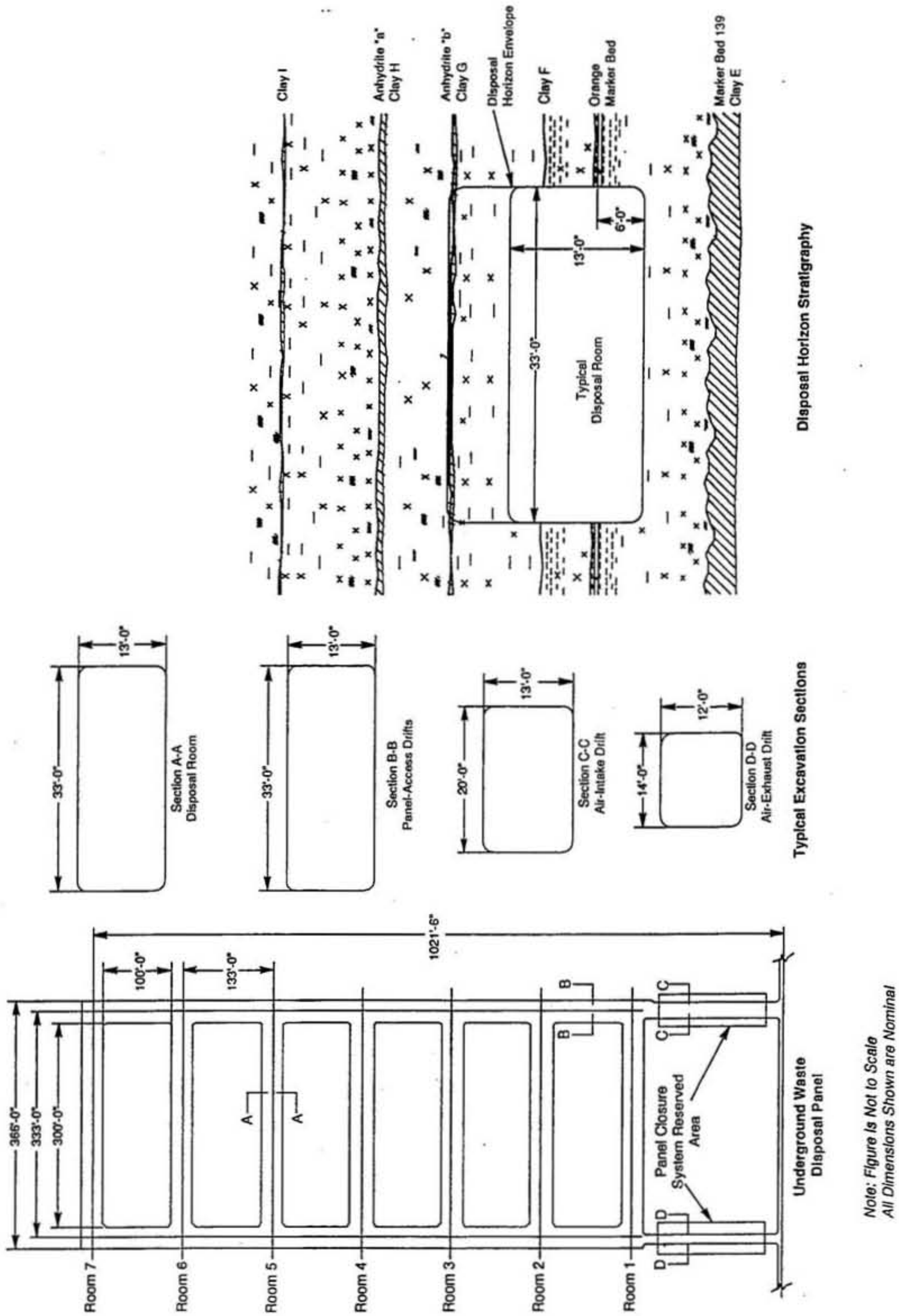

Figure I1-1
Typical Facilities—Typical Disposal Panel

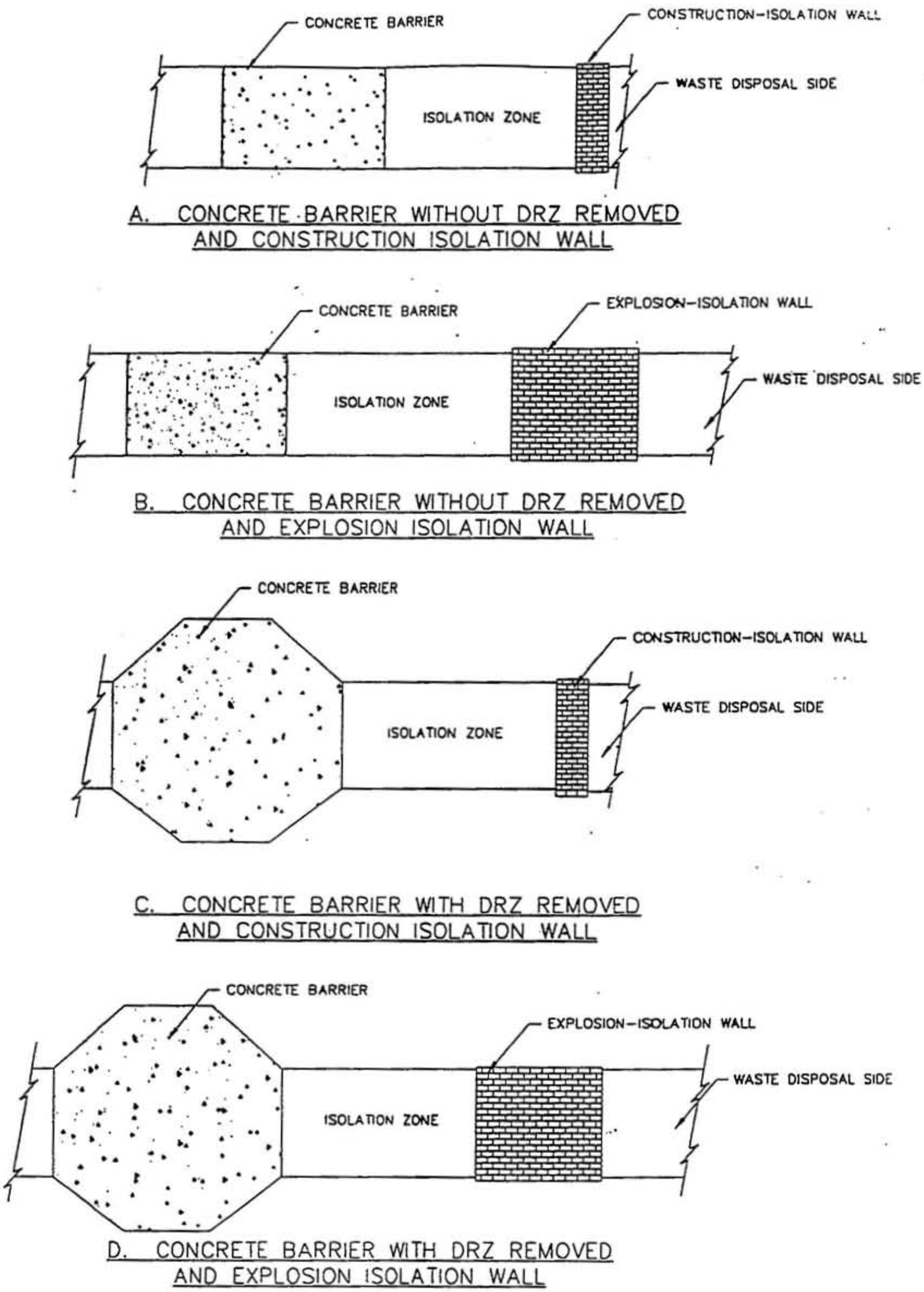

Figure I1-2
Main Barrier with Wall Combinations

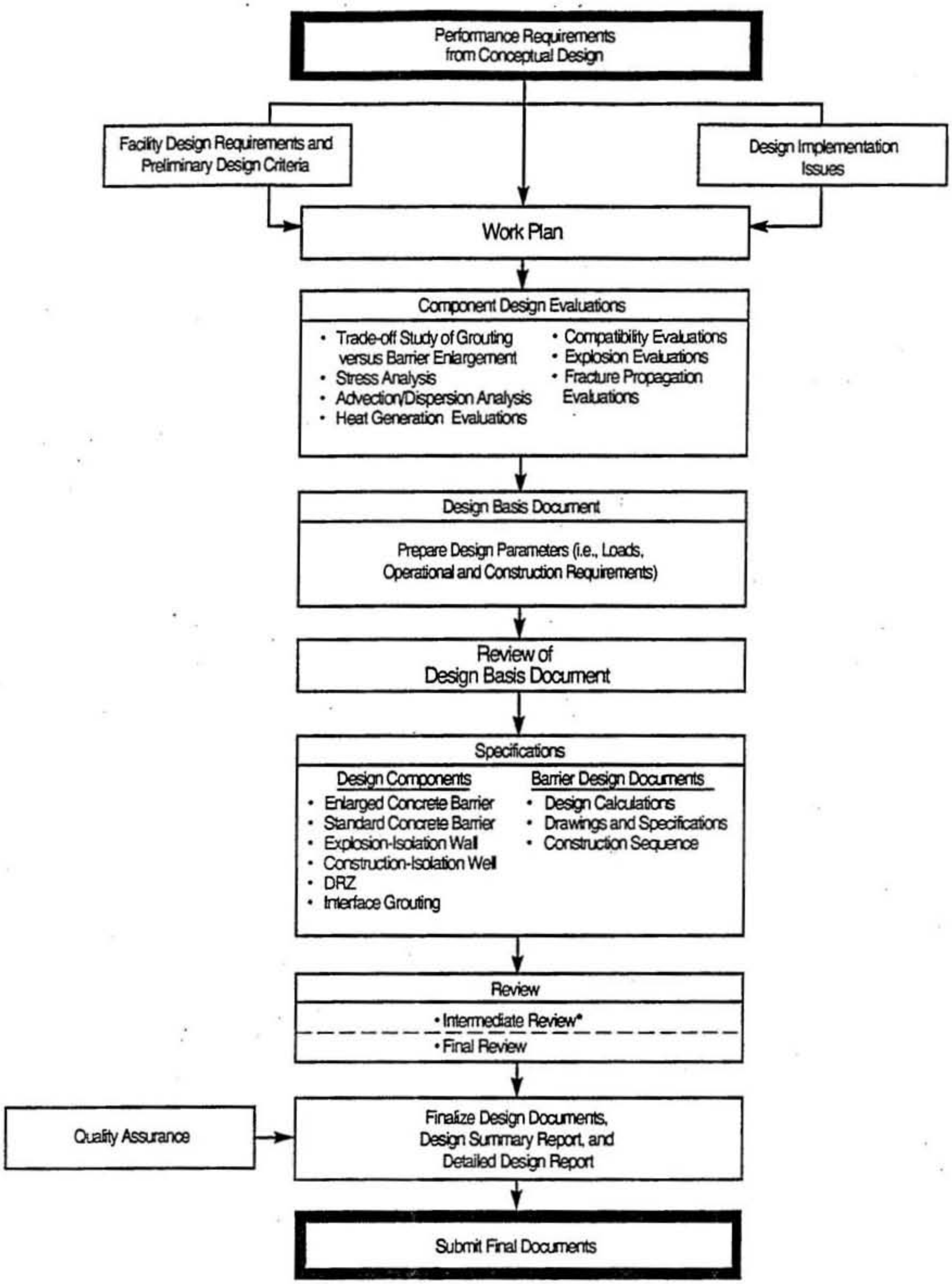

Figure I1-3
Design Process for the Panel-Closure System

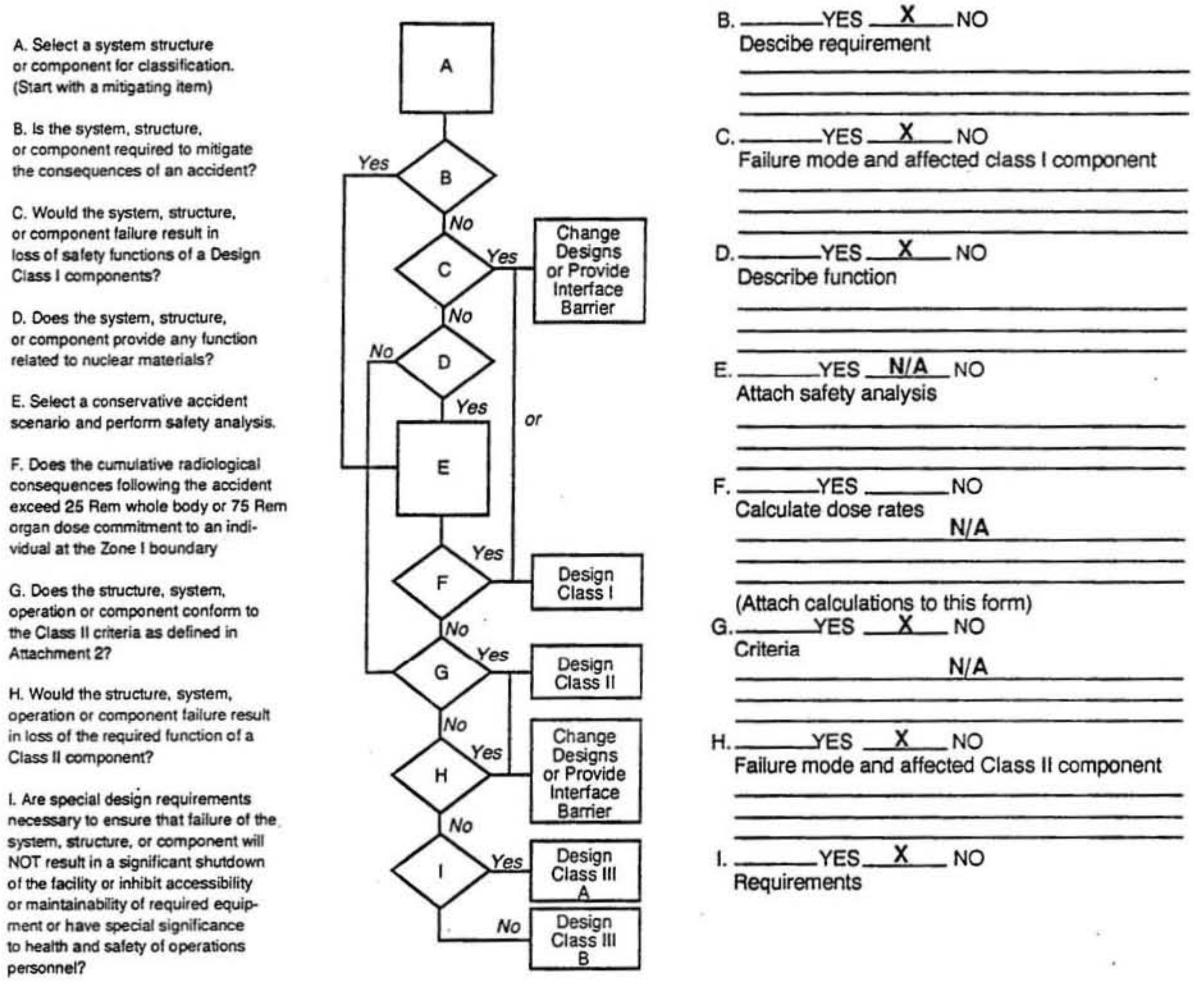

Figure I1-4
Design Classification of the Panel-Closure System

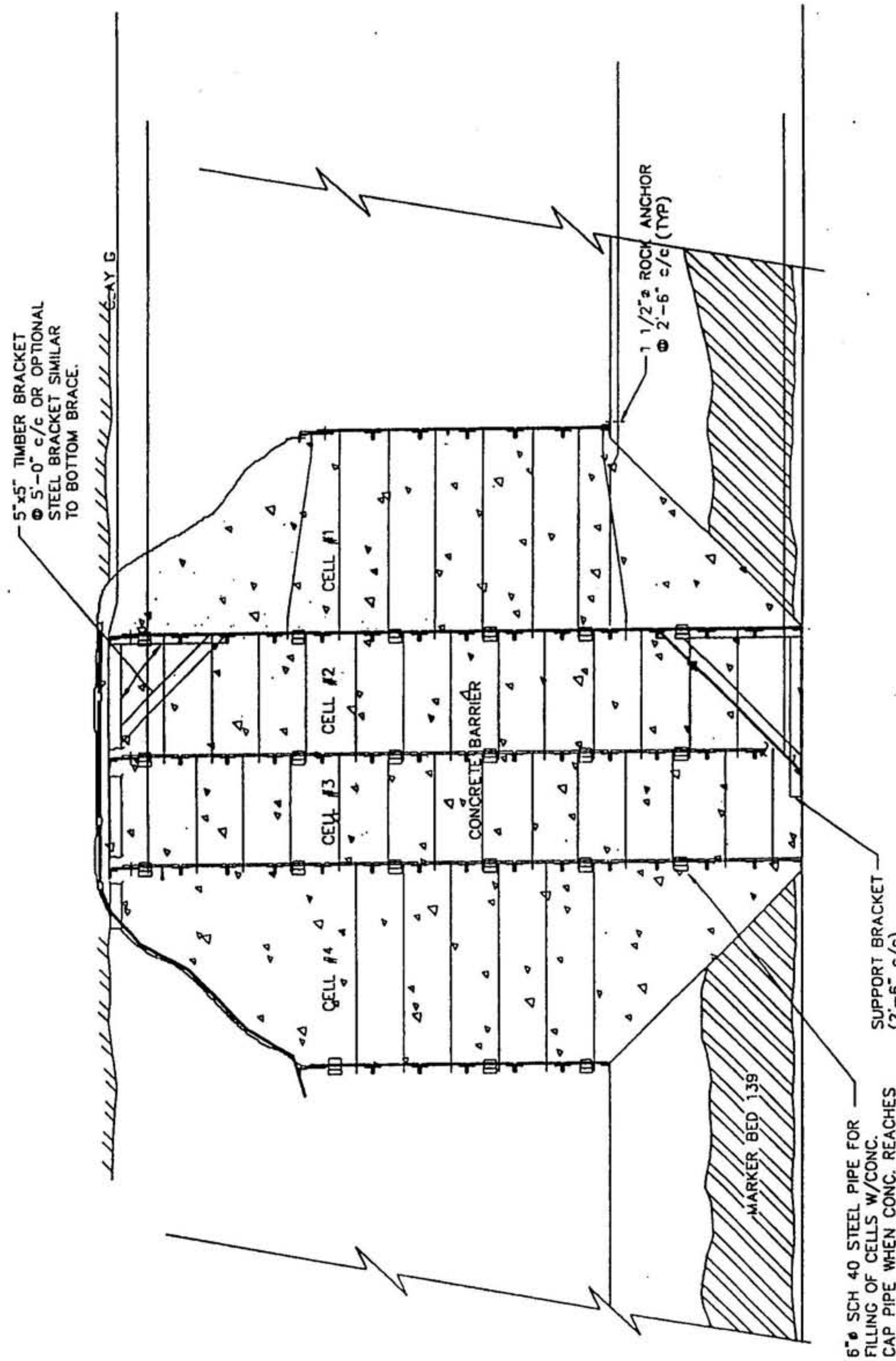

Figure I1-5
Concrete Barrier with DRZ Removal

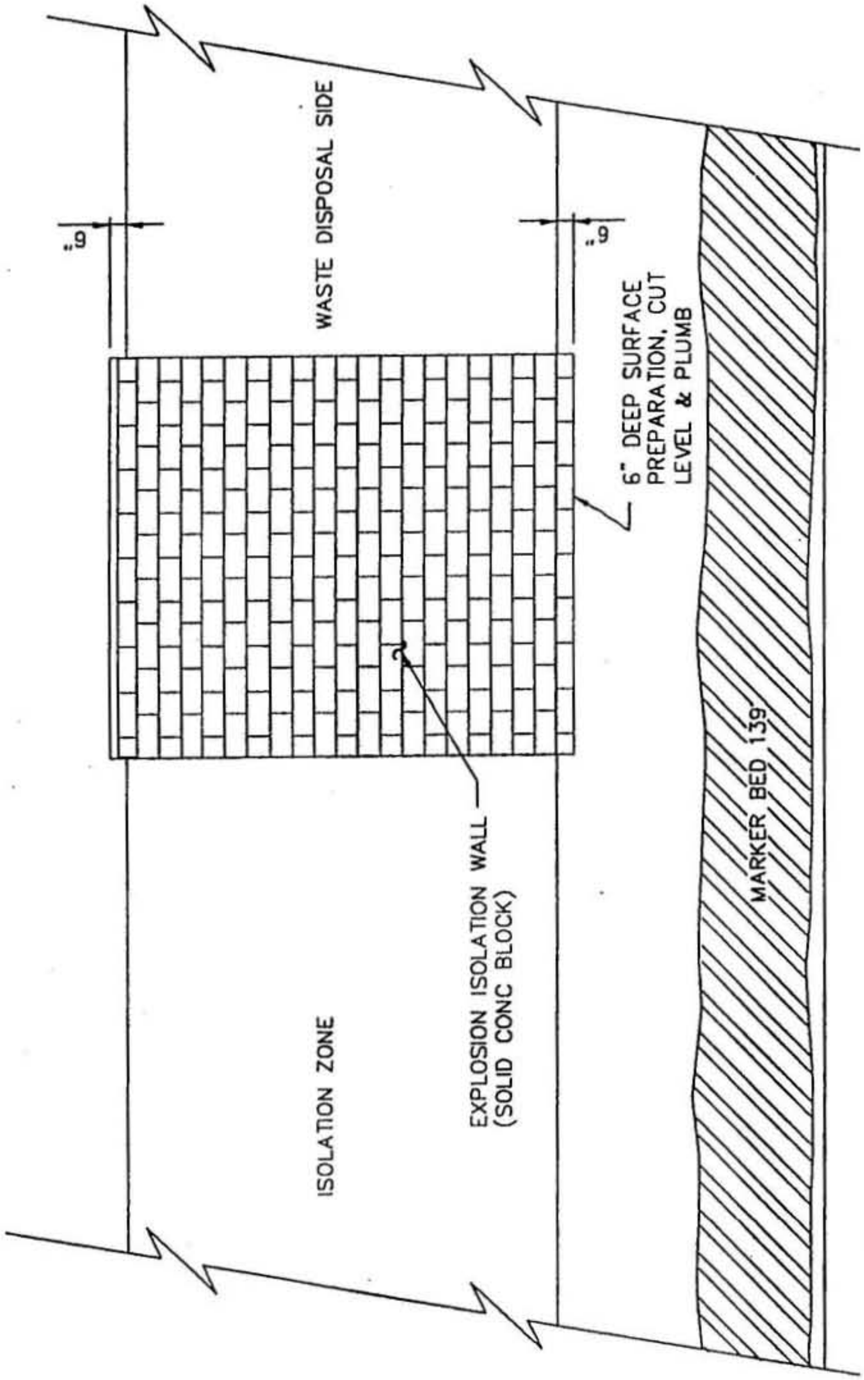

Figure I1-6
Explosion-Isolation Wall

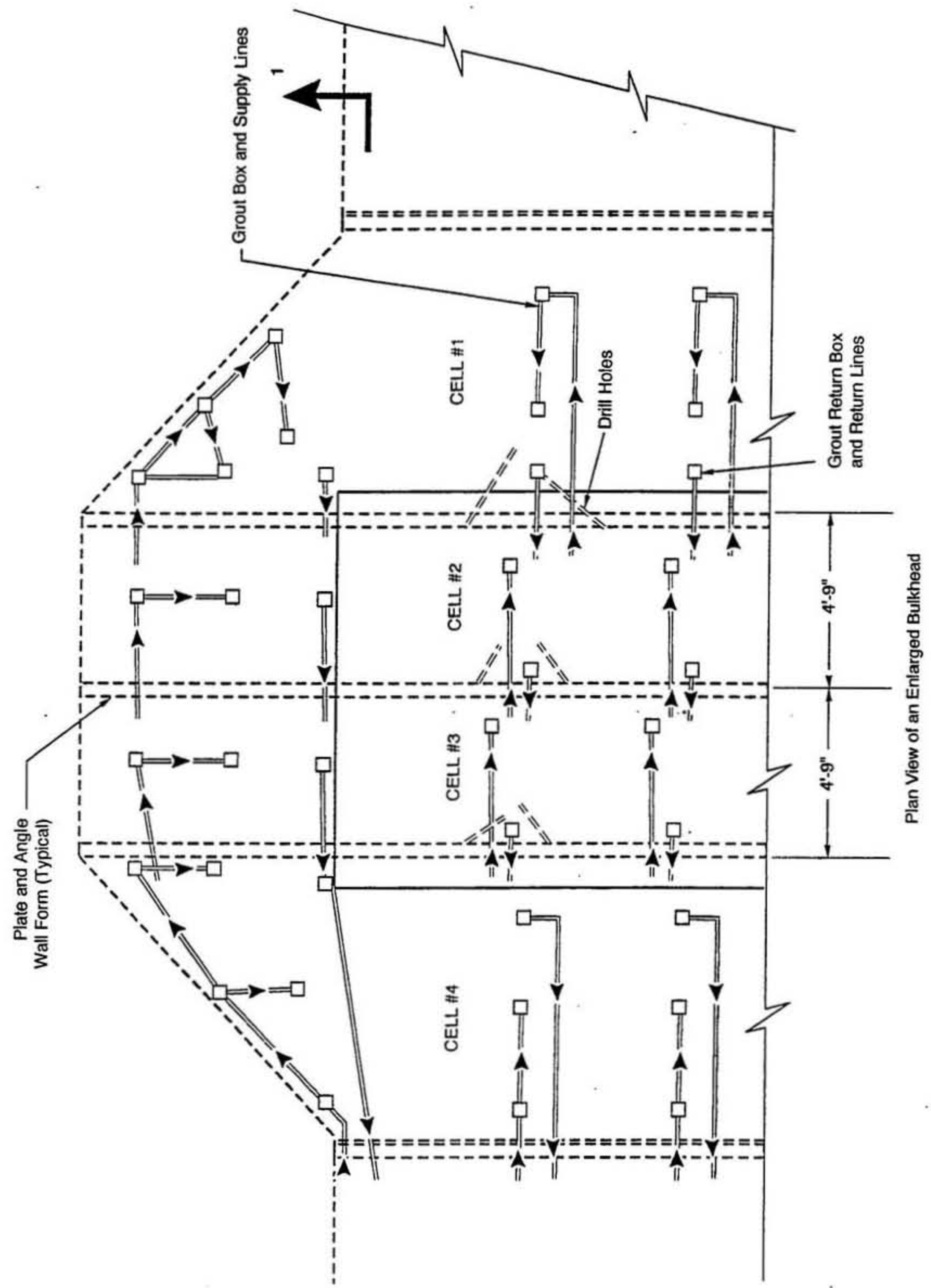

Figure I1-7
Grouting Details

APPENDIX I1
APPENDIX G

TECHNICAL SPECIFICATIONS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO

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APPENDIX I1
APPENDIX G

TECHNICAL SPECIFICATIONS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO

TABLE OF CONTENTS

List of Figures

DIVISION 1 - GENERAL REQUIREMENTS

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Section 01010 - Summary of Work
Part 1 - General

1.1 Scope

This section includes:

- Scope of Work
- Definitions and Abbreviations
- Drawings
- Work by Others
- Contractors Use of Site
- Contractors Use of Facilities
- Work Sequence
- Work Plan
- Submittals

1.2 Scope of Work

The Contractor shall furnish all labor, materials, equipment and tools to perform operations in connection with the construction of two (2) panel closure systems for each panel, one of each to be installed in the air intake drift and the air exhaust drift of a waste-emplacement panel, as shown on the drawings and called for in these specifications.

Four (4) possible arrangements of the concrete barrier and isolation walls are shown on the attached Figure I1-1 "Plan Variations."

- Concrete barrier without disturbed rock zone (**DRZ**) removal in combination with construction isolation wall (Sketch A).

- Concrete barrier without DRZ removal in combination with an explosion isolation wall (Sketch B).

- Concrete barrier with DRZ removal up through clay seam G and down through marker bed 139 (**MB 139**) in combination with a construction isolation wall (Sketch C).

- Concrete barrier with DRZ removal in combination with an explosion isolation wall (Sketch D) (This is the only approved configuration in this Permit).

The scope of work shall include but not be limited to the following units of work:

- Develop work plan, health and safety plan (**HASP**) and contractors quality control plan (**CQCP**)

- Prepare and submit all plans requiring approval

- Mobilize to site
- Coordinate construction with operations
- Perform the following for the air intake entry and the air exhaust entry.
  - Excavate the surface preparation for the explosion isolation wall
  - Construct the explosion isolation wall
  - Excavate the DRZ
  - Install the form work for the concrete barrier
  - Place concrete for the concrete barrier
  - Grout the interface of concrete barrier/back wall
  - Provide contact grouting along the contact surface (if required by the engineer)
- Clean up construction areas in underground and above ground
- Submit all required record documents
- Demobilize from site

1.3 Definitions and Abbreviations

Definitions

Contact-handled waste—Contact-handled defense transuranic (**TRU**) waste with a surface dose rate not to exceed 200 millirem per hour.

Concrete barrier—A barrier placed in the access drifts of a panel to restrict the mass flow rate of volatile organic compounds (**VOC**).

Concrete block—Concrete used for construction of either an explosion-isolation wall or a construction-isolation wall.

Construction-isolation wall—A wall immediately adjacent to the panel waste-emplacement area that is made of concrete block, with mortar or steel frame to isolate construction personnel from coming into contact with the waste.

Creep—Plastic deformation of salt under deviatoric stress.

Design migration limit—A mass flow rate that is at least 1 order of magnitude below the health-based levels for VOCs during the Waste Isolation Pilot Plant (**WIPP**) operational period.

Disturbed rock zone (**DRZ**)—A zone surrounding underground excavations where stress redistribution occurs with attendant dilation and fracturing.

Explosion-isolation wall—A concrete-block wall adjacent to the panel waste-emplacement area with mortar that can sustain the pressure and temperature transients of a methane explosion.

Health-based concentration level—The concentration level for a VOC in air that must not be exceeded at the point of compliance during the WIPP operational period.

Health-based migration limit—The mass flow rate of a VOC from all closed panels that results in the health-based concentration level at the point of compliance.

Hydration temperature—The temperature developed by a cementitious material due to the hydration of the cement.

Interface grouting—Grouting performed through grout boxes and pipe lines to fill the void at the concrete barrier/back-wall interface.

Methane explosion—A postulated deflagration caused by the buildup of methane gas to explosive levels.

Partial closure—The process of rendering a part of the underground repository inactive and closed according to approved facility closure plans. The partial-closure process is considered complete after partial-closure activities are performed in accordance with approved Resource Conservation and Recovery Act (**RCRA**) partial closure plans.

Point of compliance—The operating point of compliance for VOC levels at the WIPP, which is the 16-section land withdrawal boundary.

Remote-handled waste—Any of the various forms of high beta-gamma defense TRU waste requiring remote-handling and with a surface dose rate exceeding 200 millirem per hour.

Standard barrier—A concrete barrier emplaced into the panel-access drifts without major excavation of the surrounding rock.

Volatile Organic Compound (**VOC**)—Any VOC comprising the land-disposal-restricted indicator VOC constituents in the WIPP waste inventory.

Abbreviations/Acronyms

ACI	American Concrete Institute
AISC	American Institute for Steel Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DRZ	Disturbed rock zone
EPA	U.S. Environmental Protection Agency
MB 139	Marker Bed 139
MSHA	U.S. Mine Safety and Health Administration

NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
MOC	Management and Operating Contractor (Permit Condition I.D.3)
RCRA	Resource Conservation and Recovery Act
SMC	Salado Mass Concrete
USACE	U.S. Army Corps of Engineers
WIPP	Waste Isolation Pilot Plant

1.4 List of Drawings

The following drawings are made apart of this specification:

762447-E1	Panel closure system, air intake and exhaust drifts, title sheet
762447-E2	Panel closure system, underground waste-emplacement panel plan
762447-E3	Panel closure system, air intake drift, construction details
762447-E4	Panel closure system, air exhaust drift, construction details
762447-E5	Panel closure system, construction and explosion walls, construction details
762447-E6	Panel closure system, air intake and exhaust drifts, grouting and miscellaneous details

1.5 Work by Others

Survey

All survey work to locate the barriers and walls, control and confirm excavation, and complete the work will be supplied by the Permittees. All survey measurements for record purposes will also be performed/supplied by the Permittees. The Contractor shall be responsible for verifying the excavation dimensions to develop the form work to fit the excavation.

Excavation

The Permittees may elect to perform certain portions of the work, notably the excavation. The work performed by the Permittees will be defined prior to the contract.

1.6 Contractor's Use of Site

Site Conditions

The site is located near Carlsbad, New Mexico, as shown on the site location maps and the title sheet drawing. The underground arrangements and location of the WIPP waste-emplacement panels are shown on the plan view drawing. The work described above is to construct the concrete barriers in the air intake and exhaust drifts of one of the panels upon completion of the disposal phase of that panel. The waste-emplacement panels are located approximately 2,150 feet below the ground surface. The Contractor shall visit the site and become familiar with the site and site conditions prior to preparing his bid proposal.

Contractor's Use of Site

Areas at the ground surface will be designated for the Contractor's use in assembling and storing his equipment and materials. The Contractor shall utilize only those areas designated.

Limited space within the underground area will be designated for the Contractor's use for storage of material and setup of equipment.

Coordination of Contractor's Work

The Contractor is advised that on-going waste emplacement and excavation operations are being conducted throughout the period of construction of the panel barrier system. The Contractor shall coordinate his construction operations with that of the waste emplacement and mining operations. All coordination shall be through the Engineer.

1.7 Contractor's Use of Facilities

Existing facilities at the site which are available for use by the Contractor are:

- WIPP roadheader
- Waste shaft conveyance
- Salt skip hoist
- (1) 20 ton forklift
- (1) 40 ton forklift
- 460 volt AC, 3 phase power
- Water (underground, at waste shaft only) (above ground, at location designated by Engineer)

Additional information on these facilities is presented in Section 02010.

1.8 Work Sequence

Work Sequence shall be as shown on the drawings and directed by the Engineer .

1.9 Work Plan

The Contractor shall prepare and submit for approval by the Engineer a Work Plan fully describing his proposed construction operation. The work plan shall define all proposed equipment. The work plan shall also include the method of excavation, grouting, and pumping concrete. The work plan shall also contain such items as control of surface dust emissions. No work shall be performed prior to approval of the Work Plan.

1.10 Submittals

Submittals to the Permittees shall be in accordance with the Permittees' Submittal Procedures and as required by the individual specifications. Approval by the Permittees shall not constitute approval by NMED. Any submittals that propose a change to the panel closure requirements of this Permit (e.g., changes in grout composition, detailed design, etc.) shall be submitted to NMED as required by 20.4.1.900 NMAC (incorporating 40 CFR §270.42).

Part 2 - Products

Not used.

Part 3 - Execution

Not Used.

End of Section

Section 01090 - Reference Standards
Part 1 - General

1.1 Scope

This section includes:

- Provision of Reference Standards at Site.
- Acronyms used in Contract Documents for Reference Standards. Source of Reference Standards.

1.2 Quality Assurance

For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

Conform to reference by date of issue current on the date of the agreement between the Permittees and the contractor.

The Contractor shall obtain copy of the standards referenced in the individual specification sections. Maintain a copy at jobsite during submittals, planning, and progress of the specific work, until completion of work.

Should specified reference standards conflict with the contract documents, request clarification from the Engineer before proceeding.

1.3 Schedule of References

Various publications are referenced in other sections of the specifications to establish requirements for the work. These referenced are identified by documents number and title. The addresses of the organizations whose publications are referenced are listed below.

ACI	ACI International P.O. Box 19150 Detroit, MI 48219-0150 Ph: 313-532-2600 Fax: 313-533-4747
AITC	American Institute of Timber Construction 7012 So. Revere Parkway, Suite 140 Englewood, CO 80112 Ph: 303-792-9559 Fax: 303-792-0669

AISC	American Institute of Steel Construction One E. Wacker Dr., Suite 3100 Chicago, IL 60601-2001 Ph: 312-670-2400 Fax: 312-670-5403
ANSI	American National Standards Institute 11 West 42nd St. New York NY 10036 Ph: 212-642-4900 Fax: 212-302-1286
API	American Petroleum Institute 1220 L. St., NW Washington, DC 20005 Ph: 202-682-8375 Fax: 202-962-4776
ASTM	American Society for Testing and Materials 1916 Race St. Philadelphia, PA 19103 Ph: 215-299-5585 Fax: 215-977-9679
AWS	American Welding Society 550 LeJeune Road Miami, FL 33135 Ph: 800-443-9353 Fax: 305-443-7559
CFR	Code of Federal Regulations Government Printing Office Washington, DC 20402 Ph: 202-783-3238 Fax: 202-223-7703
EPA	Environmental Protection Agency Public Information Center 401 M St., SW Washington, DC 20460 Ph: 202-260-2080
FTM-	Federal Test Method Standards Standardization Documents Order Desk Bldg. 4D

	700 Robbins Ave. Philadelphia, PA 19111-5094 Ph: 215-697-2179 Fax: 215-697-2978
NRMCA	National Ready-Mixed Concrete Association 900 Spring St. Silver Spring, MD 20910 Ph: 301-587-1400 Fax: 301-585-4219
NTIS	National Technical Information Service U.S. Department of Commerce Springfield, VA 22161 (703) 487-4650
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077
USACE	U.S. Army Corps of Engineers U.S. Army Engineer Waterway Experiment Station ATTN: Technical Report Distribution Section, Services Branch, TIC 3909 Halls Ferry Rd. Vicksburg, MS 39180-6199 Ph: 601-634-2355 Fax: 601-634-2506
MOC	Washington TRU Solutions LLC Carlsbad, New Mexico 88221

End of Section

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Section 01400 - Contractor Quality Control
Part 1 - General

1.1 Scope

This section includes:

- Contractor Quality Control Plan (**CQCP**)
- Reference Standards
- Quality Assurance
- Tolerances
- Testing Services
- Inspection Services
- Submittals

1.2 Related Sections

- 01090 - Reference Standards
- 01600 - Material and Equipment
- 02222 - Excavation
- 02722 - Grouting
- 03100 - Concrete Formwork
- 03300 - Cast-in-Place Concrete
- 04100 - Mortar
- 04300 - Unit Masonry System

1.3 Contractor Quality Control Plan

The Contractor shall prepare and submit for approval by the Engineer, a Quality Control Plan, as described in Section 3.2. No work shall be performed prior to approval of the Contractor's Quality Control Plan.

1.4 References and Standards

Refer to individual specification sections for standards referenced therein, and to Section 01090 - Reference Standards for general listing.

Standards referenced in this section are as follows:

ASTM C1077	Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C1093	Practice for Accreditation of Testing Agencies for Unit Masonry

ASTM E329	Practice for Use in the Evaluation of Inspection and Testing Agencies as Used in Construction
ASTM E543	Practice for Determining the Qualification of Nondestructive Testing Agencies
ASTM E548	Practice for Preparation of Criteria for Use in the Evaluation of Testing Laboratories and Inspection Bodies

1.5 Quality Assurance

- Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality
- Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship
- Perform work by persons qualified to produce required and specified quality
- Verify that field measurements are as indicated on shop drawings
- Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.6 Tolerances

Monitor excavation fabrication and installation tolerance control of work and products to produce acceptable work. Do not permit tolerances to accumulate.

Adjust products to appropriate dimensions; position before securing products in place.

1.7 Testing Services

Unless otherwise indicated by the Engineer, the Contractor shall employ an independent firm to perform the testing services and other services specified in the individual specification sections, and as required by the Engineer. Testing and source quality control may occur on or off the project site.

The testing laboratory shall comply with applicable sections of the reference standards and shall be authorized to operate in the state in which the project is located.

Testing equipment shall be calibrated at reasonable intervals with devices of an accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.

1.8 Inspection Services

The Contractor shall employ an independent firm to perform inspection services as a supplement to the Contractor's quality control as specified in the individual specification sections, and as required by the Engineer. Inspection may occur on or off the project site.

The inspection firm shall comply with applicable sections of the reference standards.

1.9 Submittals

The Contractor shall submit a Contractors' Quality Control Plan as described herein.

Prior to start of work, the Contractor shall submit for approval, the testing laboratory name, address, telephone number and name of responsible officer of the firm. He shall also submit a copy of the testing laboratory compliance with the reference ASTM standards, and a copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards with memorandum of remedies of any deficiencies reported by the inspection.

Prior to start of work, the Contractor shall submit for approval the inspection firm name, address, telephone number and name of responsible officer of the firm. He shall also submit the personnel proposed to perform the required inspection, along with their individual qualifications and certifications (Example: Certified AWS Welding Inspector.)

Part 2 - Products

Not used.

Part 3 - Execution

3.1 General

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both on site and off site, and shall be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work on the job. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

3.2 Quality Control Plan

3.2.1 General

The Contractor shall furnish for review and approval by the Engineer, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (**CQC**) Plan proposed to implement the requirements of the Contract. The plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. Construction will be permitted to begin only after acceptance of the CQC Plan.

3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both on site and off site, including work by subcontractors, fabricators, suppliers, and purchasing agents:

- A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

- The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

- Description of the CQC System Manager's responsibilities and delegation of authority to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities.

- Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, off site fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with the Permittees' Submittal Procedures.

- Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be subject to approval by the Engineer.)

- Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

- Reporting procedures, including proposed reporting formats.

- A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon by the Engineer.

3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Permittees reserve the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

3.3 Quality Control Organization

3.3.1 General

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel supplemented by independent testing and inspection firms as required by the specifications, to ensure contract compliance. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Engineer.

3.3.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, with a minimum of five years construction experience on construction similar to this contract. This CQC System Manager shall be on the site at all times during construction and will be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate will be the same as for the designated CQC System Manager.

3.3.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel or third party inspectors to assist the CQC System Manager. These individuals shall be employed by the prime Contractor; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience. These individuals shall have no other duties other than quality control.

3.3.4 Organizational Changes

The Contractor shall maintain his CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Engineer for acceptance at the Contractors' expense.

3.4 Tests

3.4.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Engineer duplicate samples of test specimens for possible testing by the Engineer. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of an approved testing laboratory. The Contractor shall perform the following activities and record and provide the following data:

- Verify that testing procedures comply with contract requirements.
- Verify that facilities and testing equipment are available and comply with testing standards.
- Check test instrument calibration data against certified standards.
- Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- Results of all tests taken, both passing and failing tests, will be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. If approved by the Engineer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an off site or commercial test facility will be provided directly to the Engineer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.5 Testing Laboratory

The testing laboratory shall provide qualified personnel to perform specified sampling and testing of products in accordance with specified standards, and ascertain compliance of materials and mixes with requirements of Contract Documents. The testing laboratory shall promptly notify the Engineer and Contractor of any observed irregularities or non-conformance of Work or Products.

Reports indicating results of tests, and compliance (or noncompliance) with the contract documents will be submitted in accordance with the Permittees' submittal procedures.

The Contractor shall cooperate with the independent testing firm, furnish samples, storage, safe access, and assistance by incidental labor as required. Testing by the independent firm does not relieve the contractor of the responsibility to perform the work to the contract requirements.

The laboratory may not:

- Release, revoke, alter, or enlarge on requirements of the contract
- Approve or accept any portion of the work
- Assume any duties of the Contractor.

The laboratory has no authority to stop the work.

3.6 Inspection Services

The inspection firm shall provide qualified personnel at site to supplement the Contractor's Quality Control Program to perform specified inspection of Products in accordance with specified standards. He shall ascertain compliance of materials and mixes with requirements of Contract Documents, and promptly notify the CQC System Manager, the Engineer and the Contractor of observed irregularities or non-conformance of Work or Products. The inspector does not have the authority to stop the work. The inspector shall refer such cases to the CQC System Manager who has the authority to stop work (see Section 3.2.2).

Reports indicating results of the inspection and compliance (or noncompliance) with the contract documents will be submitted in accordance with the Permittees' submittal procedures.

The Contractor shall cooperate with the independent inspection firm, furnish samples, storage, safe access and assistance by incidental labor, as requested.

Inspection by the independent firm does not relieve the Contractor of the responsibility to perform the work to the contract requirements.

3.7 Completion Inspection

3.7.1 Pre-Final Inspection

At the completion of all work the CQC System Manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Once this is accomplished the Contractor shall notify the Engineer that the facility is complete and is ready for the "Prefinal" inspection. The Engineer will perform this inspection to verify that the facility is complete. A "Final Punch List" will be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected and notify the Engineer so that a "Final" inspection can be scheduled. Any items noted on the "Final" inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time slated for completion of the entire work.

3.7.2 Final Acceptance Inspection

The final acceptance inspection will be formally scheduled by the Engineer based upon notice from the Contractor. This notice will be given to the Engineer at least 14 days prior to the final acceptance inspection and must include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection.

3.8 Documentation

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- Contractor/subcontractor and their area of responsibility.
- Operating plant/equipment with hours worked, idle, or down for repair.
- Work performed each day, giving location, description, and by whom.
- Test and/or quality control activities performed with results and references to specifications/drawings requirements. List deficiencies noted along with corrective action.
- Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- Submittals reviewed, with contract reference, by whom, and action taken.

- Off-site surveillance activities, including actions taken.
- Instructions given/received and conflicts in plans and/or specifications.
- Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Engineer daily. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.9 Notification of Noncompliance

The Engineer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the worksite, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

End of section.

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Section 01600 - Material and Equipment
Part 1 - General

1.1 Scope

This section includes:

- Equipment
- Products
- Transportation and handling
- Storage and protection
- Substitutions

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 02010 - Mobilization and Demobilization
- 02222 - Excavation
- 02722 - Grouting
- 03100 - Concrete Formwork
- 03300 - Cast-in-Place Concrete
- 04100 - Mortar
- 04300 - Unit Masonry System

1.3 Equipment

The Contractor shall specify his proposed equipment in the Work Plan. Power equipment for use underground shall be either electrical or diesel engine driven. All diesel engine equipment shall be certified for use underground.

1.4 Products

The Contractor shall specify in the Work Plan, or in subsequently required submittals the proposed products including, but not limited to the grout mix and its components, concrete mix and its components, mortar mix and its components, formwork, and masonry. The proposed products shall be supported by laboratory test results as required by the specifications. All products shall be subject to approval by the Engineer.

1.5 Transportation and Handling

- Transport and handle products in accordance with manufacturer’s instructions.

- Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

- Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.6 Storage and Protection

- Store and protect products in accordance with manufacturers' instructions.
- Store with seals and labels intact and legible.
- Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- For exterior storage of fabricated products, place on sloped supports above ground.
- Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.7 Substitutions

1.7.1 Equipment Substitutions

The Contractor may substitute equipment for that proposed in the Work Plan subject to the Engineer's approval. The Contractor shall demonstrate the need for the substitution, and the applicability of the proposed substitute equipment.

1.7.2 Product Substitutions

The Contractor may not substitute products after the proposed products have been approved by the Engineer unless he can demonstrate that the supplier/source of that product no longer exists in which case he shall submit alternate products with lab test results to the Engineer for approval. In the case that product is a component in a mix, the Contractor shall perform mix testing using that component and submit laboratory test results.

Part 2 - Products

Not used.

Part 3 - Execution

Not used.

End of section.

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DIVISION 2 - SITE WORK

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Section 02010 - Mobilization and Demobilization

Part 1 - General

1.1 Scope

This section includes:

- Mobilization of equipment and facilities to site
- Contractor use of site
- Use of existing facilities
- Demobilization of equipment and facilities
- Site cleanup

1.2 Related Sections

- 01010 - Summary of Work
- 01600 - Material and Equipment

Part 2 - Products

Not used.

Part 3 - Execution

3.1 Mobilization of Equipment and Facilities to Site

Upon authorization to proceed, the Contractor shall mobilize his equipment and facilities to the jobsite. Equipment and facilities shall be as specified, and as defined in the Contractor's Work Plan. The Contractor shall erect the batch plant and assemble his equipment and materials in the areas designated by the Engineer. Facilities shall be located as near as practical to the existing utilities.

The Permittees will provide utilities (460 volt AC, 3 phase, and water) at designated locations. The Contractor shall be responsible for all hookups and tie-ins required for his operations.

The Contractor shall be responsible for providing his own office, storage, and sanitary facilities.

Areas will be designated for the Contractor's use in the underground area in the vicinity of the panel closure system installation. These areas are limited.

3.2 Use of Site

The Contractor shall use only those areas specifically designated for his use by the Engineer. The Contractor shall limit his on-site travel to the specific routes required for performance of his work, and designated by the Engineer.

3.3 Use of Existing Facilities

Existing facilities at the site which are available for use by the Contractor are:

- WIPP roadheader
- Waste shaft conveyance
- Salt skip hoist
- (1) 20 ton forklift
- (1) 40-ton forklift
- 460 Volt AC, 3 phase power
- Water (in mine, at waste shaft only-above ground at location designated by the Engineer).

The Contractor shall arrange for use of the facilities with the Engineer and coordinate his actions/requirements with that of the ongoing operations.

Use of water in the underground will be restricted. No washout or cleanup will be permitted in the underground. Above ground washout/cleanup or equipment will be allowed in the areas designated by the Engineer.

The Contractor is cautioned to be aware of the physical dimensions of the waste conveyance and the air lock (see Figures I1-2 and I1-3, attached).

The Contractor shall be responsible for any damage incurred by the existing site facilities as a result of his operations. Any damage shall be reported immediately to the Engineer and repaired at the Contractor's cost.

3.4 Demobilization of Equipment and Facilities

At completion of this work, the Contractor shall demobilize his equipment and facilities from the job site. The batch plant shall be disassembled and removed along with any unused material. All Contractor's equipment and materials shall be removed from the mine and all disturbed areas restored. Utilities shall be removed to their connection points unless otherwise directed by the Engineer.

3.5 Site Cleanup

At conclusion of the work, the Contractor shall remove all trash, waste, debris, excess construction materials, and restore the affected areas to its prior condition, to the satisfaction of the Engineer. A final inspection of the areas will be conducted by the Engineer and the Contractor before final payment is approved.

End of section.

Section 02222 - Excavation
Part 1 - General

1.1 Scope

This section includes:

- Excavation for main concrete barrier
- Excavation for surface preparation and leveling of base areas for isolation walls
- Disposition of excavated materials.

1.2 Related Sections

- 01010 - Summary of Work
- 01600 - Material and Equipment
- 03100 - Concrete Form Work
- 04300 - Unit Masonry System.

1.3 Reference Documents

"Reference Stratigraphy and Rock Properties for the Waste Isolation Pilot Plant (WIPP) Project" by R.D. Krieg-Sandia National Laboratory Document Sand 83-1908. [Available through National Technical Information Service (**NTIS**).]

1.4 Field Measurements and Survey

All surveys required for performance of the work will be provided by the Permittees. To develop the concrete formwork to fit the excavation, the Contractor shall be responsible for verifying the excavation dimensions.

Part 2 - Products

Not used.

Part 3 - Execution

3.1 Excavating for Concrete Barrier

Excavation for the main concrete barrier shall be performed to the lines and grades shown on the drawings. Excavate the back a minimum of 1 inch to 3 inches beyond clay seam G, and the floor a minimum of 1 inch to 3 inches below the anhydride marker bed 139 (**MB-139**) to assure removal of the disturbed rock zone (**DRZ**). Excavation shall be performed utilizing mechanical means such as a cutting head on a suitable boom, by drilling boreholes and using an expansive agent to fragment the rock or other competent equipment or methods submitted to the Engineer for review and approval. The use of explosives is prohibited. The existing WIPP roadheader mining machine may also be available for use. The Contractor is to determine availability and coordinate proposed use of the roadheader with the Engineer. The existing roadheader is capable of excavating the back and the portions of the ribs above the floor level. However, it is not capable of excavating the portion below floor level.

The tolerances for the concrete barrier excavation shall be +6 inches, to 0 inch. In addition, the Contractor is to remove all loose or spalling rock from the excavation surface to provide a sound surface abutting the concrete barrier. The Contractor shall provide and install roof bolts for support as required for personnel protection and approved ground control plans.

3.2 Excavating for Surface Preparation and leveling of Base Areas for Isolation Walls

The Contractor shall excavate a 6-inch surface preparation around the entire perimeter of the isolation walls. The surface preparation in the floor shall be made level to produce a surface for placing the first course of block in the isolation walls. Tolerances for the leveled portion of the surface preparation are ±1 inch. Excavation may be performed by either mechanical or manual means. Use of explosives is prohibited.

3.3 Disposition of Excavated Materials

The Contractor shall remove all excavated materials from the panel-access drift where they are excavated. Excavated materials shall be removed from the mine via the salt skip to the surface, where they will be disposed on site at a location as directed by the Engineer.

3.4 Field Measurements and Survey

All survey required for performance of the work will be provided by the Permittees. The Contractor shall protect all survey control points, bench marks, etc., from damage by his operations. MOC will verify by survey that the Contractor has excavated to the required lines and grades. The Contractor shall be responsible for verifying the excavation dimensions to develop concrete formwork to fit the excavation. No form work or block work is to be erected until this survey is completed. The Contractor is to coordinate the survey work with his operations to assure against lost time. The Contractor shall notify the Engineer at least 24 hours prior to the time surveying is required

End of section.

Section 02722 - Grouting
Part 1 - General

1.1 Scope

This section includes:

- Grouting of concrete barrier.

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment
- 03100 - Concrete Form Work
- 03300 - Cast-in-Place Concrete

1.3 References

ASTM C1107 Standard Specification for Nonshrink Grout

ASTM C109 Test Method for Compressive Strength of Hydraulic Cement Mortars

1.4 Submittals for Review and Approval

Thirty days prior to the initiation of grouting, the Contractor shall submit to the Engineer for review and approval, the following:

- Type of grout proposed
- Product data:
  - Manufacturer's specification and certified laboratory tests for the manufactured grout, if proposed
  - Certified laboratory tests for the salt-saturated grout, if proposed, using project-specific materials
- Proposed grouting method, including equipment and materials and construction sequence in Work Plan.

1.5 Submittals for Construction

Daily grouting report indicating the day, date, time of mixing and delivery, quantity of grout placed, water used, pressure required, problems encountered, action taken, quality control data, testing results, etc., no later than 24 hours following construction.

Part 2 - Products

2.1 Grout Materials

Grout used for grouting in connection with fresh water/plain cement concrete shall be nonshrink, cement-based grout, Five Star 110 as manufactured by Five Star Products Inc., 425 Stillson Road, Fairfield, Connecticut 06430 or approved equal. Mixing and installation shall be in accordance with the manufacturer's recommendations.

As an alternate to the above grout, in connection with the Salado Mass concrete mix, the Contractor shall use, subject to the approval of the Engineer, a salt saturated grout. The following formulation is suggested to the Contractor as an initiation point for selection of the grout mix. Salt saturated grout strength shall be 4500 psi at 28 days.

SALT-SATURATED GROUT (BCT-1F)

Component	Percent of total Mass (wt.)
Class H Cement	48.3
Class C Fly Ash	16.2
Cal Seal (Plaster - from Halliburton)	5.7
Sodium chloride	7.9
Dispersant	0.78
Defoamer	0.02
Water	21.1

Water for mixing shall be of potable quality, free from injurious amounts of oil, acid, alkali, salt, or organic matter, sediments, or other deleterious substances, as specified for concrete, Section 03300-2.3.

2.2 Product Data

If the Contractor proposes to utilize a manufactured nonshrink cement-based grout, he shall submit complete manufacturer's specifications for the product, along with certified laboratory test results of the material.

If the Contractor proposes to utilize the salt-saturated grout in connection with the Salado Mass concrete mix, he shall submit manufacturer's/supplier's specifications for the component materials, and certified laboratory test results for the resultant mix.

Part 3 - Execution

3.1 General

The Contractor shall furnish all labor material, equipment, and tools to perform all operations in connection with the grouting.

Grout delivery and return lines for interface grouting shall be installed in the form work or in the area to be grouted to provide uniform distribution of the grout as shown on the drawings. The exact location of the boxes and lines shall be determined in the field. Additional grout delivery and return lines and boxes may be required by the Engineer.

Pumps shall be positive displacement piston type pump designed for grouting service capable of operating at a discharge pressure of 100 psi. The Contractor shall supply a standby pump to be utilized in the event of a breakdown of the primary unit.

Mixers shall be high velocity "colloidal" type with a rotary speed of 1,200 to 1,500 rpm. Grout shall be mixed to a pumpable mix as per the manufacturer's recommendations.

Mixing water shall be accurately metered to control the consistency of the grout.

The Contractor shall provide all necessary valves, gages, and pressure hoses.

Water for mixing is available at the waste shaft. The Contractor is cautioned that <u>no free water discharges or spills are permitted</u> in the mine. All cleanup and washout operations shall be performed at the ground surface.

Potential spill areas in the underground shall be identified by the Contractor in the work plan. The Contractor shall provide adequate containment for potential spills. Isolation measures shall include, but are not limited to, lining with a membrane material (PVC, hypalon, HDPE), draped curtains (polyethylene, PVC, etc.), corrugated sheet metal protective walls or a combination of these and other measures.

If salt-saturated grout is selected for use, the Contractor shall make provisions to accurately proportion the components. Proportioning shall be by weighing. Sufficient quantities of dry components shall be developed prior to initiation of the grouting to perform the work so as not to incur delays during the mixing/placing sequence.

3.2 Interface Grouting of Concrete Barrier

After each cell of the concrete barrier has been allowed to cure for a period of seven days, or as directed by the Engineer, the Contractor shall interface grout the remaining space between the back wall and the top surface of the concrete barrier.

Each cell of the concrete barrier shall be grouted before the next adjacent cell is formed and concrete placed. Grout delivery and return lines shall be installed with the form work as shown and called for on the drawings, or as directed by the Engineer.

The placing of grout, unless otherwise directed by the Engineer shall be continuous until completed. Grouting shall progress from lower to higher grout pipes. Grouting shall proceed through a single delivery line until grout escapes from the adjacent return line. The Contractor shall then secure these lines and move to the next adjacent set of delivery and return lines. Pressure shall be adjusted to adequately deliver the grout to the forms, as witnessed by grout in the return line.

The grouting operation shall be conducted in a manner such that it does not affect the stability of the concrete barrier structure.

3.3 Contact Grouting

After completion of interface grouting if directed by the Engineer, the Contractor shall contact grout to fill any remaining voids at the concrete barrier/back wall interface. Contact grouting includes all operations to drill, clean, and grout holes installed in the concrete barrier.

The Contractor shall drill and grout the interface zone to the main concrete barrier as directed by the Engineer.

The location, direction, and depth of each grout hole shall be as directed by the Engineer. The order in which the holes are drilled and the manner in which each hole is drilled and grouted, the proportions of the water used in the grout, the time of grouting, the pressures used in grouting, and all other details of the grouting operations shall be as directed by the Engineer.

Wherever required, contact grouting will entail drilling the hole to a limited depth, installing a packer, and performing grouting.

3.3.1 Drilling

The holes shall be drilled with rotary-type drills. Drilling grout holes with percussion-type drills will not be permitted except as approved by the Engineer.

The requirements as to location, depth, spacing, and direction of the holes shall be as directed by the Engineer.

The minimum diameter shall be approximately 11/2 inches.

When the drilling of each hole or stage of has been completed, compressed air will be used to flush out drill cuttings. The hole shall then be temporarily capped or otherwise suitably protected to prevent the hole from becoming clogged or obstructed until it is grouted.

3.3.2 Materials for Contact Grouting

Standard weight black steel pipe conforming to ASTM A-53 shall be set in the concrete in the locations as directed by the Engineer. All pipe and fittings shall be furnished by the Contractor.

The size of the grout pipe for each hole and the depth of the holes for setting pipe for grouting shall be as directed by the Engineer. Care shall be taken to avoid clogging or obstructing the pipes before being grouted, and any pipe that becomes clogged or obstructed from any cause shall be cleaned satisfactorily or replaced.

The packers shall be furnished by the Contractor and shall consist of expansible tubes or rings of rubber, leather, or other suitable material attached to the end of the grout supply pipe. The packers shall be designed so that they can be expanded to seal the drill hole at the specified locations and when expanded shall be capable of withstanding without leakage, for a period of 5 minutes, air pressure equal to the maximum grout pressures to be used.

3.3.3 Grouting Procedures

Different grouting pressures will be required for grouting different sections of the grout holes. Pressures as high as necessary to deliver the grout but which, as determined by trial, are safe against concrete displacement shall be used in the grouting.

If, during the grouting of any hole, grout is found to flow from adjacent grout holes or connections in sufficient quantity to interfere seriously with the grouting operation or to cause appreciable loss of grout, such grout holes and connections shall be capped temporarily. Where such capping is not essential, inaugurated holes shall be left open to facilitate the escape of air as the grout is forced into other holes. Before the grout has set, the grout pump shall be connected to adjacent capped holes and to other holes from which grout flow was observed, and grouting of all holes shall be completed. If during the grouting of any hole, grout is found to flow from points in the barrier, any parts of the concrete structure, or other locations, such flows or leaks shall be plugged or caulked by the Contractor as directed by the Engineer.

As a safeguard against concrete displacement, excessive grout travel, or while grout leaks are being caulked, the Engineer may require the reduction of the pumping pressure, intermittent pumping, or the discontinuance of pumping.

The consistency of the grout mix shall be varied, as directed by the Engineer, depending on the conditions encountered. Where the grout hole or connection continues to take a large amount of grout after the mix has been thickened, the Engineer may require that pumping be done intermittently, waiting up to 8 hours between pumping periods to allow grout in the barrier to set. After the grouting is complete, the pressure shall be maintained by means of stopcocks, or other suitable valve that it will be retained in the holes or connections being grouted.

3.4 Cleanup

No clean-up or washing of equipment with water is allowed in the underground. No free water spills are permitted. All clean out or wash out requiring water will be performed above ground at the location approved by the Engineer. See note above regarding potential spill areas in Section 3.1 - General.

3.5 Quality Control

The Contractor shall provide a third-party quality control inspector at the site throughout the grout placement operations. The inspector shall determine that the grout mix is properly proportioned and properly mixed to the approved consistency. The inspector shall sample and make one set of grout cubes for compression testing for every 50 cubic feet of grout placed, or fraction thereof, for each day of grout placement.

End of section.

DIVISION 3 - CONCRETE

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Section 03100 - Concrete Formwork
Part 1 - General

1.1 Scope

This section includes:

- Formwork for cast-in-place concrete with shoring, bracing, and anchorage
- Accessory items, grout pipes, concrete delivery pipes.

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment
- 02722 - Grouting
- 03300 - Cast-in-Place Concrete
- 04300 - Unit Masonry System

1.3 References

ACI 301	Specifications for Structural Concrete for Buildings
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 347	Recommended Practice for Concrete Formwork
ASTM A-36	Standard Specification for Structural Steel
ASTM A-53	Standard Specification for Pipe, Steel, Black, and Hot-Dipped Zinc Coated
ASTM A-325	High Strength, Structural Bolts
ASTM A-615	Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcements
AWS A3.0	Welding Terms and Definitions
AWS A5.1	Specification for Mild Steel Covered Arc Welding Electrodes
AWS D1.1	Structural Welding Code-Steel
AISC	Manual of Steel Construction Latest Edition

1.4 Submittals

The Contractor shall submit the following 30 days prior to initiation of work at site.

Shop detail drawings with appropriate calculations to support the adequacy or the formwork.

Mill test certification of materials utilized in construction of the forms.

Details of installation contained in the Contractor's Work Plan.

1.5 Quality Assurance

Design and detail the formwork under direct supervision of a professional structural Engineer experienced in design of this work and licensed in the state of New Mexico.

Perform work in accordance with ACI 301, 318, and 347, AISC and AWS standards. Maintain one copy of all standards at site.

Perform all fabrication in accordance with AISC manual of steel construction.

Perform all welding in accordance with AWS D1.1 structural welding code.

Perform all bolting in accordance with AISC specification for structural joints using ASTM A325 or A490 bolts.

Part 2 - Products

2.1 Form Materials

Forms for the concrete barrier shall be constructed of ASTM A-36 steel.

Pipe inserts shall be ASTM A-53 black standard weight pipe.

Form spacers shall be ASTM A-36 round stock.

Bolts shall be ASTM A325 high strength structural bolts.

Grout pipes shall be ASTM A-53 standard weight pipe or flex conduit as shown on the drawings.

Rock anchors shall develop strength equal to or greater than ASTM A-36 round stock.

Welding electrodes shall conform to AWS A5.1.

Part 3 - Execution

3.1 General

The Contractor shall furnish all labor material equipment and tools to perform all operations in connection with the design, detail, fabrication and erection of the formwork and the fabrication and installation of grout pipes for the main concrete barrier.

The Contractor may, at his option submit an alternate design or modify the design shown on the drawings, subject to the approval of the Engineer. All designs must be supported by design calculations stamped and sealed by a registered professional engineer.

The Contractor shall furnish, fabricate and install all grout pipes and grout boxes for both the concrete barrier and the isolation walls.

3.2 Shop Drawings

The Contractor shall design and detail all formwork for the concrete barrier, complete with any required bracing and shoring for the concrete barrier as shown on the drawings, in accordance with ACI 318 and 347 and the AISC manual of steel construction.

The details shall incorporate provision for adjusting and modifying the formwork to suit the excavation. Excavation tolerances are given in Section 02222 Excavation.

The Contractor shall be responsible for verifying the excavation dimensions to develop the concrete formwork to fit the excavation.

Prior to fabrication, the Contractor shall submit shop drawings complete with supporting calculations for review/approval by the Engineer 30 days prior to initiating work. The contractor shall incorporate all Engineer’s comments, revisions, resolve all questions and resubmit drawings for final approval prior to proceeding with fabrication.

3.3 Fabrication

The Contractor shall fabricate all formwork and ancillary items in accordance with the latest edition of the AISC Manual of Steel Construction and the approved detail drawings.

Formwork shall contain all inserts for grouting and pumping concrete. Sufficient valving shall be provided on inserts to allow shut off of concrete and grout to prevent back flow through the form work.

All welding shall be in accordance with AWS D1.1 structural welding code including operator and procedure certifications. Elements shall be welded using E-7018 low hydrogen electrodes. Panels shall be piece marked to correspond to the erection drawing(s) and sequence at fabrication.

3.4 Installation

3.4.1 Grout Pipes

The Contractor shall furnish, fabricate, and install all grout pipes and boxes as approved by the Engineer. Grout pipes and boxes shall be attached to the back surface using masonry anchors as shown on the drawings or other approved methods. Grout pipes shall be connected to the inserts installed in the permanent forms and securely fastened to the formwork. All grout pipes will be blown out with compressed air after installation and prior to closure of the formwork to assure they are clean and free from debris or obstructions. Grout pipes shall then be temporarily capped to prevent entry of foreign matter until ready for grouting. The Contractor shall apply masking tape to the grout box openings to prevent concrete infiltration during concrete placement.

3.4.2 Formwork

The steel formwork for the concrete barrier is to remain in place at completion of each segment of the barrier, therefore all formwork shall be free from oil, grease, rust, dirt, mud or other material that would prevent bonding by the concrete. Forms will not be oiled or receive application of release agent.

The Contractor shall install formwork at the locations shown on the drawings to the lines and grades shown. Forms are to be mortar tight. The Contractor shall adjust the formwork to suit the contour of the excavation. Rock may be trimmed or chipped to suit where interferences are encountered. Where overexcavation has occurred in excess of the designed-in adjustability of the formwork, modifications shall be proposed to the Engineer for his approval prior to installation. Installation of the formwork shall be reviewed and approved by the Engineer prior to proceeding with concrete installation.

The Contractor shall provide a sealant or gasket material on mating surfaces to provide mortar-tite joints.

3.5 Quality Control

The Contractor shall arrange for and contract with an approved third party inspector to provide inspection/testing services for the fabrication and installation of the formwork and ancillary items, as required by the QA/QC plan.

The Contractor shall furnish certified mill test reports for all materials utilized in the fabrication.

All welding shall be in accordance with AWS D1.1 structural welding code. The Contractor shall furnish welding operator and procedure certifications for all operators and procedures utilized.

Fabricated components shall be inspected for dimension and overall quality. Welds shall be inspected by an AWS certified welding inspector.

The inspector shall visually inspect the installation for fit-up and dimensionally for location.

3.6 Handling, Shipping, Storage

The Contractor shall handle, ship, and store fabricated components with care to avoid damage. Stored components shall be placed on timbers or pallets off the ground to keep the units clean. Components shall be tarped while in outdoor storage. Components that become spattered or contaminated with mud will be thoroughly cleaned before delivering to the mine for installation. Damaged components will be rejected by the inspector and replaced by the contractor at his cost.

End of section.

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Section 03300 - Cast-in-Place Concrete
Part 1 - General

1.1 Scope

This section includes:

- Cast-in-place concrete for concrete barrier
- Concrete mix design.

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment
- 02222 - Excavation
- 02722 - Grouting
- 03100 - Concrete Formwork

1.3 References

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete
ACI 318.1	Building Code Requirements for Structural Plain Concrete
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	Standard Specification for Ready-Mixed Concrete
ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	Standard Specification for Slump of Portland Cement Concrete
ASTM C 150	Standard Specification for Portland Cement
ASTM C 186	Standard Test Method for Heath of Hydration of Hydraulic Cement
ASTM C 403	Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

ASTM C 618	Flyash and Raw or Calcined Natural Pozzolan for Use as an Admixture in Portland Cement Concrete
ASTM D 2216	Standard Test Method for Laboratory Determination of Water (moisture) Content of Soil and Rock
USACE CRD-C 36	Method of Test for Thermal Diffusivity of Concrete
USACE CRD-C 48	Standard Test Method for Water Permeability of Concrete
API 10	Cements
NRMCA	Check List for Certification of Ready Mixed Concrete Production Facilities
NRMCA	Concrete Plant Standards

MOC Standards

WIPP-DOE-71	Design Criteria Waste Isolation Pilot Plant, Revised Mission Concept -- IIA (DOE, 1984)
WP 03-1	WIPP Startup and Acceptance Test Program (Westinghouse, 1993b)
WP 09-010	Design Development Testing (Westinghouse, 1991)
WP 09-CN3021	Component Numbering (Westinghouse, 1994a)
WP 09-024	Configuration Management Board/Engineering Change Proposal (**ECP**) (Westinghouse, 1994b)

1.4 Submittals for Review/Approval

The Contractor shall submit the following for approval 30 days prior to initiating any work at the site.

Specific sources of supply and detailed product information for each component of the concrete mix is specified in Section 2.6 below.

Product Data - Laboratory test data and trial mix data for the proposed concrete to be utilized for the concrete barrier.

Proposed method of installation, including equipment and materials in work plan.

1.5 Submittals at Completion

Laboratory test data developed during the installation of the concrete barrier.

1.6 Quality Assurance

Perform work in accordance with the Contractor's Quality Control Plan and referenced ACI and ASTM standards.

Acquire cement, aggregate and component materials from the same source throughout the work.

Part 2 - Products

2.1 Cement

Portland cement shall conform to API 10 Class H oil well cements. The source of the cement to be used shall be indicated and manufacturer's certification that the cement complies to the applicable standard shall be provided with each shipment.

2.2 Aggregates

Aggregates shall be quartz aggregates conforming to the requirements of ASTM C33.

Fine aggregate shall meet the requirements of ASTM C33 having a fineness modules in the range of 2.80 to 3.00.

Coarse aggregate maximum size shall be 1 ½ inches and shall be clean, cubical, angular, 100 percent crushed aggregate without flat or elongated particles.

The source of the aggregate is to be indicated and test reports certifying that the aggregate complies with the applicable standard are to be submitted for approval with the trial mix data.

2.3 Water

Water used in mixing concrete shall be of potable quality, free of injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

Water shall conform to the provisions in ASTM C94, and in addition, shall conform to the following:

- pH not less 6.0 or greater than 8.0
- Carbonates and/or bicarbonates of sodium and potassium: 1000 ppm maximum
- Chloride ions (C1): 250 ppm maximum
- Sulfate ions (SO_4): 1000 ppm maximum
- Iron content: 0.3 ppm maximum

- Total solids: 2000 ppm maximum

When ice is used in concrete mix, the water used for making ice shall meet all of the above requirements.

The source of water is to be indicated and certified copies of test data from an approved laboratory confirming that the water to be used meets the above requirements shall be submitted for approval with the trial mix data.

2.4 Admixtures

Pozzolan shall conform to ASTM C618. Sampling and testing of pozzolans shall conform to ASTM C311. Approximately 5 percent by weight of pozzolan may be used to replace cement in the mixes when approved.

The source of any admixtures proposed are to be indicated and certified copies of test data from an approved laboratory shall be submitted for approval with the trial mix.

2.5 Concrete Mix Properties

The Contractor shall develop and proportion a Salado Mass Concrete mix for use in constructing the concrete barrier. Cement utilized in the mix shall be Class H. The Contractor shall demonstrate by trial mix that the proposed concrete meets the following properties:

TARGET PROPERTIES FOR BARRIER CONCRETE

Property	Comment
4-hr working time	Indicated by 8-inch slump (ASTM C 142) after 3-hr intermittent mixing. Max 10-inch slump at mixing.
Nonsegregating	Aggregates do not readily separated from cement paste during handling
Less than 25°F heat rise prior to placement	Difference between initial condition and temperature after 4 hr.
4,500 psi compressive strength (f'_c)	At 28 days after casting (ASTM C39)
Volume stability	Length change between +0.05 percent and -0.02 percent (ASTM C 490)
Minimal entrained air	2 percent to 3 percent air

The Contractor shall provide certified copies of test data from an approved laboratory demonstrating compliance with the above target properties.

In addition to the target properties the Contractor shall provide certified test data for the trial mix for the following properties:

- Heat of hydration ASTM C-186
- Concrete Set ASTM C-403
- Thermal Diffusivity USACE CRD-C36
- Water Permeability USACE CRD-C43

2.6 Salado Mass Concrete

The Contractor shall utilize the Salado Mass concrete. The Contractor shall demonstrate that the Salado Mass concrete meets the target properties shown above. Recommended initial proportioning of the Salado Mass concrete is as follows:

Component	Percent of Total Mass
Class H Cement	4.93
Chem Comp III	2.85
Class F fly ash	6.82
Fine aggregate	33.58
Coarse aggregate	43.02
Sodium chloride	2.18
Defoaming agent	0.15
Sodium citrate	0.09
Water	6.38

The Contractor shall prepare a trial mix and provide certified test data from an approved testing laboratory for slump, compressive strength, heat rise, heat of hydration, concrete set time, thermal diffusivity, and water permeability as indicated above for the plain concrete mix.

Part 3 - Execution

3.1 General

The Contractor shall provide all labor material, equipment and tools necessary to develop, supply, mix, transport and place mass concrete in the forms as shown on the drawings and called for in these specifications

The Contractor will be required to provide and erect on the site a batch plant, suitable to store, handle, weight and deliver the proposed concrete mix. The batch plant shall be certified to NRMCA standards. The batch plant shall be erected on site in the location as directed by the Engineer.

The Contractor shall batch, mix, and deliver to the underground, sufficient quantity of concrete to complete placement of concrete within one form section, as shown on the drawings. Once begun, placement of concrete in a section shall be continuous until completed. The time for concreting one section will not exceed ten hours.

It is expected that addition of water to the dry materials and mixing of the concrete will occur at the ground surface with transport of wet concrete to a pump at the underground level where it will be pumped into the forms.

The Contractor is to provide all transport vehicles or means to transfer the wet concrete from the mixer truck to the pump. It is expected that the Contractor will use the waste conveyance hoist to transfer from the ground surface to the mine level. The Contractor is to familiarize himself with the dimensions of the waste conveyance and the airlock in order to provide suitable transport vehicles. The Contractor is also to familiarize himself with the capacity and speed of the conveyance to allow transfer of sufficient concrete to sustain the continuing placement of concrete. (See Figures I1-2 and I1-3, attached).

The Contractor shall determine the horizontal distance to the entry where placement of the concrete barrier is to occur, and develop a route, with the approval of the Engineer for traffic flow within the underground.

Details of the logistics for handling the concrete shall be included in the Contractors' Work Plan, and submitted to the Engineer for approval prior to start of work at the site.

Potential spill areas in the underground shall be identified by the Contractor in the Work Plan. The Contractor shall provide measures to contain and isolate any water from contact with the halite in these areas. Suitable containment isolation measures shall include but are not limited to, lining with a membrane material (PVC, hypalon, HDPE), draped curtains (polyethylene, PVC, etc.), corrugated sheet metal protective walls or a combination of these and other measures.

3.2 Pumping Concrete

The Contractor shall provide pumping equipment suitable for placing the concrete into the forms. The Contractor at a minimum, shall provide an operating and a spare pump, to be used in the event of breakdown of the primary unit. After transporting and prior to pumping the concrete shall be remixed to compensate for segregation of aggregate during transport. The Contractor shall indicate the equipment proposed for pumping (manufacturer, model, type, capacity, pressure and remixing at the point of delivery in the Work Plan).

Each batch of concrete shall be checked at the surface at the time of mixing and again at the point of transfer to the pump for slump and temperature, and shall conform to the following:

- Maximum slump at mixing - 10 inches
- Maximum slump at delivery to pump - 8 inches
- Maximum mix temperature at placement = 70°F

Note: No water is to be added to the mix after the initial mixing and slump are determined.

The Contractor shall connect to the pipe ports fabricated into the forms for delivery of the concrete, beginning with the lowest ports first. Pumping shall continue until concrete is seen in the adjacent port at which time the delivery hose will be transferred to that port and the first port capped.

Pumping shall continue moving laterally then upward until the entire form is filled and the pour is completed.

3.3 Coordination of Work

The Contractor is to coordinate his work mixing, transporting, and placing the mass concrete with the on-going operations in the underground. Coordination of use of the facilities and existing equipment shall be through the Engineer.

3.4 Clean-Up

No clean up or washing of equipment with water will be allowed in the underground. No free water spills are permitted in the underground. All clean-out or wash-out requiring water will be performed above ground at the location approved by the Engineer.

3.5 Quality Control

The Contractor shall provide a third-party quality control inspector at the site throughout the concrete placement. The inspector shall be responsible for determining that the batch plant is proportioning the mix according to the approved proportions. The batch plant shall provide a print out of batch quantities for each truck delivered to the mine. The inspector shall also determine the slump for each batch as it is mixed and allow additional water to be added until the initial slump is achieved. No additional water is to be added after this time. Temperature will also be recorded at this time.

The inspector shall also determine the slump and temperature following the remixing when concrete is transferred to the pump. Concrete not meeting or exceeding the specification is to be rejected and removed from the underground.

Concrete test cylinders to determine unconfined compression strength shall be taken by the inspection at the delivery from remixer to the pump in the underground. Four (4) cylinders shall be made for each 50 cubic yards of concrete placed. Cylinders shall be sealed with polyethylene and taped and field cured at ambient temperatures in the mine adjacent to the concrete barrier area. Two (2) samples shall be tested at 7 days and the remaining two (2) at 28 days.

End of section.

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DIVISION 4 - MASONRY

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Section 04100 - Mortar
Part 1 - General

1.1 Scope

This section includes:

- Mortar for Isolation Wall Construction.

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment
- 04300 - Unit Masonry System

1.3 References

ASTM C91	Standard Specification for Masonry Cement
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C207	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C270	Standard Specification for Mortar for Unit Masonry
ASTM C7805	Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C1142	Ready-Mixed Mortar for Unit Masonry
ASTM E447	Test Methods for Compressive Strength of Masonry Prisms

1.4 Submittals for Review and Approval

The Contractor shall submit for approval the following 30 days prior to the initiation of work at the site:

Design mix.

Certified laboratory tests for the proposed design mix, indicating conformance of mortar to property requirements of ASTM C270, and test and evaluation reports to ASTM C780.

1.5 Submittals at Completion

Certified laboratory test results for the construction testing of mortar mix.

1.6 Quality Assurance

Perform work in accordance with the Contractor's Quality Control Plan and referenced ASTM standards. Acquire cement, aggregate, and component materials from the same source throughout the work.

1.7 Delivery Storage Handling

Maintain packaged materials clean, dry and protected against dampness, freezing and foreign matter.

Part 2 - Products

2.1 Mortar Mix

The Contractor shall provide mortar for Isolation Walls, which shall be in conformance with ASTM C270 type M, using the property specification (3,000 psi at 28 days).

Sand for mortar shall conform to ASTM C144.

Water used for mixing mortar shall be of potable quality, free of injurious amounts of oil, acid alkali, organic matter, sediments, or other deleterious substances, as specified for Concrete, Section 03300 2.3.

The supply of materials as defined in the design mix shall remain the same throughout the job.

Part 3 - Execution

3.1 General

The Contractor shall furnish all labor material equipment and tools to perform all operations in connection with supplying and mixing mortar for constructing the isolation walls.

The Contractor shall fully describe his proposed mortar mixing operation, including proposed equipment and materials in the Work Plan.

3.2 Mortar Mixing

Mortar shall be machine-mixed with sufficient water to achieve satisfactory workability. Maintain sand uniformly damp immediately before the mixing process. If water is lost by evaporation, retemper only within one and one half hours of mixing. Use mortar within two hours of mixing at ambient temperature of 85° in the mine.

3.3 Installation

The Contractor shall install mortar to the requirements of Section 04300 Unit Masonry System.

3.4 Field Quality Control

The Contractor shall provide a third party Quality Control Inspector to perform all sampling and testing to confirm that the mortar mix conforms to the proposed mix properties developed in the design mix.

Construction testing of mortar mix shall be in accordance with ASTM C780 for compression strength. Four (4) prism specimens shall be taken for each 50 cu. ft. of mortar or fraction thereof placed each day.

End of Section.

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Section 04300 - Unit Masonry System

Part 1 - General

1.1 Scope

This section includes:

- Concrete Masonry Units

1.2 Related Sections

- 01010 Summary of Work
- 01400 Contractor Quality Control
- 01600 Material and Equipment
- 02722 Grouting
- 03100 Concrete Formwork
- 04100 Mortar

1.3 References

ASTM C55 Standard Specification for Concrete Building Brick

ASTM C140 Standard Method of Sampling and Testing Concrete Masonry Units

1.4 Submittals for Revision and Approval

The Contractor shall submit for approval the following 30 days prior to initiation of the work at the site.

Certified laboratory test results for the proposed solid masonry units.

1.5 Quality Assurance

Perform the work in accordance with the Contractor's Quality Control Plan.

Part 2 - Products

2.1 Concrete Masonry Units

Concrete masonry units shall be solid (no cavities or cores), load bearing high-strength units having a minimum compressive strength of 3500 psi. Concrete masonry units shall be tested in accordance with ASTM C140. All other aspects of the concrete masonry units shall comply with ASTM C55, Type I Moisture Controlled.

Nominal modular size shall be 8 x 8 x 16 inches, or as otherwise approved by the Engineer.

Concrete brick shall comply with ASTM C55, Grade N, Type I (moisture controlled) having a minimum compressive strength of 3500 psi (Avg. 3 units) or 3000 psi for individual unit.

2.2 Mortar

Mortar shall be as specified in Section 04100 Mortar.

Part 3 - Execution

3.1 General

The Contractor shall furnish all labor, material, equipment and tools to perform all operations of installing Unit Masonry Isolation Walls to the lines and grades shown on the drawings.

The Contractor shall examine the excavation of the entry to affirm that the keys have been properly leveled and cut to the appropriate depths, at the proper locations prior to any to any work.

3.2 Installation

The Contractor shall install the isolation walls using concrete masonry units as specified above. Masonry units shall be installed with 3/8-inch mortar joints with full mortar bedding and full head joints. Masonry units shall be installed in running bond with headers every third course. Masonry units shall be mortared tight to the ribs and the back wall to provide a seal all around the isolation wall.

Concrete brick may be used as required for fit-up around grout pipes, or minimizing the dimensional fit-up at the top or sides of the isolation walls as approved by the Engineer. The interface between the top of the isolation wall and the back wall shall be completely mortared to provide full contact between the back and the block wall.

3.3 Field Quality Control

The Contractor shall provide a third-party Quality Control Inspector to inspect the installation of the Concrete Masonry Unit Isolation Walls. Inspection and testing of the mortar shall be in accordance with Section 04100 Mortar.

End of Section

FIGURES

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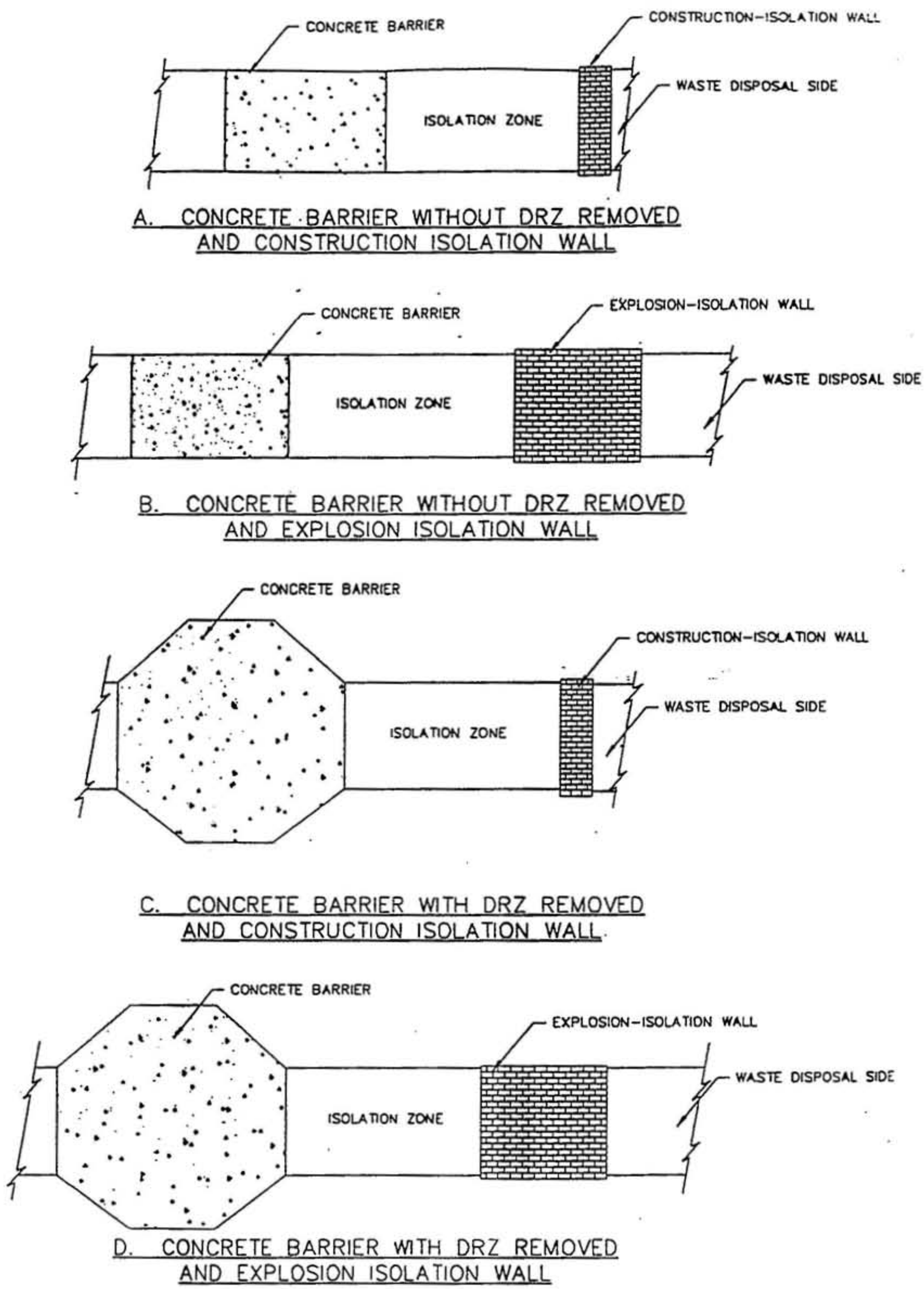


Figure I1G-1
Plan Variations

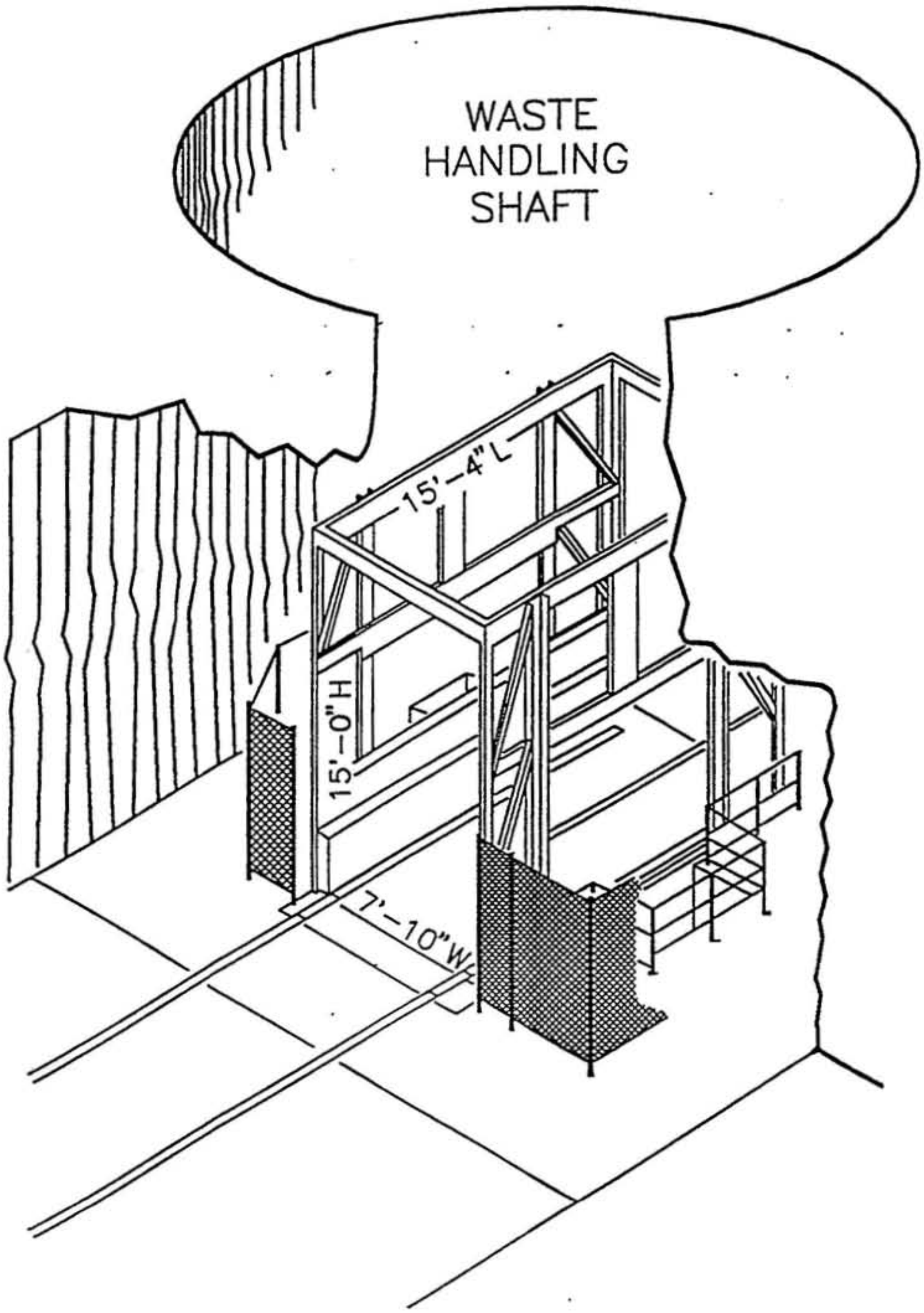
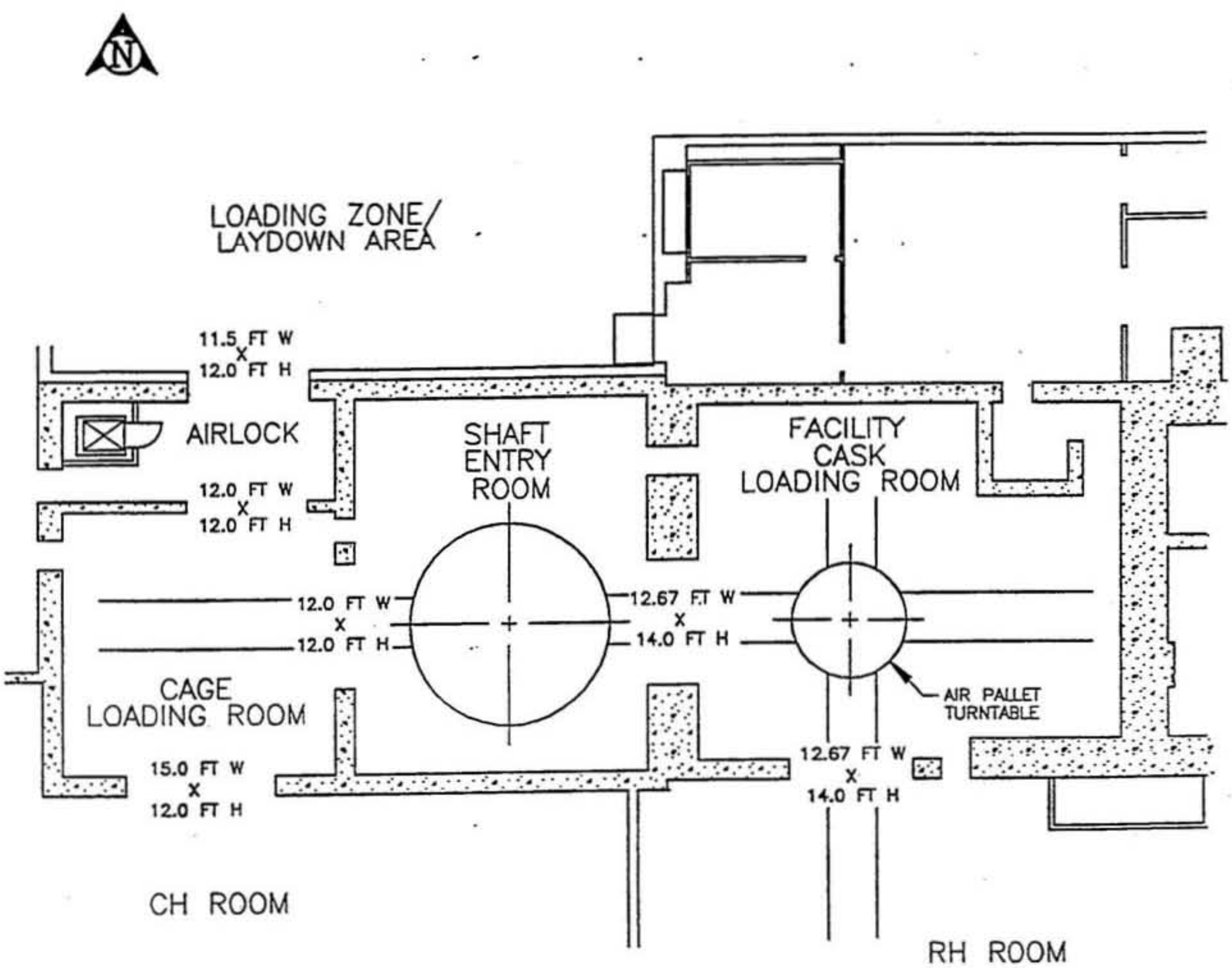


Figure I1G-2
Waste Handling Shaft Cage Dimensions

1



2 Figure I1G-3
3 Waste Shaft Collar and Airlock Arrangement

APPENDIX I1
APPENDIX H

DESIGN DRAWINGS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO

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APPENDIX I1
APPENDIX H

DESIGN DRAWINGS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO

Drawing	***Title***
762447-E1	Panel closure system, air intake and exhaust drifts, title sheet
762447-E2	Panel closure system, underground waste-emplacement panel plan
762447-E3	Panel closure system, air intake drift, construction details
762447-E4	Panel closure system, air exhaust drift, construction details
762447-E5	Panel closure system, construction and explosion walls, construction details
762447-E6	Panel closure system, air intake and exhaust drifts, grouting and miscellaneous details

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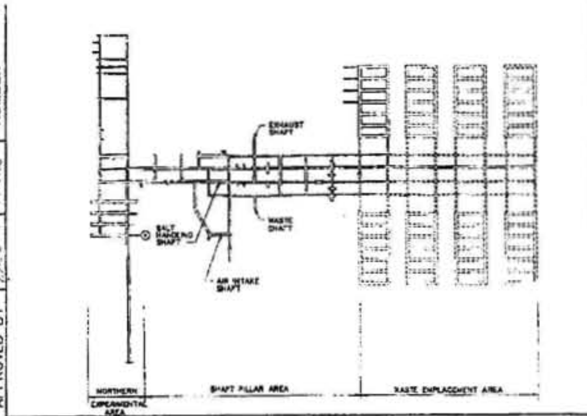
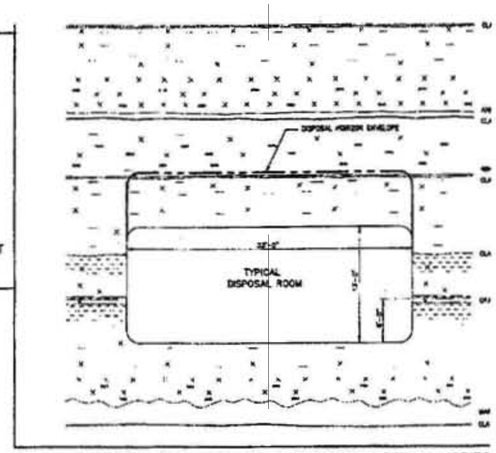


UNDERGROUND REPOSITORY LAYOUT PLAN

762447-E1	TITLE SHEET
762447-E2	UNDERGROUND WASTE DISPOSAL PANEL-PLAN
762447-E3	PANEL CLOSURE SYSTEM-AIR INTAKE DRIFT-CONSTRUCTION DETAILS
762447-E4	PANEL CLOSURE SYSTEM-AIR EXHAUST DRIFT-CONSTRUCTION DETAILS
762447-E5	PANEL CLOSURE SYSTEM-CONSTRUCTION AND EXPLOSION WALLS-CONSTRUCTION DETAILS
762447-E6	PANEL CLOSURE SYSTEM-AIR ENTRANCE AND EXHAUST DRIFT GROUTING AND MISCELLANEOUS DETAILS

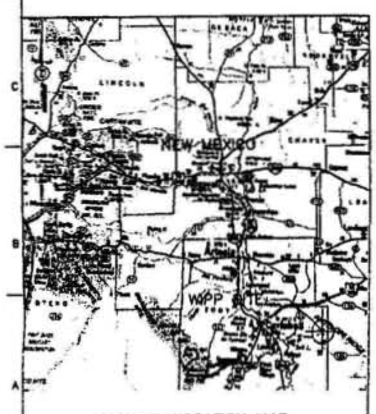


DETAILED STRATIGRAPHY AT THE REPOSITORY HORIZO

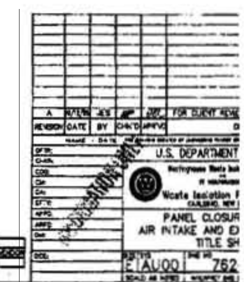
WASTE ISOLATION PILOT PLANT
PANEL CLOSURE SYSTEM
CARLSBAD, NEW MEXICO

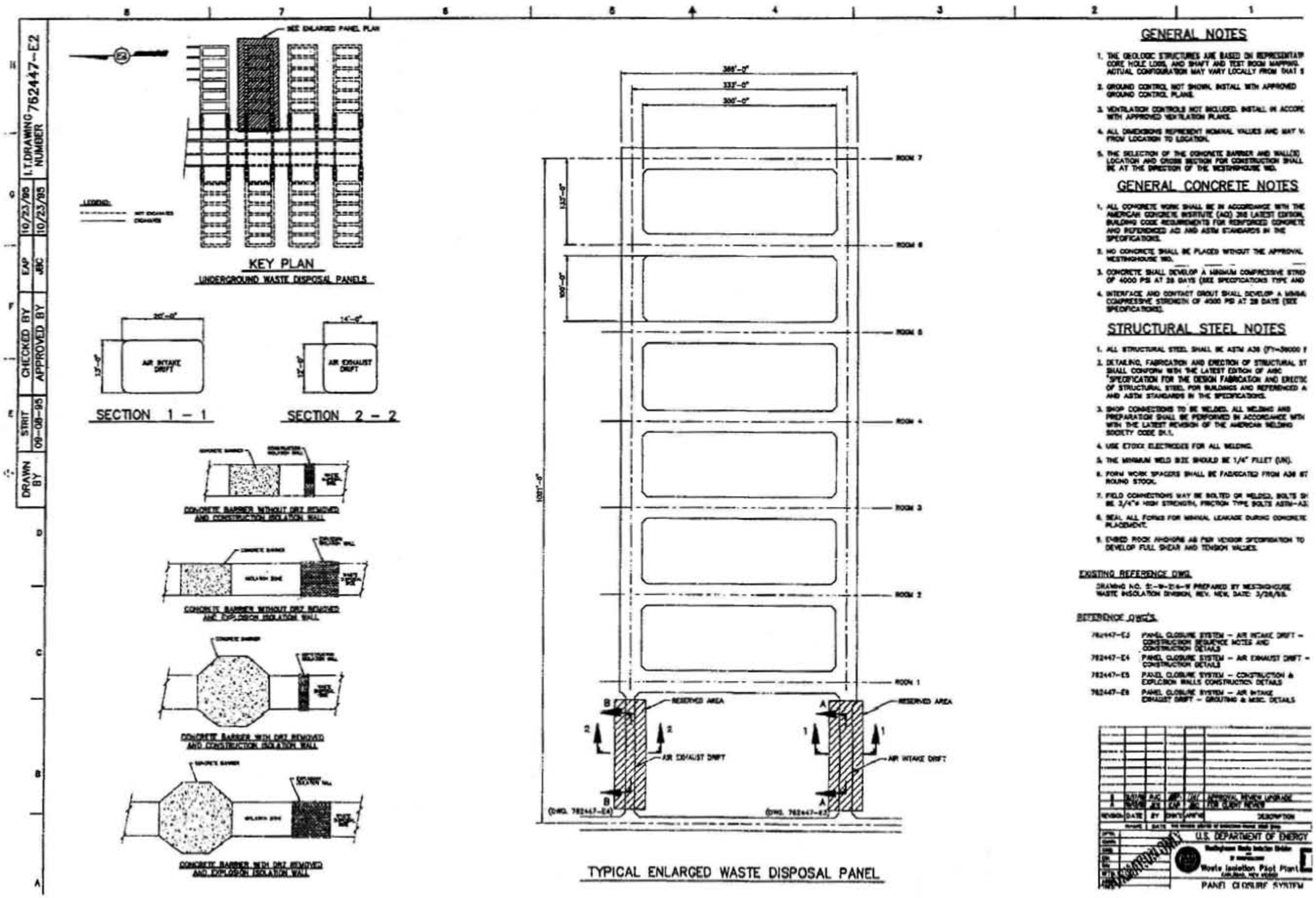
prepared by

IT CORPORATION
ALBUQUERQUE, NEW MEXICO

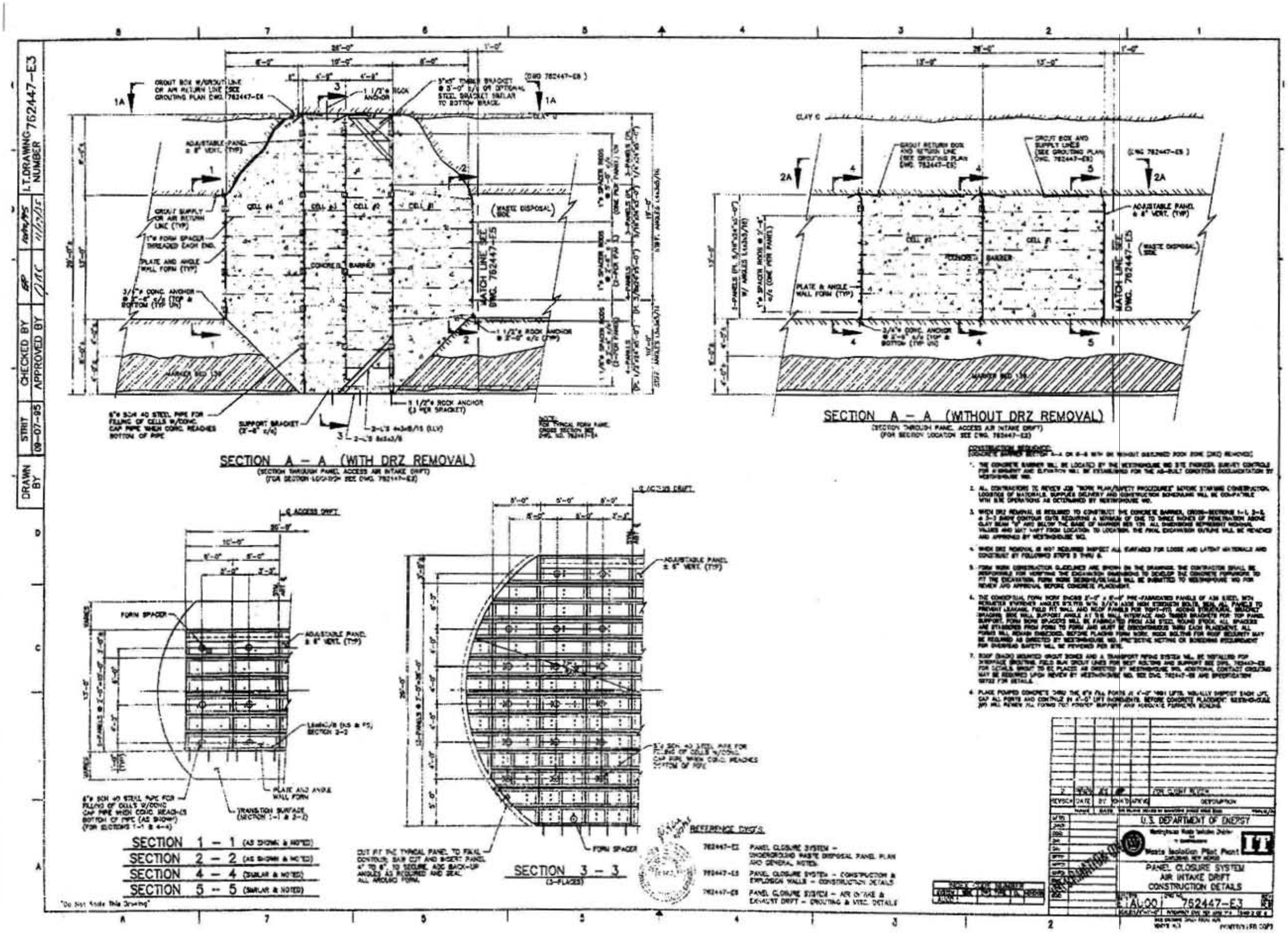


GENERAL LOCATION MAP




GENERAL NOTES
GENERAL CONCRETE NOTES
STRUCTURAL STEEL NOTES
KEY PLAN
UNDERGROUND WASTE DISPOSAL PANELS
SECTION 1 - 1
SECTION 2 - 2
TYPICAL ENLARGED WASTE DISPOSAL PANEL
U.S. DEPARTMENT OF ENERGY
Waste Isolation Pilot Plant
PANEL CLOSURE SYSTEM
762447-E2

1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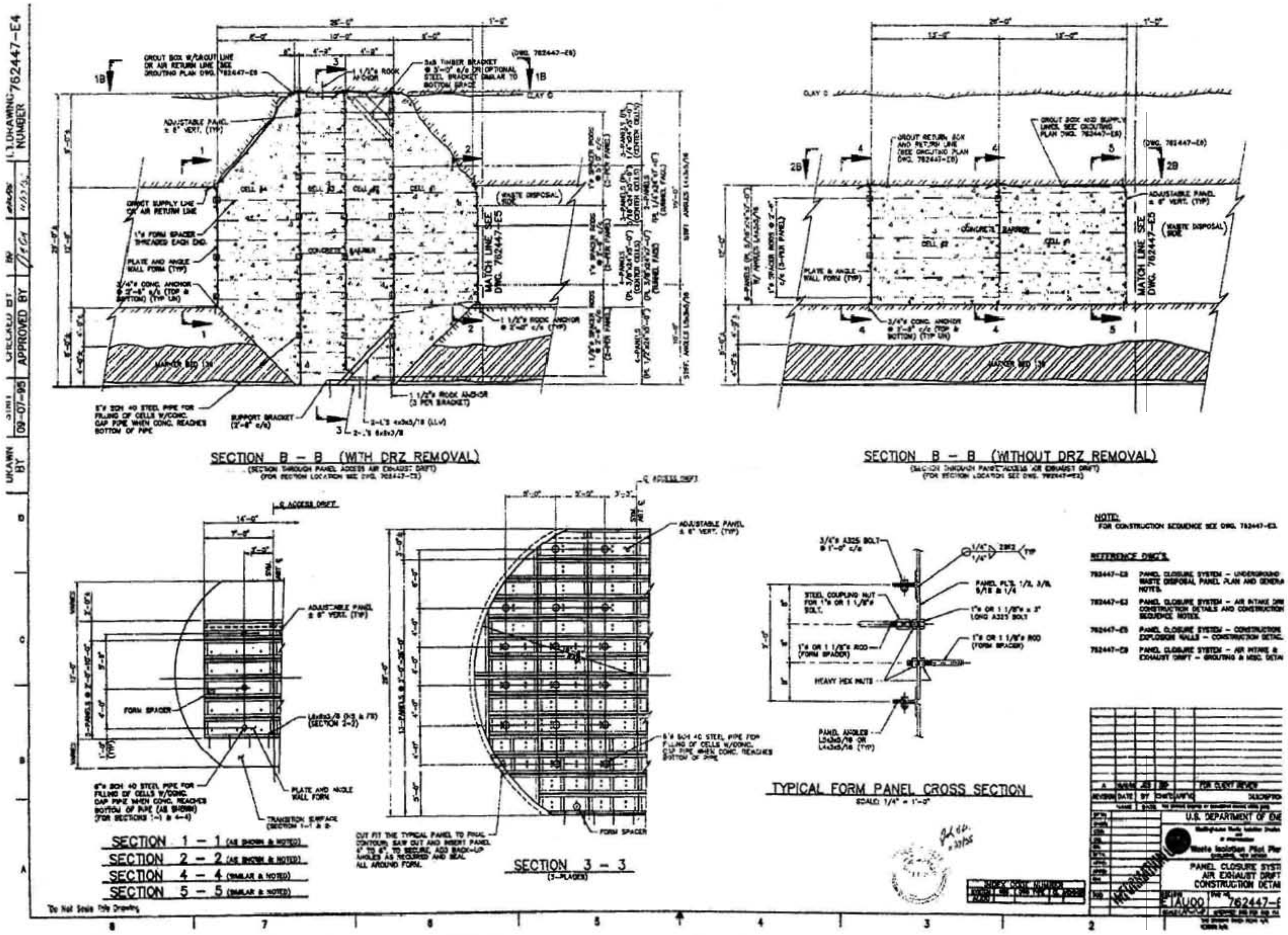
SECTION A – A (WITHOUT DRZ REMOVAL)
SECTION 1 – 1
SECTION 2 – 2
SECTION 4 – 4
SECTION 5 – 5
SECTION 3 – 3
U.S. DEPARTMENT OF ENERGY
Waste Isolation Pilot Plant
PANEL CLOSURE SYSTEM
AIR INTAKE DRIFT
CONSTRUCTION DETAILS
762447-E3


SECTION B – B (WITH DRZ REMOVAL)
SECTION B – B (WITHOUT DRZ REMOVAL)
TYPICAL FORM PANEL CROSS SECTION
SECTION 3 – 3
SECTION 1 – 1
SECTION 2 – 2
SECTION 4 – 4
SECTION 5 – 5
MARKER BED 139
CONCRETE BARRIER
U.S. DEPARTMENT OF ENE
PANEL CLOSURE SYST
AIR EXHAUST DRIFT
CONSTRUCTION DETAI
762447-E4

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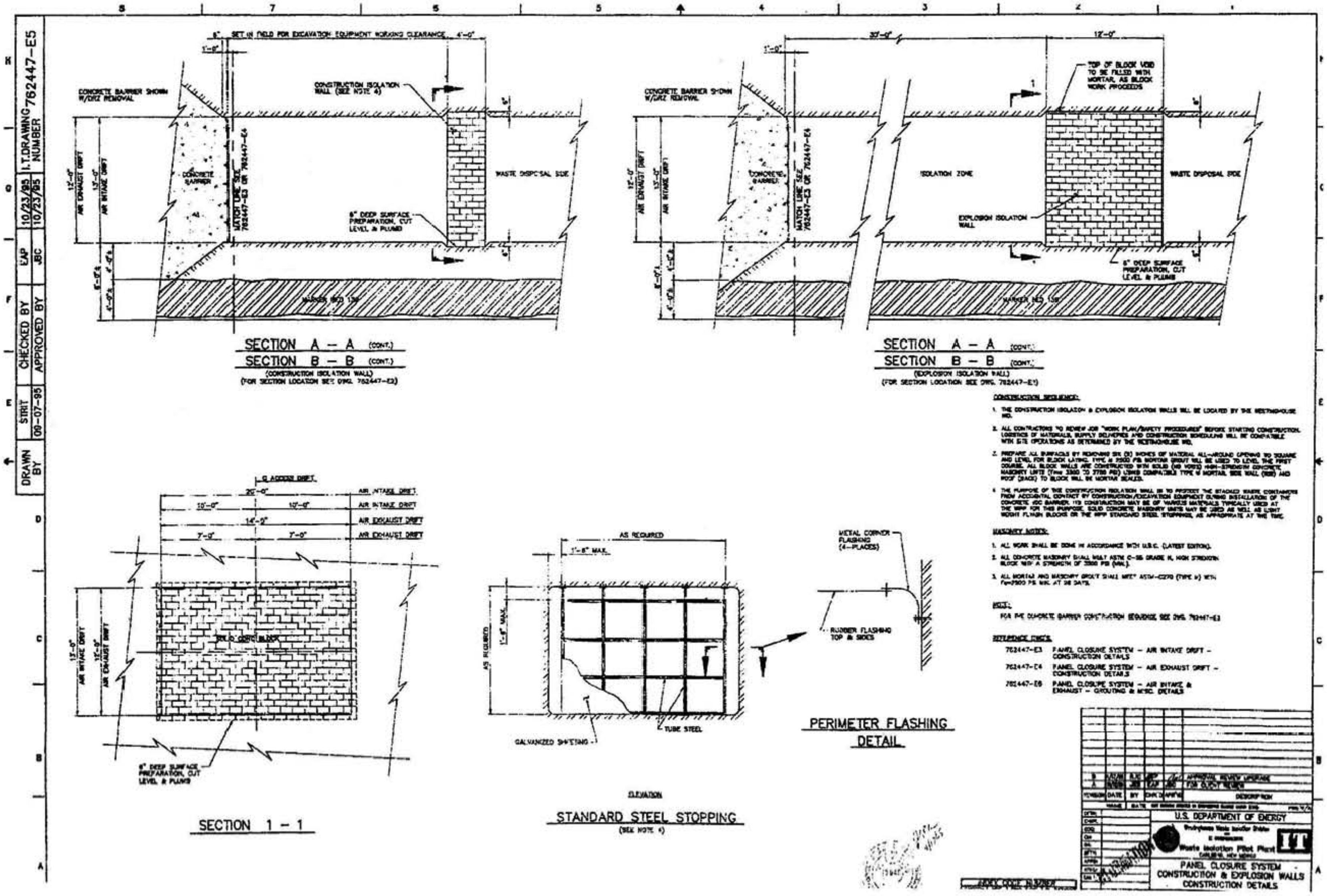
SECTION A – A (CONT.)
SECTION B – B (CONT.)
(CONSTRUCTION ISOLATION WALL)
SECTION A – A (CONT.)
SECTION B – B (CONT.)
(EXPLOSION ISOLATION WALL)
SECTION 1 – 1
STANDARD STEEL STOPPING
PERIMETER FLASHING DETAIL
U.S. DEPARTMENT OF ENERGY
PANEL CLOSURE SYSTEM CONSTRUCTION & EXPLOSION WALLS CONSTRUCTION DETAILS
762447-E5

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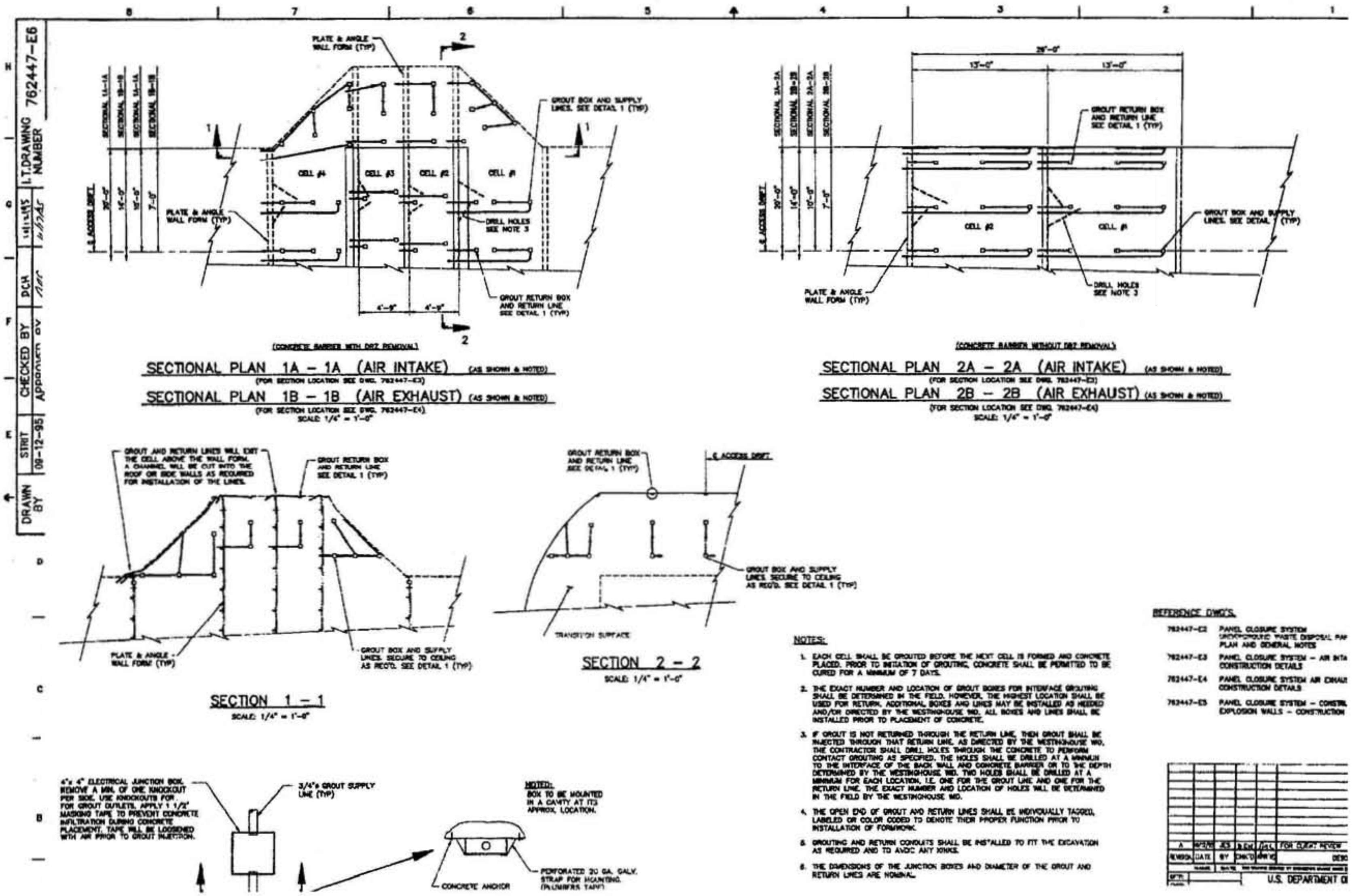
762447–E6
SECTIONAL PLAN 1A – 1A (AIR INTAKE)
SECTIONAL PLAN 1B – 1B (AIR EXHAUST)
SECTIONAL PLAN 2A – 2A (AIR INTAKE)
SECTIONAL PLAN 2B – 2B (AIR EXHAUST)
SECTION 1 – 1
SECTION 2 – 2
NOTES:
REFERENCE DWG'S.
U.S. DEPARTMENT OF

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APPENDIX I2

WASTE ISOLATION PILOT PLANT
SHAFT SEALING SYSTEM COMPLIANCE
SUBMITTAL DESIGN REPORT

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APPENDIX I2

WASTE ISOLATION PILOT PLANT
SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

Adapted from:

SAND96-1326/1
Distribution Unlimited
Release Category UC-721
Printed August 1996

Waste Isolation Pilot Plant
Shaft Sealing System
Compliance Submittal Design Report

Volume 1 of 2: Main Report
Appendices A and B

Repository Isolation Systems Department
Sandia National Laboratories
Albuquerque, NM 87185

Abstract

This report describes a shaft sealing system design for the Waste Isolation Pilot Plant (WIPP), a proposed nuclear waste repository in bedded salt. The system is designed to limit entry of water and release of contaminants through the four existing shafts after the WIPP is decommissioned. The design approach applies redundancy to functional elements and specifies multiple, common, low-permeability materials to reduce uncertainty in performance. The system comprises 13 elements that completely fill the shafts with engineered materials possessing high density and low permeability. Laboratory and field measurements of component properties and performance provide the basis for the design and related evaluations. Hydrologic, mechanical, thermal, and physical features of the system are evaluated in a series of calculations. These evaluations indicate that the design guidance is addressed by effectively limiting transport of fluids within the shafts, thereby limiting transport of hazardous material to regulatory boundaries. Additionally, the use or adaptation of existing technologies for placement of the seal components combined with the use of available, common materials assure that the design can be constructed.

This report was modified to make it a part of the RCRA Facility Permit issued by the New Mexico Environment Department (NMED). The modifications included removal of Appendices C and D from the original document. Although they were important to demonstrate compliance with the performance standards in the hazardous waste regulations, they do not provide plans or procedures that will be implemented under the authority of the Permit. Appendices A, B and E

are retained as Attachments to the Permit (Attachments I2-A, I2-B and I2-E). The Figures in this report, which were interspersed in the text in the original document, have been moved to a common section following the References.

Acknowledgments

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Table of Contents

* Appendices C and D are not included in the facility Permit.

*FIGURES

*NOTE: All Figures are attached following References

Tables

Acronyms

AIS	Air Intake Shaft
AMM	asphalt mastic mix
CFR	Code of Federal Regulations
DOE	Department of Energy
DRZ	disturbed rock zone
EPA	Environmental Protection Agency
HMAC	hot mix asphalt concrete
MDCF	Multimechanism Deformation Coupled Fracture
MD	Munson-Dawson
NMED	New Mexico Environment Department
NMVP	No Migration Variance Petition
PA	performance assessment
PTM	Plug Test Matrix
QA	quality assurance
SMC	Salado Mass Concrete
SPVD	Site Preliminary Design Validation
SSSPT	Small Scale Seal Performance Test
SWCF	Sandia WIPP Central Files
TRU	transuranic
WIPP	Waste Isolation Pilot Plant

Executive Summary

Introduction

This report documents a shaft seal system design developed as part of a submittal to the Environmental Protection Agency (**EPA**) and the New Mexico Environment Department (**NMED**) that will demonstrate regulatory compliance of the Waste Isolation Pilot Plant (**WIPP**) for disposal of transuranic waste. The shaft seal system limits entry of water into the repository and restricts the release of contaminants. Shaft seals address fluid transport paths through the opening itself, along the interface between the seal material and the host rock, and within the disturbed rock surrounding the opening. The entire shaft seal system is described in this Permit Attachment and its three appendices, which include seal material specifications, construction methods, rock mechanics analyses, fluid flow evaluations, and the design drawings. The design represents a culmination of several years of effort that has most recently focused on providing to the EPA and NMED a viable shaft seal system design. Sections of this report and the appendices explore function and performance of the WIPP shaft seal system and provide well documented assurance that such a shaft seal system could be constructed using available materials and methods. The purpose of the shaft seal system is to limit fluid flow within four existing shafts after the repository is decommissioned. Such a seal system would not be implemented for several decades, but to establish that regulatory compliance can be achieved at that future date, a shaft seal system has been designed that exhibits excellent durability and performance and is constructable using existing technology. The design approach is conservative, applying redundancy to functional elements and specifying various common, low-permeability materials to reduce uncertainty in performance. It is recognized that changes in the design described here will occur before construction and that this design is not the only possible combination of materials and construction strategies that would adequately limit fluid flow within the shafts.

Site Setting

One of the Department of Energy's (**DOE's**) site selection criteria is a favorable geologic setting which minimizes fluid flow as a transport mechanism. Groundwater hydrology in the proximity of the WIPP site is characterized by geologic strata with low transmissivity and low hydrologic gradients, both very positive features with regard to sealing shafts. For purposes of performance evaluations, hydrological analyses divide lithologies and requirements into the Rustler Formation (and overlying strata) and the Salado Formation, comprised mostly of salt. The principal design concern is fluid transport phenomena of seal materials and lithologies within the Salado Formation. The rock mechanics setting is an important consideration in terms of system performance. Rock properties affect hydrologic response of the shaft seal system. The stratigraphic section contains lithologies that exhibit brittle and ductile behavior. A zone of rock around the shafts is disturbed owing to the creation of the opening. The disturbed rock zone (**DRZ**) is an important design consideration because it possesses higher permeability than intact rock. Host rock response and its potential to fracture, flow, and heal around WIPP shaft openings are relevant to the performance of the shaft seal system.

Design Guidance

Use of both engineered and natural barriers to isolate wastes from the accessible environment is required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR §191.14(d). The use of engineered barriers to prevent or substantially delay movement of water, hazardous constituents, or radionuclides toward the accessible environment is required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR §194.44. Hazardous constituent release performance standards are specified in Permit Module V and 20.4.1.500 NMAC (incorporating 40 CFR §§264.111(b), 264.601(a), and 264 Subpart F). Radionuclide release limits are specified in 40 CFR §191 for the entire repository system (EPA, 1996a; 1996b). Design guidance for the shaft seal system addresses the need for the WIPP to comply with system requirements and to follow accepted engineering practices using demonstrated technology. Design guidance is categorized below:

- limit hazardous constituents reaching regulatory boundaries,
- restrict groundwater flow through the sealing system,
- use materials possessing mechanical and chemical compatibility,
- protect against structural failure of system components,
- limit subsidence and prevent accidental entry, and
- utilize available construction methods and materials.

Discussions of the design presented in the text of this report and the details presented in the appendices respond to these qualitative design guidelines. The shaft seal system design was completed under a Quality Assurance program that includes review by independent, qualified experts to assure the best possible information is provided to the DOE on selection of engineered barriers (40 CFR §194.27). Technical reviewers examined the complete design including conceptual, mathematical, and numerical models and computer codes (40 CFR §194.26). The design reduces the impact of uncertainty associated with any particular element by using multiple sealing system components and by using components constructed from different materials.

Design Description

The shaft sealing system comprises 13 elements that completely fill the shaft with engineered materials possessing high density and low permeability. Salado Formation components provide the primary regulatory barrier by limiting fluid transport along the shaft during and beyond the 10,000-year regulatory period. Components within the Rustler Formation limit commingling between brine-bearing members, as required by state regulations. Components from the Rustler to the surface fill the shaft with common materials of high density, consistent with good engineering practice. A synopsis of each component is given below.

Shaft Station Monolith. At the bottom of each shaft a salt-saturated concrete monolith supports the local roof. A salt-saturated concrete, called Salado Mass Concrete (**SMC**), is specified and is placed using a conventional slickline construction procedure where the concrete is batched at the surface. SMC has been tailored to match site conditions. The salt-handling shaft and the waste-handling shaft have sumps which also will be filled with salt-saturated concrete as part of the monolith.

Clay Columns. A sodium bentonite is used for three compacted clay components in the Salado and Rustler Formations. Although alternative construction specifications are viable, labor-intensive placement of compressed blocks is specified because of proven performance. Clay columns effectively limit brine movement from the time they are placed to beyond the 10,000-year regulatory period. Stiffness of the clay is sufficient to promote healing of fractures in the surrounding rock salt near the bottom of the shafts, thus removing the proximal DRZ as a potential pathway. The Rustler clay column limits brine communication between the Magenta and Culebra Members of the Rustler Formation.

Concrete-Asphalt Waterstop Components. Concrete-asphalt waterstop components comprise three elements: an upper concrete plug, a central asphalt waterstop, and a lower concrete plug. Three such components are located within the Salado Formation. These concrete-asphalt waterstop components provide independent shaft cross-section and DRZ seals that limit fluid transport, either downward or upward. Concrete fills irregularities in the shaft wall, while use of the salt-saturated concrete assures good bonding with salt. Salt creep against the rigid concrete components establishes a compressive stress state and promotes early healing of the salt DRZ surrounding the concrete plugs. The asphalt intersects the shaft cross section and the DRZ.

Compacted Salt Column. Each shaft seal includes a column of compacted WIPP salt with 1.5 percent weight water added to the natural material. Construction demonstrations have shown that mine-run WIPP salt can be dynamically compacted to a density equivalent to approximately 90% of the average density of intact Salado salt. The remaining void space is removed through consolidation caused by creep closure. The salt column becomes less permeable as density increases. The location of the compacted salt column near the bottom of the shaft assures the fastest achievable consolidation of the compacted salt column after closure of the repository. Analyses indicate that the salt column becomes an effective long-term barrier in under 100 years.

Asphalt Column. An asphalt-aggregate mixture is specified for the asphalt column, which bridges the Rustler/Salado contact and provides a seal essentially impermeable to brine for the shaft cross-section and the shaft wall interface. All asphalt is placed with a heated slickline.

Concrete Plugs. A concrete plug is located just above the asphalt column and keyed into the surrounding rock. Mass concrete is separated from the cooling asphalt column with a layer of fibercrete, which permits work to begin on the overlying clay column before the asphalt has completely cooled. Another concrete plug is located near the surface, extending downward from the top of the Dewey Lake Redbeds.

Earthen Fill. The upper shaft is filled with locally available earthen fill. Most of the fill is dynamically compacted (the same method used to construct the salt column) to a density approximating the surrounding lithologies. The uppermost earthen fill is compacted with a sheepsfoot roller or vibratory plate compactor.

Structural Analysis

Structural issues pertaining to the shaft seal system have been evaluated. Mechanical, thermal, physical, and hydrological features of the system are included in a broad suite of structural calculations. Conventional structural mechanics applications would normally calculate load on system elements and compare the loads to failure criteria. Several such conventional calculations have been performed and show that the seal elements exist in a favorable, compressive stress state that is low in comparison to the strength of the seal materials. Thermal analyses have been performed to examine the effects of concrete heat of hydration and heat transfer for asphalt elements. Coupling between damaged rock and fluid flow and between the density and permeability of the consolidating salt column is evaluated within the scope of structural calculations. The appendices provide descriptions of various structural calculations conducted as part of the design study. The purpose of each calculation varies; however, the calculations generally address one or more of the following concerns: (1) stability of the component, (2) influences of the component on hydrological properties of the seal and surrounding rock, or (3) construction methods. Stability calculations address:

- potential for thermal cracking of concrete;
- structural loads on seal components resulting from salt creep, gravity, swelling clay, dynamic compaction, or possible repository-generated gas pressures.

Structural calculations defining input conditions to hydrological calculations include:

- spatial extent of the DRZ within the Salado Formation salt beds as a function of depth, time, and seal material;
- fracturing and DRZ development within Salado Formation interbeds;
- shaft-closure induced consolidation of compacted salt columns; and
- impact of pore pressures on salt consolidation.

Construction analyses examine:

- placement and structural performance of asphalt waterstops, and
- potential subsidence reduction through backfilling the shaft station areas.

Structural calculations model shaft features including representation of the host rock and its damaged zone as well as the seal materials themselves. Two important structural calculations discussed below are unique to shaft seal applications.

DRZ Behavior. The development and subsequent healing of a DRZ that forms in the rock mass surrounding the WIPP shafts is a significant concern in the seal design. It is well known that a

DRZ will develop in rock salt adjacent to the shaft upon excavation. Placement of rigid components in the shaft promotes healing within the salt DRZ as seal elements restrain inward creep and reduce the stress difference. Two computer models to calculate development and extent of the salt DRZ are used. The first model uses a ratio of stress invariants to predict fracture; the second approach uses a damage stress criterion. The temporal and spatial extent of the DRZ along the entire shaft length is evaluated. Several analyses are performed to examine DRZ behavior of the rock salt surrounding the shaft. The time-dependent DRZ development and subsequent healing in the Salado salt surrounding each of the four seal materials are considered. All seal materials below a depth of about 300 m provide sufficient rigidity to heal the DRZ, a phenomenon that occurs quickly around rigid components near the shaft bottom. An extensive calculation is made of construction effects on the DRZ during placement of the asphalt-concrete waterstops. The time-dependent development of the DRZ within anhydrite and polyhalite interbeds of the Salado Formation is calculated. For all interbeds, the factor of safety against shear or tensile fracturing increases with depth into the rock surrounding the shaft wall. These results indicate that a continuous DRZ will not develop in nonsalt Salado rocks. Rock mechanics analysis also determines which of the near surface lithologies fracture in the proximity of the shaft. Results from these rock mechanics analyses are used as input conditions for the fluid-flow analyses.

Compacted Salt Behavior. Unique application of crushed salt as a seal component required development of a constitutive model for salt reconsolidation. The model developed includes a nonlinear elastic component and a creep consolidation component. The nonlinear elastic modulus is density-dependent, based on laboratory test data performed on WIPP crushed salt. Creep consolidation behavior of crushed salt is based on three candidate models whose parameters are obtained from model fitting to hydrostatic and shear consolidation test data gathered for WIPP crushed salt. The model for consolidating crushed salt is used to predict permeability of the salt column. The seal system prevents fluid transport to the consolidating salt column to ensure that pore pressure does not unacceptably inhibit the reconsolidation process. Calculations made to estimate fractional density of the crushed salt seal as a function of time, depth, and pore pressure show consolidation time increases as pore pressure increases, as expected. At a constant pore pressure of one atmosphere, compacted salt will increase from its initial fractional density of 90% to 96% within 40, 80, and 120 years after placement at the bottom, middle, and top of the salt component, respectively. At a fractional density of 96%, the permeability of reconsolidating salt is approximately 10^{-18} m^2. A pore pressure of 2 MPa increases times required to achieve a fractional density of 96% to 92 years, 205 years, and 560 years at the bottom, middle, and top of the crushed salt column, respectively. A pore pressure of 4 MPa would effectively prevent reconsolidation of the crushed salt within 1,000 years. Fluid flow calculations show only minimal transport of fluids to the salt column, so pore pressure equilibrium in the consolidating salt does not occur before low permeabilities (~10^{-18} m^2) are achieved.

Hydrologic Evaluations

The ability of the shaft seal system to satisfy design guidance is determined by the performance of the actual seal components within the physical setting in which they are constructed.

Important elements of the physical setting are hydraulic gradients of the region, properties of the lithologic units surrounding a given seal component, and potential gas generation within the repository. Hydrologic evaluations focus on processes that could result in fluid flow through the shaft seal system and the ability of the seal system to limit any such flow. Transport of radiological or hazardous constituents will be limited if the carrier fluids are similarly limited. Physical processes that could impact seal system performance have been incorporated into four models. These models evaluate: (1) downward migration of groundwater from the Rustler Formation, (2) gas migration and reconsolidation of the crushed salt seal component, (3) upward migration of brines from the repository, and (4) flow between water-bearing zones in the Rustler Formation.

Downward Migration of Rustler Groundwater. The shaft seal system is designed to limit groundwater flowing into and through the shaft sealing system. The principal source of groundwater to the seal system is the Culebra Member of the Rustler Formation. No significant sources of groundwater exist within the Salado Formation; however, brine seepage has been noted at a number of the marker beds and is included in the models. Downward migration of Rustler groundwater is limited to ensure that liquid saturation of the compacted salt column does not impact the consolidation process and to limit quantities of brine reaching the repository horizon. Consolidation of the compacted salt column will be most rapid immediately following seal construction. Simulations conducted for the 200-year period following closure demonstrate that, during this initial period, downward migration of Rustler groundwater is insufficient to impact the consolidation process. Rock mechanics analyses show that this period encompasses the reconsolidation process. Lateral migration of brine through the marker beds is quantified in the analysis and shown to be inconsequential. At steady-state, the flow rate is most dependent on permeability of the system. Potential flow paths within the seal system consist of the seal material, an interface with the surrounding rock, and the host rock DRZ. Low permeability is specified for the engineered materials, and construction methods ensure a tight interface. Thus the flow path most likely to impact performance is the DRZ. Effects of the DRZ and sensitivity of the seal system performance to both engineered and host rock barriers show that the DRZ is successfully mitigated by the proposed design.

Gas Migration and Salt Column Consolidation. A multi-phase flow model of the lower seal system evaluates the performance of components extending from the middle concrete-asphalt waterstop located at the top of the salt column to the repository horizon for 200 years following closure. During this time period, the principal fluid sources to the model consist of potential gas generated by the waste and lateral brine migration within the Salado Formation. The predicted downward migration of a small quantity of Rustler groundwater (discussed above) is included in this analysis. Effects of gas generation are evaluated for three different repository repressurization scenarios, which simulate pressures as high as 14 MPa. Model results predict that high repository pressures do not produce appreciable differences in the volume of gas migration over the 200-year simulation period. Relatively low gas flow is a result of the low permeability and rapid healing of the DRZ around the lower concrete-asphalt waterstop.

Upward Migration of Brine. The Salado Formation is overpressurized with respect to the measured heads in the Rustler, and upward migration of contaminated brines could occur through an inadequately sealed shaft. Results from the model discussed above demonstrate that the crushed salt seal will reconsolidate to a very low permeability within 100 years following repository closure. Structural results show that the DRZ surrounding the long-term clay and crushed salt seal components will completely heal within the first several decades. Model calculations predict that very little brine flows from the repository to the Rustler/Salado contact.

Intra-Rustler Flow. Based on head differences between the various members of the Rustler Formation, nonhydrostatic conditions exist within the Rustler Formation. Therefore, the potential exists for vertical flow within water-bearing strata within the Rustler. The two units with the greatest transmissivity within the Rustler are the Culebra and the Magenta dolomites, which have the greatest potential for interflow. The relatively low undisturbed permeabilities of the mudstone and anhydrite units separating the Culebra and the Magenta naturally limit crossflow. However, the construction and subsequent closure of the shaft provide a potentially permeable vertical conduit connecting water-bearing units. The primary motivation for limiting formation crossflow within the Rustler is to prevent mixing of formation waters within the Rustler, as required by State of New Mexico statute. Commonly, such an undertaking would limit migration of higher dissolved solids (high-density) groundwater into lower dissolved solids groundwater. In the vicinity of the WIPP site, the Culebra has a higher density groundwater than the Magenta, and the potential for fluid migration between the two most transmissive units is from the unit with the lower total dissolved solids to the unit with the higher dissolved solids. This calculation shows that potential flow rates between the Culebra and the Magenta are insignificant. Under expected conditions, intra-Rustler flow is expected to be of such a limited quantity that (1) it will not affect either the hydraulic or chemical regime within the Culebra or the Magenta and (2) it will not be detrimental to the seal system itself.

Concluding Remarks

The principal conclusion is that an effective, implementable shaft seal system has been designed for the WIPP. Design guidance is addressed by limiting any transport of fluids within the shaft, thereby limiting transport of hazardous material to regulatory boundaries. The application or adaptation of existing technologies for placement of seal components combined with the use of available, common materials provide confidence that the design can be constructed. The structural setting for seal elements is compressive, with shear stresses well below the strength of seal materials. Because of the favorable hydrologic regime coupled with the low intrinsic permeability of seal materials, long-term stability of the shaft seal system is expected. Credibility of these conclusions is bolstered by the basic design approach of using multiple components to perform each sealing function and by using extensive lengths within the shafts to effect a sealing system. The shaft seal system adequately meets design requirements and can be constructed.

1. Introduction

1.1 Purpose of Compliance Submittal Design Report

This report documents the detailed design of the shaft sealing system for the Waste Isolation Pilot Plant (**WIPP**). The design documented in this report builds on the concepts and preliminary evaluations presented in the Sealing System Design Report issued in 1995 (DOE, 1995). The report contains a detailed description of the design and associated construction procedures, material specifications, analyses of structural and fluid flow performance, and design drawings. The design documented in this report forms the basis for the shaft sealing system which will be constructed under the authority of the hazardous waste facility Permit issued by NMED and as required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111(b) and 264.601(a)).

1.2 WIPP Description

The WIPP is designed as a full-scale, mined geological repository for the safe management, storage, and disposal of transuranic (**TRU**) radioactive wastes and TRU mixed wastes generated by US government defense programs. The facility is located near Carlsbad, New Mexico, in the southeastern portion of the state. The underground facility (Figure I2-1) consists of a series of shafts, drifts, panels, and disposal rooms. Four shafts, ranging in diameter from 3.5 to 6.1 m, connect the disposal horizon to the surface. Sealing of these four shafts is the focus of this report.

The disposal horizon is at a depth of approximately 655 m in bedded halite within the Salado Formation. The Salado is a sequence of bedded evaporites approximately 600 m thick that were deposited during the Permian Period, which ended about 225 million years ago. Salado salt has been identified as a good geologic medium to host a nuclear waste repository because of several favorable characteristics. The characteristics present at the WIPP site include very low permeability, vertical and lateral stratigraphic extent, tectonic stability, and the ability of salt to creep and ultimately entomb material placed in excavated openings. Creep closure also plays an important role in the shaft sealing strategy.

The WIPP facility must be determined to be in compliance with applicable regulations prior to the disposal of waste. After the facility meets the regulatory requirements, disposal rooms will be filled with containers holding TRU wastes of various forms. Wastes placed in the drifts and disposal rooms will be at least 150 m from the shafts. Regulatory requirements include use of both engineered and natural barriers to limit migration of hazardous constituents from the repository to the accessible environment. The shaft seals are part of the engineered barriers.

1.3 Performance Objective for WIPP Shaft Seal System

Each of the four shafts from the surface to the underground repository must be sealed to limit hazardous material release to the accessible environment and to limit groundwater flow into the repository. Although the seals will be permanent, the regulatory period applicable to the repository system analyses is 10,000 years.

1.4 Sealing System Design Development Process

This report presents a conservative approach to shaft sealing system design. Shaft sealing system performance plays a crucial role in meeting regulatory radionuclide and hazardous constituents release requirements. Although all engineering materials have uncertainties in properties, a combination of available, low-permeability materials can provide an effective sealing system. To reduce the impact of system uncertainties and to provide a high level of assurance of compliance, numerous components are used in this sealing system. Components in this design include long columns of clay, densely compacted crushed salt, a waterstop of asphaltic material sandwiched between massive low-permeability concrete plugs, a column of asphalt, and a column of earthen fill. Different materials perform identical functions within the design, thereby adding confidence in the system performance through redundancy.

The design is based on common materials and construction methods that utilize available technologies. When choosing materials, emphasis was given to permeability characteristics and mechanical properties of seal materials. However, the system is also chemically and physically compatible with the host formations, enhancing long-term performance.

Recent laboratory experiments, construction demonstrations, and field test results have been added to the broad and credible database and have supported advances in modeling capability. Results from a series of multi-year, in situ, small-scale seal performance tests show that bentonite and concrete seals maintain very low permeabilities and show no deleterious effects in the WIPP environment. A large-scale dynamic compaction demonstration established that crushed salt can be successfully compacted. Laboratory tests show that compacted crushed salt consolidates through creep closure of the shaft from initial conditions achieved in dynamic compaction to a dense salt mass with regions where permeability approaches that of in situ salt. These technological advances have allowed more credible analysis of the shaft sealing system.

The design was developed through an interactive process involving a design team consisting of technical specialists in the design and construction of underground facilities, materials behavior, rock mechanics analysis, and fluid flow analysis. The design team included specialists drawn from the staff of Sandia National Laboratories, Parsons Brinckerhoff Quade and Douglas, Inc. (contract number AG-4909), INTERA, Inc. (contract number AG-4910), and RE/SPEC Inc. (contract number AG-4911), with management by Sandia National Laboratories. The contractors developed a quality assurance program consistent with the Sandia National Laboratories Quality Assurance Program Description for the WIPP project. All three contractors received quality assurance support visits and were audited through the Sandia National Laboratories audit and assessment program. Quality assurance (**QA**) documentation is maintained in the Sandia National Laboratories WIPP Central Files. Access to project files for each contractor can be accomplished using the contract numbers specified above. In addition to the contractor support, technical input was obtained from consultants in various technical specialty areas.

Formal preliminary and final design reviews have been conducted on the technical information documented in the report. In addition, technical, management, and QA reviews have been performed on this report. Documentation is in the WIPP Central File.

It is recognized that additional information, such as on specific seal material or formation characteristics, on the sensitivity of system performance to component properties, on placement effectiveness, and on long-term performance, could be used to simplify the design and perhaps reduce the length or number of components. Such design optimization and associated simplifications are left to future research that may be used to update the compliance evaluations completed between now and the time of actual seal emplacement.

1.5 Organization of Document

This report contains an Executive Summary, 10 sections, and 5 appendices. The body of the report does not generally contain detailed backup information; this information is incorporated by reference or in the appendices.

The Executive Summary is a synopsis of the design and the supporting discussions related to seal materials, construction procedures, structural analyses, and fluid flow analyses. Introductory material in Section 1 sets the stage for and provides a "road map" to the remainder of the report.

Site characteristics that detail the setting into which the seals would be placed are documented in Section 2. These characteristics include the WIPP geology and stratigraphy for both the region and the shafts as well as a brief discussion of rock mechanics considerations of the site that impact the sealing system. Regional and local characteristics of the hydrologic and geochemical settings are also briefly discussed.

Section 3 presents the design guidance used for development of the shaft sealing system design. Seal-related guidance from applicable regulations is briefly described. The design guidance is then provided along with the design approach used to implement the guidance. The guidance forms the basis both for the design and for evaluations of the sealing system presented in other sections.

The shaft sealing system is documented in Section 4; detailed drawings for the design are provided in Appendix I2-E. The seal components, their design, and their functions are discussed for the Salado, the Rustler, and the overlying formations.

The sealing materials are described briefly in Section 5, with more detail provided in the materials specifications (Appendix I2-A). The materials used in the various seal components are discussed along with the reasons they are expected to function as intended. Material properties including permeability, strength, and mechanical constitutive response are given for each material. Brief discussions of expected compatibility, performance, construction techniques, and other characteristics relevant to the WIPP setting are also given.

Section 6 contains a brief description of the construction techniques proposed for use. General site and sealing preparation activities are discussed, including construction of a multi-deck stage for use throughout the placement of the components. Construction procedures to be used for the various types of components are then summarized based on the more detailed discussions provided in Appendix I2-B.

Section 7 summarizes structural analyses performed to assess the ability of the shaft sealing system to function in accordance with the design guidance provided in Section 3 and to provide input to hydrological calculations. The methods and computer programs, the models used to simulate the behavior of the seal materials and surrounding salt, and the results of the analyses are discussed. Particular emphasis is placed on the evaluations of the behavior of the disturbed rock zone. Details of the structural analyses are presented in Appendix D of Appendix I2 in the permit application (Appendix D is not included in the Permit). Section 8 summarizes fluid flow analyses performed to assess the ability of the shaft sealing system to function in accordance with the design guidance provided in Section 3. Hydrologic evaluations are focused on processes that could result in fluid flow through the shaft seal system and the ability of the seal system to limit such flow. Processes evaluated are downward migration of groundwater from the overlying formation, gas migration and reconsolidation of the crushed salt component, upward migration of brines from the repository, and flow between water-bearing zones in the overlying formation. Hydrologic models are described and the results are discussed as they relate to satisfying the design guidance, with extensive reference to Appendix C of Appendix I2 in the permit application that documents details of the flow analyses (Appendix C is not included in the Permit). Conclusions drawn about the performance of the WIPP shaft sealing system are described in Section 9. The principal conclusion that an effective, implementable design has been presented is based on the presentations in the previous sections. A reference list that documents principal references used in developing this design is then provided.

The three appendices that follow provide details related to the following subjects:

Appendix I2-A — Material Specification
Appendix I2-B — Shaft Sealing Construction Procedures
Appendix I2-E — Design Drawings (separate volume)

1.6 Systems of Measurement

Two systems of measurement are used in this document and its appendices. Both the System International d'Unites (SI) and English Gravitational (*fps* units) system are used. This usage corresponds to common practice in the United States, where SI units are used for scientific studies and *fps* units are used for facility design, construction materials, codes, and standards. Dual dimensioning is used in the design description and other areas where this use will aid the reader.

2. Site Geologic, Hydrologic, and Geochemical Setting

The site characteristics relevant to the sealing system are discussed in this section. The location and geologic setting of the WIPP are discussed first to provide background. The geology and stratigraphy, which affect the shafts, are then discussed. The hydrologic and geochemical settings, which influence the seals, are described last.

2.1 Introduction

The WIPP site is located in an area of semiarid rangeland in southeastern New Mexico. The nearest major population center is Carlsbad, 42 km west of the WIPP. Two smaller communities, Loving and Malaga, are about 33 km to the southwest. Population density close to the WIPP is very low: fewer than 30 permanent residents live within a 16-km radius.

2.2 Site Geologic Setting

Geologically the WIPP is located in the Delaware Basin, an elongated depression that extends from just north of Carlsbad southward into Texas. The Delaware Basin is bounded by the Capitan Reef (see Figure I2-2). The basin covers over 33,000 km^2 and is filled with sedimentary rocks to depths of 7,300 m (Hills, 1984). Rock units of the Delaware Basin (representing the Permian System through the Quaternary System) are listed in Figure I2-3.

Minimal tectonic activity has occurred in the region since the Permian Period (Powers et al., 1978). Faulting during the late Tertiary Period formed the Guadalupe and Delaware Mountains along the western edge of the basin. The most recent igneous activity in the area occurred during the mid-Tertiary Period about 35 million years ago and is evidenced by a dike in the subsurface 16 km northwest of the WIPP. Major volcanic activity last occurred more than 1 billion years ago during Precambrian time (Powers et al., 1978). None of these processes affected the Salado Formation at the WIPP. Therefore, seismic-related design criteria are not included in the current seal systems design guidelines.

2.2.1 Regional WIPP Geology and Stratigraphy

The Delaware Basin began forming with crustal subsidence during the Pennsylvanian Period approximately 300 million years ago. Relatively rapid subsidence over a period of about 14 million years resulted in the deposition of a sequence of deep-water sandstones, shales, and limestones rimmed by shallow-water limestone reefs such as the Capitan Reef (see Figure I2-2). Subsidence slowed during the late Permian Period. Evaporite deposits of the Castile Formation and the Salado Formation (which hosts the WIPP underground workings) filled the basin and extended over the reef margins. The evaporites, carbonates, and clastic rocks of the Rustler Formation and the Dewey Lake Redbeds were deposited above the Salado Formation near the end of the Permian Period. The Santa Rosa and Gatuña Formations were deposited after the close of the Permian Period.

From the surface downward to the repository horizon the stratigraphic units are the Quaternary surface sand sediments, Gatuña Formation, Santa Rosa Formation, Dewey Lake Redbeds, Rustler Formation, and Salado Formation. Three principal stratigraphic units (the Dewey Lake Redbeds, the Rustler Formation, and the Salado Formation) comprise all but the upper 15 to 30 m (50 to 100 ft) of the geologic section above the WIPP facility.

The Dewey Lake Redbeds consist of alternating layers of reddish-brown, fine-grained sandstone and siltstone cemented with calcite and gypsum (Vine, 1963). The Rustler Formation lies below the Dewey Lake Redbeds; this formation, the youngest of the Late Permian evaporite sequence, includes units that provide potential pathways for radionuclide migration from the WIPP. The five units of the Rustler, from youngest to oldest, are: (1) the Forty-niner Member, (2) the Magenta Dolomite Member, (3) the Tamarisk Member, (4) the Culebra Dolomite Member, and (5) an unnamed lower member.

The 250-million-year-old Salado Formation lies below the Rustler Formation. This unit is about 600 m thick and consists of three informal members. From youngest to oldest, they are: (1) an upper member (unnamed) composed of reddish-orange to brown halite interbedded with polyhalite, anhydrite, and sandstone, (2) a middle member (the McNutt Potash Zone) composed of reddish-orange and brown halite with deposits of sylvite and langbeinite; and (3) a lower member (unnamed) composed of mostly halite with lesser amounts of anhydrite, polyhalite, and glauberite, with some layers of fine clastic material. These lithologic layers are nearly horizontal at the WIPP, with a regional dip of less than one degree. The WIPP repository is located in the unnamed lower member of the Salado Formation, approximately 655 m (2150 ft) below the ground surface.

2.2.2 Local WIPP Stratigraphy

The generalized stratigraphy of the WIPP site, with the location of the repository, is shown in Figure I2-4. To establish the geologic framework required for the design of the WIPP facility shaft sealing system, an evaluation was performed to assess the geologic conditions existing in and between the shafts, where the individual shaft sealing systems will eventually be emplaced (DOE, 1995: Appendix I2-A). The study evaluated shaft stratigraphy, regional groundwater occurrence, brine occurrence in the exposed Salado Formation section, and the consistency between recorded data and actual field data.

Four shafts connect the WIPP underground workings to the surface, the (1) Air Intake Shaft (**AIS**), (2) Exhaust Shaft, (3) Salt Handling Shaft, and (4) Waste Shaft. Stratigraphic correlation and evaluation of the unit contacts show that lithologic units occur at approximately the same levels in all four shaft locations. Some stratigraphic contact elevations vary because of regional structure and stratigraphic thinning and thickening of units. However, the majority of the stratigraphic contacts used to date are suitable for engineering design reference because they intersect all four shafts.

2.2.3 Rock Mechanics Setting

The WIPP stratigraphy includes rock types that exhibit both brittle and ductile behaviors. The majority of the stratigraphy intercepted by the shafts consists of the Salado Formation, which is predominantly halite. The primary mechanical behavior of halitic rocks is creep. Except near free surfaces (such as the shaft wall), the salt rocks will remain tight and undisturbed despite the long-term creep deformation they sustain. The other rock types within the Salado Formation are anhydrites and polyhalites. These two rock types are typically brittle, stiff, and exhibit high strength in laboratory tests. The structural strength of particular anhydritic rock layers, however, depends on the thickness of the layers, which range from thin (<1 m) to fairly thick (10 m or more). Brittle failure of these noncreeping rocks can occur as they restrain, or attempt to restrain, the creep of the salt above and below the stiff layer. Although thick layers can resist the induced stresses, thin layers are fractured in tension by the salt creep. Because the deformation in the bounding salt is time dependent, the damage in the brittle rock is also time dependent.

Above the Salado Formation, the Rustler Formation stratigraphy consists of relatively strong limestones and siltstones. The shaft excavation is the only significant disturbance to these rocks. Any subsurface subsidence (deformation) or loading induced by the presence of the repository are negligible in a rock mechanics sense.

Regardless of rock type, the shafts create a disturbed zone in the surrounding rock. Microfracturing will occur in the rock adjacent to the shaft wall, where confining stresses are low or nonexistent. The extent of the zone depends on the rock strength and the prevailing stress state, which is depth dependent. In the salt rocks, microfracturing occurs to form the disturbed zone both at the time of excavation and later as dilatant creep deformations occur. In the brittle rocks, the disturbance occurs at the time of excavation and does not worsen with time. The extent of disturbed zones in the salt and brittle rocks can be calculated, as will be described in Section 7 and Appendix D in the permit application.

Preventing the salt surrounding the shafts from creeping causes reintroduction of stresses that reverse the damage process and cause healing (Van Sambeek et al., 1993). The seal system design relies on this principle for sealing the disturbed zone in salt. In the brittle rocks, grouting of the damage is a viable means of reducing the interconnected fractures that increase the permeability of the rock.

2.3 Site Hydrologic Setting

The WIPP shafts penetrate approximately 655 m (2150 ft) of sediments and rocks. From a hydrogeologic perspective, relevant information includes the permeability of the water-bearing units, the thickness of the water-bearing units, and the observed vertical pressure (head) gradients expected to exist after shaft construction and ambient pressure recovery. This section will discuss these three aspects of the site hydrogeology. The geochemistry of the pore fluids adjacent to the shaft system is also important hydrogeologic information and will be provided in Section 2.4.

2.3.1 Hydrostratigraphy

The WIPP shafts penetrate Quaternary surface sediments, the Gatuña Formation, the Santa Rosa Formation, the Dewey Lake Redbeds, the Rustler Formation, and the Salado Formation. The Rustler Formation contains the only laterally-persistent water-bearing units in the WIPP vicinity. As a result, flow-field characterization, regional flow-modeling, and performance assessment off-site release scenarios focus on the Rustler Formation. The hydrogeology of the stratigraphic units in contact with the upper portion of the AIS sealing system is fairly well known from detailed hydraulic testing of the Rustler Formation at well H-16 located 17 m from the AIS (Beauheim, 1987). The H-16 borehole was drilled in July and August 1987 to monitor the hydraulic responses of the Rustler members to the drilling and construction of the AIS. During the drilling of H-16, each member of the Rustler Formation was cored. In addition, detailed drill-stem, pulse, and slug hydraulic tests were performed in H-16 on the members of the Rustler. Through the detailed testing program at H-16, the permeability of each of the Rustler members was estimated. Detailed mapping of the AIS by Holt and Powers (1990) and other investigators provided information on the location of wet zones and weeps within the Salado Formation. This information will be summarized below. The reader, unless particularly interested in this subject, should proceed to Section 2.3.2.

Water-bearing zones have been observed in units above the Rustler Formation in the WIPP site vicinity. However, drilling in the Dewey Lake Redbeds has not identified any continuous saturated units at the WIPP site. Water-bearing units within stratigraphic intervals above the Rustler are typically perched saturated zones of very low yield. Thin perched groundwater intervals have been encountered in WIPP wells H-1, H-2, and H-3 (Mercer and Orr, 1979). The only Dewey Lake Redbed wells that have sufficient yields for watering livestock are the James Ranch wells, the Pocket well, and the Fairfield well (Brinster, 1991). These wells are located to the south of the WIPP and are not in the immediate vicinity of the WIPP shafts.

The Dewey Lake Redbeds overlie the Rustler Formation. The Rustler is composed of five members defined by lithology. These are, in ascending order, the unnamed lower member, the Culebra dolomite, the Tamarisk, the Magenta dolomite, and the Forty-niner (see Figure I2-4). Of these five members, the unnamed lower member, the Culebra, and the Magenta are the most transmissive units in the Rustler. The Tamarisk and the Forty-niner are aquitards within the Rustler and have very low permeabilities relative to the three members listed above.

To the east of the shafts in Nash Draw, the Rustler/Salado contact has been observed to be permeable and water-bearing. This contact unit has been referred to as the “brine aquifer” (Mercer, 1983). The brine aquifer is not reported to exist in the vicinity of the shafts. The hydraulic conductivity of the Rustler/Salado contact in the vicinity of the shafts is reported to be approximately 4×10^{-11} m/s, which is equivalent to a permeability of 6×10^{-18} m^2 using reference brine fluid properties (Brinster, 1991). The unnamed lower member was hydraulic tested at well H-16 in close proximity to the AIS. The maximum permeability of the unnamed lower member was interpreted to be 2.2×10^{-18} m^2 and was attributed to the unnamed lower member claystone by Beauheim (1987), which correlates to the transition and bioturbated clastic zones of Holt and Powers (1990).

The Culebra Dolomite Member is the most transmissive member of the Rustler Formation in the vicinity of the WIPP site and is the most transmissive saturated unit in contact with the shaft sealing system. The Culebra is an argillaceous dolomicrite which contains secondary porosity in the form of abundant vugs and fractures. The permeability of the Culebra varies greatly in the vicinity of the WIPP and is controlled by the condition of the secondary porosity (fractures). The permeability of the Culebra in the vicinity of the shafts is approximately 2.1×10^{-14} m^2.

The Tamarisk Member is composed primarily of massive, lithified anhydrite, including anhydrite 2, mudstone 3, and anhydrite 3. Testing of the Tamarisk at H-16 was unsuccessful. The estimated transmissivity of the Tamarisk at H-16 is one to two orders of magnitude lower than the least-transmissive unit successfully tested at H-16, which results in a permeability range from 4.6×10^{-20} to 4.6×10^{-19} m^2. Anhydrites in the Rustler have an approximate permeability of 1×10^{-19} m^2. The permeability of mudstone 3 is 1.5×10^{-19} m^2 (Brinster, 1991).

The Magenta is a dolomite that is typically less permeable than the Culebra. The Magenta Dolomite Member overlies the Tamarisk Member. The Magenta is an indurated, gypsiferous, arenaceous, dolomite that Holt and Powers (1990) classify as a dolarenite. The dolomite grains are primarily composed of silt to fine sand-sized clasts. Wavy to lenticular bedding and ripple cross laminae are prevalent through most of the Magenta. Holt and Powers (1990) estimate that inflow to the shaft from the Magenta during shaft mapping was less than 1 gal/min. The Magenta has a permeability of approximately 1.5×10^{-15} m^2 (Saulnier and Avis, 1988).

The Forty-niner Member is divided into three informal lithologic units. The lowest unit is anhydrite 4, a laminated anhydrite having a gradational contact with the underlying Magenta. Mudstone 4 overlies anhydrite 4 and is composed of multiple units containing mudstones, siltstones, and very fine sandstones. Anhydrite 5 is the uppermost informal lithologic unit of the Forty-niner Member. The permeability of mudstone 4, determined from the pressure responses in the Forty-niner interval of H-16 to the drilling of the AIS, is 3.9×10^{-16} m^2 (referred to as the Forty-niner claystone by Avis and Saulnier, 1990).

The Salado Formation is a very low permeability formation that is composed of bedded halite, polyhalite, anhydrite, and mudstones. Inflows in the shafts have been observed over select intervals during shaft mapping, but flows are below the threshold of quantification. In some cases these weeps are individual, lithologically distinct marker beds, and in some cases they are not. Directly observable brine flow from the Salado Formation into excavated openings is a short-lived process. Table I2-1 lists the brine seepage intervals identified by Holt and Powers (1990) during their detailed mapping of the AIS. Seepage could be indicated by a wet rockface or by the presence of precipitate from brine evaporation on the shaft rockface. The zones listed in Table I2-1 make up less than 10% of the Salado section that is intersected by the WIPP shafts.

Table I2-1. Salado Brine Seepage Intervals[1]

Stratigraphic Unit	Lithology	Thickness (m)
Marker Bed 103	Anhydrite	5.0
Marker Bed 109	Anhydrite	7.7
Vaca Triste	Mudstone	2.4
Zone A	Halite	2.9
Marker Bed 121	Polyhalite	0.5
Union Anhydrite	Anhydrite	2.3
Marker Bed 124	Anhydrite	2.7
Zone B	Halite	0.9
Zone C	Halite	2.7
Zone D	Halite	3.2
Zone E	Halite	0.6
Zone F	Halite	0.9
Zone G	Halite	0.6
Zone H	Halite	1.8
Marker Bed 129	Polyhalite	0.5
Zone I	Halite	1.7
Zone J	Halite	1.2

(1) After US DOE, 1995.

To gain perspective into the important stratigraphic units from a hydrogeologic view, the permeability and thickness of the units adjacent to the shafts can be compared. Table I2-2 lists the lithologic units in the Rustler and the Salado Formations with their best estimate permeabilities and their thickness as determined from the AIS mapping. The stratigraphy of the units overlying the Rustler is not considered in Table I2-2 because these units are typically not saturated in the vicinity of the WIPP shafts. The overlying sediments account for approximately 25% of the stratigraphy column adjacent to the shafts.

Because permeability varies over several orders of magnitude, the log of the permeability is also listed to simplify comparison between units. Table I2-2 shows that by far the two most transmissive zones occur in the Rustler Formation; these are the Culebra and Magenta dolomites. These units are relatively thin when compared to the combined Rustler and Salado thickness adjacent to the shafts (3% of Rustler and Salado combined thickness). The Magenta and the Culebra are the only two units that are known to possess permeabilities higher than 1×10^{-18} m^2.

Table I2-2. Permeability and Thickness of Hydrostratigraphic Units in Contact with Seals

Formation	Member/Lithology	Undisturbed Permeability (m^2)	Thickness (m)
Rustler	Anhydrite[(1)]	1.0×10^{-19}	46.7
Rustler	Mudstone 4	3.9×10^{-16}	4.4
Rustler	Magenta	1.5×10^{-15}	7.8
Rustler	Mudstone 3	1.5×10^{-19}	2.9
Rustler	Culebra	2.1×10^{-14}	8.9
Rustler	Transition/ Bioturbated Clastics	2.2×10^{-18}	18.7
Salado	Halite	1.0×10^{-21}	356.6
Salado	Polyhalite	3.0×10^{-21}	10.9
Salado	Anhydrite	1.0×10^{-19}	28.2

[(1)] Anhydrite 5, Anhydrite 4, Anhydrite 3, and Anhydrite 2

The vast majority (97%) of the rocks adjacent to the shaft in the Rustler and the Salado Formations are low permeability ($<1 \times 10^{-18}$ m^2). The conclusion that can be drawn from reviewing Table I2-2 is that the shafts are located hydrogeologically in a low permeability, low groundwater flow regime. Inflow measurements have historically been made at the shafts, and observable flow is attributed to leakage from the Rustler Formation.

Flow modeling of the Culebra has demonstrated that depressurization has occurred as a result of the sinking of the shafts at the site. Maximum estimated head drawdown in the Culebra at the centroid of the shafts was estimated by Haug et al. (1987) to be 33 m in the mid-1980s. This drawdown in the permeable units intersected by the shafts is expected because the shafts act as long-term constant pressure (atmospheric) sinks. Measurements of fluid flow into the WIPP shafts when they were unlined show a range from a maximum of 0.11 L/s (3,469 m^3/yr) measured in the Salt Handling Shaft on September 13, 1981 to a minimum of 0.008 L/s (252 m^3/yr) measured at the Waste Handling Shaft on August 6, 1987 (LaVenue et al., 1990).

The following summary of shaft inflow rates from the Rustler is based on a review of LaVenue et al. (1990) and Cauffman et al. (1990). Shortly after excavation and prior to grouting and liner installation, the inflow into the Salt Handling Shaft was 0.11 L/s (3,469 m^3/yr). The average flow rate measured after shaft lining for the period from mid-1982 through October 1992 was 0.027 L/s (851 m^3/yr). The average flow rate into the Waste Handling Shaft during the time when the shaft was open and unlined was about 0.027 L/s (851 m^3/yr). Between the first and second grouting events (July 1984 to November 1987) the average inflow rate was 0.016 L/s (505 m^3/yr). No estimates were found after the second grouting. Inflow to the pilot holes for the Exhaust Shaft averaged 0.028 L/s (883 m^3/yr). In December 1984 a liner plate was grouted across the Culebra. After this time, a single measurement of inflow from the Culebra was 0.022 L/s (694 m^3/yr). After liner plate installation, three separate grouting events occurred at the Culebra. No measurable flow was reported after the third grouting event in the summer of 1987.

Flow into the AIS when it was unlined and draining averaged 0.044 L/s (1,388 m^3/yr). Since the Rustler has been lined, flow into the AIS has been negligible.

The majority of the flow represented by these shaft measurements originates from the Rustler. This is clearly evident by the fact that lining of the WIPP shafts was found to be unnecessary in the Salado Formation below the Rustler/Salado contact. When the liners were installed, flow rates diminished greatly. Under sealed conditions, hydraulic gradients in rocks adjacent to the shaft will diminish as the far-field pressures approach ambient conditions. The low-permeability materials sealing the shaft combined with the reduction in lateral hydraulic gradients will likely result in flow rates into the shaft that are several orders of magnitude less than observed under open shaft or lined shaft conditions.

2.3.2 Observed Vertical Gradients

Hydraulic heads within the Rustler and between the Rustler and Salado Formations are not in hydrostatic equilibrium. Mercer (1983) recognized that heads at the Rustler Salado transition (referred to as the brine aquifer and not present in the vicinity of the WIPP shafts) indicate an upward hydraulic gradient from that zone to the Culebra. Later, with the availability of more head measurements within the Salado and Rustler members, Beauheim (1987) provided additional insight into the potential direction of vertical fluid movement within the Rustler. He reported that the hydraulic data indicate an upward gradient from the Salado to the Rustler.

Formation pressures in the Salado Formation have been decreased in the near vicinity of the WIPP underground facility. The highest, and thought to be least disturbed, estimated formation fluid pressure from hydraulic testing is 12.55 MPa estimated from interpretation of testing within borehole SCP01 in Marker Bed 139 (**MB139**) just below the underground facility horizon (Beauheim et al., 1993). The fresh-water head within MB139, based on the estimated static formation pressure of 12.55 MPa, is 1,663.6 m (5,458 ft) above mean sea level (**msl**).

Hydraulic heads in the Rustler have also been impacted by the presence of the WIPP shafts. Impacts in the Culebra were significant in the 1980s with a large drawdown cone extending away from the shafts in the Culebra (Haug et al., 1987). The undisturbed head of the Rustler Salado contact in the vicinity of the AIS is estimated to be about 936.0 m (3,071 ft) msl (Brinster, 1991). The undisturbed head in the Culebra is estimated to be approximately 926.9 m (3,041 ft) msl in the vicinity of the AIS (LaVenue et al., 1990). The undisturbed head in the Magenta is estimated to be approximately 960.1 m (3,150 ft) msl (Brinster, 1991).

The disturbed and undisturbed heads in the Rustler are summarized in Table I2-3. Also included is the freshwater head of MB139 based on hydraulic testing in the WIPP underground. Consistent with the vertical flow directions proposed by previous investigators, estimated vertical gradients in the vicinity of the AIS before the shafts were drilled indicate a hydraulic gradient from the Magenta to the Culebra and from the Rustler/Salado contact to the Culebra. There is also the potential for flow from the Salado Formation to the Rustler Formation.

Table I2-3. Freshwater Head Estimates in the Vicinity of the Air Intake Shaft

Hydrologic Unit	Freshwater Head (m asl)		Reference
	Undisturbed	Disturbed	
Magenta Member	960.1[1]	948.8[2] (H-16)	Brinster (1991) Beauheim (1987)
Culebra Member	926.9[1]	915.0[2] (H-16)	LaVenue et al. (1990) Beauheim (1987)
Lower Unnamed Member	—	953.4[2] (H-16)	Beauheim (1987)
Rustler/Salado Contact	936.0 - 940.0[1]	—	Brinster (1991)
Salado MB139	1,663.6[2]	—	Beauheim et al. (1993)

[1] Estimated from a contoured head surface plot based principally on well data collected prior to shaft construction.
[2] Measured through hydraulic testing and/or long-term monitoring.

2.4 Site Geochemical Setting

2.4.1 Regional and Local Geochemistry in Rustler Formation and Shallower Units

The Rustler Formation, overlying the Salado Formation, consists of interbedded anhydrite/gypsum, mudstone/siltstone, halite east of the WIPP site, and two layers of dolomite. Principal occurrences of NaCl/$MgSO_4$ brackish to briny groundwater in the Rustler at the WIPP site and to the north, west, and south are found (1) at the lower member near its contact with the underlying Salado and (2) in the two dolomite members having a variable fracture-induced secondary porosity. The mineralogy of the Rustler Formation is summarized in Table I2-4.

The five members of the Rustler Formation are described as follows: (1) The Forty-niner Member is similar in lithology to the other non-dolomitic units but contains halite east of the WIPP site. (2) The Magenta Member is another variably fractured dolomite/sulfate unit containing sporadic occurrences of groundwater near and west of the WIPP site. (3) The Tamarisk Member is dominantly anhydrite (locally altered to gypsum) with subordinate fine-grained clastics, containing halite to the east of the WIPP site. (4) The Culebra Dolomite Member is dominantly dolomite with subordinate anhydrite and/or gypsum, having a variable fracture-induced secondary porosity containing regionally continuous occurrences of groundwater at the WIPP site and to the north, west, and south. (5) An unnamed lower member consists of sandstone, siltstone, mudstone, claystone, and anhydrite locally altered to gypsum, and containing halite under most of the WIPP site and occurrences of brine at its base, mostly west of the WIPP site.

Table I2-4. Chemical Formulas, Distributions, and Relative Abundance of Minerals in the Rustler and Salado Formations (after Lambert, 1992)

Mineral	Formula	Occurrence/Abundance
Amesite	$(Mg_4Al_2)(Si_2Al_2)O_{10}(OH)_8$	S, R
Anhydrite	$CaSO_4$	SSS, RRR
Calcite	$CaCO_3$	S, RR
Carnallite	$KMgCl_3 \bullet 6H_2O$	SS†
Chlorite	$(Mg,Al,Fe)_{12}(Si,Al)_8O_{20}$ $(OH)_{16}$	S‡, R‡
Corrensite	Mixed-layer chlorite/smectite	S‡, R‡
Dolomite	$CaMg(CO_3)_2$	RR
Feldspar	$(K,Na,Ca)(Si,Al)_4O_8$	S‡, R‡
Glauberite	$Na2Ca(SO_4)_2$	S
Gypsum	$CaSO_4 \bullet 2H_2O$	S, RRR
Halite	NaCl	SSS, RRR
Illite	$K_{1-1.5}Al_4(Si_{7-6.5}Al_{1-1.5}O_{20})(OH)_4$	S‡, R‡
Kainite	$KMgClSO_4 \bullet 3H_2O$	SS†
Kieserite	$MgSO_4 \bullet H_2O$	SS†
Langbeinite	$K_2Mg_2(SO_4)_3$	S*
Magnesite	$MgCO_3$	S, R
Polyhalite	$K_2Ca_2Mg(SO_4)_4 \bullet 2H_2O$	SS, R
Pyrite	FeS_2	S, R
Quartz	SiO_2	S‡, R‡
Serpentine	$Mg_3Si_2O_5(OH)_4$	S‡, R‡
Smectite	$(Ca_{1/2},Na)_{0.7}(Al,Mg,Fe)_4(Si,Al)_8O_{20}(OH)_4 \bullet nH_2O$	S‡, R‡
Sylvite	KCl	SS*

Key to Occurrence/Abundance notations:

S = Salado Formation; R = Rustler Formation; 3× = abundant, 2× = common, 1× = rare or accessory; * = potash-ore mineral (never near surface); † = potash-zone non-ore mineral; ‡ = in claystone interbeds.

The Dewey Lake Redbeds, overlying the Rustler Formation, are the uppermost Permian unit; they consist of siltstones and claystones locally transected by concordant and discordant fractures that may contain gypsum. The Dewey Lake Redbeds contain sporadic occurrences of groundwater that may be locally perched, mostly in the area south of the WIPP site. The Triassic Dockum Group (undivided) rests on the Dewey Lake Redbeds in the eastern half of the WIPP site and thickens eastward; it is a locally important source of groundwater for agricultural and domestic use.

The Gatuña Formation, overlying the Dewey Lake Redbeds, occurs locally as channel and alluvial pond deposits (sands, gravels, and boulder conglomerates). The pedogenic Mescalero caliche is commonly developed on top of the Gatuña Formation and on many other erosionally truncated rock types. Surficial dune sand, which may be intermittently damp, covers virtually all outcrops at and near the WIPP site. Siliceous alluvial deposits southwest of the WIPP site also contain potable water. The geochemistry of groundwater found in the Rustler Formation and Dewey Lake Redbeds is summarized in Table I2-5.

Table I2-5. Major Solutes in Selected Representative Groundwater from the Rustler Formation and Dewey Lake Redbeds, in mg/L (after Lambert, 1992)

Well	Date	Zone	Ca	Mg	Na	K	SO_4	Cl
WIPP-30	July 1980	R/S	955	2770	121,000	2180	7390	192,000
WIPP-29	July 1980	R/S	1080	2320	36,100	1480	12,000	58,000
H-5B	June 1981	Cul	1710	2140	52,400	1290	7360	89,500
H-9B	November 1985	Cul	590	37	146	7	1900	194
H-2A	April 1986	Cul	743	167	3570	94	2980	5310
P-17	March 1986	Cul	1620	1460	28,300	782	6020	48,200
WIPP-29	December 1985	Cul	413	6500	94,900	23,300	20,000	179,000
H-3B1	July 1985	Mag	1000	292	1520	35	2310	3360
H-4C	November 1986	Mag	651	411	7110	85	7100	8460
Ranch	June 1986	DL	420	202	200	4	1100	418

Key to Zone:

R/S = "basal brine aquifer" near the contact between the Rustler and Salado Formations; Cul = Culebra Member, Rustler Formation; Mag = Magenta Member, Rustler Formation; DL = Dewey Lake Redbeds.

2.4.2 Regional and Local Geochemistry in the Salado Formation

The Salado Formation consists dominantly of halite, interrupted at intervals of meters to tens of meters by beds of anhydrite, polyhalite, mudstone, and local potash mineralization (sylvite or langbeinite, with or without accessory carnallite, kieserite, kainite and glauberite, all in a halite matrix). Some uniquely identifiable non-halite units, 0.1 to 10 m thick, have been numbered from the top down (100 to 144) for convenience as marker beds to facilitate cross-basinal stratigraphic correlation. The WIPP facility was excavated just above Marker Bed 139 in the Salado Formation at a depth of about 655 m.

Although the most common Delaware Basin evaporite mineral is halite, the presence of less soluble interbeds (dominantly anhydrite, polyhalite, and claystone) and more soluble admixtures (e.g. sylvite, glauberite, kainite) has resulted in chemical and physical properties significantly different from those of pure NaCl. Under differential stress produced near excavations, brittle interbeds (anhydrite, polyhalite, magnesite, dolomite) may fracture, whereas under a similar stress regime pure NaCl would undergo plastic deformation. Fracturing of these interbeds has locally enhanced the permeability, allowing otherwise nonporous rock to carry groundwater (e.g., the fractured polyhalitic anhydrite of Marker Bed 139 under the floor of the WIPP excavations).

Groundwater in evaporites represents the exposure of chemical precipitates to fluids that may be agents (as in the case of dissolution) or consequences of postdepositional alteration of the evaporites (as in the cases of dehydration of gypsum and diagenetic dewatering of other minerals). Early in the geological studies of the WIPP site, groundwater occurrences that could be hydrologically characterized were identified.

Since the beginning of conventional mining in the Delaware Basin, relatively short-lived seeps (pools on the floor, efflorescences on the walls, and stalactitic deposits on the ceiling) have been known to occur in the Salado Formation where excavations have penetrated. These brine occurrences are commonly associated with the non-halitic interbeds whose porosity is governed either by fracturing (as in brittle beds) or mineralogical discontinuities (as in "clay" seams).

The geochemistry of brines encountered in the Salado Formation is summarized in Table I2-6. The relative abundance of minerals was summarized in Table 2-4.

Table I2-6. Variations in Major Solutes in Brines from the Salado Formation, in mg/L (after Lambert, 1992)

Source of Brine	Date	Ca	Mg	K	Na	Cl	SO_4
Room G Seep	Sep-87	278	14800	15800	99000	188000	29500
	Nov-87	300	18700	15400	97100	190000	32000
	Feb-88	260	18200	17100	94100	186000	36200
	Mar-88	280	17000	16200	92100	187000	34800
	Jul-88	292	13000	14800	96600	188000	29300
	Sep-88	273	14700	13700	86500	185000	28000
	Apr-91	240	14400	12900	95000	189000	28000
	Jul-91	239	14100	13100	93000	190000	27700
	Oct-91	252	14700	14100	95000	189000	27100
Marker Bed 139 (under repository)		300	18900	14800	67700	155900	14700
		300	17100	15600	72700	158900	13400
		300	17600	15800	71600	182200	14700
Room J		230	17700	13500	63600	167000	15100
		210	27400	22400	56400	168000	19600
		220	17900	15600	73400	165000	9300
		250	22200	18300	63000	165000	31100
		190	31000	19900	46800	170000	24600
		100	35400	27800	40200	173000	30000
		270	18900	14500	59900	166000	16200
		280	20200	17000	70400	165000	10600
Room Q		279	31500	22600	68000	205000	19400
		288	31100	24100	68000	203000	19200
		257	34000	26300	63000	205000	23500
AIS Sump (accumulation in bottom of sump)	Jul-88	960	1040	1720	118000	187000	6170
	May-89	900	500	600	83100	122700	7700
	May-89	1000	800	1100	82400	114200	8800
McNutt Potash Zone							
Duval mine		640	55400	30000	27500	236500	3650
Miss. Chem. mine		200	44200	45800	43600	226200	12050

3. Design Guidance

3.1 Introduction

The WIPP is subject to regulatory requirements contained in applicable portions of the New Mexico Hazardous Waste Act, specifically 20.4.1.500 NMAC and .900 (incorporating 40 CFR §264 and §270), and requirements contained in 40 CFR §191 and 40 CFR §194. The use of both engineered and natural barriers to isolate wastes from the accessible environment is required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR §191.14(d). The use of engineered barriers to prevent or substantially delay the movement of water, hazardous constituents, or radionuclides toward the accessible environment is required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR §194.44. Hazardous constituent release performance standards are specified in Permit Module V and 20.4.1.500 NMAC (incorporating 40 CFR §§264.111(b), 264.601(a), and 264 Subpart F). Quantitative requirements for potential releases of radioactive materials from the repository system are specified in 40 CFR §191. The regulations impose quantitative release requirements on the total repository system, not on individual subsystems of the repository system, for example, the shaft sealing subsystem.

3.2 Design Guidance and Design Approach

The guidance described for the design of the shaft sealing system addresses the need for the WIPP to comply with system requirements and to follow accepted engineering practices using demonstrated technology. The design guidance addresses the need to limit:

1. radiological or other hazardous constituents reaching the regulatory boundaries,
2. groundwater flow into and through the sealing system,
3. chemical and mechanical incompatibility,
4. structural failure of system components,
5. subsidence and accidental entry, and
6. development of new construction technologies and/or materials.

For each element of design guidance, a design approach has been developed. Table I2-7 contains qualitative design guidance and the design approach used to implement it.

Table I2-7. Shaft Sealing System Design Guidance

Qualitative Design Guidance	Design Approach
The shaft sealing system shall limit:	*The shaft sealing system shall be designed to meet the qualitative design guidance in the following ways:*
1. the migration of radiological or other hazardous constituents from the repository horizon to the regulatory boundary during the 10,000-year regulatory period following closure;	1. In the absence of human intrusion, brine migrating from the repository horizon to the Rustler Formation must pass through a low permeability sealing system.
2. groundwater flowing into and through the shaft sealing system;	2. In the absence of human intrusion, groundwater migrating from the Rustler Formation to the repository horizon must pass through a low permeability sealing system.
3. chemical and mechanical incompatibility of seal materials with the seal environment;	3. Brine contact with seal elements is limited and materials possess acceptable mechanical properties.
4. the possibility for structural failure of individual components of the sealing system;	4. State of stress from forces expected from rock creep and other mechanical loads is favorable for seal materials.
5. subsidence of the ground surface in the vicinity of the shafts and the possibility of accidental entry after sealing;	5. The shaft is completely filled with low-porosity materials, and construction equipment would be needed to gain entry.
6. the need to develop new technologies or materials for construction of the shaft sealing system.	6. Construction of the shaft sealing system is feasible using available technologies and materials.

4. Design Description

4.1 Introduction

The design presented in this section was developed based on (1) the design guidance outlined in Section 3.0, (2) past design experience, and (3) a desire to reduce uncertainties associated with the performance of the WIPP sealing system. The WIPP shaft sealing system design has evolved over the past decade from the initial concepts presented by Stormont (1984) to the design concepts presented in this document. The past designs are:

- the plugging and sealing program for the WIPP (Stormont, 1984),
- the initial reference seal system design (Nowak et al., 1990),
- the seal design alternative study (Van Sambeek et al., 1993),
- the WIPP sealing system design (DOE, 1995).

The present design changes were implemented to take advantage of knowledge gained from small-scale seals tests conducted at the WIPP (Knowles and Howard, 1996), advances in the ability to predict the time-dependent mechanical behavior of compacted salt rock (Callahan et al., 1996), large-scale dynamic salt compaction tests and associated laboratory determination of the permeability of compacted salt samples (Hansen and Ahrens, 1996; Brodsky et al., 1996), field tests to measure the permeability of the DRZ surrounding the WIPP AIS (Dale and Hurtado, 1996), and around seals (Knowles et al., 1996). A summary paper (Hansen et al., 1996) describing the design has been prepared.

The shaft sealing system is composed of seals within the Salado Formation, the Rustler Formation, and the Dewey Lake Redbeds and overlying units. All components of the sealing system are designed to meet Items 3, 4, and 6 of the Design Guidance (Table I2-7.); that is, all sealing system components are designed to be chemically and mechanically compatible with the seal environment, structurally adequate, and constructable using currently available technology and materials. The seals in the Salado Formation are also designed to meet Items 1 and 2 of the Design Guidance. These seals will limit fluid migration upward from the repository to the Rustler Formation and downward from the Rustler Formation to the repository. Migration of brine upward and downward is discussed in Sections 8.5 and 8.4 respectively. The seals in the Rustler Formation are designed to meet Item 2 in addition to Items 3, 4, and 6 of the Design Guidance. The seals in the Rustler Formation limit migration of Rustler brines into the shaft cross-section and also limit cross-flow between the Culebra and Magenta members. The principal function of the seals in the Dewey Lake Redbeds and overlying units is to meet Item 5 of the Design Guidance, that is, to limit subsidence of the ground surface in the vicinity of the shafts and to prevent accidental entry after repository closure. Entry of water (surface water and any groundwater that might be present in the Dewey Lake Redbeds and overlying units) into the sealing system is limited by restraining subsidence and by placing high density fill in the shafts.

4.2 Existing Shafts

The WIPP underground facilities are accessed by four shafts commonly referred to as the Waste, Air Intake, Exhaust, and Salt Handling Shafts. These shafts were constructed between 1981 and 1988. All four shafts are lined from the surface to just below the contact of the Rustler and Salado Formations. The lined portion of the shafts terminates in a substantial concrete structure called the "key," which is located in the uppermost portion of the Salado Formation. Drawings showing the configuration of the existing shafts are included in Appendix I2-E and listed below in Table I2-8. Table I2-9 contains a summary of information describing the existing shafts.

The upper portions of the WIPP shafts are lined. The Waste, Air Intake, and Exhaust shafts have concrete linings; the Salt Handling Shaft has a steel lining with grout backing. In addition, during shaft construction, steel liner plates, wire mesh, and pressure grouting were used to stabilize portions of the shaft walls in the Rustler Formation and overlying units. Seepage of groundwater into the lined portions of the shafts has been observed. This seepage was expected; in fact, the shaft keys (massive concrete structures located at the base of each shaft liner) were designed to collect the seepage and transport it through a piping system to collection points at the repository horizon. In general, the seepage originates in the Magenta and Culebra members of the Rustler Formation and in the interface zone between the Rustler and Salado formations. It flows along the interface between the shaft liner and the shaft wall and through the DRZ immediately adjacent to the shaft wall. In those cases where seepage through the liner occurred, it happened where the liner offered lower resistance to flow than the interface and DRZ, for example, at construction joints. Maintenance grouting, in selected areas of the WIPP shafts, has been utilized to reduce seepage.

Table I2-8. Drawings Showing Configuration of Existing WIPP Shafts (Drawings are in Appendix I2-E)

Shaft	Drawing Title	Sheet Number of Drawing SNL-007
Waste	Near-Surface/Rustler Formation Waste Shaft Stratigraphy & As-Built Elements	2 of 28
Waste	Salado Formation Waste Shaft Stratigraphy & As-Built Elements	3 of 28
AIS	Near-Surface/Rustler Formation Air Intake Shaft Stratigraphy & As-Built Elements	7 of 28
AIS	Salado Formation Air Intake Shaft Stratigraphy & As-Built Elements	8 of 28
Exhaust	Near-Surface/Rustler Formation Exhaust Shaft Stratigraphy & As-Built Elements	12 of 28
Exhaust	Salado Formation Exhaust Shaft Stratigraphy & As-Built Elements	13 of 28
Salt Handling	Near-Surface/Rustler Formation Salt Handling Shaft Stratigraphy & As-Built Elements	17 of 28
Salt Handling	Salado Formation Salt Handling Shaft Stratigraphy & As-Built Elements	18 of 28

1 Table I2-9. Summary of Information Describing Existing WIPP Shafts

	Shafts			
	Salt Handling	**Waste**	**Air Intake**	**Exhaust**
A. Construction Method				
i. Sinking method	Blind bored	Initial 6′ pilot hole slashed by drill & blast (smooth wall blasting)	Raise bored	Initial 6′ pilot hole slashed by drill & blast (smooth wall blasting)
ii. Dates of shaft sinking	7/81-10/81	Drilled 12/81-2/82 Slashed 10/83-6/84	12/87-8/88	9/83-11/84
iii. Ground treatment in water-bearing zone	Grout behind steel liner during construction	Grouted 1984 & 1988	Grouted 1993	Grouted 1985, 1986, & 1987
iv. Sump construction	Drill & blast	Drill & blast	No sump	No sump
B. Upper Portion of Shaft *				
i. Type of liner	Steel	Concrete	Concrete	Concrete
ii. Lining diameter (ID)	10′-0″	19′-0″	18′-0″/16′-7″	14′-0″
iii. Excavated diameter	11′-10″	20′-8″ to 22′-4″	20′-3″	15′-8″ to 16′-8″
iv. Installed depth of liner	838.5′	812′	816′	846′
C. Key Portion of Shaft *				
i. Construction material	Reinf. conc. w/chem. seals	Reinf. concrete w/chem. seals	Reinf. concrete w/chem. seals	Reinf. concrete w/chem. seals
ii. Liner diameter (ID)	10′-0″	19′-0″	16′-7″	14′-0″
iii. Excavated diameter	15′-0″ to 18′-0″	27′-6″ to 31′-0″	29′-3″ to 35′-3″	21′-0″ to 26′-0″
iv. Depth-top of Key	844′	836′	834′	846′
v. Depth-bottom of Key	883′	900′	897′	910′
vi. Dow Seal #1 depth	846′ to 848′	846′ to 849′	839′ to 842′	853′ to 856′
vii. Dow Seal #2 depth	853′ to 856′	856′ to 859′	854′ to 857′	867′ to 870′
viii. Dow Seal #3 depth	868 to 891′	NA	NA	NA
ix. Top of salt (Rustler/Salado contact)	851′	843′	841′	853′
D. Lower Shaft (Unlined) *				
i. Type of support	Unlined	Chain link mesh	Unlined	Chain link mesh
ii. Excavated diameter	11′-10″	20′-0″	20′-3″	15′-0″
iii. Depth-top of “unlined”	882′	900′	904′	913′
iv. Depth-bottom of “unlined”	2144′	2142′	2128′	2148′
E. Station *				
i. Type of support	Wire mesh		Wire mesh	Wire mesh
ii. Principal dimensions	21H × 31W	12H × 30W	25H × 36W	12H × 23W
iii. Depth-top of station	2144′	2142′	2128′	2148′
iv. Depth-floor of station	2162′	2160′	2150′	2160′
F. Sump *				
Depth-top of sump	2162′	2160′	No sump	No sump
Depth-bottom of sump	2272′	2286′		
G. Shaft Duty	Construction hoisting of excavated salt; personnel hoisting	Hoisting shaft for lowering waste containers; personnel hoisting until waste receipt	Ventilation shaft for intake (fresh) air; personnel hoisting	Exhaust air ventilation shaft

2 *This information is from the MOC drawings identified on Sheets 2, 3, 7, 8, 12, 13, 17, and 18 of Drawing SNL-007 (see Appendix I2-E).

4.3 Sealing System Design Description

This section describes the shaft sealing system design, components, and functions. The shaft sealing system consists of three essentially independent parts:

1. The seals in the Salado Formation provide the primary regulatory barrier. They will limit fluid flow into and out of the repository throughout the 10,000-year regulatory period.
2. The seals in the Rustler Formation will limit flow from the water-bearing members of the Rustler Formation and limit commingling of Magenta and Culebra groundwaters.
3. The seals in the Dewey Lake Redbeds and the near-surface units will limit infiltration of surface water and preclude accidental entry through the shaft openings.

The same sealing system is used in all four shafts. Therefore an understanding of the sealing system for one shaft is sufficient to understand the sealing system in all shafts. Only minor differences exist in the lengths of the components, and the component diameters differ to accommodate the existing shaft diameters.

The shaft liner will be removed in four locations in each shaft. All of these locations are within the Rustler Formation. Additionally, the upper portion of each shaft key will be eliminated. The portion of the shaft key that will be eliminated spans the Rustler/Salado interface and extends into the Salado Formation. The shaft liner removal locations are

1. from 10 ft above the Magenta Member to the base of the Magenta (removal distances vary from 34–39 ft because of different member thickness at shaft locations),
2. for a distance of 10 ft in the anhydrite of the Tamarisk Member,
3. through the full height of the Culebra (17–24 ft), and
4. from the top anhydrite unit in the unnamed lower member to the top of the key (67–85 ft).

Additionally, the concrete will be removed from the top of the key to the bottom of the key's lower chemical seal ring (23 to 29 ft). Drawing SNL-007, Sheets 4, 9, 14, and 19 in Appendix I2-E show shaft liner removal plans, and Sheet 23 shows key removal plans.

The decision to abandon portions of the shaft lining and key in place is based on two factors. First, no improvements in the performance of the sealing system associated with removal of these isolated sections of concrete have been identified. Second, because the keys are thick and heavily reinforced, their removal would be costly and time consuming. No technical problems are associated with the removal of this concrete; thus, if necessary, its removal can be incorporated in any future design.

The DRZ will be pressure grouted throughout the liner and key removal areas and for a distance of 10 ft above and below all liner removal areas. The pressure grouting will stabilize the DRZ during liner removal and shaft sealing operations. The grouting will also control groundwater seepage during and after liner removal. The pressure grouting of the DRZ has not been assigned a sealing function beyond the construction period. It is likely that this grout will seal the DRZ for an extended period of time. However, past experience with grout in the mining and tunneling industries demonstrates that groundwater eventually opens alternative pathways through the media and reestablishes seepage patterns (maintenance grouting is common in both mines and tunnels). Therefore, post-closure sealing of the DRZ in the Rustler Formation has not been assumed in the design.

The compacted clay sealing material (bentonite) will seal the shaft cross-section in the Rustler Formation. In those areas where the shaft liner has been removed, the compacted clay will confine the vertical movement of groundwater in the Rustler to the DRZ. Sealing the shaft DRZ is accomplished in the Salado Formation. It is achieved initially through the interruption of the halite DRZ by concrete-asphalt waterstops and on a long-term basis through the natural process of healing the halite DRZ. The properties of the compacted clay are discussed in Section 5.3.2. The concrete-asphalt waterstops and DRZ healing in the Salado are discussed in Sections 7.6.1 and 7.5.2 respectively.

Reduction of the uncertainty associated with long-term performance is addressed by replacing the upper and lower Salado Formation salt columns used in some of the earlier designs with compacted clay columns and by adding asphalt sealing components in the Salado Formation. Use of disparate materials for sealing components reduces the uncertainty associated with a common-mode failure.

The compacted salt column provides a seal with an initial permeability several orders of magnitude higher than the clay or asphalt columns; however, its long-term properties will approach those of the host rock. The permeability of the compacted salt, after consolidation, will be several orders of magnitude lower than that of the clay and comparable to that of the asphalt. The clay provides seals of known low permeability at emplacement, and asphalt provides an independent low permeability seal of the shaft cross-section and the shaft wall interface at the time of installation. Sealing of the DRZ in the Rustler Formation during the construction period is accomplished by grouting, and initial sealing of the DRZ in the Salado Formation is accomplished by three concrete-asphalt waterstops.

In the following sections, each component of each of the three shaft segments is identified by name and component number (see Figure I2-5 for nomenclature). Associated drawings in Appendix I2-E are also identified. Drawings showing the overall system configurations for each shaft are listed in Table I2-10.

4.3.1 Salado Seals

The seals placed in the Salado Formation are composed of (1) consolidated salt, clay, and asphalt components that will function for very long periods, exceeding the 10,000-year regulatory period; and (2) salt saturated concrete components that will function for extended periods. The specific components that comprise the Salado seals are described below.

4.3.1.1 Compacted Salt Column

The compacted salt column (Component 10 in Figure I2-5, and shown in Drawing SNL-007, Sheet 25) will be constructed of crushed salt taken from the Salado Formation. The length of the salt column varies from 170 to 172 m (556 to 564 ft) in the four shafts. The compacted salt column is sized to allow the column and concrete-asphalt waterstops at either end to be placed between the Vaca Triste Unit and Marker Bed 136. The salt will be placed and compacted to a density approaching 90% of the average density of intact Salado salt. The effects of creep closure will cause this density to increase with time, further reducing permeability.

The salt column will offer limited resistance to fluid migration immediately after emplacement, but it will become less permeable as creep closure further compacts the salt. Salt creep increases rapidly with depth; therefore, at any time, creep closure of the shaft will be greater at greater depth. The location and initial compaction density of the compacted salt column were chosen to assure consolidation of the compacted salt column in the 100 years following repository closure. The state of salt consolidation, results of analyses predicting the creep closure of the shaft, consolidation and healing of the compacted salt, and healing of the DRZ surrounding the compacted salt column are presented in Sections 7.5 and 8.4 of this document. These results indicate that the salt column will become an effective long-term barrier within 100 years.

Table I2-10. Drawings Showing the Sealing System for Each Shaft (Drawings are in Appendix I2-E)

Shaft	Drawing Title	Sheet Number of Drawing SNL 007
Waste	Near-Surface/Rustler Formation Waste Shaft Stratigraphy & Sealing Subsystem Profile	4 of 28
Waste	Salado Formation Waste Shaft Stratigraphy & Sealing Subsystem Profile	5 of 28
AIS	Near-Surface/Rustler Formation Air Intake Shaft Stratigraphy & Sealing Subsystem Profile	9 of 28
AIS	Salado Formation Air Intake Shaft Stratigraphy & Sealing Subsystem Profile	10 of 28
Exhaust	Near-Surface/Rustler Formation Exhaust Shaft Stratigraphy & Sealing Subsystem Profile	14 of 28
Exhaust	Salado Formation Exhaust Shaft Stratigraphy & Sealing Subsystem Profile	15 of 28
Salt Handling	Near-Surface/Rustler Formation Salt Handling Shaft Stratigraphy & Sealing Subsystem Profile	19 of 28
Salt Handling	Salado Formation Salt Handling Shaft Stratigraphy & Sealing Subsystem Profile	20 of 28

4.3.1.2 Upper and Lower Salado Compacted Clay Columns

The upper and lower Salado compacted clay columns (Components 8 and 12 respectively in Figure I2-5) are shown in detail on Drawing SNL-007, Sheet 24. A commercial well-sealing grade sodium bentonite will be used to construct the upper and lower Salado clay columns. These clay columns will effectively limit fluid movement from the time they are placed and will provide an effective barrier to fluid migration throughout the 10,000-year regulatory period and thereafter. The upper clay column ranges in length from 102 to 107 m (335 to 351 ft), and the lower clay column ranges in length from 29 to 33 m (94 to 107 ft) in the four shafts. The locations for the upper and lower clay columns were selected based on the need to limit fluid migration into the compacting salt column. The lower clay column stiffness is sufficient to promote early healing of the DRZ, thus removing the DRZ as a potential pathway for fluids (Appendix D in the permit application, Section 5.2.1).

4.3.1.3 Upper, Middle, and Lower Concrete-Asphalt Waterstops

The upper, middle, and lower concrete-asphalt waterstops (Components 7, 9, and 11 respectively in Figure I2-5) are identical and are composed of three elements: an upper concrete plug, a central asphalt waterstop, and a lower concrete plug. These components are also shown on Drawing SNL-007, Sheet 22. The concrete specified is a specially developed salt-saturated concrete called Salado Mass Concrete (**SMC**). In all cases the component's overall design length is 15 m (50 ft).

The upper and lower concrete plugs of the concrete-asphalt waterstop are identical. They fill the shaft cross-section and have a design length of 7 m (23 ft). The plugs are keyed into the shaft wall to provide positive support for the plug and overlying sealing materials. The interface between the concrete plugs and the surrounding formation will be pressure grouted. The upper plug in each component will support dynamic compaction of the overlying sealing material if compaction is specified. Dynamic compaction of the salt column is discussed in Section 6.

The asphalt waterstop is located between the upper and lower concrete plugs. In all cases a kerf extending one shaft radius beyond the shaft wall is cut in the surrounding salt to contain the waterstop. The kerf is 0.3 m (1 ft) high at its edge and 0.6 m (2 ft) high at the shaft wall. The kerf, which cuts through the existing shaft DRZ, will result in the formation of a new DRZ along its perimeter. This new DRZ will heal shortly after construction of the waterstop, and thereafter the waterstop will provide a very low permeability barrier to fluid migration through the DRZ. The formation and healing of the DRZ around the waterstop are addressed in Section 7.6.1. The asphalt fill for the waterstop extends two feet above the top of the kerf to assure complete filling of the kerf. The construction procedure used assures that shrinkage of the asphalt from cooling will not result in the creation of voids within the kerf and will minimize the size of any void below the upper plug.

Concrete-asphalt waterstops are placed at the top of the upper clay column, the top of the compacted salt column, and the top of the lower clay column. The concrete-asphalt waterstops provide independent seals of the shaft cross-section and the DRZ. The SMC plugs (and grout) will fill irregularities in the shaft wall, bond to the shaft wall, and seal the interface. Salt creep against the rigid concrete components will place a compressive load on the salt and promote early healing of the salt DRZ surrounding the SMC plugs. The asphalt waterstop will seal the shaft cross-section and the DRZ.

The position of the concrete components was first determined by the location of the salt and clay columns. The components were then moved upward or downward from their initial design location to assure the components were located in regions where halite was predominant. This positioning, coupled with variations in stratigraphy, is responsible for the variations in the lengths of the salt and clay columns.

4.3.1.4 Asphalt Column

An asphalt-aggregate mixture is specified for the asphalt column (Component 6 in Figure I2-5). This column is 42 to 44 m (138 to 143 ft) in length in the four shafts, as shown in Drawing SNL-007, Sheet 23. The asphalt column is located above the upper concrete-asphalt waterstop; it extends approximately 5 m (16 ft) above the Rustler/Salado interface. A 6-m (20-ft) long concrete plug (part of the Rustler seals) is located just above the asphalt column.

The existing shaft linings will be removed from a point well above the top of the asphalt column to the top of the shaft keys. The concrete shaft keys will be removed to a point just below the lowest chemical seal ring in each key. The asphalt column is located at the top of the Salado Formation and provides an essentially impermeable seal for the shaft cross section and along the shaft wall interface. The length of the asphalt column will decrease slightly as the column cools. The procedure for placing the flowable asphalt-aggregate mixture is described in Section 6.

4.3.1.5 Shaft Station Monolith

A shaft station monolith (Component 13) is located at the base of the each shaft. Because the configurations of each shaft differ, drawings of the shaft station monoliths for each shaft were prepared. These drawings are identified in Table I2-11. The shaft station monoliths will be constructed with SMC. The monoliths function to support the shaft wall and adjacent drift roof, thus preventing damage to the seal system as the access drift closes from natural processes.

Table I2-11. Drawings Showing the Shaft Station Monoliths (Drawings are in Appendix I2-E)

Shaft	Drawing Title	Sheet Number of Drawing SNL-007
Waste	Waste Shaft Shaft Station Monolith	6 of 28
AIS	Air Intake Shaft Shaft Station Monolith	11 of 28
Exhaust	Exhaust Shaft Shaft Station Monolith	16 of 28
Salt Handling	Salt Handling Shaft Shaft Station Monolith	21 of 28

4.3.2 Rustler Seals

The seals in the Rustler Formation are composed of the Rustler compacted clay column and a concrete plug. The concrete plug rests on top of the asphalt column of the Salado seals. The clay column extends from the concrete plug through most of the Rustler Formation and terminates above the Rustler's highest water-bearing zone in the Forty-niner Member.

4.3.2.1 Rustler Compacted Clay Column

The Rustler compacted clay column (Component 4 in Figure I2-5) is shown on Drawing SNL-007, Sheet 27 for each of the four shafts. A commercial well-sealing-grade sodium bentonite will be used to construct the Rustler clay column, which will effectively limit fluid movement from the time of placement and provide an effective barrier to fluid migration throughout the 10,000-year regulatory period and thereafter. Design length of the Rustler clay column is about 71 m (234 to 235 ft) in the four shafts.

The location for the Rustler clay columns was selected to limit fluid migration into the shaft cross-section and along the shaft wall interface and to limit mixing of Culebra and Magenta waters. The clay column extends from above the Magenta Member to below the Culebra Member of the Rustler Formation. The Magenta and Culebra are the water-bearing units of the Rustler. The members above the Magenta (the Forty-niner), between the Magenta and Culebra (the Tamarisk), and below the Culebra (the unnamed lower member) are aquitards in the vicinity of the WIPP shafts.

4.3.2.2 Rustler Concrete Plug

The Rustler concrete plug (Component 5 in Figure I2-5) is constructed of SMC. The plugs for the four shafts are shown on Drawing SNL-007, Sheet 26. The plug is 6 m (20 ft) long and will fill the shaft cross-section. The plug is placed directly on top of the asphalt column of the Salado seals. The plug will be keyed into the surrounding rock and grouted. The plug permits work to begin on the overlying clay column before the asphalt has completely cooled. The option of constructing the overlying clay columns using dynamic compaction (present planning calls for construction using compressed clay blocks) is also maintained by keying the plug into the surrounding rock.

4.3.3 Near-Surface Seals

The near-surface region is composed of dune sand, the Mescalero caliche, the Gatuña Formation, the Santa Rosa Formation, and the Dewey Lake Redbeds. This region extends from the ground surface to the top of the Rustler Formation—a distance of about 160 m (525 ft). All but about 15 m (50 ft) of this distance is composed of the Dewey Lake Redbeds Formation. The near-surface seals are composed of two earthen fill columns and a concrete plug. The upper earthen fill column (Component 1) extends from the shaft collar through the surficial deposits downward to the top of the Dewey Lake Redbeds. The concrete plug (Component 2) is placed in the top portion of the Dewey Lake Redbeds, and the lower earthen fill column (Component 3) extends from the concrete plug into the Rustler Formation. These components are shown on Drawing SNL-007, Sheet 28.

This seal will limit the amount of surface water entering the shafts and will limit the potential for any future groundwater migration into the shafts. The near surface seals will also completely close the shafts and prevent accidental entry and excessive subsidence in the vicinity of the shafts. As discussed in Section 4.3.2, the existing shaft linings will be abandoned in place throughout the near-surface region.

4.3.3.1 Near-Surface Upper Compacted Earthen Fill

This component (Component 1 in Figure I2-5) will be constructed using locally available fill. The fill will be compacted to a density near that of the surrounding material to inhibit the migration of surface waters into the shaft cross-section. The length of this column varies from 17 to 28 m (56 to 92 ft) in the four shafts. In all cases, this portion of the WIPP sealing system may be modified as required to facilitate decommissioning of the WIPP surface facilities.

4.3.3.2 Near-Surface Concrete Plug

Current plans call for an SMC plug (Component 2 in Figure I2-5). However, freshwater concrete may be used if found to be desirable at a future time, and if approved by NMED through the Permit modification process specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.42). The plug extends 12 m (40 ft) downward from the top of the Dewey Lake Redbeds. It is placed inside the existing shaft lining, and the interface is grouted.

4.3.3.3 Near-Surface Lower Compacted Earthen Fill

This component (Component 3 in Figure I2-5) will be constructed using locally available fill, which will be placed using dynamic compaction (the same method used to construct the salt column). The fill will be compacted to a density equal to or greater than the surrounding materials to inhibit the migration of surface waters into the shaft cross-section. The length of this column varies from 136 to 148 m (447 to 486 ft) in the four shafts.

5. Material Specification

Appendix I2-A provides a body of technical information for each of the WIPP shaft seal materials. The materials specification characterizes each seal material, establishes the adequacy of its function, states briefly the method of component placement, and quantifies expected characteristics (particularly permeability) pertinent to a WIPP-specific shaft seal design. The goal of the materials specifications is to substantiate why materials used in this seal system design will limit fluid flow within the shafts and thereby limit releases of hazardous constituents from the WIPP site at the regulatory boundary.

This section summarizes materials characteristics for shaft seal system components designed for the WIPP. The shaft seal system will not be constructed for decades; however, if it were to be constructed in the near term, materials specified could be placed in the shaft and meet performance specifications using current materials and construction techniques. Construction methods are described in Appendix I2-B. Materials specifications and construction specifications are not to be construed as the only materials or methods that would suffice to seal the shafts effectively. Undoubtedly, the design will be modified, perhaps simplified, and construction alternatives may prove to be advantageous during the years before seal construction proceeds. Nonetheless, a materials specification is necessary to establish a frame of reference for shaft seal design and analysis, to guide construction specifications, and to provide a basis for seal material parameters.

Design detail and other characteristics of the geologic, hydrologic, and chemical setting are provided in the text, appendices, and references. The four shafts will be entirely filled with dense materials possessing low permeability and other desirable engineering and economic attributes. Seal materials include concrete, clay, asphalt, and compacted salt. Other construction and fill materials include cementitious grout and earthen fill. Concrete, clay, and asphalt are common construction materials used extensively in sealing applications. Their descriptions, drawn from literature and site-specific references, are given in Appendix I2-A. Compaction and natural reconsolidation of crushed salt are uniquely applied here. Therefore, crushed salt specification includes discussion of constitutive behavior and sealing performance, specific to WIPP applications. Cementitious grout is also specified in some detail. Only rudimentary discussion of earthen fill is given here and in Appendices A and B. Specifications for each material are discussed in the following order:

- functions,
- material characteristics,
- construction,
- performance requirements,
- verification methods.

Seal system components are materials possessing high durability and compatibility with the host rock. The system contains functional redundancy and uses differing materials to reduce uncertainty in performance. All materials used in the shaft seal system are expected to maintain their integrity for very long periods. Some sealing components reduce fluid flow soon after placement while other components are designed to function well beyond the regulatory period.

5.1 Longevity

A major environmental advantage of the WIPP locale is an overall lack of groundwater to seal against. Even though very little regional water is present in the geologic setting, the seal system reflects great concern for groundwater's potential influence on the shaft seal system. If the hydrologic system sustained considerable fluid flow, brine geochemistry could impact engineered materials. Brine would not chemically change the compacted salt column, but mechanical effects of pore pressure are of concern to reconsolidation. The geochemical setting, as further discussed in Section 2.4, will have little influence on concrete, asphalt, and clay shaft seal materials. Each material is durable because the potential for degradation or alteration is very low.

Materials used to form the shaft seals are the same as those identified in the scientific and engineering literature as appropriate for sealing deep geologic repositories for radioactive wastes. Durability or longevity of seal components is a primary concern for any long-term isolation system. Issues of possible degradation have been studied throughout the international community and within waste isolation programs in the USA. Specific degradation studies are not detailed in this document because longevity is one of the over-riding attributes of the materials selected and degradation is not perceived to be likely. However, it is acknowledged here that microbial degradation, seal material interaction, mineral transformation, such as silicification of bentonite, and effects of a thermal pulse from asphalt or hydrating concrete are areas of continuing investigations

Among longevity concerns, degradation of concrete is the most recognized. At this stage of the design, it is established that only small volumes of brine ever reach the concrete elements (see Section C4). Further analysis concerned with borehole plugging using cementitious materials shows that at least 100 pore volumes of brine in an open system would be needed to begin degradation processes. In a closed system, such as the hydrologic setting in the WIPP shafts, phase transformations create a degradation product of increased volume. Net volume increase owing to phase transformation in the absence of mass transport would decrease rather than increase permeability of concrete seal elements.

Asphalt has existed for thousands of years as natural seeps. Longevity studies specific to DOE's Hanford site have utilized asphalt artifacts buried in ancient ceremonies to assess long-term stability (Wing and Gee, 1994). Asphalt used as a seal component deep in the shaft will inhabit a benign environment, devoid of ultraviolet light or an oxidizing atmosphere. Additional assurance against possible microbial degradation in asphalt elements is provided with addition of lime. For these reasons, it is believed that asphalt components will possess their design characteristics well beyond the regulatory period.

Natural bentonite is a stable material that generally will not change significantly over a period of ten thousand years. Bentonitic clays have been widely used in field and laboratory experiments concerned with radioactive waste disposal. As noted by Gray (1993), three internal mechanisms, illitization, silicification and charge change, could affect sealing properties of bentonite. Illitization and silicification are thermally driven processes and, following discussion by Gray (1993), are not possible in the environment or time-frame of concern at the WIPP. The naturally occurring Wyoming bentonite which is the specified material for the WIPP shaft seal is well over a million years old. It is, therefore, highly unlikely that the metamorphism of bentonite enters as a design concern.

5.2 Materials

5.2.1 Mass Concrete

Concrete has low permeability and is widely used for hydraulic applications. The specification for mass concrete presents a special design mixture of a salt-saturated concrete called Salado Mass Concrete (**SMC**). Performance of SMC and similar salt-saturated mixtures has been established through analogous industrial applications and in laboratory and field testing. The documentation substantiates adequacy of SMC for concrete applications within the WIPP shafts.

The function of the concrete is to provide durable components with small void volume, adequate structural compressive strength, and low permeability. SMC is used as massive plugs, a monolith at the base of each shaft, and in tandem with asphalt waterstops. Concrete is a rigid material that will support overlying seal components while promoting natural healing processes within the salt DRZ. Concrete is one of the redundant components that protects the reconsolidating salt column. The salt column will achieve low permeabilities in fewer than 100 years, and concrete will no longer be needed at that time. However, concrete will continue to provide good sealing characteristics for a very long time.

Salt-saturated concrete contains sufficient salt as an aggregate to saturate hydration water with respect to NaCl. Salt-saturated concrete is required for all uses within the Salado Formation because fresh water concrete would dissolve part of the host rock. The concrete specified for the shaft seal system has been tailored for the service environment and includes all the engineering properties of high quality concrete, as described in Appendix I2-A. Among these are low heat of hydration, high compressive strength, and low permeability. Because SMC provides material characteristics of high-performance concrete, it will likely be the concrete of choice for all seal applications at the WIPP.

Construction involves surface preparation and slickline placement. A batching and mixing operation on the surface will produce a wet mixture having low initial temperatures. Placement uses a tremie line, where the fresh concrete exits the slickline below the surface level of the concrete being placed. Placed in this manner, the SMC will have low porosity (about 5%) with or without vibration. Tremie line placement is a standard construction method in mining operations.

Specifications of concrete properties include mixture proportions and characteristics before and after hydration. SMC strength is much greater than required for shaft seal elements, and the state of stress within the shafts is compressional with little shear stress developing. Volume stability of the SMC is also excellent; this, combined with salt-saturation, assures a good bond with the salt. Permeability of SMC is very low, consistent with most concrete (Pfeifle et al., 1996). Because of a favorable state of stress and isothermal conditions, the SMC will remain intact. Because little brine is available to alter concrete elements, minimal degradation is possible. These favorable attributes combine to assure concrete elements within the Salado will remain structurally sound and possess very low permeability (between 2×10^{-21} and 1×10^{-17} m^2) for exceedingly long periods. A permeability distribution function and associated discussion are given in Appendix I2-A.

Standard ASTM specifications are made for the green and hydrated concrete properties. Quality control and a history of successful use in both civil construction and mining applications assure proper placement and performance.

5.2.2 Compacted Clay

Compacted clays are commonly proposed as primary sealing materials for nuclear waste repositories and have been extensively investigated against rigorous performance requirements. Advantages of clays for sealing purposes include low permeability, demonstrated longevity in many types of natural environments, deformability, sorptive capacity, and demonstrated successful utilization in practice for a variety of sealing purposes.

Compacted clay as a shaft sealing component functions as a barrier to brine flow and possibly to gas flow (see alternative construction methods in Appendix I2-B). Compacted bentonitic clay can generate swelling pressure and clays have sufficient rigidity to promote healing of any DRZ in the salt. Wetted swelling clay will seal fractures as it expands into available space and will ensure tightness between the clay seal component and the shaft walls.

The Rustler and Salado compacted clay columns are specified to be constructed of dense sodium bentonite blocks. An extensive experimental data base exists for the permeability of sodium bentonites under a variety of conditions. Many other properties of sodium bentonite, such as strength, stiffness, and chemical stability, are established. Bentonitic clays heal when fractured and can penetrate small fractures or irregularities in the host rock. Further, bentonite is stable in the seal environment. These properties, noted by international waste isolation programs, make bentonite a widely accepted seal material.

From the bottom clay component to the top earthen fill, different methods will be used to place clay materials in the shaft. Seal performance within the Salado Formation is far more important to regulatory compliance of the seal system than is performance of clay and earthen fill in the overlying formations. Therefore, more time and effort will be expended on placement of Salado clay components. Three potential construction methods could be used to place clay in the shaft, as discussed in Appendix I2-B: compacted blocks, vibratory roller, and dynamic compaction. Construction of Salado clay components specifies block assembly.

Required sealing performance of compacted clay elements varies with location. For example, Component 4 provides separation of water-bearing zones, while the lowest clay column

(Component 12) limits fluid flow to the reconsolidating salt column. If liquid saturation in the clay column of 85% can be achieved, it would serve as a gas barrier. In addition, compacted clay seal components promote healing of the salt DRZ. To achieve low permeabilities, the dry density of the emplaced bentonite should be about 1.8 g/cm^3. A permeability distribution function for performance assessment and the logic for its selection are given in Appendix I2-A.

Verification of specified properties such as density, moisture content, permeability, or strength of compacted clay seals can be determined by direct measurement during construction. However, indirect methods are preferred because certain measurements, such as permeability, are likely to be time consuming and invasive. Methods used to verify the quality of emplaced seals will include quality of block production and field measurements of density.

5.2.3 Asphalt

Asphalt is used to prevent water migration down the shaft in two ways: as an asphalt column near the Rustler/Salado contact and as a “waterstop” sandwiched between concrete plugs at three locations within the Salado Formation. Asphalt components of the WIPP seal design add assurance that minimal transport of brine down the sealed shaft will occur.

Asphalt is a widely used construction material because of its many desirable engineering properties. Asphalt is a strong cement, readily adhesive, highly waterproof, and durable. Furthermore, it is a plastic substance that is readily mixed with mineral aggregates. A range of viscosity is achievable for asphalt mixtures. It is highly resistant to most acids, salts, and alkalis. These properties are well suited to the requirements of the WIPP shaft seal system.

Construction of the seal components containing asphalt can be accomplished using a slickline process where low-viscosity heated material is effectively pumped into the shaft. The technology to apply the asphalt in this manner is available as described in the construction procedures in Appendix I2-B.

The asphalt components are required to endure for about 100 years and limit brine flow down the shaft to the compacted salt component. Since asphalt will not be subjected to ultraviolet light or an oxidizing environment, it is expected to provide an effective seal for centuries. Air voids less than 2% ensure low permeability. The permeability of the massive asphalt column is expected to have an upper limit 1×10^{-18} m^2.

Sufficient construction practice and laboratory testing information is available to assure performance of the asphalt component. Laboratory validation tests to optimize viscosity may be desirable before final installation specifications are prepared. In general, verification tests would add quantitative documentation to expected performance values and have direct application to WIPP.

5.2.4 Compacted Salt Column

A reconsolidated column of natural WIPP salt will seal the shafts permanently. If salt reconsolidation is unimpeded by fluid pore pressures, the material will eventually achieve extremely low permeabilities approaching those of the native Salado Formation. Recent developments in support of the WIPP shaft seal system have produced confirming experimental results, constitutive material models, and construction methods that substantiate use of a salt column to create a low permeability seal component. Reuse of salt excavated in the process of creating the underground openings has been advocated since its initial proposal in the 1950s. Replacing the natural material in its original setting ensures physical, chemical, and mechanical compatibility with the host formation.

The function of the compacted and reconsolidated salt column is to limit transmission of fluids into or out of the repository for the statutory period of 10,000 years. The functional period starts within a hundred years and lasts essentially forever. After a period of consolidation, the salt column will almost completely retard gas or brine migration within the former shaft opening. A completely consolidated salt column will achieve flow properties indistinguishable from natural Salado salt.

The salt component is composed of crushed Salado salt with additional small amounts of water. The total water content of the crushed salt will be adjusted to 1.5 wt% before it is tamped into place. Field and laboratory tests have verified that natural salt can be compacted to significant fractional density ($\rho \geq 0.9$) with addition of these moderate amounts of water.

Dynamic compaction is the specified construction procedure to tamp crushed salt in the shaft. Deep dynamic compaction provides great energy to the crushed salt, is easy to apply, and has an effective depth of compactive influence greater than lift thickness. Dynamic compaction is relatively straightforward and requires a minimal work force in the shaft. Compaction itself will follow procedures developed in a large-scale compaction demonstration, as outlined in Appendix I2-B.

Numerical models of the shaft provide density of the compacted salt column as a function of depth and time. Many calculations comparing models for consolidation of crushed salt were performed to quantify performance of the salt column, as discussed in Appendix D of Appendix I2 in the permit application and the references (Callahan et al., 1996; Brodsky et al., 1996). From the density-permeability relationship of reconsolidating crushed salt, permeability of the compacted salt seal component is calculated. In general, results show that the bottom of the salt column consolidates rapidly, achieving permeability of 1×10^{-19} m^2 in about 50 years. By 100 years, the middle of the salt column reaches similar permeability.

Results of the large-scale dynamic compaction demonstration suggest that deep dynamic compaction will produce a sufficiently dense starting material. As with other seal components, testing of the material in situ will be difficult and probably not optimal to ensure quality of the seal element. This is particularly apparent for the compacted salt component because the compactive effort produces a finely powdered layer on the top of each lift. It was demonstrated

(Hansen and Ahrens, 1996) that the fine powder is very densely compacted upon tamping the superincumbent lifts. The best means to ensure that the crushed salt element is placed properly is to establish performance through verification of quality assurance/quality control procedures. If crushed salt is placed with a reasonable uniformity of water and compacted with sufficient energy, long-term performance can be assured.

5.2.5 Cementitious Grout

Cementitious grouting is specified for all concrete members. Grouting is also used in advance of liner removal to stabilize the ground and to limit water inflow during shaft seal construction. Cementitious grout is specified because of its proven performance, nontoxicity, and previous use at the WIPP.

The function of grout is to stabilize the surrounding rock before existing concrete liners are removed. Grout will fill fractures within adjacent lithologies, thereby adding strength and reducing permeability and, hence, water inflow during shaft seal construction. Grout around concrete members of the concrete asphalt waterstop will be employed in an attempt to tighten the interface and fill microcracks in the DRZ. Efficacy of grouting will be determined during construction.

An ultrafine cementitious grout has been specifically developed for use at the WIPP (Ahrens and Onofrei, 1996). This grout consists of Type 5 portland cement, pumice as a pozollanic material, and superplasticizer. The average particle size is approximately 2 microns. The ultrafine grout is mixed in a colloidal grout mixer, with a water to components ratio (**W:C**) of 0.6:1.

Drilling and grouting sequences provided in Appendix I2-B follow standard procedures. Grout will be mixed on the surface and transported by slickline to the middle deck on the multi-deck stage (galloway). Grout pressures are specified below lithostatic to prevent hydrofracturing.

Performance of grout is not a consideration for compliance issues. Grouting of concrete elements is an added assurance to tighten interfaces. Grouting is used to facilitate construction by stabilizing any loose rock behind the concrete liner.

No verification of the effectiveness of grouting is currently specified. If injection around concrete plugs is possible, an evaluation of quantities and significance of grouting will be made during construction. Procedural specifications will include measurements of fineness and determination of rheology in keeping with processes established during the WIPP demonstration grouting (Ahrens et al., 1996).

5.2.6 Earthen Fill

A brief description of the earthen fill is provided in Appendix I2-A, and construction is summarized in Appendix I2-B. Compacted fill can be obtained from local borrow pits, or material excavated during shaft construction can be returned to the shaft. There are minimal design requirements for earthen fill and none that are related to WIPP regulatory performance.

5.3 Concluding Remarks

Materials specifications in Appendix I2-A provide descriptions of seal materials along with reasoning on their expected reliability in the WIPP setting. The specification follows a framework that states the function of the seal component, a description of the material, and a summary of construction techniques. The performance requirements for each material are detailed. Materials chosen for use in the shaft seal system have several common desirable attributes: low permeability, high density, compatibility, longevity, low cost, constructability, availability, and supporting documentation.

6. Construction Techniques

Construction of the shaft sealing system is feasible. The described procedures utilize currently available technology, equipment, and materials to satisfy shaft sealing system design guidance. Although alternative methods are possible, those described satisfy the design guidance requirements listed in Table I2-7 and detailed in the appendices. Construction feasibility is established by reference to comparable equipment and activities in the mining, petroleum, and food industries and test results obtained at the WIPP. Equipment and procedures for emplacement of sealing materials are described below.

6.1 Multi-Deck Stage

A multi-deck stage (Figures I2-6 and I2-7) consisting of three vertically connected decks will be the conveyance utilized during the shaft sealing operation. Detailed sketches of the multi-deck stage appear in Appendix I2-E. The stage facilitates installation and removal of utilities and provides a working platform for the various sealing operations. A polar crane attached to the lower deck provides the mechanism required for dynamic compaction and excavation of the shaft walls. Additionally, the header at the bottom of the slickline is supported by a reinforced steel shelf, which is securely bolted to the shaft wall during emplacement of sealing materials. The multi-deck stage can be securely locked in place in the shaft whenever desired (e.g., during dynamic compaction, excavation of the salt walls of the shaft, grouting, liner removal, etc.). The multi-deck stage is equipped with floodlights, remotely aimed closed-circuit television, fold-out floor extensions, a jib crane, and range-finding devices. Similar stages are commonly employed in shaft sinking operations.

The polar crane can be configured for dynamic compaction (Figure I2-6) or for excavation of salt (Figure I2-7); a man cage or bucket can be lowered through the stage to the working surface below. Controlled manually or by computer, the crane and its trolley utilize a geared track drive. The crane can swiftly position the tamper (required for dynamic compaction) in the drop positions required (Figure I2-8) or accommodate the undercutter required for excavation of the shaft walls. The crane incorporates a hoist on the trolley and an electromagnet, enabling it to position, hoist, and drop the tamper. A production rate of one drop every two minutes during dynamic compaction is possible.

6.2 Salado Mass Concrete (Shaft Station Monolith and Shaft Plugs)

Salado Mass Concrete, described in Appendix I2-A, will be mixed on surface at 20ºC and transferred to emplacement depth through a slickline (i.e., a steel pipe fastened to the shaft wall and used for the transfer of sealing materials from surface to the fill horizon) minimizing air entrainment and ensuring negligible segregation. Existing sumps will be filled to the elevation of the floor of the repository horizon, and emplacement of the shaft station monolith is designed to eliminate voids at the top (back) of the workings.

When excavating salt for waterstops or plugs in the Salado Formation, an undercutter attached to the trolley of the polar crane will be forced into the shaft wall by a combination of geared trolley and undercutter drives. Full circumferential cuts will be accomplished utilizing the torque developed by the geared polar crane drive.

The undercutter proposed is a modified version of those currently in use in salt and coal mines, where their performance is proven. Such modifications and applications have been judged feasible by the manufacturer.

The concrete-salt interface and DRZ around concrete plugs in the Salado Formation (and the one at the base of the Rustler Formation) will be grouted with ultrafine grout. Injection holes will be collared in the top of the plug and drilled downward at 45º below horizontal. The holes will be drilled in a "spin" pattern describing a downward opening cone designed to intercept both vertical and horizontal fractures (Figure I2-9). The holes will be stage grouted (i.e., primary holes will be drilled and grouted, one at a time). Secondary holes will then be drilled and grouted, one at a time, on either side of primaries that accepted grout.

6.3 Compacted Clay Columns (Salado and Rustler Formations)

Cubic blocks of sodium bentonite, 20.8 cm on the edge and weighing approximately 18 kg, will be precompacted on surface to a density between 1.8 and 2.0 gm/cm^3 and emplaced manually. The blocks will be transferred from surface on the man cage. Block surfaces will be moistened with a fine spray of potable water, and the blocks will be manually placed so that all surfaces are in contact. Peripheral blocks will be trimmed to fit irregularities in the shaft wall, and remaining voids will be filled with a thick mortar of sodium bentonite and potable water. Such blocks have been produced at the WIPP and used in the construction of 0.9-m-diameter seals, where they performed effectively (Knowles and Howard, 1996). Alternatives, which may be considered in future design evaluations, are discussed in Appendix I2-B.

6.4 Asphalt Waterstops and Asphaltic Mix Columns

Neat asphalt is selected for the asphalt waterstops, and an asphaltic mastic mix (**AMM**) consisting of neat asphalt, fine silica sand, and hydrated lime will be the sealing material for the columns. Both will be fluid at emplacement temperature and remotely emplaced. Neat asphalt (or AMM, prepared in a pug mill near the shaft collar) will be heated to 180°C and transferred to emplacement depth via an impedance-heated, insulated tremie line (steel pipe) suspended from slips (pipe holding device) at the collar of the shaft.

This method of line heating is common practice in the mining and petroleum industries. This method lowers the viscosity of the asphalt so that it can be pumped easily. Remote emplacement by tremie line eliminates safety hazards associated with the high temperature and gas produced by the hot asphalt. Fluidity ensures that the material will flow readily and completely fill the excavations and shaft. Slight vertical shrinkage will result from cooling (calculations in Appendix D of Appendix I2 in the permit application), but the material will maintain contact with the shaft walls and the excavation for the waterstop. Vertical shrinkage will be counteracted by the emplacement of additional material.

6.5 Compacted WIPP Salt

Dynamic compaction of mine-run WIPP salt has been demonstrated (Ahrens and Hansen, 1995). The surface demonstration produced salt compacted to 90% of in-place rock salt density, with a statistically averaged permeability of 1.65×10^{-15} m^2. Additional laboratory consolidation of this material at 5 MPa confining pressure (simulating creep closure of the salt) resulted in increased compaction and lower permeability (Brodsky, 1994). Dynamic compaction was selected because it is simple, robust, proven, has excellent depth of compaction, and is applicable to the vertical WIPP shafts.

The compactive effect expanded laterally and downward in the demonstration, and observation during excavation of the compacted salt revealed that the lateral compactive effect will fill irregularities in the shaft walls. Additionally, the depth of compaction, which was greater than that of the three lifts of salt compacted, resulted in the bottom lift being additionally compacted during compaction of the two overlying lifts. This cumulative effect will occur in the shafts.

Construction of the salt column will proceed in the following manner:

- Crushed and screened salt will be transferred to the fill elevation via slickline. Use of slicklines is common in the mining industry, where they are used to transfer backfill materials or concrete to depths far greater than those required at the WIPP. Potable water will be added via a fine spray during emplacement at the fill surface to adjust the moisture content to 1.5 ±0.3 wt%, accomplished by electronically coordinating the weight of the water with that of the salt exiting the hose.
- Dynamic compaction will then be used to compact the salt by dropping the tamper in specific, pre-selected positions such as those shown in Figure I2-8.

6.6 Grouting of Shaft Walls and Removal of Liners

The procedure listed below is a common mining practice which will be followed at each elevation where liner removal is specified. If a steel liner is present, it will be cut into manageable pieces and hoisted to the surface for disposal, prior to initiation of grouting.

Upward opening cones of diamond drill holes will be drilled into the shaft walls in a spin pattern (Figure I2-10) to a depth ensuring complete penetration of the Disturbed Rock Zone (**DRZ**) surrounding the shaft. For safety reasons, no major work will be done from the top deck; all sealing activities will be conducted from the bottom deck. The ends of the holes will be 3 m apart, and the fans will be 3 m apart vertically, covering the interval from 3 m below to 3 m above the interval of liner removal. Tests at the WIPP demonstrated that the ultrafine cementitious grout penetrated more than 2 m from the injection holes(Ahrens et al., 1996).

Injection holes will be drilled and grouted one at a time, as is the practice in stage grouting. Primary holes are grouted first, followed by the grouting of secondary holes on either side of primaries that accepted grout. Ultrafine grout will be injected below lithostatic pressure to avoid hydrofracturing the rock, proceeding from the bottom fan upward. Grout will be mixed on surface and transferred to depth via the slickline.

Radial, horizontal holes will then be drilled on a 0.3-m grid, covering the interval to be removed. These will be drilled to a depth sufficient to just penetrate the concrete liner. A chipping hammer will be used to break a hole through the liner at the bottom of the interval. This hole, approximately 0.3 m in diameter, will serve as "free face," to which the liner can be broken. Hydraulically-actuated steel wedges will then be used in the pre-drilled holes to break out the liner in manageable pieces, beginning adjacent to the hole and proceeding upward. Broken concrete will be allowed to fall to the fill surface, where it will be gathered and hoisted to the surface for disposal. Chemical seal rings will be removed as encountered.

6.7 Earthen Fill

Local soil, screened to produce a maximum particle dimension of approximately 15 mm, will be the seal material. This material will be transferred to the fill surface via the slickline and emplaced in the same manner as the salt. After adjusting the moisture content of the earthen fill below the concrete plug in the Dewey Lake Redbeds to achieve maximum compaction, the fill will be dynamically compacted, achieving a permeability as low as that of the enclosing formation.

The portion of the earthen fill above the plug will be compacted with a vibratory-impact sheepsfoot roller, a vibratory sheepsfoot roller, or a walk-behind vibratory plate compactor, because of insufficient height for dynamic compaction.

6.8 Schedule

For discussion purposes, it has been assumed that the shafts will be sealed two at a time. This results in the four shafts being sealed in approximately six and a half years. The schedules presented in Appendix I2-B are based on this logic. Sealing the shafts sequentially would require approximately eleven and a half years.

7. Structural Analyses of Shaft Seals

7.1 Introduction

The shaft seal system was designed in accordance with design guidance described in Section 3.2. To be successful, seal system components must exhibit desired structural behavior. The desired structural behavior can be as simple as providing sufficient strength to resist imposed loads. In other cases, structural behavior is critical to achieving desired hydrological properties. For example, permeability of compacted salt depends on the consolidation induced by shaft closure resulting from salt creep. In this example, results from structural analyses feed directly into fluid-flow calculations, which are described in Section 8, because structural behavior affects both time-dependent permeabilities of the compacted salt and pore pressures within the compacted salt. In other structural considerations, thermal effects are analyzed as they affect the constructability and schedule for the seal system. Thus a series of analyses, loosely termed structural analyses, were performed to accomplish three purposes:

1. to determine loads imposed on components and to assess both structural stability based on the strength of the component and mechanical interaction between components;
2. to estimate the influence of structural behavior of seal materials and surrounding rock on hydrological properties; and
3. to provide structural and thermal related information on construction issues.

For the most part, structural analyses rely on information and design details presented in the Design Description (Section 4), the Design Drawings (Appendix I2-E), and Material Specification (Section 5 and Appendix I2-A). Some analyses are generic, and calculation input and subsequent results are general in nature.

7.2 Analysis Methods

Finite-element modeling was the primary numerical modeling technique used to evaluate structural performance of the shaft seals and surrounding rock mass. Well documented finite-element computer programs, SPECTROM-32 and SPECTROM-41, were used in structural and thermal modeling, respectively. The computer program SALT_SUBSID was used in the subsidence modeling over the backfilled shaft-pillar area. Specific details of these computer programs as they relate to structural calculations are listed in Appendix D of Appendix I2 in the permit application, Section D2.

7.3 Models of Shaft Seals Features

Structural calculations require material models to characterize the behavior of (1) each seal material (concrete, crushed salt, compacted clay, and asphalt); (2) the intact rock lithologies in the near-surface, Rustler, and Salado formations; and (3) any DRZ within the surrounding rock. A general description of the material models used in characterizing each of these materials and features is given below. Details of the models and specific values of model parameters are given in Appendix D in the permit application, Section D3.

7.3.1 Seal Material Models

The SMC thermal properties required for the structural analyses (thermal conductivity, density, specific heat, and volumetric heat generation rate) were obtained from SMC test data. Concrete was assumed to behave as a viscoelastic material, based on experimental data, and the elastic modulus of SMC was modeled as age-dependent. Strength properties of SMC were specified in the design (see Appendix I2-A).

For crushed salt, the deformational model included a nonlinear elastic component and a creep consolidation component. The nonlinear elastic modulus was assumed to be density-dependent, based on laboratory test data performed on WIPP crushed salt. Creep consolidation behavior of crushed salt was based on three candidate models whose parameters were obtained from model fitting to hydrostatic and shear consolidation test data performed on WIPP crushed salt. Creep consolidation models include functional dependencies on density, mean stress, stress difference, temperature, grain size, and moisture content.

Compacted clay was assumed to behave according to a nonlinear elastic model in which shear stiffness is negligible, and asphalt was assumed to behave as a weak elastic material. Thermal properties of asphalt were taken from literature.

7.3.2 Intact Rock Lithologies

Salado salt was assumed to be argillaceous salt that is governed by the Multimechanism Deformation Coupled Fracture (**MDCF**) model, which is an extension of the Munson-Dawson (**M-D**) creep model. A temperature-dependent thermal conductivity was necessary.

Salado interbeds were assumed to behave elastically. Their material strength was assumed to be described by a Drucker-Prager yield function, consistent with values used in previous WIPP analyses.

Deformational behavior of the near-surface and Rustler Formation rock types was assumed to be time-invariant, and their strength was assumed to be described by a Coulomb criterion, consistent with literature values.

7.3.3 Disturbed Rock Zone Models

Two different models were used to evaluate the development and extent of the DRZ within intact salt. The first approach used ratios of time-dependent stress invariants to quantify the potential for damage or healing to occur. The second approach used the damage stress criterion according to the MDCF model for WIPP salt.

7.4 Structural Analyses of Shaft Seal Components

7.4.1 Salado Mass Concrete Seals

Five analyses related to structural performance of SMC seals were performed, including (1) a thermal analysis, (2) a structural analysis, (3) a thermal stress analysis, (4) a dynamic compaction analysis, and (5) an analysis of the effects of clay swelling pressure. This section presents these analyses and evaluates the results in terms of the performance of the SMC seal. Details of these calculations are given in Appendix D in the permit application, Section D4.

7.4.1.1 Thermal Analysis of Concrete Seals

The objective of this calculation was to determine expected temperatures within (and surrounding) an SMC emplacement resulting from its heat of hydration. Results indicate that the concrete component temperature increases from ambient (27°C) to a maximum of 53°C at 0.02 year after emplacement. The maximum temperature in the surrounding salt is 38°C at approximately the same time. The thermal gradient within the concrete is approximately 1.5°C/m. Most of the higher temperatures are contained within the concrete. At a radial distance of 2 m into the surrounding salt, the temperature rise is less than 1°C. These conditions are favorable for proper performance of the SMC components. A 26°C temperature rise and a 1.5°C/m temperature gradient are not large enough to cause thermal cracking as the concrete cools (Andersen et al., 1992).

7.4.1.2 Structural Analysis of Concrete Seals

The objectives of this calculation were to determine (1) expected stresses within the concrete components caused by restrained creep of the surrounding salt and (2) expected stresses in the concrete component from weight of overlying seal material.

In the upper concrete-asphalt waterstop, radial stresses increase (compression is positive) from zero at time of emplacement (t = 0) to 2.5 MPa at t = 50 years. Similarly, radial stresses in the middle concrete component range from 3.5 to 4.5 MPa at 50 years after emplacement. In the lower concrete-asphalt waterstop, radial stresses range from 4.5 to 5.5 MPa at t = 50 years. All the calculated stresses are well below the unconfined compressive strength of the concrete (30 MPa).

The upper, middle, and lower concrete-asphalt waterstops are located at depths of 300, 420, and 610 m, respectively. When performing these calculations, it was assumed that each concrete component must support the weight of the overlying materials between it and the next concrete component above it. Using an average overburden density of 0.02 MPa/m, stresses induced by the overlying material are significantly less than the strength of the concrete. The structural integrity of concrete components will not be compromised by either induced radial stress or imposed vertical stress.

7.4.1.3 Thermal Stress Analysis of Concrete Seals

The objectives of this calculation were (1) to determine thermal stresses in concrete components from the heat of hydration and (2) to determine thermal impact on the creep of the surrounding salt.

Thermoelastic stresses in the concrete were calculated based on a maximum temperature increase of 26°C and assuming a fully confined condition. Results of this calculation indicate that short-term compressive thermal stresses in the concrete will be less than 9.2 MPa. The temperature rise in the surrounding salt is insignificant in terms of producing either detrimental or beneficial effects. Based on these results, the structural integrity of concrete components will not be compromised by thermoelastic stresses caused by heat of hydration.

7.4.1.4 Effect of Dynamic Compaction on Concrete Seals

The objective of this calculation was to determine a required thickness of seal layers above concrete components to reduce the impact of dynamic compaction. Compaction depths for crushed salt and clay layers are 2.8 m and 2.2 m, respectively. Layers 3.7-m thick for crushed salt and 3-m thick for clay are to be emplaced before compaction begins, thus providing a layer about 30% thicker than the calculated compaction depths.

7.4.1.5 Effect of Clay Swelling Pressures on Concrete Seals

The objective of this calculation was to determine the increased stresses within concrete components as a result of clay swelling pressures. Test measurements on confined bentonite at an emplaced density of 1.8 g/cm^3 indicate that anticipated swelling pressures are on the order of 3.5 MPa. In order to fracture the salt surrounding the clay, the swelling pressures must exceed the lithostatic rock stress in the salt, which ranges from nominally 8.3 MPa at the upper clay seal to 14.4 MPa at the lower clay seal. The design strength of the concrete (31.0 MPa) is significantly greater than the swelling pressure of 3.5 MPa. Even in the unlikely event that the clay swelled to lithostatic pressures, the resulting state of stress in the concrete seal would lie well below any failure surface. Furthermore, the compressive tangential stress in the salt along the shaft wall, even after stress relaxation from creep, is always larger than lithostatic. Hence, radial fracturing from clay swelling pressure is not expected.

7.4.2 Crushed Salt Seals

Two analyses related to structural performance of crushed salt seals were performed, including (1) a structural analysis and (2) an analysis to determine effects of pore pressure on consolidation of crushed salt seals. This section presents the results of these analyses and evaluates the results in terms of performance of crushed salt seals. Details of these analyses are given in Appendix D in the permit application, Section D4.

7.4.2.1 Structural Analysis of Compacted Salt Seal

The objectives of this calculation were (1) to determine the fractional density of the crushed salt seal as a function of time and depth and, using these results, (2) to determine permeability of the crushed salt as a function of time and depth.

Results indicate that compacted salt will increase from its emplaced fractional density of 90% to a density of 95% approximately 40, 80, and 120 years after emplacement at the bottom, middle, and top of the shaft seal, respectively. Using the modified Sjaardema-Krieg creep consolidation model, the times required to fully reconsolidate the crushed salt to 100% fractional density are 70 years, 140 years, and 325 years at the bottom, middle, and top of the salt column, respectively. Based on these results, the desired fractional densities (hence, permeability) can be achieved over a substantial length of the compacted salt seal in the range of 50 to 100 years.

7.4.2.2 Pore Pressure Effects on Reconsolidation of Crushed Salt Seals

The objective of this calculation was to determine the effect of pore pressure on the reconsolidation of the crushed salt seal. Fractional densities of the crushed salt seal were calculated using the modified Sjaardema-Krieg consolidation model for a range of pore pressures (0, 2, and 4 MPa). Results indicate that times required to consolidate the crushed salt increase as the pore pressure increases, as expected. For example, for a pore pressure of 2 MPa, the times required to achieve a fractional density of 96% are about 90 years, 205 years, and 560 years at the bottom, middle, and top of the crushed salt column, respectively. A pore pressure of 4 MPa would effectively prevent reconsolidation of the crushed salt within a reasonable period (<1,000 years). The results of this calculation were used in the fluid flow calculations, and the impact of these pore pressures on the permeability of the crushed salt seal is described in Section 8 and Appendix C of Appendix I2 in the permit application.

7.4.3 Compacted Clay Seals

One analysis was performed to determine the structural response of compacted clay seals. The objective of this calculation was to determine stresses in the upper Salado compacted clay component and the lower Salado compacted clay component as a result of creep of the surrounding salt. Details of this calculation are given in Appendix D in the permit application, Section D4. Results of this calculation indicate that after 50 years the compressive stresses in the upper Salado compacted clay component are about 0.7 MPa, not including the effects of swelling pressures. Similarly, after 50 years the stresses in the lower Salado compacted clay component are approximately 2.6 MPa. Based on these results, the compacted clay component will provide some restraint to the creep of salt and induce a back (radial) stress in the clay seal, which will promote healing of the DRZ in the surrounding intact salt (see discussion about DRZ in Section 7.5.1).

7.4.4 Asphalt Seals

Three analyses were performed related to structural performance of the asphalt seals, including (1) a thermal analysis, (2) a structural analysis, and (3) a shrinkage analysis. This section presents the results of these analyses and evaluates the results in terms of the performance of the asphalt seal. Details of these analyses are given in Appendix D of Appendix I2 in the permit application Section D4.

7.4.4.1 Thermal Analysis

The objectives of this calculation were (1) to determine temperature histories within the asphalt seal and the surrounding salt and (2) to determine effects of the length of the waterstop.

Results indicate that the center of the asphalt column will cool from its emplaced temperature of 180°C to 83°C, 49°C, 31°C, and 26°C at times 0.1 year, 0.2 year, 0.5 year, and 1.0 year, respectively. Similarly, the asphalt/salt interface temperatures at corresponding times are 47°C, 38°C, 29°C, and 26°C. The time required for a waterstop to cool is significantly less than that required to cool the asphalt column. Based on these results, about 40 days are required for asphalt to cool to an acceptable working environment temperature. The thermal impact on enhanced creep rate of the surrounding salt is considered to be negligible.

7.4.4.2 Structural Analysis

The objective of this analysis was to calculate pressures in asphalt that result from restrained creep of the surrounding salt and to evaluate stresses induced on the concrete seal component by such pressurization.

Results indicate that pressures in the waterstops after 100 years are 1.8 MPa, 2.5 MPa, and 3.2 MPa for the upper, middle, and lower waterstops, respectively. Based on these results, the structural integrity of concrete components will not be compromised by imposed pressures, and the rock surrounding the asphalt will not be fractured by the pressure. The pressure from asphalt is enough to initiate healing of the DRZ surrounding the waterstop.

7.4.4.3 Shrinkage Analysis

The objective of this analysis was to calculate shrinkage of the asphalt column as it cools from its emplaced temperature to an acceptable working environment temperature. Results of this analysis indicate that the 42-m asphalt column will shrink 0.9 m in height as the asphalt cools from its emplaced temperature of 180°C to 38°C.

7.5 Disturbed Rock Zone Considerations

7.5.1 General Discussion of DRZ

Microfracturing leading to a DRZ occurs within salt whenever excavations are made. Laboratory and field measurements show that a DRZ has enhanced permeability. The body of evidence strongly suggests that induced fracturing is reversible and healed when deviatoric stress states created by the opening are reduced. Rigid seal components in the shaft provide a restraint to salt creep closure, thereby inducing healing stress states in the salt. A more detailed discussion of the DRZ is included in Appendix D in the permit application.

7.5.2 Structural Analyses

Three analyses were performed to determine the behavior of the DRZ in the rock mass surrounding the shaft. The first analysis considered time-dependent DRZ development and subsequent healing of intact Salado salt surrounding each of the four seal materials. The second analysis considered time-dependent development of the DRZ within anhydrite and polyhalite interbeds within the Salado Formation. The last analysis considered time-independent DRZ development within the near-surface and Rustler formations. These analyses are discussed below and given in more detail in Appendix D of Appendix I2 in the permit application, Section D5. Results from these analyses were used as input conditions for the fluid flow analysis presented in Section 8 and Appendix C of Appendix I2 in the permit application.

7.5.2.1 Salado Salt

The objective of this calculation was to determine time-dependent extent of the DRZ in salt, assuming no pore pressure effects, for each of the four shaft seal materials (i.e., concrete, crushed salt, compacted clay, and asphalt. The seal materials below a depth of about 300 m provide sufficient rigidity to heal the DRZ within 100 years. Asphalt, modeled as a weak elastic material, will not create a stress state capable of healing the DRZ because it is located high in the Salado.

7.5.2.2 Salado Anhydrite Beds

The objective of this calculation was to determine the extent of the DRZ within the Salado anhydrite and polyhalite interbeds as a result of creep of surrounding salt.

For all interbeds, the factor of safety against failure (shear or tensile fracturing) increases with depth into the rock surrounding the shaft wall. These results indicate that, with the exception of Marker Bed 117 (**MB117**), the factor of safety is greater than 1 (no DRZ will develop) for all interbeds. For MB117, the potential for fracturing is localized to within 1 m of the shaft wall.

7.5.2.3 Near-Surface and Rustler Formations

The objective of this calculation was to determine the extent of the DRZ surrounding the shafts in the near-surface and Rustler formations.

Rock types in near-surface and Rustler formations are anhydrite, dolomite, and mudstone. These rock types exhibit time-independent behavior. Results indicate that no DRZ will develop in anhydrite and dolomite (depths between 165 and 213 m). For mudstone layers, the radial extent of the DRZ increases with depth, reaching a maximum of 2.6 shaft radii at a depth of 223 m.

7.6 Other Analyses

This section discusses two structural analyses performed in support of design concerns, namely (1) the asphalt waterstops constructability and (2) benefits from shaft station backfilling. Analyses performed in support of these efforts are discussed below and given in more detail in Appendix D of Appendix I2 in the permit application, Section D6.

7.6.1 Asphalt Waterstops

The DRZ is a major contributor to fluid flows through a low permeability shaft seal system, regardless of the materials emplaced within the shaft. Therefore, to increase the confidence in the overall shaft seal, low permeability layers (termed radial waterstops) were included to intersect the DRZ surrounding the shaft. These waterstops are emplaced to alter the flow direction either inward toward the shaft seal or outward toward intact salt. Asphalt-filled waterstops will be effective soon after emplacement. The objectives of these structural calculations were to evaluate performance of the waterstops in terms of (1) intersecting the DRZ around the shaft, (2) inducing a new DRZ because of special excavation, and (3) promoting healing of the DRZ.

Results indicate that the DRZ from the shaft extends to a radial distance of less than one shaft radius (3.04 m). Waterstop excavation extends the DRZ radially to about 1.4 shaft radii (4.3 m). However, this extension is localized within the span of the concrete component and extends minimally past the waterstop edge. The DRZ extent reduced rapidly after the concrete and asphalt restrained creep of the surrounding salt. After 20 years, the spatial extent of the DRZ is localized near the asphalt-concrete interface, extending spatially into the salt at a distance of less than 2 m. Based on these results, construction of waterstops is possible without substantially increasing the DRZ. Furthermore, the waterstop extends well beyond the maximum extent of the DRZ surrounding the shaft and effectively blocks this flow path (within 2 years after emplacement), albeit over only a short length of the flow path.

7.6.2 Shaft Pillar Backfilling

The objective of this calculation was to assess potential benefits from backfilling a portion of the shaft pillar to reduce subsurface subsidence and thereby decrease the potential for inducing fractures along the shaft wall. The calculated subsidence without backfilling is less than one foot, due to the relatively low extraction ratio at the WIPP. Based on the results of this analysis, backfilling portions of the shaft pillar would result in only 10% to 20% reduction in surface subsidence. This reduction in subsidence from backfilling is not considered enough to warrant backfilling the shaft pillar area. The shaft seals within the Salado are outside the angle-of-draw for any horizontal displacements caused by the subsidence over the waste panels. Moreover, horizontal strains caused by subsidence induced by closures within the shaft pillar are compressive in nature and insignificant in magnitude to induce fracturing along the shaft wall.

8. Hydrologic Evaluation of the Shaft Seal System

8.1 Introduction

The design guidance in Section 3 presented the rationale for sealing the shaft seal system with low permeability materials, but it did not provide specific performance measures for the seal system. This section compares the hydrologic behavior of the system to several performance measures that are directly related to the ability of the seal system to limit liquid and gas flows through the seal system. The hydrologic evaluation is focused on the processes that could result in fluid flow through the shaft seal system and the ability of the seal system to limit any such flow. Transport of radiological or hazardous constituents will be limited if the carrier fluids are similarly limited.

The hydrologic performance models are fully described in Appendix C of Appendix I2 in the permit application. The analyses presented are deterministic. Quantitative values for those parameters that are considered uncertain and that may significantly impact the primary performance measures have been varied, and the results are presented in Appendix C of Appendix I2 in the permit application. This section summarizes the seal system performance analyses and discusses results within the context of the design guidance of Section 3. The results demonstrate that (1) fluid flows will be limited within the shaft seal system and (2) uncertainty in the conceptual models and parameters for the seal system are mitigated by redundancy in component function and materials.

8.2 Performance Models

The physical processes that could impact seal system performance are presented in detail in Appendix C of Appendix I2 in the permit application. These processes have been incorporated into four performance models. These models evaluate (1) downward migration of groundwater from the Rustler Formation, (2) gas migration and consolidation of the crushed salt seal component, (3) upward migration of brines from the repository, and (4) flow between water-bearing zones in the Rustler Formation. The first three are analyzed using numerical models of the Air Intake Shaft (**AIS**) seal system and the finite-difference codes SWIFT II and TOUGH28W. These codes are extensively used and well documented within the scientific community. A complete description of the models is provided in Appendix C of Appendix I2 in the permit application. The fourth performance model uses a simple, analytical solution for fluid flow. Results from the analyses are summarized in the following sections and evaluated in terms of the design guidance presented in Section 3.

Material properties and conceptual models that may significantly impact seal system performance have been identified, and uncertainty in properties and models have been addressed through variation of model parameters. These parameters include (1) the effective permeability of the DRZ, (2) those describing salt column consolidation and the relationship between compacted salt density and permeability, and (3) repository gas pressure applied at the base of the shaft seal system.

8.3 Downward Migration of Rustler Groundwater

The shaft seal system is designed to limit groundwater flowing into and through the shaft sealing system (see Section 3). The principal source of groundwater to the seal system is the Culebra Member of the Rustler Formation. The Magenta Member of this formation is also considered a groundwater source, albeit a less significant source than the Culebra. No significant sources of groundwater exist within the Salado Formation; however, brine seepage has been noted at a number of the marker beds. The modeling includes the marker beds, as discussed in Appendix C of Appendix I2 in the permit application. Downward migration of Rustler groundwater must be limited so that liquid saturation of the compacted salt column salt column does not impact the consolidation process and to ensure that significant quantities of brine do not reach the repository horizon. Because it is clear that limitation of liquid flow into the salt column necessarily limits liquid flow to the repository, the volumetric flux of liquid into and through the salt column were selected as performance measures for this model.

Consolidation of the compacted salt column salt column will be most rapid immediately following seal construction. Simulations were conducted for the 200-year period following closure to demonstrate that, during this initial period, downward migration of Rustler groundwater will be insufficient to impact the consolidation process. Lateral migration of brine through the marker beds is also quantified in the analysis and shown to be nondetrimental to the function of the salt column.

8.3.1 Analysis Method

Seal materials will not, in general, be fully saturated with liquid at the time of construction. The host rock surrounding the shafts will also be partially desaturated at the time of seal construction. The analysis presented in this section assumes a fully saturated system. The effects of partial saturation of the shaft seal system are favorable in terms of system performance, as will be discussed in Section 8.3.2.

Seal material and host rock properties used in the analyses are discussed in Appendix C of Appendix I2 in the permit application, Section C3. Appendix I2-A contains a detailed discussion of seal material properties. A simple perspective on the effects of material and host rock properties may be obtained from Darcy's Law. At steady-state, the flow rate in a fully saturated system depends directly on the system permeability. The seal system consists of the component material and host rock DRZ. Low permeability is specified for the engineered materials; thus the system component most likely to impact performance is the DRZ. Rock mechanics calculations presented in Appendix D of Appendix I2 in the permit application predict that the DRZ in the Salado Formation will not be vertically continuous because of the intermittent layers of stiff anhydrites (marker beds). Asphalt waterstops are included in the design to minimize DRZ impacts. The effects of the marker beds and the asphalt waterstops on limiting downward migration are explicitly simulated through variation of the permeability of the layers of Salado DRZ.

Initial, upper, and lateral boundary conditions for the performance model are consistent with field measurements for the physical system. At the base of the shaft a constant atmospheric pressure is assumed.

8.3.2 Summary of Results

The initial pore volumes in the filled repository and the AIS salt column are approximately 460,000 m^3 and 250 m^3, respectively. The performance model predicts a maximum cumulative flow of less than 5 m^3 through the sealed shafts for the 200 years following closure. If the marker beds have a disturbed zone immediately surrounding the shaft, the maximum flow is less than 10 m^3 during the same period. Assuming the asphalt waterstops are not effective in interrupting the vertical DRZ, the volumetric flow increases but is still less than 30 m^3 for the 200 years following closure. These volumes are less than 1/100 of 1% of the pore volume in the repository and less than 20% of the initial pore volume of the salt column.

Two additional features of the model predictions should also be considered. The first of these is that flow rates fall from less than 1 m^3 / year in the first five years to negligible values within 10 years of seal construction. Therefore most of the cumulative flow occurs within a few years following closure. The second feature is the model prediction that the system returns to nearly ambient undisturbed pressures within two years. The repressurization occurs quickly within the model due to the assumption of a fully saturated flow regime because of brine incompressibility. As will be discussed in Section 8.4, the pore pressure in the compacted salt column is a critical variable in the analysis. The pressure profiles predicted by the model are an artifact of the assumption of full liquid saturation and do not apply to the pore pressure analysis of the salt column.

The magnitude of brine flow that can reach the repository through a sealed shaft is minimal and will not impact repository performance. The flow that reaches the salt column must be assessed with regard to the probable impacts on the consolidation process. Although the volume of flow to the salt column is a small percentage of the available pore volume, the saturation state and fluid pore pressure of this component are the variables of significance. These issues cannot be addressed by a fully saturated model. Instead it is necessary to include these findings in a multi-phase model that includes the salt column. This is the topic of Section 8.4.

The results of the fully saturated model will over-predict the flow rates through the sealed shaft. This analysis does not take credit for the time required for the system to resaturate, nor does it take credit for the sorptive capabilities of the clay components. The principal source of groundwater to the system is the Rustler Formation. The upper clay component is located below the Rustler and above the salt column and will be emplaced at a liquid saturation state of approximately 80%. Bentonite clays exhibit strong hydrophilic characteristics, and it is expected that the upper clay component will have these same characteristics. As a result, it is possible that a significant amount of the minimal Rustler groundwater that reaches the clay column will be absorbed and retained by this seal component. Although this effect is not directly included in the present analysis, the installation of a partially saturated clay component provides assurance that the flow rates predicted by the model are maximum values.

8.4 Gas Migration and Consolidation of Compacted Salt Column

The seal system is designed to limit the flow of gas from the disposal system through the sealed shafts. Migration of gas could impact performance if this migration substantially increases the fluid pore pressure of the compacted salt column. The initial pore pressure of the salt column will be approximately atmospheric. The sealed system will interact with the adjacent desaturated host rock as well as the far-field formation. Natural pressurization will occur as the system returns to an equilibrium state. This pressurization, coupled with seepage of brine through the marker beds, will also result in increasing fluid pore pressure within the compacted salt column. The analysis presented in this section addresses the issue of fluid pore pressure in the compacted salt column resulting from the effects of gas generation at the repository horizon and natural repressurization from the surrounding formation. A brief discussion on the impedance to gas flow afforded by the lower compacted clay column is also presented.

8.4.1 Analysis Method

A multi-phase flow model of the lower seal system was developed to evaluate the performance of components extending from the middle SMC component to the repository horizon. Rock mechanics calculations presented in Section 7 and Appendix D of Appendix I2 in the permit application predict that the compacted salt column will consolidate for a period of approximately 400 years if the fluid-filled pores of the column do not produce a backstress. Within the physical setting of the compacted salt column, three processes have been identified which may result in a significant increase in pore pressure: groundwater flow from the Rustler Formation, gas migration from the repository, and natural fluid flow and repressurization from the Salado Formation. The first two processes were incorporated into the model as initial and boundary conditions, respectively. The third process was captured in all simulations through modeling of the lithologies surrounding the shaft. Simulations were conducted for 200 years following closure to evaluate any effects these processes might have on the salt column during this initial period.

As discussed in Section 8.3.1, the host rock DRZ is an important consideration in seal system performance. A vertically continuous DRZ could exist in both the Rustler and Salado Formations. Concrete-asphalt waterstops are included in the design to add assurance that a DRZ will not adversely impact seal performance. The significance of a continuous DRZ and waterstops will be evaluated based on results of the performance model.

A detailed description of the model grid, assumptions, and parameters is presented in Appendix C of Appendix I2 in the permit application.

8.4.2 Summary of Results

The consolidation process is a function of both time and depth. The resultant permeability of the compacted salt column will similarly vary. To simplify the evaluation, an effective permeability of the salt component was calculated. This permeability is calculated by analogy to electrical circuit theory. The permeability of each model layer is equated to a resistor in a series of resistors. The equivalent resistance (i.e., permeability) of a homogeneous column of identical length is derived in this manner. Figure I2-11 illustrates this process.

Results of the performance model simulations are summarized in Table I2-12. The effective permeabilities were calculated by the model assuming that, as the salt consolidated, permeability was reduced pursuant to the best-fit line through the experimental data (Appendix I2-A, Figure I2A-7). From Table I2-12 it is clear that, for all simulated conditions, the salt column consolidates to very low values in 200 years. Differences in the effective permeability because of increased repository gas pressure and a vertically continuous DRZ were negligible. The DRZ around concrete components is predicted to heal (Appendix D of Appendix I2 in the permit application) within 25 years. If the asphalt waterstops do not function as intended, the DRZ in this region will still heal in 25 years, as compared to 2 years for effective waterstops. The effective permeability of the compacted salt column increases by about a factor of two for this condition. However, the resultant permeability is sufficiently low that the compacted salt columns will comprise permanent effective seals within the WIPP shafts.

Table I2-12. Summary of Results from Performance Model

Repository Pressure	Rustler Flow (m^3)	Continuous DRZ (Yes/No)	Concrete-Asphalt Waterstop Healing Time (Years)	Effective Permeability at 200 Years (m^2)
7 MPa in 100 Years	0	No	2	3.3×10^{-20}
14 MPa in 200 Years	0	No	2	3.3×10^{-20}
7 MPa in 100 Years	2.7	Yes	2	3.4×10^{-20}
7 MPa in 100 Years	17.2	Yes	25	6.0×10^{-20}

The relationship between the fractional density (i.e., consolidation state) of the compacted salt column and permeability is uncertain, as discussed in Appendix I2-A. Lines drawn through the experimental data (Figure A-7) provide a means to quantify this uncertainty but do not capture the actual physical process of consolidation. As observed through microscopy, consolidation is dominated by pressure solution and redeposition, a mechanism of mass movement facilitated by the presence of moisture on grain boundaries (Hansen and Ahrens, 1996). As this process continues, the connected porosity and hence permeability of the composite mass will reduce at a rate that has not been characterized by the data collected in WIPP experiments. The results of the multi-phase performance model presented in Table I2-12 used a best-fit line through the data. Additional simulations were conducted using a line that represents a 95% certainty that the permeability is less than or equal to values taken from this line. Model simulations that used the 95% line are not considered representative of the consolidation process. However, these results provide an estimation of the significance that this uncertainty may have on the seal system performance.

Figure I2-12 depicts the effective permeability of the salt column as a function of time using the 95% line. The consolidation process, and hence permeability reduction, essentially stopped at 75 years for this simulation. Although the model predicts that the fractional density at the base of the salt column will reach approximately 97% of the density of intact halite, the permeability remains several orders of magnitude higher than that of the surrounding host rock. As a result, repressurization occurs rapidly throughout the vertical extent of the compacted salt column, and consolidation ceases. Laboratory experiments have shown that permeability to brine should decrease to levels of 10^{-18} to 10^{-20} m^2 at the fractional densities predicted by the performance model. The transport of brine within the consolidating salt will reduce the permeability even further (Brodsky et al., 1995). The predicted permeability of 10^{-16} m^2 is still sufficiently low that brine migration would be limited (DOE, 1995). However, the results of this analysis are more valuable in terms of demonstrating the coupled nature of the mechanical and hydrological behavior of consolidating crushed salt.

A final consideration within this performance model relates to the lower compacted clay column. This clay column is included in the design to provide a barrier to both gas and brine migration from the repository horizon. The ability of the clay to prevent gas migration will depend upon its liquid saturation state (Section 5 and Appendix I2-A). The lower clay component has an initial liquid saturation of about 80%, and portions of the column achieve brine saturations of nearly 100% during the 200 year simulation period. If the clay component performs as designed, gas migration through this component should be minimal. An examination of the model gas saturations indicates that, for all runs, gas flow occurs primarily through the DRZ prior to healing. These model predictions are consistent with field demonstrations that brine-saturated bentonite seals will prevent gas flow at differential pressures of up to 4 MPa (Knowles and Howard, 1996).

8.5 Upward Migration of Brine

The performance model discussed in Section 8.3 was modified to simulate undisturbed equilibrium pressures. As discussed in Appendix C of Appendix I2 in the permit application, the Salado Formation is overpressurized with respect to the measured heads in the Rustler, and upward migration of contaminated brines could occur through an inadequately sealed shaft. Sections 8.3 and 8.4 demonstrated that the compacted salt column will consolidate to a low permeability following repository closure. Appendix D of Appendix I2 in the permit application and Section 7 show that the DRZ surrounding the long-term clay and crushed salt seal components will completely heal within the first several decades. As a result, upward migration at the base of the Salado salt is predicted to be approximately 1 m^3 over the regulatory period. At the Rustler/Salado contact, a total of approximately 20 m^3 migrates through the sealed AIS over the regulatory period. The only brine sources between these two depths are the marker beds. It can therefore be concluded that most of the brine flow reaching the Rustler/Salado contact originates in marker beds above the repository horizon. The seal system effectively limits the flow of brine and gas from the repository through the sealed shafts throughout the regulatory period.

8.6 Intra-Rustler Flow

The potential exists for vertical flow within water-bearing strata of the Rustler Formation. Flow rates were estimated using a closed form solution of the steady-state saturated flow equation (Darcy's Law). The significance of the calculated flow rates can be assessed in terms of the width of the hydraulic disturbance (i.e., plume half-width) generated in the recipient flow field. The plume half-width was calculated to be minimal for all expected conditions (Section C7). Intra-Rustler flow is therefore concluded to be of such a limited quantity that (1) it will not affect either the hydraulic or chemical regime in the Rustler and (2) it will not be detrimental to the seal system.

9. Conclusions

The principal conclusion drawn from discussions in the previous sections and details provided in the appendices is that an effective, implementable design has been documented for the WIPP shaft sealing system. Specifically, the six elements of the Design Guidance, Table I2-12, are implemented in the design in the following manner:

1. The shaft sealing system shall limit the migration of radiological or other hazardous constituents from the repository horizon to the regulatory boundary during the 10,000-year regulatory period following closure.

Based on the analysis presented in Section 8.5, it was determined that this shaft sealing system effectively limits the migration of radiological or other hazardous constituents from the repository horizon to the regulatory boundary during the 10,000-year regulatory period following closure.

2. The shaft sealing system shall limit groundwater flowing into and through the shaft sealing system.

The combination of the seal components in the Salado Formation, the Rustler Formation, and above the Rustler combine to produce a robust system. Based on analysis presented in Section 8.3, it was concluded that the magnitude of brine flow that can reach the repository through the sealed shaft is minimal and will not impact repository performance.

3. The shaft sealing system shall limit chemical and mechanical incompatibility of seal materials with the seal environment.

The sealing system components are constructed of materials possessing high durability and compatibility with the host rock. Engineered materials including salt-saturated concrete, bentonite, clays, and asphalt are expected to retain their design properties over the regulatory period.

4. The shaft sealing system shall limit the possibility for structural failure of individual components of the sealing system.

Analysis of components has determined that: (a) the structural integrity of concrete components will not be compromised by induced radial stress, imposed vertical stress, temperature gradients, dynamic compaction of overlying materials, or swelling pressure associated with bentonite (Section 7.4.1); (b) the thermal impact of asphalt on the creep rate of the salt surrounding the asphalt waterstops is negligible (Section 7.4.4); and (c) the pressure from the asphalt element of the concrete-asphalt waterstops is sufficient to initiate healing of the surrounding DRZ within two years of emplacement (Section 7.6.1). The potential for structural failure of sealing components is minimized by the favorable compressive stress state that will exist in the sealed WIPP shafts.

5. The shaft sealing system shall limit subsidence of the ground surface in the vicinity of the shafts and the possibility of accidental entry after sealing.

The use of high density sealing materials that completely fill the shafts eliminates the potential for shaft wall collapse, eliminates the possibility of accidental entry after closure, and assures that local surface depressions will not occur at shaft locations.

6. The shaft sealing system shall limit the need to develop new technologies or materials for construction of the shaft sealing system.

The shaft sealing system utilizes existing construction technologies (identified in Section 6) and materials (identified in Section 5).

The design guidance can be summarized as focusing on two principal questions: Can you build it, and will it work? The use or adaptation of existing technologies for the placement of the seal components combined with the use of available, common materials assure that the design can be constructed. Performance of the sealing system has been demonstrated in the hydrologic analyses that show very limited flows of gas or brine, in structural analyses that assure acceptable stress and deformation conditions, and in the use of low permeability materials that will function well in the environment in which they are placed. Confidence in these conclusions is bolstered by the basic design approach of using multiple components to perform each intended sealing function and by using extensive lengths within the shafts to effect a sealing system. Additional confidence is added by the results of field and lab tests in the WIPP environment that support the data base for the seal materials.

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FIGURES

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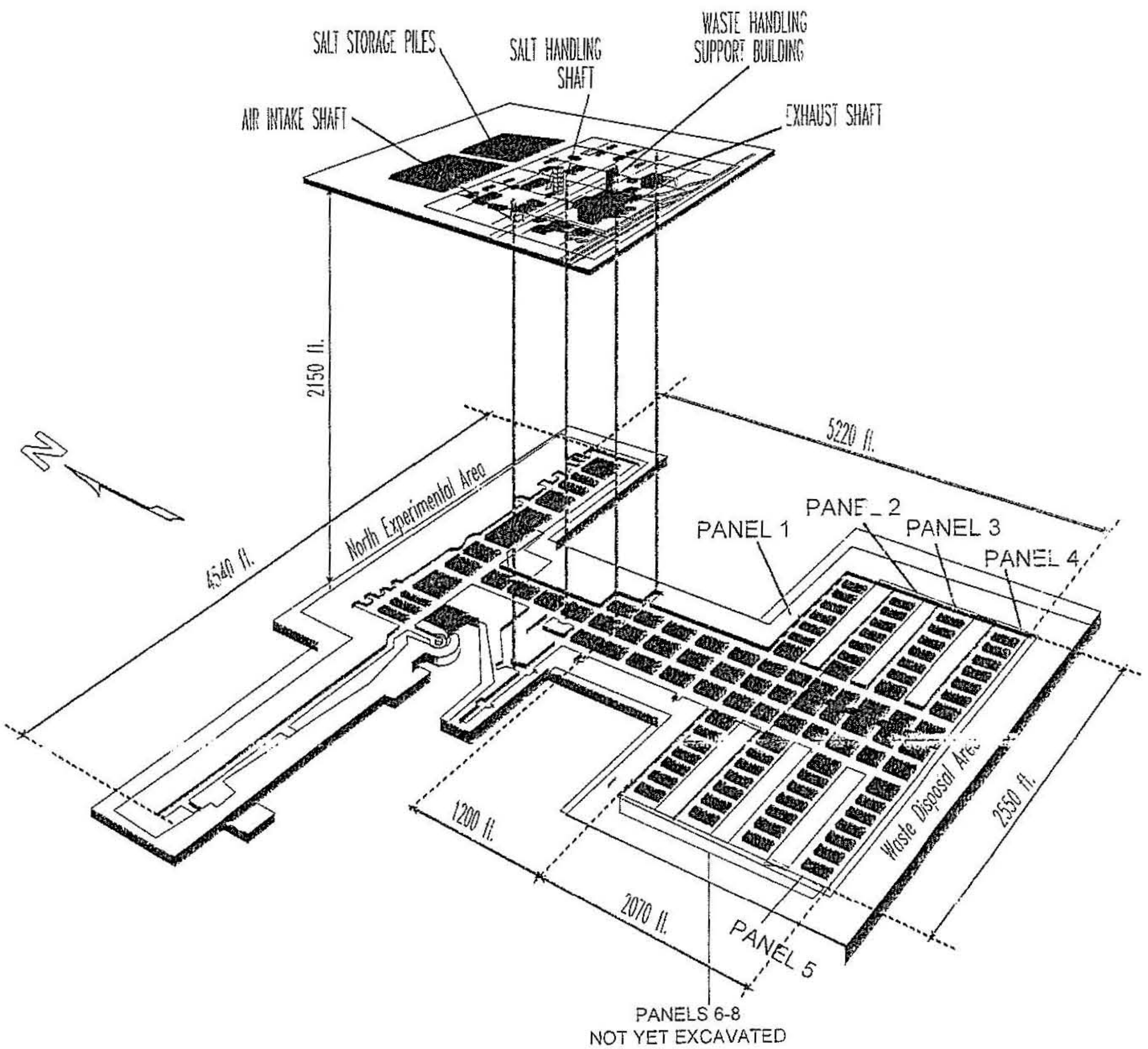
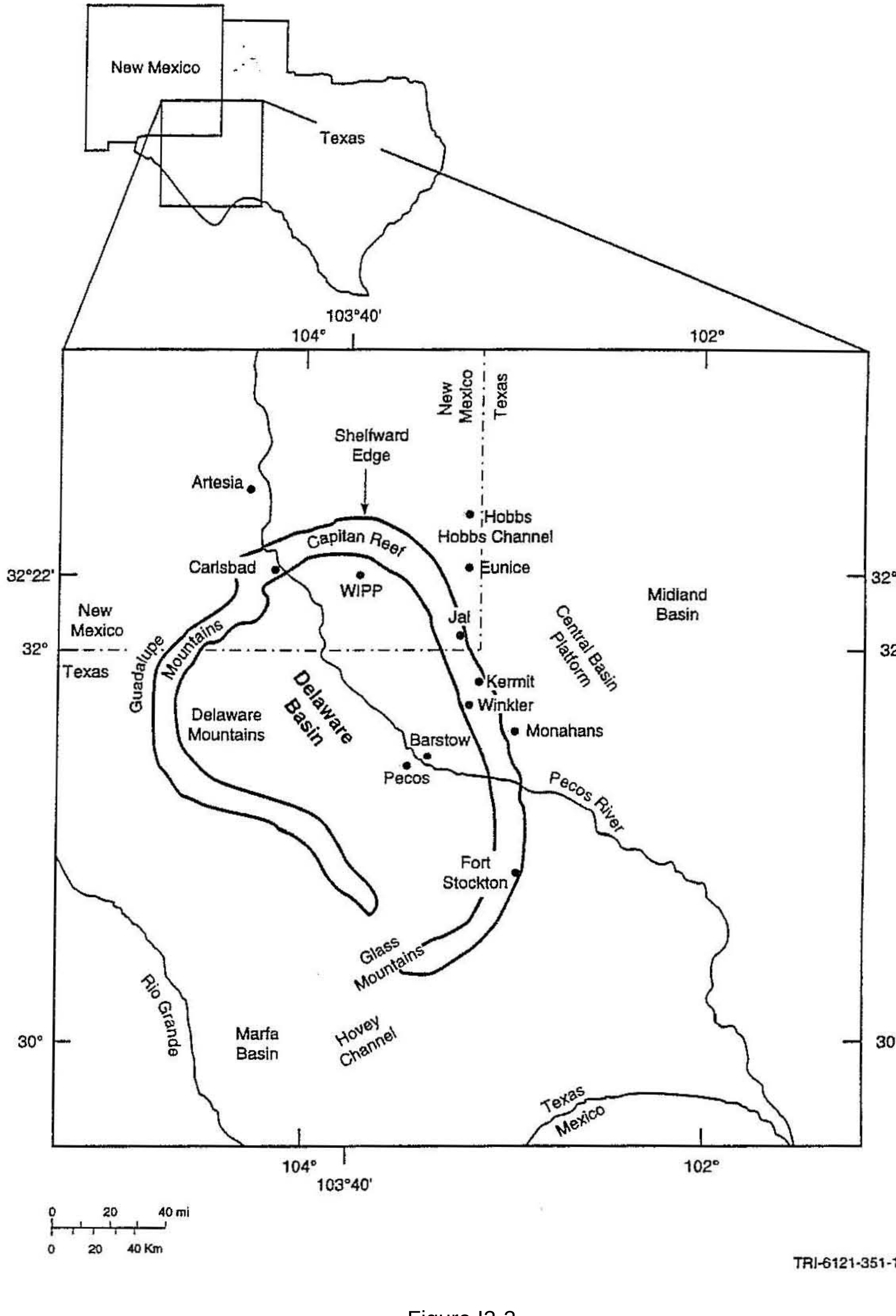


Figure I2-1
View of the WIPP underground facility



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2 Figure I2-2
3 Location of the WIPP in the Delaware Basin

Erathem	System	Series	Lithostratigraphic Unit	Age Estimate (yr)
Cenozoic	Quaternary	Holocene	Windblown sand	
		Pleistocene	Mescalero caliche	~500,000
			Gatuña Formation	~600,000
	Tertiary	Pliocene		
			Ogallala Formation	5.5 million
		Miocene		
				24 million
		Oligocene	Absent in southeastern	
		Eocene	New Mexico	
		Paleocene		
				66 million
Mesozoic	Cretaceous	Upper	Absent in southeastern New Mexico	
		Lower	Detritus preserved	
				144 million
	Jurassic		Absent in southeastern New Mexico	
				208 million
	Triassic	Upper	Dockum Group	
		Lower	Absent in southeastern New Mexico	
				245 million
Paleozoic	Permian (Upper)	Ochoan	Dewey Lake Redbeds	
			Rustler Formation	
			Salado Formation	
			Castile Formation	
		Guadalupian	Capitan Limestone and Bell Canyon Formation	
	Permian (Lower)	Leonardian	Bone Springs	
		Wolfcampian	Wolfcamp (informal)	
				286 million

Modified from Bachman, 1987

Figure I2-3
Chart showing major stratigraphic divisions, southeastern New Mexico

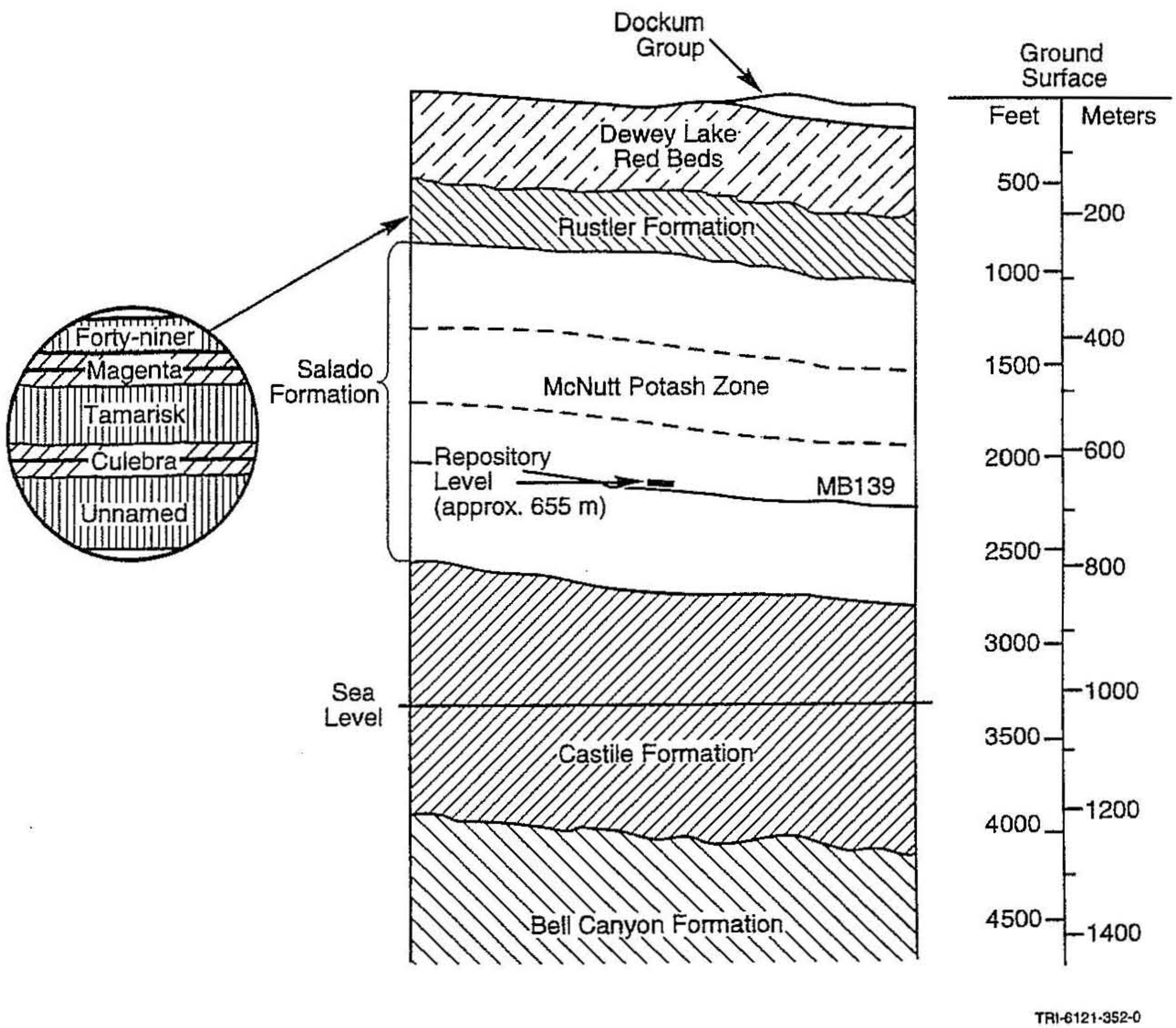

Figure I2-4
Generalized stratigraphy of the WIPP site showing repository level

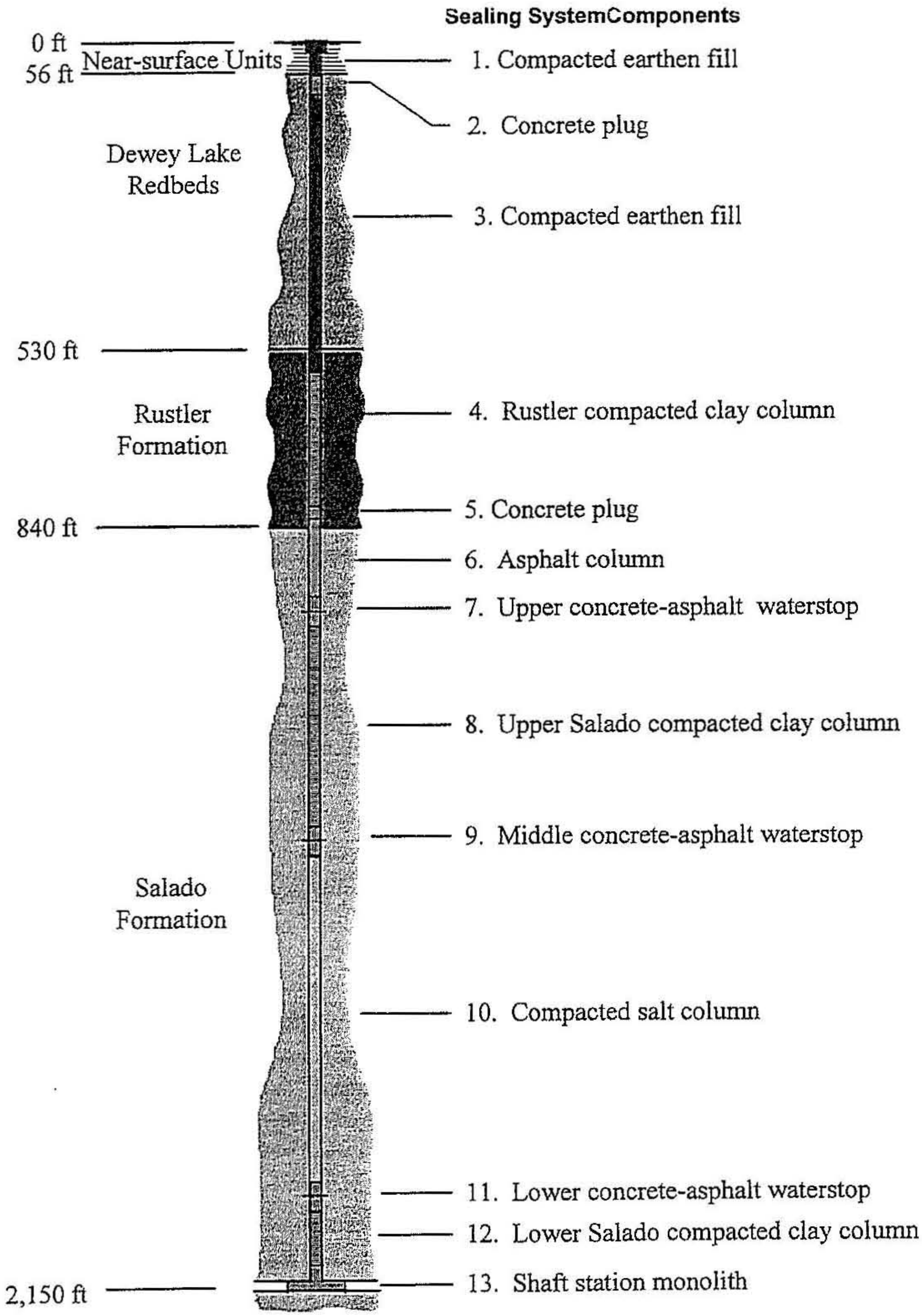

Figure I2-
Arrangement of the Air Intake Shaft sealing system

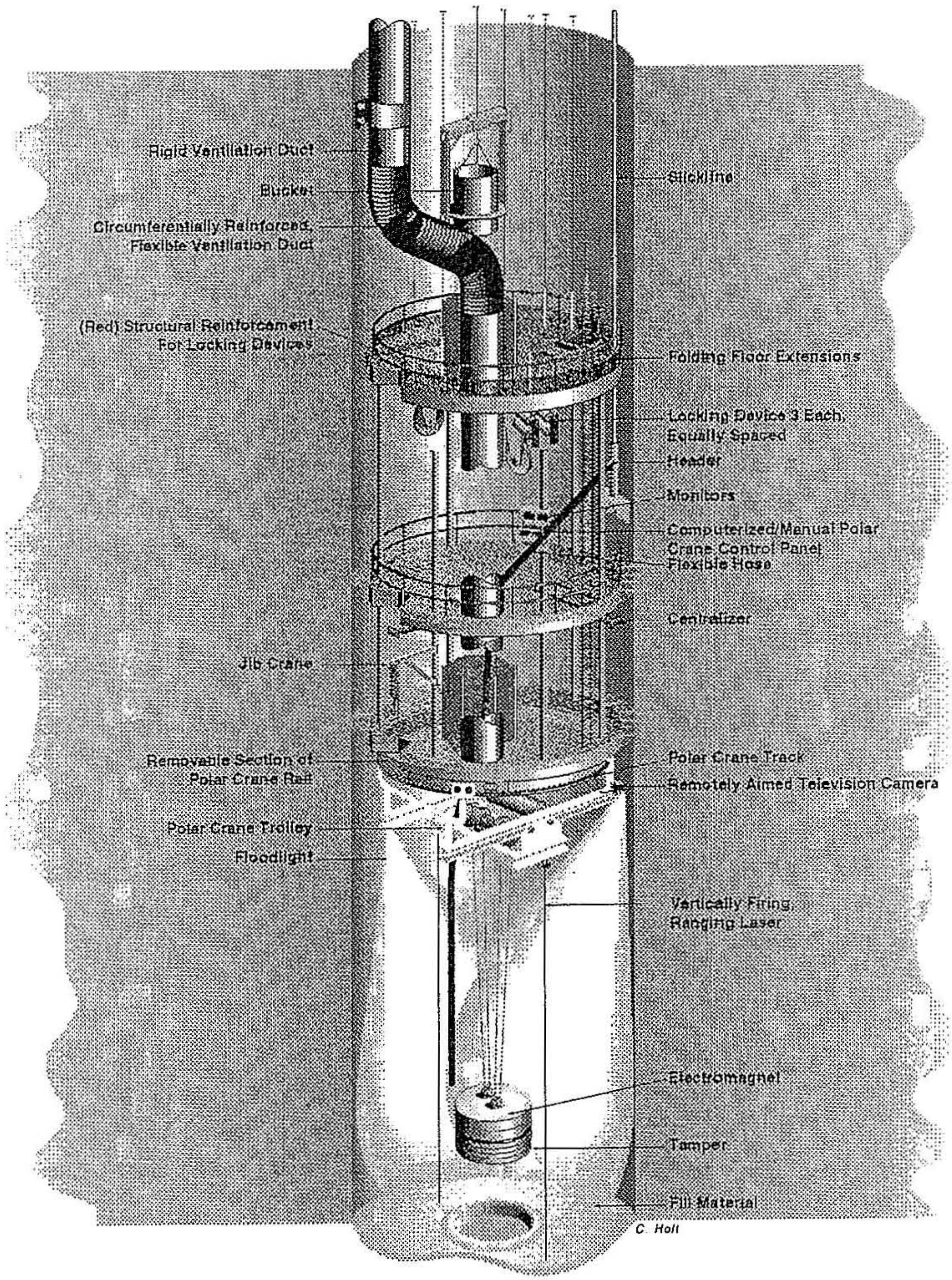

Figure I2-6
Multi-deck stage illustrating dynamic compaction

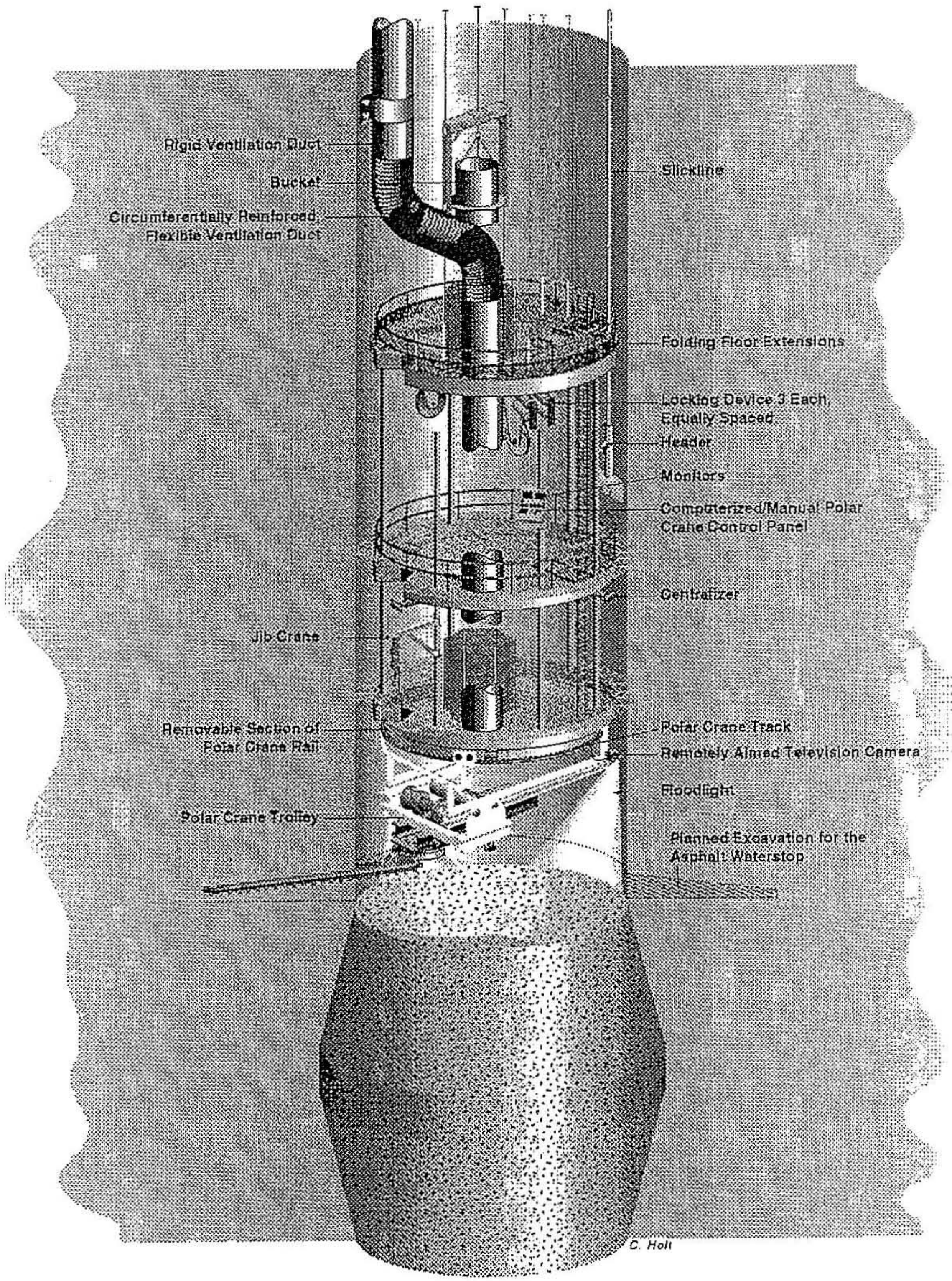

Figure I2-7
Multi-deck stage illustrating excavation for asphalt waterstop

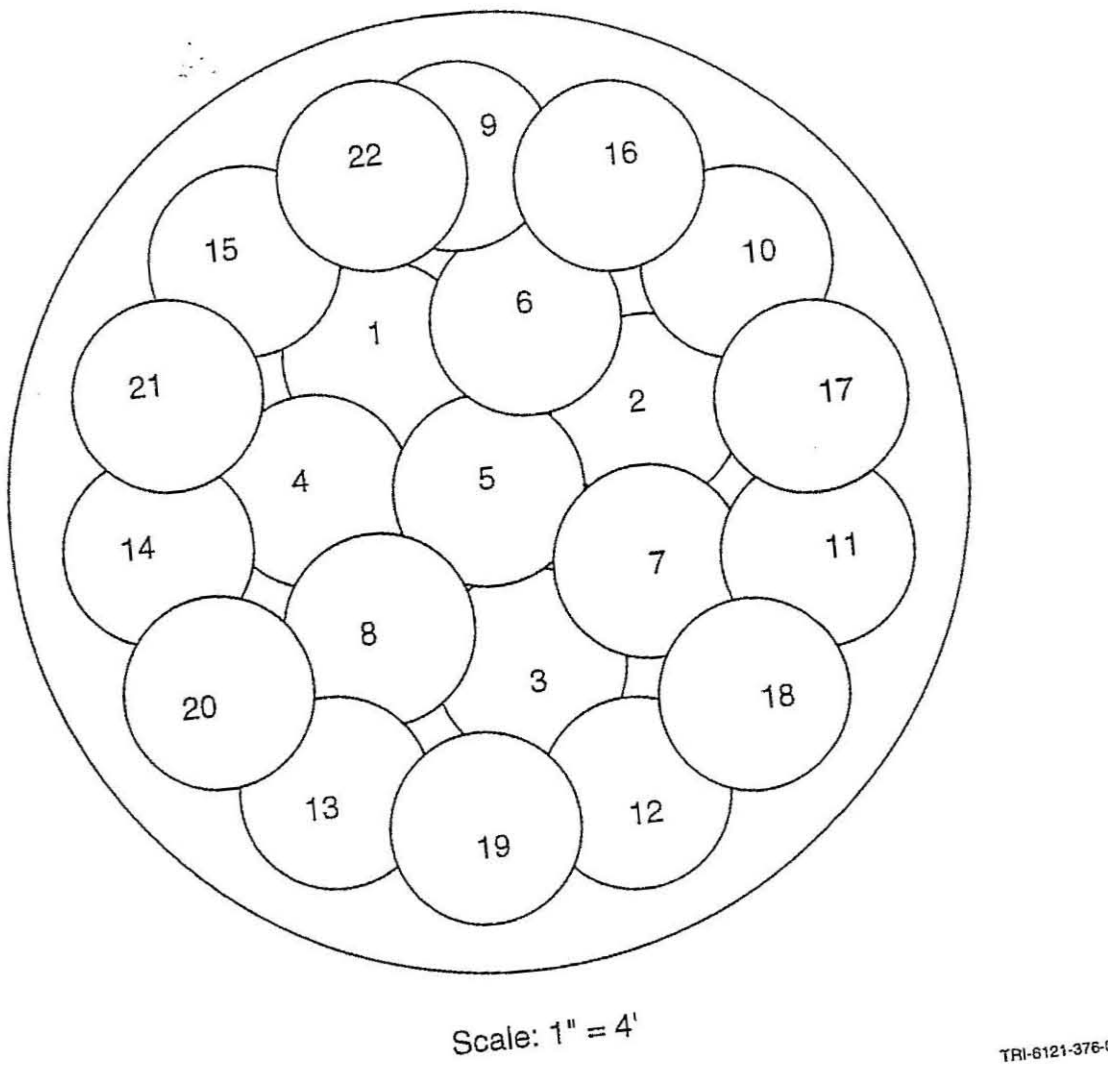

Figure I2-8
Drop pattern for 6-m-diameter shaft using a 1.2-m-diameter tamper

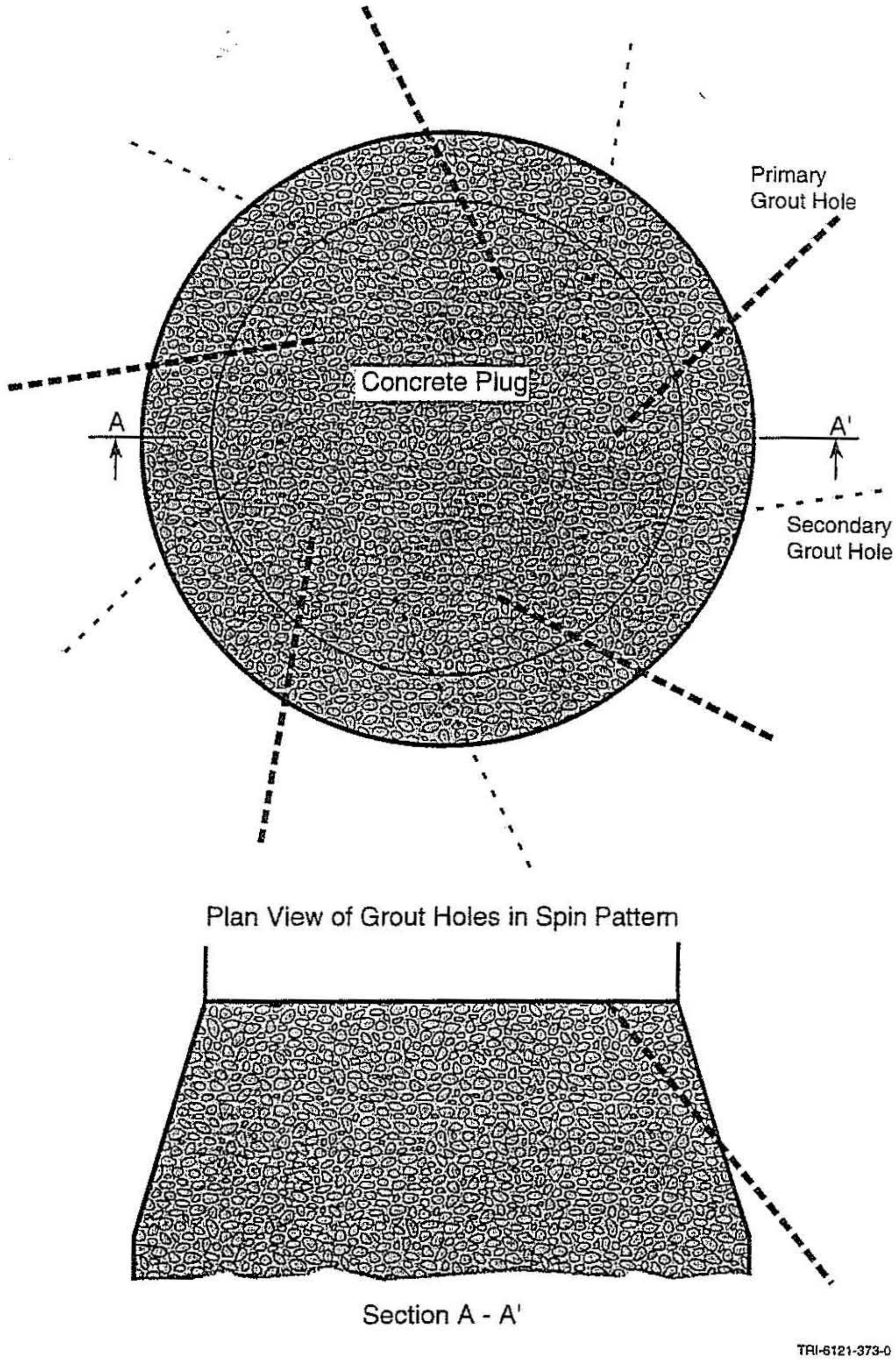

Figure I2-9
Plan and section views of downward spin pattern of grout holes

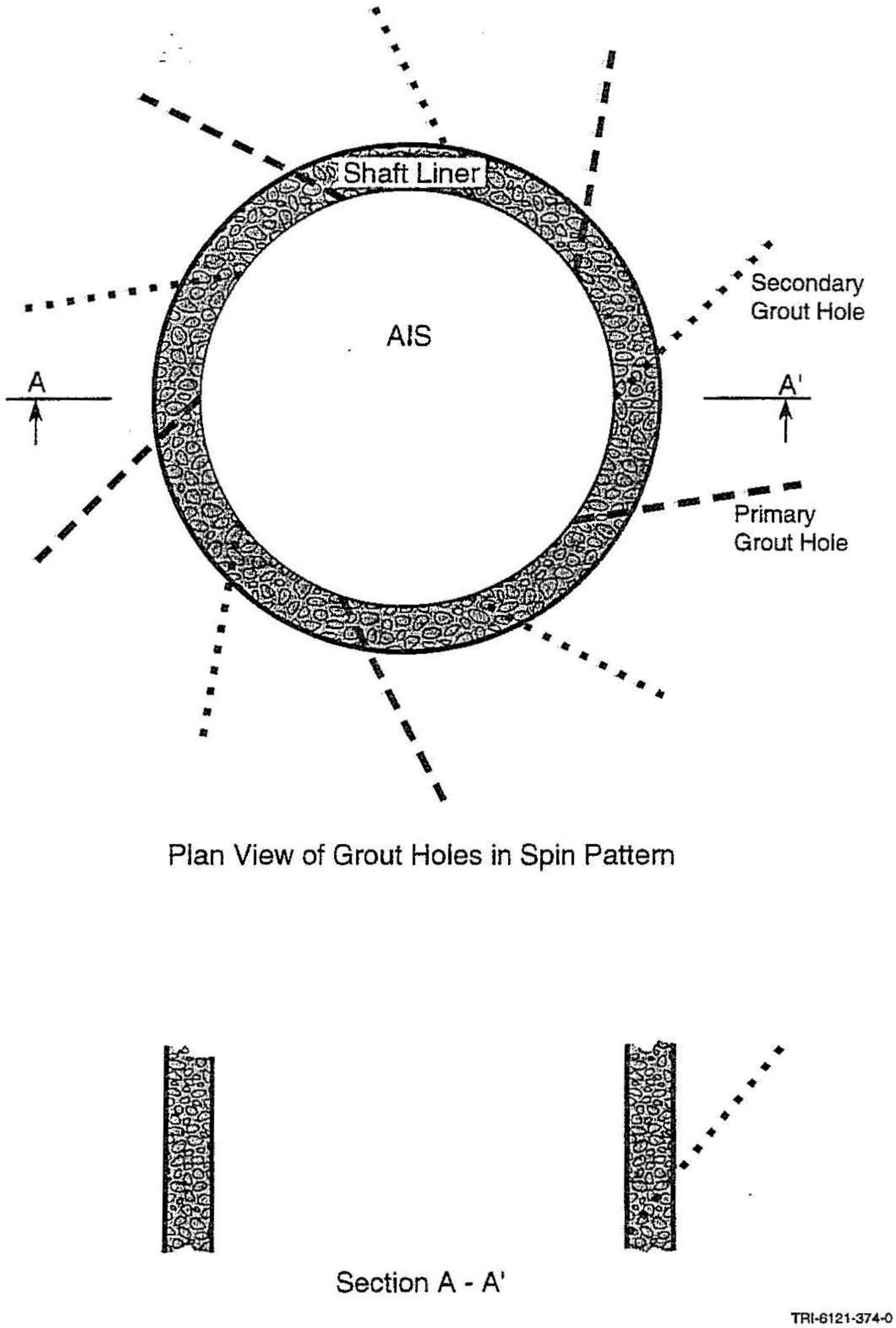

Figure I2-10
Plan and section views of upward spin pattern of grout holes

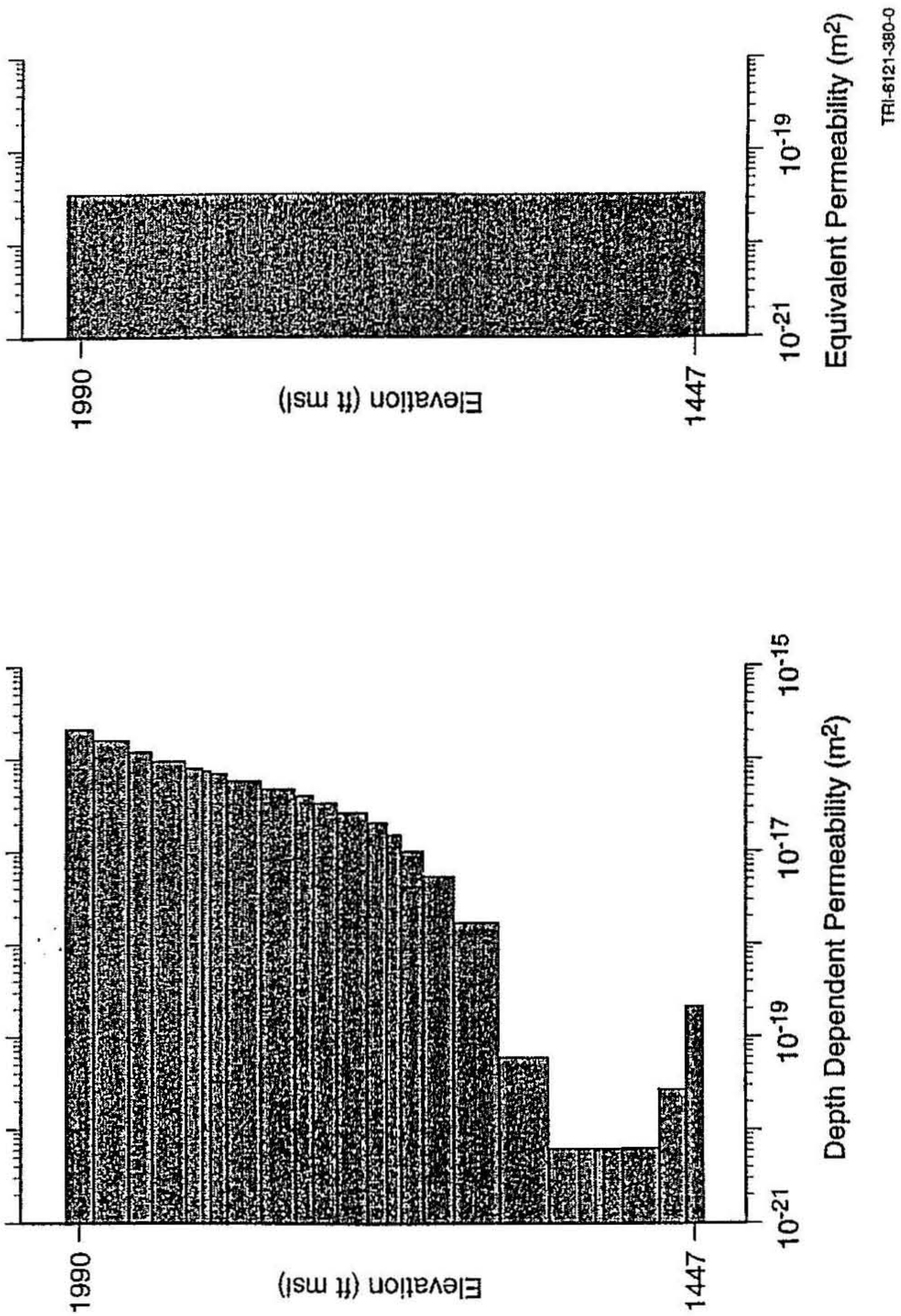

Figure I2-11
Example of calculation of an effective salt column permeability from the depth-dependent permeability at a point in time

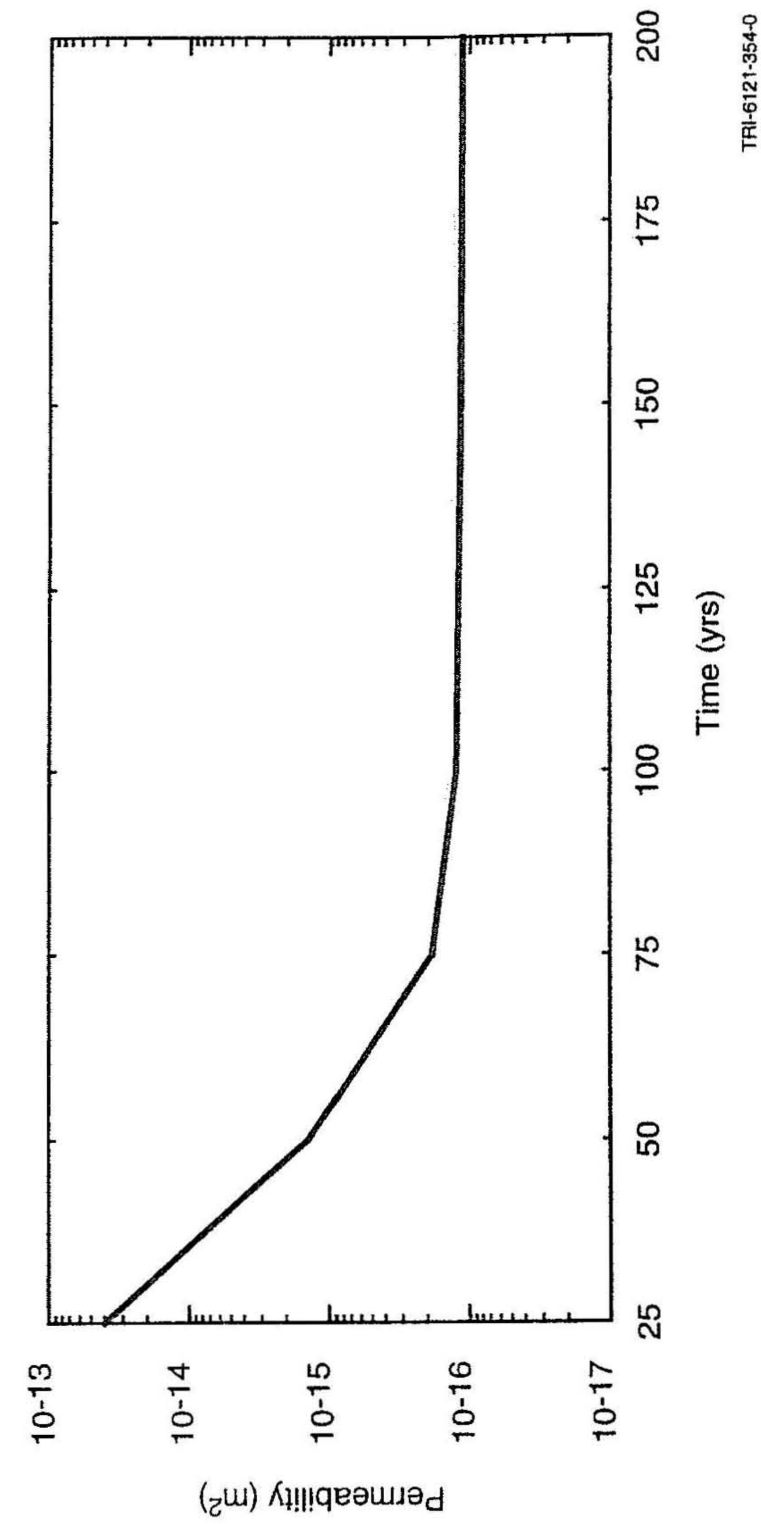

Figure I2-12
Effective permeability of the compacted salt column using the 95% certainty line

APPENDIX I2
APPENDIX A

MATERIAL SPECIFICATION

SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

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APPENDIX I2
APPENDIX A

MATERIAL SPECIFICATION

SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

Appendix A Abstract

This appendix specifies material characteristics for shaft seal system components designed for the Waste Isolation Pilot Plant. The shaft seal system will not be constructed for decades; however, if it were to be constructed in the near term, materials specified here could be placed in the shaft and meet performance specifications. A material specification is necessary today to establish a frame of reference for design and analysis activities and to provide a basis for seal material parameters. This document was used by three integrated working groups: (1) the architect/engineer for development of construction methods and supporting infrastructure, (2) fluid flow and structural analysis personnel for evaluation of seal system adequacy, and (3) technical staff to develop probability distribution functions for use in performance assessment. The architect/engineers provide design drawings, construction methods and schedules as appendices to the final shaft seal system design report, called the *Compliance Submittal Design Report* (Permit Attachment I2). Similarly, analyses of structural aspects of the design and fluid flow calculations comprise other appendices to the final design report (not included in this Permit Attachment). These products together are produced to demonstrate the adequacy of the shaft seal system to independent reviewers, regulators, and stakeholders. It is recognized that actual placement of shaft seals is many years in the future, so design, planned construction method, and components will almost certainly change between now and the time that detailed construction specifications are prepared for the bidding process. Specifications provided here are likely to guide future work between now and the time of construction, perhaps benefiting from optimization studies, technological advancements, or experimental demonstrations.

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CONTENTS

Figures

Tables

A1. Introduction

This appendix provides a body of technical information for each of the WIPP shaft seal system materials identified in the text of the *Compliance Submittal Design Report* (Permit Attachment I2). This material specification characterizes each seal material, establishes why it will function adequately, states briefly how each component will be placed, and quantifies expected characteristics, particularly permeability, pertinent to a WIPP-specific shaft seal design. Each material is first described from an engineering viewpoint, then appropriate properties are summarized in tables and figures which emphasize permeability parameter distribution functions used in performance calculations. Materials are discussed beyond limits normally found in conventional construction specifications. Descriptive elements focus on stringent shaft seal system requirements that are vital to regulatory compliance demonstration. Information normally contained in an engineering *performance specification* is included because more than one construction method, or even a completely different material, may function adequately. Content that would eventually be included contractually in *specifications for materials* or *specifications for workmanship* are not included in detail. The goal of these specifications is to substantiate why materials used in this seal system design will limit fluid flow and thereby adequately limit releases of hazardous constituents from the WIPP site at the point of compliance defined in Permit Module V and limit releases of radionuclides at the regulatory boundary.

Figure I2A-1 is a schematic drawing of the proposed WIPP shaft sealing system. Design detail and other characteristics of the geologic, hydrologic and chemical setting are provided in the main body of Permit Attachment I2, other appendices, and references. The four shafts will be entirely filled with dense materials possessing low permeability and other desirable engineering and economic attributes. Seal materials include concrete, clay, asphalt, and compacted salt. Other construction and fill materials include cementitious grout and earthen fill. The level of detail included for each material, and the emphasis of detail, vary among the materials. Concrete, clay, and asphalt are common construction materials used extensively in hydrologic applications. Their descriptions will be rather complete, and performance expectations will be drawn from the literature and site-specific references. Portland cement concrete is the most common structural material being proposed for the WIPP shaft seal system and its use has a long history. Considerable specific detail is provided for concrete because it is salt-saturated. Clay is used extensively in the seal system. Clay is often specified in industry as a construction material, and bentonitic clay has been widely specified as a low permeability liner for hazardous waste sites. Therefore, a considerable body of information is available for clay materials, particularly bentonite. Asphalt is a widely used paving and waterproofing material, so its specification here reflects industry practice. It has been used to seal shaft linings as a filler between the concrete and the surrounding rock, but has not been used as a full shaft seal component. Compaction and natural reconsolidation of crushed salt are uniquely applied here. Therefore, the crushed salt specification provides additional information on its constitutive behavior and sealing performance. Cementitious grout is also specified in some detail because it has been developed and tested for WIPP-specific applications and similar international waste programs. Earthen fill will be given only cursory specifications here because it has little impact on the shaft seal performance and placement to nominal standards is easily attained.

Discussion of each material is divided into sections, which are described in the annotated bullets below:

Functions

A general summary of functions of specific seal components is presented. Each seal component must function within a natural setting, so design considerations embrace naturally occurring characteristics of the surrounding rock.

Material Characteristics

Constitution of the seal material is described and key physical, chemical, mechanical, hydrological, and thermal features are discussed.

Construction

A brief mention is made regarding construction, which is more thoroughly treated in Appendix B of the *Compliance Submittal Design Report* (Permit Attachment I2, Appendix B). Construction, as discussed in this section, is primarily concerned with proper placement of materials. A viable construction procedure that will attain placement specifications is identified, but such a specification does not preclude other potential methods from use when the seal system is eventually constructed.

Performance Requirements

Regulations to which the WIPP must comply do not provide quantitative specifications applicable to seal design. Performance of the WIPP repository is judged against performance standards for miscellaneous units specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.601) for releases of hazardous constituents at the point of compliance defined in Permit Module V. Performance is also judged against potential releases of radionuclides at the regulatory boundary, which is a probabilistic calculation. To this end, probability distribution functions for permeabilities (referred to as PDFs) of each material have been derived for performance assessment of the WIPP system and are included within this subsection on performance requirements.

Verification Methods

It must be assured that seal materials placed in the shaft meet specifications. Both design and selection of materials reflect this principal concern. Assurance is provided by quality control procedures, quality assurance protocol, real-time testing, demonstrations of technology before construction, and personnel training. Materials and construction procedures are kept relatively simple, which creates robustness within the overall system. In addition, elements of the seal system often are extensive in length, and construction will require years to complete. If atypical placement of materials is detected, corrections can be implemented without impacting performance. These specifications limit in situ testing of seal material as it is constructed although, if it is later determined to be desirable, certain in situ tests can be amended in construction specifications. Invasive testing has the potential to compromise the material, add cost, and create logistic and safety problems. Conventional specifications are made for property testing and quality control.

References

These specifications draw on a wealth of information available for each material. Reference to literature values, existing data, anecdotal information, similar applications, laboratory and field testing, and other applicable supportive documentation is made.

A1.1 Sealing Strategy

The shaft seal system design is an integral part of compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264) and 40 CFR §191. The EPA has also promulgated 40 CFR §194, entitled "Criteria for the Certification and Re-certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191," to which this design and these specifications are responsive. Other seal design requirements, such as State of New Mexico regulations, apply to stratigraphy above the Salado.

Compliance of the site with 20.4.1.500 NMAC (incorporating 40 CFR §264) and 40 CFR §191 will be determined in part by the ability of the seal system to limit migration of hazardous constituents to the point of compliance defined in Permit Module V, and migration of radionuclides to the regulatory boundary. Both natural and engineered barriers may combine to form the isolation system, with the shaft seal system forming an engineered barrier in a natural setting. Seal system materials possess high durability and compatibility with the host rock. All materials used in the shaft seal system are expected to maintain their integrity for very long periods. The system contains functional redundancy and uses differing materials to reduce uncertainty in performance. Some sealing components are used to retard fluid flow soon after placement, while other components are designed to function well beyond the regulatory period. International programs engaged in research and demonstration of sealant technology provide significant information on longevity of materials similar to those proposed for this shaft seal system (Gray, 1993). When this information is applied to the setting and context of the WIPP, there is strong evidence that the materials specified will maintain their positive attributes for defensibly long periods.

A1.2 Longevity

Longevity of materials is considered within the site geologic and hydrologic setting as summarized in the main body of this report (Permit Attachment I2) and described in the Seal System Design Report (DOE, 1995). A major environmental advantage of the WIPP locality is an overall lack of groundwater to seal against. In terms of sealing the WIPP site, the stratigraphy can be conveniently divided into the Salado Formation and the superincumbent formations comprising primarily the Rustler Formation and the Dewey Lake Redbeds. The Salado Formation, composed mainly of evaporite sequences dominated by halite, is nearly impermeable.

Transmissivity of engineering importance in the Salado Formation is lateral along anhydrite interbeds, basal clays, and fractured zones near underground openings. Neither the Dewey Lake Redbeds nor the Rustler Formation contains regionally productive sources of water, although seepage near the surface in the Exhaust Shaft has been observed. Permeability of materials placed in the Salado below the contact with the Rustler, and their effects on the surrounding disturbed rock zone, are the primary engineering properties of concern. Even though very little regional water is present in the geologic setting, the seal system reflects great concern for groundwater's potential influence on materials comprising the shaft seal system.

Shaft seal materials have been selected in part because of their exceptional durability. However, it is recognized that brine chemistry *could* impact engineered materials if conditions permitted. Highly concentrated saline solutions can, under severe circumstances, affect performance of cementitious materials and clay. Concrete has been shown to degrade under certain conditions, and clays can be more transmissive to brine than to potable water. Asphalt and compacted salt are essentially chemically inert to brine. Although stable in naturally occurring seeps such as those in the Santa Barbara Channel (California), asphalt can degrade when subjected to ultraviolet light or through microbial activity. Brine would not chemically change the compacted salt column, but mechanical effects of pore pressure are of concern to reconsolidation. Mechanical influences of brine on the reconsolidating salt column are discussed in Sections 7 and 8 of the main report (Permit Attachment I2), which summarize Appendices D and C, respectively (Appendices C and D are not included in the Permit, but are contained in Appendix I2 of the permit application).

Because of limited volumes of brine, low hydraulic gradients, and low permeability materials, the geochemical setting will have little influence on shaft seal materials. Each material is durable, though the potential exists for degradation or alteration under extreme conditions. For example, the three major components of portland cement concrete, portlandite ($Ca\ (OH)_2$,) calcium-aluminate-hydrate (CAH) and calcium-silicate-hydrate (CSH), are not thermodynamically compatible with WIPP brines. If large quantities of high ionic strength brine were available and transport of mass was possible, degradation of cementitious phases would certainly occur. Such a localized phenomenon was observed on a construction joint in the liner of the Waste Handling Shaft at the WIPP site. Within the shaft seal system, however, the hydrologic setting does not support such a scenario. Locally brine will undoubtedly contact the surface of mass placements of concrete. A low hydrologic gradient will limit mass transport, although degradation of paste constituents is expected where brine contacts concrete.

Among longevity concerns, degradation of concrete is the most recognized. At this stage of the design, it is established that only small volumes of brine ever reach the concrete elements (see Section 8). Further analysis concerned with borehole plugging using cementitious materials shows that at least 100 pore volumes of brine in an open system would be needed to begin degradation processes. In a closed system, such as the hydrologic setting in the WIPP shafts, phase transformations create a degradation product of increased volume. Net volume increase owing to phase transformation in the absence of mass transport would decrease rather than increase permeability of concrete seal elements.

Mechanical and chemical stability of clays, in this case the emphasis is on bentonitic clay, is particularly favorable in the WIPP geochemical and hydrological environment. A compendium of recent work associated with the Stripa project in Sweden (Gray, 1993) provides field-scale testing results, supportive laboratory experimental data, and thermodynamic modeling that lead to a conclusion that negligible transformation of the bentonite structure will occur over the regulatory period of the WIPP. In fact, very little brine penetration into clay components is expected, based on intermediate-scale experiments at WIPP. Any wetting of bentonite will result in development of swelling pressure, a favorable situation that would accelerate return to a uniform stress state within the clay component.

Natural bentonite is a stable material that generally will not change significantly over a period of ten thousand years. Bentonitic clays have been widely used in field and laboratory experiments concerned with radioactive waste disposal. As noted by Gray (1993), three internal mechanisms, illitization, silicification and charge change, could affect sealing properties of bentonite. Illitization and silicification are thermally driven processes and, following discussion by Gray (1993), are not possible in the environment or time-frame of concern at the WIPP. The naturally occurring Wyoming bentonite which is the specified material for the WIPP shaft seal is well over a million years old. It is, therefore, highly unlikely that metamorphism of bentonite enters as a design concern.

Asphalt has existed for thousands of years as natural seeps. Longevity studies specific to DOE's Hanford site have utilized asphalt artifacts buried in ancient ceremonies to assess long-term stability (Wing and Gee, 1994). Asphalt used as a seal component deep in the shaft will inhabit a benign environment, devoid of ultraviolet light or an oxidizing atmosphere. Additional assurance against possible microbial degradation in asphalt elements is mitigated with addition of lime. For these reasons, it is thought that design characteristics of asphalt components will endure well beyond the regulatory period.

Materials being used to form the shaft seals are the same as those being suggested in the scientific and engineering literature as appropriate for sealing deep geologic repositories for radioactive wastes. This fact was noted during independent technical review. Durability or longevity of seal components is a primary concern for any long-term isolation system. Issues of possible degradation have been studied throughout the international community and within waste isolation programs in the USA. Specific degradation studies are not detailed in this document because longevity is one of the over-riding attributes of the materials selected and degradation is not perceived to be likely. However, it is acknowledged here that microbial degradation, seal material interaction, mineral transformation, such as silicification of bentonite, and effects of a thermal pulse from asphalt or hydrating concrete remain areas of continued study.

A2. Material Specifications

The WIPP shaft seal system plays an important role in meeting regulatory requirements such as 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR 191. A combination of available, durable materials which can be emplaced with low permeability is proposed as the seal system. Components include mass concrete, asphalt waterstops sandwiched between concrete plugs, a column of asphalt, long columns of compacted clay, and a column of compacted crushed WIPP salt. The design is based on common materials and construction technologies that could be implemented using today's technology. In choosing materials, emphasis was given to permeability characteristics and mechanical properties. The function, constitution, construction, performance, and verification of each material are given in the following sections.

A2.1 Mass Concrete

Concrete has exceptionally low permeability and is widely used for hydraulic applications such as water storage tanks, water and sewer systems, and massive dams. Salt-saturated concrete has been used successfully as a seal material in potash and salt mining applications. Upon hydration, unfractured concrete is nearly impermeable, having a permeability less than 10^{-20} m^2. In addition, concrete is a primary structural material used for compression members in countless applications. Use of concrete as a shaft seal component takes advantage of its many attributes and the extensive documentation of its use.

This specification for mass concrete will discuss a special design mixture of a salt-saturated concrete called Salado Mass Concrete or SMC (Wakeley et al., 1995). Performance of SMC and similar salt-saturated mixtures is established and will be completely adequate for concrete applications within the WIPP shafts. Because concrete is such a widely used material, it has been written into specifications many times. Therefore, the specification for SMC contains recognized standard practices, established test methods, quality controls, and other details that are not available at a similar level for other seal materials. Use of salt-saturated concrete, especially SMC, is backed by extensive laboratory and field studies that establish performance characteristics far exceeding requirements of the WIPP shaft seal system.

A2.1.1 Functions

The function of the concrete is to provide a durable component with small void volume, adequate structural compressive strength, and low permeability. Concrete components appear within the shaft seal system at the very bottom, the very top, and several locations in between where they provide a massive plug that fills the opening and a tight interface between the plug and host rock. In addition, concrete is a rigid material that will support overlying seal components while promoting natural healing processes within the salt disturbed rock zone (the DRZ is discussed further in Appendix D of Appendix I2 in the permit application, which is not included in the Permit).

Concrete is one of the redundant components that protects the reconsolidating salt column. Since the salt column will achieve low permeabilities in fewer than 100 years (see Section 2.4.4 of this specification), concrete would no longer be needed after that time. For purposes of performance assessment calculations, a change in concrete permeability to degraded values is "allowed" to occur. However, concrete within the Salado Formation is likely to endure throughout the regulatory period with sustained engineering properties.

All concrete sealing elements, with the exception of a possible concrete cap, are unreinforced. In conventional civil engineering design, reinforcement is used to resist tensile stresses since concrete is weak in tension and reinforcement bar (rebar) balances tensile stresses in the steel with compressive stresses in concrete. However, concrete has exceptional compressive strength, and all the states of stress within the shaft will be dominated by compressive stress. Mass concrete, by definition, is related to any volume of concrete where heat of hydration is a design concern. SMC is tailored to minimize heat of hydration and overall differential temperature. An analysis of hydration heat distribution is included in Appendix D of Appendix I2 in the permit application. Boundary conditions are favorable for reducing any possible thermally induced tensile cracking during the hydration process.

A2.1.2 Material Characteristics

Salt-saturated concrete contains sufficient salt as an aggregate to saturate hydration water with respect to NaCl. Salt-saturated concrete is required for all uses within the Salado Formation because fresh water concrete would dissolve part of the host rock. Dissolution would cause a poor bond and perhaps a more porous interface, at least initially.

Dry materials for SMC include cementitious materials, fine and coarse aggregates, and sodium chloride. Concrete mixture proportions of materials for one cubic yard of concrete appear in Table A-1.

Table A-1. Concrete Mixture Proportions

Material	lb/yd^3
Portland cement	278
Class F fly ash	207
Expansive cement	134
Fine aggregate	1292
Coarse aggregate	1592
Sodium chloride	88
Water	225

kg/m^3 = (lb/yd^3) * (0.59). Water: Cement Ratio is weight of water divided by all cementitious materials.

Table A-2 is a summary of standard specifications for concrete materials. Further discussion of each specification is presented in subsequent text, where additional specifications pertinent to particular concrete components are also given.

Table A-2. Standard Specifications for Concrete Materials

Material	Applicable Standard Tests and Specifications	Comments
Class H oilwell cement	American Petroleum Institute Specification 10	Chemical composition determined according to ASTM C 114
Class F fly ash	ASTM C 618, Standard Specification for Fly Ash	Composition and properties determined according to ASTM C 311
Expansive cement	Similar to ASTM C 845	Composition determined according to ASTM C 114
Salt	ASTM E 534, Chemical Analysis of Sodium Chloride	Batched as dry ingredient, not as an admixture
Coarse and fine aggregates	ASTM C 33, Standard Specification for Concrete Aggregates; ASTM C 294 and C 295 also applied	Moisture content determined by ASTM C 566

Portland cement shall conform to American Petroleum Institute (API) Specification 10 Class G or Class H. Additional requirements for the cement are that the fineness as determined according to ASTM C 204 shall not exceed 300 m^2/kg, and the cement must meet the requirement in ASTM C 150 for moderate heat of hydration.

Fly Ash shall conform to ASTM C 618, Class F, with the additional requirement that the percentage of Ca cannot exceed 10 %.

Expansive cement for shrinkage-compensation shall have properties so that, when used with portland cement, the resulting blend is shrinkage compensating by the mechanism described in ASTM C 845 for Type K cement. Additional requirements for chemical composition of the shrinkage compensating cement appear in Table A-3.

Table A-3. Chemical Composition of Expansive Cement

Chemical composition	Weight %
Magnesium oxide, max	1.0
Calcium oxide, min	38.0
Sulfur trioxide, max	28.0
Aluminum trioxide (AL_2O_3), min	7.0
Silicon dioxide, min	7.0
Insoluble residue, max	1.0
Loss on ignition, max	12.0

Sodium Chloride shall be of a technical grade consisting of a minimum of 99.0 % sodium chloride as determined according to ASTM E 534, and shall have a maximum particle size of 600 µm.

Aggregate proportions are reported here on saturated surface-dry basis. Specific gravity of coarse and fine aggregates used in these proportions were 2.55 and 2.58, respectively. Absorptions used in calculations were 2.25 (coarse) and 0.63 (fine) % by mass. Concrete mixture proportions will be adjusted to accommodate variations in the materials selected, especially differences in specific gravity and absorptions of aggregates. Fine aggregate shall consist of natural silica sand. Coarse aggregate shall consist of gravel. The quantity of flat and elongated particles in the separate size groups of coarse aggregates, as determined by ASTM D 4791, using a value of 3 for width-thickness ratio and length-width ratio, shall not exceed 25 % in any size group. Moisture in the fine and coarse aggregate shall not exceed 0.1 % when determined in accordance with ASTM C 566. Aggregates shall meet the requirements listed in Table A-4.

A2.1.3 Construction

Construction techniques include surface preparation of mass concrete and slickline (a drop pipe from the surface) placement at depth within the shaft. A batching and mixing operation on the surface will produce a wet mixture having initial temperatures not exceeding 20°C. Placement uses a tremie line, where the fresh concrete exits the slickline below the surface level of the concrete being placed. This procedure will minimize entrained air. Placement requires no vibration and, except for the large concrete monolith at the base of each shaft, no form work. No special curing is required for the concrete because its natural environment ensures retention of humidity and excellent hydration conditions. It is desired that each concrete pour be continuous, with the complete volume of each component placed without construction joints. However, no perceivable reduction in performance is anticipated if, for any reason, concrete placement is interrupted. A free face or cold joint could allow lateral flow but would remain perpendicular to flow down the shaft. Further discussion of concrete construction is presented in Appendix B.

Table A-4. Requirements for Salado Mass Concrete Aggregates

Property	Fine Aggregate	Coarse Aggregate
Specific Gravity (ASTM C 127, ASTM C 128)	2.65, max	2.80, max
Absorption (ASTM C 127, ASTM C 128)	1.5 percent, max	3.5 percent, max
Clay Lumps and Friable Particles (ASTM C 142)	3.0 percent, max	3.0 percent, max
Material Finer than 75-μm (No. 200) Sieve (ASTM C 117)	3.0 percent, max	1.0 percent, max
Organic Impurities (ASTM C 40)	No. 3, max	N/A
L.A. Abrasion (ASTM C 131, ASTM C 535)	N/A	50 percent, max
Petrographic Examination (ASTM C 295)	Carbonate mineral aggregates shall not be used	Carbonate rock aggregates shall not be used
Coal and Lignite, less than 2.00 specific gravity (ASTM C 123)	0.5 percent, max	0.5 percent, max

A2.1.4 Performance Requirements

Specifications of concrete properties include characteristics in the green state as well as the hardened state. Properties of hydrated concrete include conventional mechanical properties and projections of permeabilities over hundreds of years, a topic discussed at the end of this section. Table A-5 summarizes target properties for SMC. Attainment of these characteristics has been demonstrated (Wakeley et al., 1995). SMC has a strength of about 40 MPa at 28 days and continues to gain strength after that time, as is typical of hydrating cementitious materials. Concrete strength is naturally much greater than required for shaft seal elements because the state of stress within the shafts is compressional with little shear stress developing. In addition, compressive strength of SMC increases as confining pressure increases (Pfeifle et al., 1996). Volume stability of the SMC is also excellent, which assures a good bond with the salt.

Thermal and constitutive models for the SMC are described in Appendix D of Appendix I2 in the permit application. Thermal properties are fit to laboratory data and used to calculate heat distribution during hydration. An isothermal creep law and an increasing modulus are used to represent the concrete in structural calculations. The resistance established by concrete to inward creep of the Salado Formation accelerates healing of microcracks in the salt. The state of stress impinging on concrete elements within the Salado Formation will approach a lithostatic condition.

Table A-5. Target Properties for Salado Mass Concrete

Property	Comment
Initial slump 10 ± 1.0 in. Slump at 2 hr 8 ± 1.5 in.	ASTM C 143, high slump needed for pumping and placement
Initial temperature ≤ 20°C	ASTM C 1064, using ice as part of mixing water
Air content ≤ 2.0%	ASTM C 231 (Type B meter), tight microstructure and higher strength
Self-leveling	Restrictions on underground placement may preclude vibration
No separately batched admixtures	Simple and reproducible operations
Adiabatic temperature rise ≤ 16°C at 28 days	To reduce thermally induced cracking
30 MPa (4500 psi) compressive strength	ASTM C 39, at 180 days after placement
Volume stability	ASTM C 157, length change between +0.05 and -0.02% through 180 days

Permeability of SMC is very low, consistent with most concretes. Owing to a favorable state of stress and isothermal conditions, the SMC will remain intact. Because little brine is available to alter concrete elements, minimal degradation is possible. Resistance to phase changes of salt-saturated concretes and mortars within the WIPP setting has been excellent. These favorable attributes combine to assure concrete elements within the Salado will remain structurally sound and possess very low permeability for exceedingly long periods.

Permeabilities of SMC and other salt-saturated concretes have been measured in Small-Scale Seal Performance Tests (SSSPT) and Plug Test Matrix (PTM) at the WIPP for a decade and are corroborated by laboratory measurements (e.g., Knowles and Howard, 1996; Pfeifle et al., 1996). From these tests, values and ranges of concrete permeability have been developed. For performance assessments calculations, permeability of SMC seal components is treated as a random variable defined by a log triangular distribution with a best estimator of 1.78×10^{-19} m^2 and lower and upper limits of 2.0×10^{-21} and 1.0×10^{-17} m^2, respectively.

The probability distribution function is shown in Figure I2A-2. Further, it is recognized that concrete function is required for only a relatively short-term period as salt reconsolidates. Concrete is expected to function adequately beyond its design life. For calculational expediency, a higher, very conservative permeability of 1.0×10^{-14} is assigned to concrete after 400 years. This abrupt change in permeability does not imply degradation, but rather reflects system redundancy and the fact that concrete is no longer relied on as a seal component.

A2.1.5 Verification Methods

The concrete supplier shall perform the inspection and tests described below (Tables A-6 and A-7) and, based on the results of these inspections and tests, shall take appropriate action. The laboratory performing verification tests shall be on-site and shall conform with ASTM C 1077. Individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Laboratory Testing Technicians, Grade I. The Buyer will inspect the laboratory, equipment, and test procedures for conformance with ASTM C 1077 prior to start of dry materials batching operations and prior to restarting operations.

A2.1.5.1 Fine Aggregate

(*A) Grading*. Dry materials will be sampled while the batch plant is operating; there shall be a sieve analysis and fineness modulus determination in accordance with ASTM C 136.

(B) Fineness Modulus Control Chart. Results for fineness modulus shall be grouped in sets of three consecutive tests, and the average and range of each group shall be plotted on a control chart. The upper and lower control limits for average shall be drawn 0.10 units above and below the target fineness modulus, and the upper control limit for range shall be 0.20 units above the target fineness modulus.

Table A-6. Test Methods Used for Measuring Concrete Properties During and After Mixing

Property	Test Method	Title
Slump	ASTM C 143	Slump of Portland Cement Concrete
Unit weight	ASTM C 138	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
Air content	ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method
Mixture temperature	ASTM C 1064	Temperature of Freshly Mixed Concrete

Table A-7. Test Methods Used for Measuring Properties of Hardened Concrete

Property	Test Method	Title
Compressive strength	ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
Modulus of elasticity	ASTM C 469	Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
Volume stability	ASTM C 157	Length Change of Hardened Cement Mortar and Concrete

(C) Corrective Action for Fine Aggregate Grading. When the amount passing any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure for any sieve, the fact shall be immediately reported to the Buyer. Whenever a point on the fineness modulus control chart, either for average or range, is beyond one of the control limits, the frequency of testing shall be doubled. If two consecutive points are beyond the control limits, the process shall be stopped and stock discarded if necessary.

(D) Moisture Content Testing. There shall be at least two tests for moisture content in accordance with ASTM C 566 during each 8-hour period of dry materials batch plant operation.

(E) Moisture Content Corrective Action. Whenever the moisture content of fine aggregate exceeds 0.1 % by weight, the fine aggregate shall be immediately resampled and retested. If there is another failure the batching shall be stopped.

A2.1.5.2 Coarse Aggregate

(A) Grading. Coarse aggregate shall be analyzed in accordance with ASTM C 136.

(B) Corrective Action for Grading. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Buyer. Where two consecutive averages of five tests are outside specification limits, the dry materials batch plant operation shall be stopped, and immediate steps shall be taken to correct the grading.

(C) Moisture Content Testing. There shall be at least two tests for moisture content in accordance with ASTM C 566 during each 8-hour period of dry materials batch plant operation.

(D) Moisture Content Corrective Action. Whenever the moisture content of coarse aggregate exceed 0.1 % by weight, the coarse aggregate shall be immediately resampled and retested. If there is another failure, batching shall be stopped.

A2.1.5.3 Batch-Plant Control

The measurement of all constituent materials including cementitious materials, each size of aggregate, and granular sodium chloride shall be continuously controlled. The aggregate batch weights shall be adjusted as necessary to compensate for their nonsaturated surface-dry condition.

A2.1.5.4 Concrete Products

Concrete products will be tested during preparation and after curing as summarized in Tables A-6 and A-7 for preparation and hydrated concrete, respectively.

A2.2 Compacted Clay

Compacted clays are commonly proposed as primary sealing materials for nuclear waste repositories and have been extensively investigated (e.g., Gray, 1993). Compacted clay as a shaft sealing component provides a barrier to brine and possibly to gas flow into or out of the repository and supports the shaft with a high density material to minimize subsidence. In the event that brine does contact the compacted clay columns, bentonitic clay can generate a beneficial swelling pressure. Swelling would increase internal supporting pressure on the shaft wall and accelerate healing of any disturbed rock zone. Wetted, swelling clay will seal fractures as it expands into available space and will ensure tightness between the clay seal component and the shaft walls.

A2.2.1 Functions

In general, clay is used to prevent fluid flow either down or up the shaft. In addition, clay will stabilize the shaft opening and provide a backstress within the Salado Formation that will enhance healing of microfractures in the disturbed rock. Bentonitic clays are specified for Components 4, 8, and 12. In addition to limiting brine migration down the shafts, a primary function of a compacted clay seal through the Rustler Formation (Component 4) is to provide separation of water bearing units. The primary function of the upper Salado clay column (Component 8) is to limit groundwater flow down the shaft, thereby adding assurance that the reconsolidating salt column is protected. The lower Salado compacted clay column (Component 12) will act as a barrier to brine and possibly to gas flow (see construction alternatives in Appendix B) soon after placement and remain a barrier throughout the regulatory period.

A2.2.2 Material Characteristics

The Rustler and Salado compacted clay columns will be constructed of a commercial well-sealing grade sodium bentonite blocks compacted to between 1.8 and 2.0 g/cm^3. An extensive experimental data base exists for the permeability of sodium bentonites under a variety of conditions. Many other properties of sodium bentonite, such as strength, stiffness, and chemical stability also have been thoroughly investigated. Advantages of clays for sealing purposes include low permeability, demonstrated longevity in many types of natural environments, deformability, sorptive capacity, and demonstrated successful utilization in practice for a variety of sealing purposes.

A variety of clays could be considered for WIPP sealing purposes. For WIPP, as for most if not all nuclear waste repository projects, bentonite has been and continues to be a prime candidate as the clay sealing material. Bentonite clay is chosen here because of its overwhelming positive sealing characteristics. Bentonite is a highly plastic swelling clay material (e.g., Mitchell, 1993), consisting predominantly of smectite minerals (e.g., IAEA, 1990). Montmorillonite, the predominant smectite mineral in most bentonites, has the typical plate-like structure characteristic of most clay minerals.

The composition of a typical commercially available sodium bentonite (e.g. Volclay, granular sodium bentonite) contains over 90% montmorillonite and small portions of feldspar, biotite, selenite, etc. A typical sodium bentonite has the chemical composition summarized in Table A-8 (American Colloid Company, 1995). This chemical composition is close to that reported for MX-80 which was used successfully in the Stripa experiments (Gray, 1993). Sodium bentonite has a tri-layer expanding mineral structure of approximately (Al $Fe_{1.67}$ $Mg_{0.33}$) Si_4O_{10} (OH_2) $Na^+Ca^{++}{}_{0.33}$. Specific gravity of the sodium bentonite is about 2.5. The dry bulk density of granular bentonite is about 1.04 g/cm^3.

Densely compacted bentonite (of the order of 1.75 g/cm^3), when confined, can generate a swelling pressure up to 20 MPa when permeated by water (IAEA, 1990). The magnitude of the swelling pressure generated depends on the chemistry of the permeating water. Laboratory and field measurements suggest that the bentonite specified for shaft seal materials in the Salado may achieve swell pressures of 3 to 4 MPa, and likely substantially less. Swelling pressure in the bentonite column is not expected to be appreciable because little contact with brine fluids is conceivable. Further considerations of potential swelling of bentonite within the Rustler Formation may be appropriate, however.

Table A-8. Representative Bentonite Composition.

Chemical Compound	Weight %
SiO_2	63.0
Al_2O_3	21.1
Fe_2O_3	3.0
FeO	0.4
MgO	2.7
Na_2O	2.6
CaO	0.7
H_2O	5.6
Trace Elements	0.7

Mixtures of bentonite and water can range in rheological characteristics from a virtually Newtonian fluid to a stiff solid, depending on water content. Bentonite can form stiff seals at low moisture content, and can penetrate fractures and cracks when it has a higher water content. Under the latter conditions it can fill void space in the seal itself and disturbed rock zones. Bentonite with dry density of 1.75 g/cm^3 has a cohesion of 5-50 kPa, and a friction angle of 5 to 15° (IAEA, 1990). At density greater than 1.6-1.7 g/cm^3, swelling pressure of bentonite is less affected by the salinity of groundwater providing better chemical and physical stabilities.

A2.2.3 Construction

Seal performance within the Salado Formation is far more important to regulatory compliance than is performance of earthen fill in the overlying formations. Three potential construction methods might be used to place clay in the shaft, as discussed in Appendix B. Construction of bentonite clay components specifies block assembly procedures demonstrated successfully at the WIPP site (Knowles and Howard, 1996) and in a considerable body of work by Roland Pusch (see summary in Gray, 1993). To achieve low permeabilities, dry density of the bentonite blocks should be about 2.0 g/cm^3, although a range of densities is discussed in Section 2.2.4. A high density of clay components is also desirable to carry the weight of overlying seal material effectively and to minimize subsidence.

Placement of clay in the shaft is one area of construction that might be made more cost and time effective through optimization studies. An option to construct clay columns using dynamic compaction will likely prove to be efficient, so it is specified for earthen fill in the Dewey Lake Redbeds (as discussed later) and may prove to be an acceptable placement method for other components. Dynamic compaction would use equipment developed for placement of crushed salt. The Canadian nuclear waste program has conducted extensive testing, both in situ and in large scale laboratory compaction of clay-based barrier materials with dynamic hydraulically powered impact hammers (e.g., Kjartanson et al, 1992). The Swedish program similarly has investigated field compaction of bentonite-based tunnel backfill by means of plate vibrators (e.g., Nilsson, 1985). Both studies demonstrated the feasibility of in situ compaction of bentonite-based materials to a high density. Near surface, conventional compaction methods will be used because insufficient space remains for dynamic compaction using the multi-deck work stage.

A2.2.4 Performance Requirements

The proven characteristics of bentonite assure attainment of very low permeability seals. It is recognized that the local environment contributes to the behavior of compacted clay components. Long-term material stability is a highly desired sealing attribute. Clay components located in brine environments will have to resist cation exchange and material structure alteration. Clay is geochemically mature, reducing likelihood of alteration and imbibition of brine is limited to isolated areas. Compacted clay is designed to withstand possible pressure gradients and to resist erosion and channeling that could conceivably lead to groundwater flow through the seal. Compacted clay seal components support the shaft walls and promote healing of the salt DRZ. Volume expansion or swelling would accelerate healing in the salt. A barrier to gas flow could be constructed if moisture content of approximately 85% of saturation could be achieved.

Permeability of bentonite is inversely correlated to dry density. Figure I2A-3 plots bentonite permeability as a function of reported sample density for sodium bentonite samples. The permeability ranges from approximately 1×10^{-21} to 1×10^{-17} m^2. In all cases, the data in Figure I2A-3 are representative of low ionic strength permeant waters. Data provided in this figure are limited to sodium bentonite and bentonite/sand mixtures with clay content greater than or equal to 50 %. Cheung et al. (1987) report that in bentonite/sand mixtures, sand acts as an inert fraction which does not alter the permeability of the mixture from that of a 100 % bentonite sample at the same equivalent dry density. Also included in Figure I2A-3 are the three point estimates of permeability at dry densities of 1.4, 1.8, and 2.1 g/cm^3 provided by Jaak Daemen of the University of Nevada, Reno, who is actively engaged in WIPP-specific bentonite testing.

A series of in situ tests (SSSPTs) that evaluated compacted bentonite as a sealing material at the WIPP site corroborate data shown in Figure I2A-3. Test Series D tested two 100 % bentonite seals in vertical boreholes within the Salado Formation at the repository horizon. The diameter of each seal was 0.91 m, and the length of each seal was 0.91 m. Cores of the two bentonite seals had initial dry densities of 1.8 and 2.0 g/cm^3. Pressure differentials of 0.72 and 0.32 MPa were maintained across the bentonite seals with a brine reservoir on the upstream (bottom) of the seals for several years.

Over the course of the seal test, no visible brine was observed at the downstream end of the seals. Upon decommissioning the SSSPT, brine penetration was found to be only 15 cm. Determination of the absolute permeability of the bentonite seal was not precise; however, a bounding calculation of 1×10^{-19} m^2 was made by Knowles and Howard (1996).

Beginning with a specified dry density of 1.8 to 2.0 g/cm^3 and Figure I2A-3, a distribution function for clay permeability was developed and is provided in Figure I2A-4. Parameter distribution reflects some conservative assumptions pertaining to WIPP seal applications. The following provide rationale behind the distribution presented in Figure I2A-4.

1. A practical minimum for the distribution can be specified at 1×10^{-21} m^2.
2. If effective dry density of the bentonite emplaced in the seals only varies from 1.8 to 2.0 g/cm^3, then a maximum expected permeability can be extrapolated from Figure I2A-3 as 1×10^{-19} m^2.
3. Uncertainty exists in being able to place massive columns of bentonite to design specifications. To address this uncertainty in a conservative manner, it is assumed that the compacted clay be placed at a dry density as low as 1.6 g/cm^3. At 1.6 g/cm^3, the maximum permeability for the clay would be approximately 5×10^{-19} m^2. Therefore, neglecting salinity effects, a range of permeability from 1×10^{-21} to 5×10^{-19} m^2 with a best estimate of less than 1×10^{-19} m^2 could be reasonably defined (assuming a best estimate emplacement density of 1.8 g/cm^3). It could be argued, based on Figure I2A-3, that a best estimate could be as low as 2×10^{-20}m^2.

Salinity increases bentonite permeability; however, these effects are greatly reduced at the densities specified for the shaft seal. At seawater salinity, Pusch et al. (1989) report the effects on permeability could be as much as a factor of 5 (one-half order of magnitude). To account for salinity effects in a conservative manner, the maximum permeability is increased from 5×10^{-19} to 5×10^{-18} m^2. The best estimate permeability is increased by one-half order of magnitude to 5×10^{-19} m^2. The lower limit is held at 1×10^{-21} m^2. Because salinity effects are greatest at lower densities, the maximum is adjusted one full order of magnitude while the best estimate (assumed to reside at a density of 1.8 g/cm^3) is adjusted one-half of an order.

The four arguments presented above give rise to the permeability cumulative frequency distribution plotted in Figure I2A-4, which summarizes the performance specification for bentonite columns.

A2.2.5 Verification Methods

Verification of specified properties such as density, moisture content or strength of compacted clay seals can be determined by direct access during construction. However, indirect methods are preferred because certain measurements, such as permeability, are likely to be time consuming and invasive. Methods used to verify the quality of emplaced seals will include quality of block production and field measurements of density. As a minimum, standard quality control procedures recommended for compaction operations will be implemented including visual observation, in situ density measurements, and moisture content measurements. Visual observation accompanied by detailed record keeping will assure design procedures are being followed. In situ testing will confirm design objectives are accomplished in the field.

Density measurements of compacted clay shall follow standard procedures such as ASTM D 1556, D 2167, and D 2922. The moisture content of clay blocks shall be calculated based on the water added during mixing and can be confirmed by following ASTM Standard procedures D 2216 and D 3017. It is probable that verification procedures will require modifications to be applicable within the shaft. As a minimum, laboratory testing to certify the above referenced quality control measures will be performed to assure that the field measurements provide reliable results.

A2.3 Asphalt Components

Asphalt is used to prevent water migration down the shaft in two ways: an asphalt column bridging the Rustler/Salado contact and a "waterstop" sandwiched between concrete plugs at three locations within the Salado Formation, two above the salt column and one below the salt column. An asphalt mastic mix (AMM) that contains aggregate is specified for the column while the specification for the waterstop layer is pure asphalt.

Asphalt is a widely used construction material with many desirable properties. Asphalt is a strong cement, is readily adhesive, highly waterproof, and durable. Furthermore, it is a plastic substance that provides controlled flexibility to mixtures of mineral aggregates with which it is usually combined. It is highly resistant to most acids, salts, and alkalis. A number of asphalts and asphalt mixes are available that cover a wide range of viscoelastic properties which allows the properties of the mixture to be designed for a wide range of requirements for each application. These properties are well suited to the requirements of the WIPP shaft seal system.

A2.3.1 Functions

The generic purpose of asphalt seal components above the salt column is to eliminate water migration downward. The asphalt waterstops above the salt column are designed to intersect the DRZ and limit fluid flow. Asphalt is not the lone component preventing flow of brine downward; it functions in tandem with concrete and a compacted clay column. Waterstop Component # 11 located below the salt column would naturally limit upward flow of brine or gas. Concrete abutting the asphalt waterstops provides a rigid element that creates a backstress upon the inward creeping salt, promoting healing within the DRZ. Asphalt is included in the WIPP shaft seal system to reduce uncertainty of system performance by providing redundancy of function while using an alternative material type. The combination of shaft seal components restricts fluid flow up or down to allow time for the salt column to reconsolidate and form a natural fluid-tight seal.

The physical and thermal attributes of asphalt combine to reduce fluid flow processes. The placement fluidity permits asphalt to flow into uneven interstices or fractures along the shaft wall. Asphalt will self-level into a nearly voidless mass. As it cools, the asphalt will eventually cease flowing. The elevated temperature and thermal mass of the asphalt will enhance creep deformation of the salt and promote healing of the DRZ surrounding the shaft. Asphalt adheres tightly to most materials, eliminating flow along the interface between the seal material and the surrounding rock.

A2.3.2 Material Characteristics

The asphalt column specified for the WIPP seal system is an AMM commonly used for hydraulic structures. The AMM is a mixture of asphalt, sand, and hydrated lime. The asphalt content of AMM is higher than those used in typical hot mix asphalt concrete (pavements). High asphalt contents (10-20% by weight) and fine, well-graded aggregate (sand and mineral fillers) are used to obtain a near voidless mix. A low void content ensures a material with extremely low water permeability because there are a minimum number of connected pathways for brine migration.

A number of different asphaltic construction materials, including hot mix asphalt concrete (HMAC), neat asphalt, and AMMs, were evaluated for use in the WIPP seal design. HMAC was eliminated because of construction difficulty that might have led to questionable performance. An AMM is selected as a preferred alternative for the asphalt columns because it has economic and performance advantages over the other asphaltic options. Aggregate and mineral fines in the AMM increase rigidity and strength of the asphalt seal component, thereby enhancing the potential to heal the DRZ and reducing shrinkage relative to neat asphalt.

Viscosity of the AMM is an important physical property affecting construction and performance. The AMM is designed to have low enough viscosity to be pumpable at application temperatures and able to flow readily into voids. High viscosity of the AMM at operating temperatures prevents long-term flow, although none is expected. Hydrated lime is included in the mix design to increase the stability of the material, decrease moisture susceptibility, and act as an anti-microbial agent. Table A-9 details the mix design specifications for the AMM.

The asphalt used in the waterstop is AR-4000, a graded asphalt of intermediate viscosity. The waterstop uses pure, or neat, asphalt because it is a relatively small volume when compared to the column.

A2.3.3 Construction

Construction of asphalt seal components can be accomplished using a slickline process where the molten material is effectively pumped into the shaft. The AMM will be mixed at ground level in a pug mill at approximately 180°C. At this temperature the material is readily pourable. The AMM will be slicklined and placed using a heated and insulated tremie line. The AMM will easily flow into irregularities in the surface of the shaft or open fractures until the AMM cools. After cooling, flow into surface irregularities in the shaft and DRZ will slow considerably because of the sand and mineral filler components in the AMM and the temperature dependence of the viscosity of the asphalt. AMM requires no compaction in construction. Neat asphalt will be placed in a similar fashion.

The technology to pump AMM is available as described in the construction procedures in Appendix B. One potential problem with this method of construction is ensuring that the slickline remains heated throughout the construction phase. Impedance heating (a current construction technique) can be used to ensure the pipe remains at temperatures sufficient to promote flow. The lower section (say 10 m) of the pipe may not need to be heated, and it may not be desirable to heat it as it is routinely immersed in the molten asphalt during construction to minimize air entrainment. Construction using large volumes of hot asphalt would be facilitated by placement in sections. After several meters of asphalt are placed, the slickline would be retracted by two lengths of pipe and pumping resumed. Once installed, the asphalt components will cool; the column will require several months to approach ambient conditions. Calculations of cooling times and plots of isotherms for the asphalt column are given in Appendix D of Appendix I2 in the permit application. It should be noted that a thermal pulse into the surrounding rock salt could produce positive rock mechanics conditions. Fractures will heal much faster owing to thermally activated dislocation motion and diffusion. Salt itself will creep inward at a much greater rate as well.

Table A-9. Asphalt Component Specifications

AMM Composition:	20 wt% asphalt (AR-4000 graded asphalt) 70 wt% aggregate (silicate sand) 10 wt% hydrated lime	
Aggregate (% passing by weight)		
US Sieve Size		Specification Limits
2.36 mm	(No. 8)	100
1.18 mm	(No. 16)	90
600	(No. 30)	55-75
300	(No. 50)	35-50
150	(No. 100)	15-30
75	(No. 200)	5-15

Mineral Filler: Hydrated Lime Chemical Composition:
Total active lime content (% by weight).. min. 90.0%
Unhydrated lime weight (% by weight CaO)... max. 5.0%
Free water (% by weight H_2O)... max. 4.0%
Residue Analysis:
Residue retained on No. 6 sieve .... max. 0.1%
Residue retained on No. 30 sieve .... max. 3.0%

A2.3.4 Performance Requirements

Asphalt components are required to endure for about 100 years as an interim seal while the compacted salt component reconsolidates to create a very low permeability seal component. Since asphalt will not be subjected to ultraviolet light or an oxidizing environment, it is expected to provide an effective brine seal for several centuries. Air voids should be less than 2% to ensure low permeability. Asphalt mixtures do not become measurably permeable to water until voids approach 8% (Brown, 1990).

At Hanford, experiments are ongoing on the development of a passive surface barrier designed to isolate wastes (in this case to prevent downward flux of water and upward flux of gases) for 1000 years with no maintenance. The surface barrier uses asphalt as one of many horizontal components because low-air-void, high-asphalt-content materials are noted for low permeability and improved mechanically stable compositions. The design objective of this asphalt concrete was to limit infiltration to 1.6×10^{-9} cm/s (1.6×10^{-11} m/s, or for fresh water, an intrinsic permeability of 1.6×10^{-18} m^2). The asphalt component of the barrier is composed of a 15 cm layer of asphaltic concrete overlain with a 5-mm layer of fluid-applied asphalt. The reported hydraulic conductivity of the asphalt concrete is estimated to be 1×10^{-9} m/s (equivalent to an intrinsic permeability of approximately 1×10^{-16} m^2 assuming fresh water). Myers and Duranceau (1994) report that the hydraulic conductivity of fluid-applied asphalt is estimated to be 1.0×10^{-11} to 1.0×10^{-10} cm/s (equivalent to an intrinsic permeability of approximately 1.0×10^{-20} to 1.0×10^{-19} m^2 assuming fresh water).

Consideration of published values results in a lowest practical permeability of 1×10^{-21} m^2. The upper limit of the asphalt seal permeability is assumed to be 1×10^{-18} m^2. Intrinsic permeability of the asphalt column is defined as a log triangular distributed parameter, with a best estimate value of 1×10^{-20} m^2 , a minimum value of 1×10^{-21} m^2, and a maximum value of 1×10^{-18} m^2, as shown in Figure I2A-5. It is recognized that the halite DRZ in the uppermost portion of the Salado Formation is not likely to heal because creep of salt is relatively slow.

These values are used in performance assessment of regulatory compliance analyses and in fluid flow calculations (Appendix C of Appendix I2 in the permit application) pertaining to seal system functional evaluation (Appendix C is not included in the Permit). Other calculations pertaining to rock mechanics and structural considerations of asphalt elements are discussed in Appendix D of Appendix I2 in the permit application.

A2.3.5 Verification Methods

Viscosity of the AMM must be low enough for easy delivery through a heated slickline. Sufficient text book information is available to assure performance of the asphalt component; however, laboratory validation tests may be desirable before installation. There are no plans to test asphalt components after they are placed. With that in mind, some general tests identified below would add quantitative documentation to expected performance values and have direct application to WIPP. The types and objectives of the verification tests are:

Mix Design. A standard mix design which evaluates a combination of asphalt and aggregate mixtures would quantify density, air voids, viscosity, and permeability. Although the specified mixture will function adequately, studies could optimize the mix design.

Viscoelastic Properties at Service Temperatures. Viscoelastic properties over the range of expected service temperatures would refine the rheological model.

Accelerated Aging Analysis. Asphalt longevity issues could be further addressed by using the approach detailed in PNL-Report 9336 (Freeman and Romine, 1994).

Brine Susceptibility Analysis. The presumed inert nature of the asphalt mix can be demonstrated through exposure to groundwater brine solutions found in the Salado Formation. Potential for degradation will be characterized by monitoring the presence of asphalt degradation products in

WIPP brine or brine simulant as a function of time. Effects on hydraulic conductivity can be measured during these experiments.

A2.4 Compacted Salt Column

A reconstituted salt column has been proposed as a primary means to isolate for several decades those repositories containing hazardous materials situated in evaporite sequences. Reuse of salt excavated in the process of creating the underground openings has been advocated since the initial proposal by the NAS in the 1950s. Replacing the natural material to its original setting ensures physical, chemical, and mechanical compatibility with the host formation. Recent developments in support of the WIPP shaft seal system have produced confirming experimental results, constitutive material laws, and construction methods that substantiate use of a salt column for a low permeability, perfectly compatible seal component.

Numerical models of the shaft and seal system have been used to provide information on the mechanical processes that affect potential pathways and overall performance of the seal system. Several of these types of analyses are developed in Appendix D of Appendix I2 in the permit application. Simulations of the excavated shaft and the compacted salt seal element behavior after placement show that as time passes, the host salt creeps inward, the compacted salt is loaded by the host formation and consolidates, and a back pressure is developed along the shaft wall. The back pressure imparted to the host formation by the compacted salt promotes healing of any microcracks in the host rock. As compacted salt consolidates, density and stiffness increase and permeability decreases.

A2.4.1 Functions

The function of the compacted and reconsolidated salt column is to limit transmission of fluids into or out of the repository for the statutory period of 10,000 years. The functional period starts within a hundred years and lasts essentially forever. After a period of consolidation, the salt column will almost completely retard gas or brine migration within the former shaft opening. A completely consolidated salt column will achieve flow properties indistinguishable from natural Salado salt.

A2.4.2 Material Characteristics

The salt component comprises crushed Salado salt with addition of small amounts of water. No admixtures other than water are needed to meet design specifications. Natural Salado salt (also called WIPP salt) is typical of most salts in the Permian Basin: it has an overall composition approaching 90-95 % halite with minor clays, carbonate, anhydrite, and other halite minerals. Secondary minerals and other impurities are of little consequence to construction or performance of the compacted salt column as long as the halite content is approximately 90 %.

The total water content of the crushed salt should be approximately 1.5 wt% as it is tamped into place. Field and laboratory testing verified that natural salt can be compacted to significant density ($\rho \geq 0.9$) with addition of these modest amounts of water. In situ WIPP salt contains approximately 0.5 wt% water. After it is mined, transported, and stored, some of the connate water is lost to evaporation and dehydration. Water content of the bulk material that would be used for compaction in the shaft is normally quite small, on the order of 0.25 wt%, as measured during compaction demonstrations (Hansen and Ahrens, 1996). Measurements of water content of the salt will be necessary periodically during construction to calibrate the proper amount of water to be added to the salt as it is placed.

Water added to the salt will be sprayed in a fine mist onto the crushed salt as it is cast in each lift. Methods similar to those used in the large-scale compaction demonstration will be developed such that the spray visibly wets the salt grain surfaces. General uniformity of spray is desired. The water has no special chemical requirements for purity. It can be of high quality (drinkable) but need not be potable. Brackish water would suffice because water of any quality would become brackish upon application to the salt.

The mined salt will be crushed and screened to a nominal maximum diameter of 5 mm. Gradation of particles smaller than 5 mm is not of concern because the crushing process will create relatively few fines compared to the act of dynamic compaction. Based on preliminary large-scale demonstrations, excellent compaction was achieved without optimization of particle sizes. It is evident from results of the large compaction demonstration coupled with laboratory studies that initial density can be increased and permeability decreased beyond existing favorable results. Further demonstrations of techniques, including crushing and addition of water may be undertaken in ensuing years between compliance certification and beginning of seal placement.

A2.4.3 Construction

Dynamic compaction is the specified procedure to tamp crushed salt in the shaft. Other techniques of compaction have potential, but their application has not been demonstrated. Deep dynamic compaction provides the greatest energy input to the crushed salt, is easy to apply, and has an effective depth of compactive influence far greater than lift thickness. Dynamic compaction is relatively straightforward and requires a minimal work force. If the number of drops remains constant, diameter and weight of the tamper increases in proportion to the diameter of the shaft. The weight of the tamper is a factor in design of the infrastructure supporting the hoisting apparatus. Larger, heavier tampers require equally stout staging. The construction method outlined in Appendix B balances these opposing criteria. Compaction itself will follow the successful procedure developed in the large-scale compaction demonstration (Hansen and Ahrens, 1996).

Transport of crushed salt to the working level can be accomplished by dropping it down a slickline. As noted, additional water will be sprayed onto the crushed salt at the bottom of the shaft as it is placed. Lift heights of approximately 2 m are specified, though greater depths could be compacted effectively using dynamic compaction. Uneven piles of salt can be hand leveled.

A2.4.4 Performance Requirements

Compacted crushed salt is a unique seal material because it consolidates naturally as the host formation creeps inward. As the crushed salt consolidates, void space diminishes, density increases, and permeability decreases. Thus, sealing effectiveness of the compacted salt column will improve with time. Laboratory testing over the last decade has shown that pulverized salt specimens can be compressed to high densities and low permeabilities (Brodsky et al., 1996). In addition, consolidated crushed salt uniquely guarantees chemical and mechanical compatibility with the host salt formation. Therefore, crushed salt will provide a seal that will function essentially forever once the consolidation process is completed. Primary performance results of these analyses include plots of fractional density as a function of depth and time for the crushed salt column and permeability distribution functions that will be used for performance assessment calculations. These performance results are summarized near the end of this section, following a limited background discussion.

To predict performance, a constitutive model for crushed salt is required. To this end, a technical evaluation of potential crushed salt constitutive models was completed (Callahan et al., 1996). Ten potential crushed salt constitutive models were identified in a literature search to describe the phenomenological and micromechanical processes governing consolidation of crushed salt. Three of the ten potential models were selected for rigorous comparisons to a specially developed, although somewhat limited, database. The database contained data from hydrostatic and shear consolidation laboratory experiments. The experiments provide deformation (strain) data as a function of time under constant stress conditions. Based on volumetric strain measurements from experiments, change in crushed salt density and porosity are known. In some experiments, permeability was also measured, which provides a relationship between density and permeability of crushed salt. Models were fit to the experimental database to determine material parameter values and the model that best represents experimental data.

Modeling has been used to predict consolidating salt density as a function of time and position in the shaft. Position or depth of the calculation is important because creep rates of intact salt and crushed salt are strong functions of stress difference. Analyses made use of a "pineapple" slice structural model at the top (430 m), middle (515 m), and bottom (600 m) of the compacted salt column. Initial fractional density of the compacted crushed salt was 0.90 (1944 kg m^{-3}). The structural model, constitutive material models, boundary conditions, etc. are described in Appendix D of Appendix I2 in the permit application. Modeling results coupled with laboratory-determined relationships between density and permeability were used to develop distribution functions for permeability of the compacted crushed salt column for centuries after seal emplacement.

Analyses used reference engineering values for parameters in the constitutive models (e.g., the creep model for intact salt and consolidation models for crushed salt). Some uncertainty associated with model parameters exists in these constitutive models. Consolidating salt density was quantified by predicting density at specific times using parameter variations. Many of these types of calculations comparing three models for consolidation of crushed salt were performed to quantify performance of the salt column, and the reader is referred to Appendix D of Appendix I2 in the permit application for more detail.

Predictions of fractional density as a function of time and depth are shown in Figure I2A-6. Performance calculations of the seal system require quantification of the resultant salt permeability. The permeability can be derived from the experimental data presented in Figure I2A-7. This plot depicts probabilistic lines through the experimental data. From these lines, distribution functions can be derived. Permeability of the compacted salt column is treated as a transient random variable defined by a log triangular distribution. Distribution functions were provided for 0, 50, 100, 200, and 400 years after seal emplacement, assuming that fluids in the salt column pores spaces would not produce a backstress. The resultant cumulative frequency distribution for seal permeability at the seal mid-height is shown in Figure I2A-8. This method predicts permeabilities ranging from 1×10^{-23} m^2 to 1×10^{-16} m^2. Because crushed salt consolidation will be affected by both mechanical and hydrological processes, detailed calculations were performed. These calculations are presented in Appendices C and D.

Numerical models of the shaft provide density of the compacted salt column as a function of depth and time. From the density-permeability relationship, permeability of the compacted salt seal component can be calculated. Similarly, the extent of the disturbed rock zone around the shaft is provided by numerical models. From field measurements of the halite DRZ, permeability of the DRZ is known as a function of depth and time. These spatial and temporal permeability values provide information required to assess the potential for brine and gas movement in and around the consolidating salt column.

A2.4.5 Verification Methods

Results of the large-scale dynamic compaction demonstration suggest that deep dynamic compaction will produce a dense starting material, and laboratory work and modeling show that compacted salt will reconsolidate within several decades to an essentially impermeable mass. As with other seal components, testing of the material in situ will be difficult and probably not the best way to ensure quality of the seal element. This is particularly apparent for the compacted salt component because the compactive effort produces a finely powdered layer on the top of each lift. It turns out that the fine powder compacts into a very dense material when the next lift is compacted. The best way to ensure that the crushed salt element functions properly is to establish performance through QA/QC procedures. If crushed salt is placed with a reasonable uniformity of water and is compacted with sufficient energy, long-term performance can be assured.

Periodic measurements of the water content of loose salt as it is placed in lifts will be used for verification and quality control. Thickness of lifts will be controlled. Energy imparted to each lift will be documented by logging drop patterns and drop height. If deemed necessary, visual inspection of the tamped salt can be made by human access. The powder layer can be shoveled aside and hardness of underlying material can be qualitatively determined or tested. Overall geometric measurements made from the original surface of each lift could be used to approximate compacted density.

A2.5 Cementitious Grout

Cementitious grouting is specified for all concrete members in response to external review suggestions. Grouting is also used in advance of liner removal to stabilize the ground. Cementitious grout is specified because of its proven performance, nontoxicity, and previous use at the WIPP.

A2.5.1 Functions

The function of grout is to stabilize the surrounding rock before existing concrete liners are removed. Grout will fill fractures within adjacent lithologies, thereby adding strength and reducing permeability. Grout around concrete members of the concrete asphalt waterstop will be employed in an attempt to tighten the interface and fill microcracks in the DRZ. Efficacy of grouting will be determined during construction. In addition, reduction of local permeability will further limit groundwater influx into the shaft during construction. Concrete plugs are planned for specific elevations in the lined portion of each shaft. The formation behind the concrete liner will be grouted from approximately 3 m below to 3 m above the plug positions to ensure stability of any loose rock.

A2.5.2 Material Characteristics

The grout developed for use in the shaft seal system has the following characteristics:

- no water separation upon hydration,
- low permeability paste,
- fine particle size,
- low hydrational heat,
- no measurable agglomeration subsequent to mixing,
- two hours of injectability subsequent to mixing,
- short set time,
- high compressive strength, and
- competitive cost.

A cementitious grout developed by Ahrens and coworkers (Ahrens et al., 1996) is specified for application in the shaft seal design. This grout consists of portland cement, pumice as a pozollanic material, and superplasticizer in the proportions listed in Table A-10. The ultrafine grout is mixed in a colloidal grout mixer, with a water to components ratio (W:C) of 0.6:1. Grout has been produced with 90 % of the particles smaller than 5 microns and an average particle size of 2 microns. The extremely small particle size enables the grout to penetrate fractures with apertures as small as 6 microns.

Table A-10. Ultrafine Grout Mix Specification

Component	Weight Percent (wt%)
Type 5 portland cement	45
Pumice	55
Superplasticizer	1.5

A2.5.3 Construction

Grout holes will be drilled in a spin pattern that extends from 3 m below to 3 m above that portion of the lining to be removed. The drilling and grouting sequence will be defined in the workmanship specifications prior to construction. Grout will be mixed on surface and transferred to the work deck via the slick line. Maximum injection pressure will be lithostatic, less 50 psig. It is estimated that four holes can be drilled and grouted per shift.

A2.5.4 Performance Requirements

Performance of grout is not a consideration for compliance issues. Grouting is used to facilitate construction by stabilizing any loose rock behind the concrete liner. If the country rock is fractured, grouting will reduce the permeability of the DRZ significantly. Application at the WIPP demonstrated permeability reduction in an anhydrite marker bed of two to three orders of magnitude (Ahrens et al., 1996). Reduction of local permeability adds to longevity of the grout itself and reduces the possibility of brine contacting seal elements. Because grout does not influence compliance issues, a model for it is not used and has not been developed. General performance achievements are:

- filled fractures as small as 6 microns,
- no water separation upon hydration,
- no evidence of halite dissolution,
- no measurable agglomeration subsequent to mixing,
- one hour of injectability,
- initial Vicat needle set in 2.5 hours,
- compressive strength 40 MPa at 28 days, and
- competitive cost.

A2.5.5 Verification Methods

No verification of the effectiveness of grouting is currently specified. If injection around concrete plugs is possible, an evaluation of quantities and significance of grouting will be made during construction. Procedural specifications will include measurements of fineness and determination of rheology in keeping with processes established during the WIPP demonstration grouting (Ahrens et al., 1996).

A2.6 Earthen Fill

Compacted earthen fill comprise approximately 150 m of shaft fill in the Dewey Lake Redbeds and near surface stratigraphy.

A2.6.1 Functions

There are minimal performance requirements imposed for Components 1 and 3 and none that affect regulatory compliance of the site. Specifications for Components 1 and 3 are general: fill the shaft with relatively dense material to reduce subsidence.

A2.6.2 Material Characteristics

Fill can utilize material that was excavated during shaft sinking and stored at the WIPP site, or a borrow pit may be excavated to secure fill material. The bulk fill material may include bentonite additive, if deemed appropriate.

A2.6.3 Construction

Dynamic compaction is specified for the clay column in the Dewey Lake Formation because of its perceived expediency. Vibratory compaction will be used near surface when there is no longer space for the three stage construction deck.

A2.6.4 Performance Requirements

Care will be taken to compact the earthen fill with an energy of twice Modified Proctor energy, which has been shown to produce a dense, uniform fill.

A2.6.6 Verification

Materials placed will be documented, with density measurements as appropriate.

A3. Concluding Remarks

Material specifications in this appendix provide descriptions of seal materials along with reasoning about why they are expected to function well in the WIPP setting. The specification follows a framework that states the function of the seal component, a description of the material, and a summary of construction techniques that could be implemented without resorting to extensive development efforts. Discussion of performance requirements for each material is the most detailed section because design of the seal system requires analysis of performance to ascertain compliance with regulations. Successful design of the shaft seal system is demonstrated by an evaluation of how well the design performs, rather than by comparison with a predetermined quantity.

Materials chosen for use in the shaft seal system have several common desirable attributes: low permeability, availability, high density, longevity, low cost, constructability, and supporting documentation. Functional redundancy using different materials provides an economically and technologically feasible shaft seal system that limits fluid transport.

A4. References

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FIGURES

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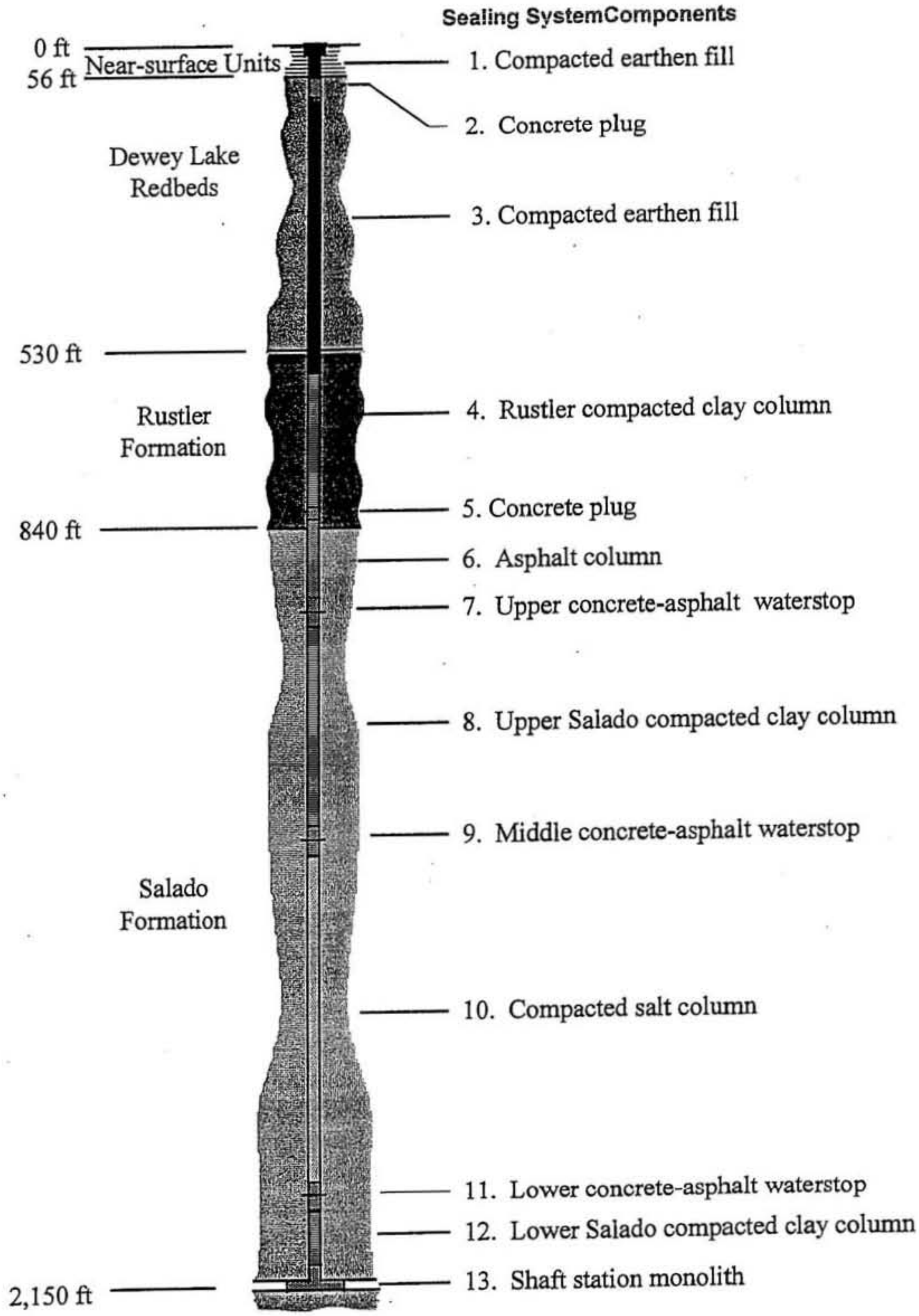


Figure I2A-1
Schematic of the WIPP shaft seal design

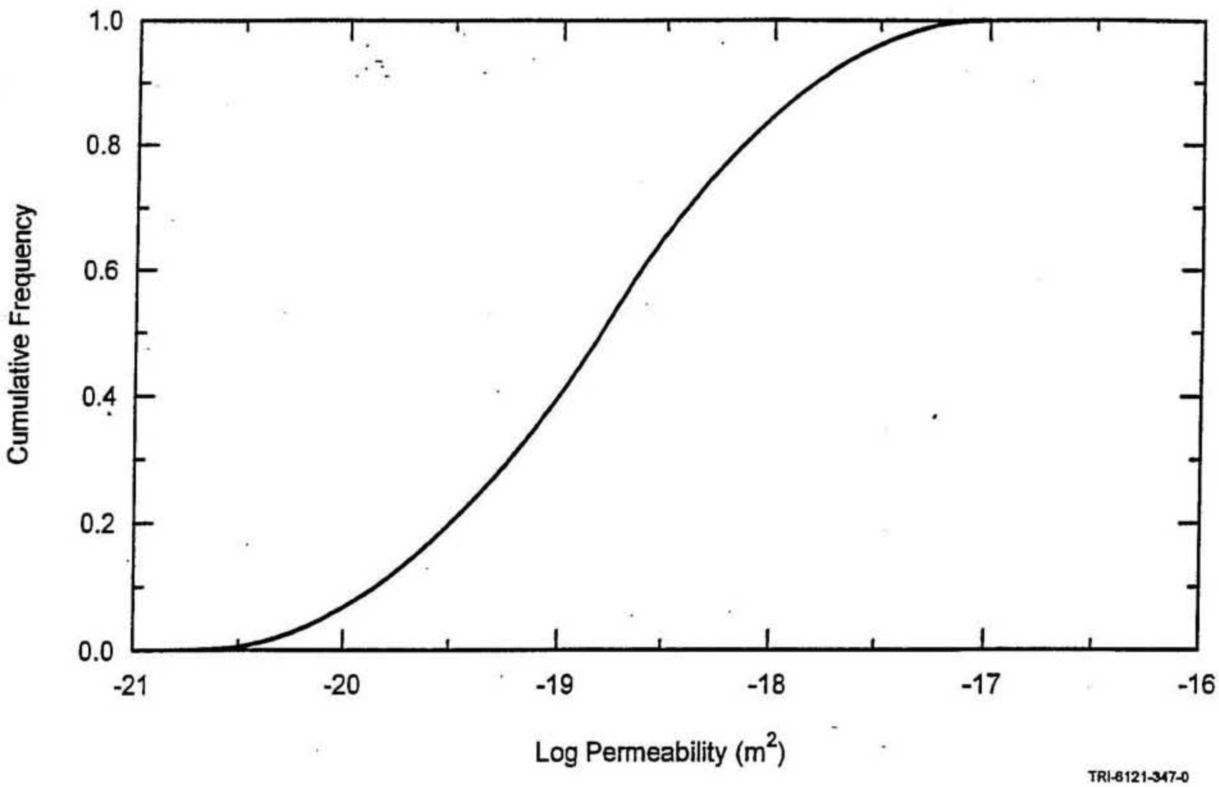


Figure I2A-2
Cumulative distribution function for SMC

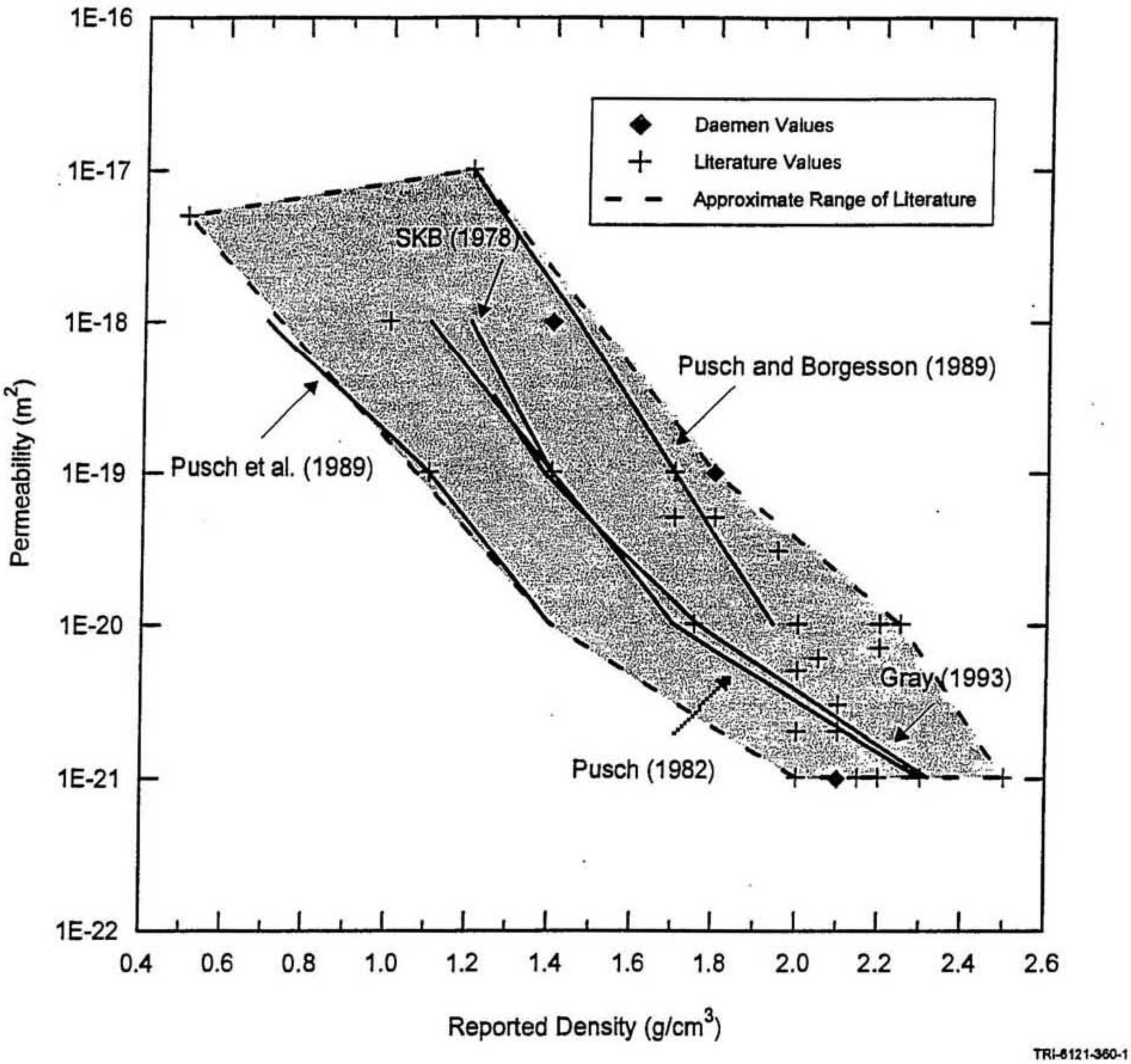


Figure I2A-3
Sodium bentonite permeability versus density

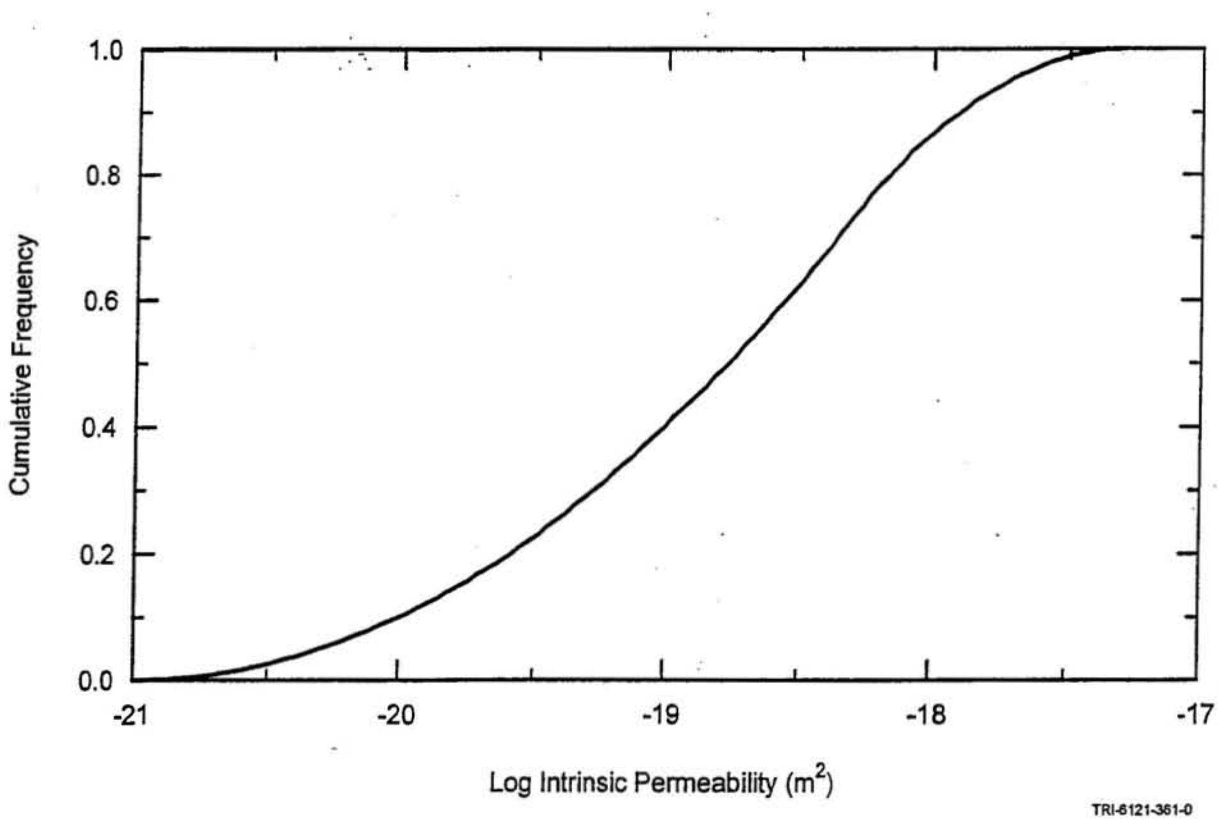


Figure I2A-4
Cumulative frequency distribution for compacted bentonite

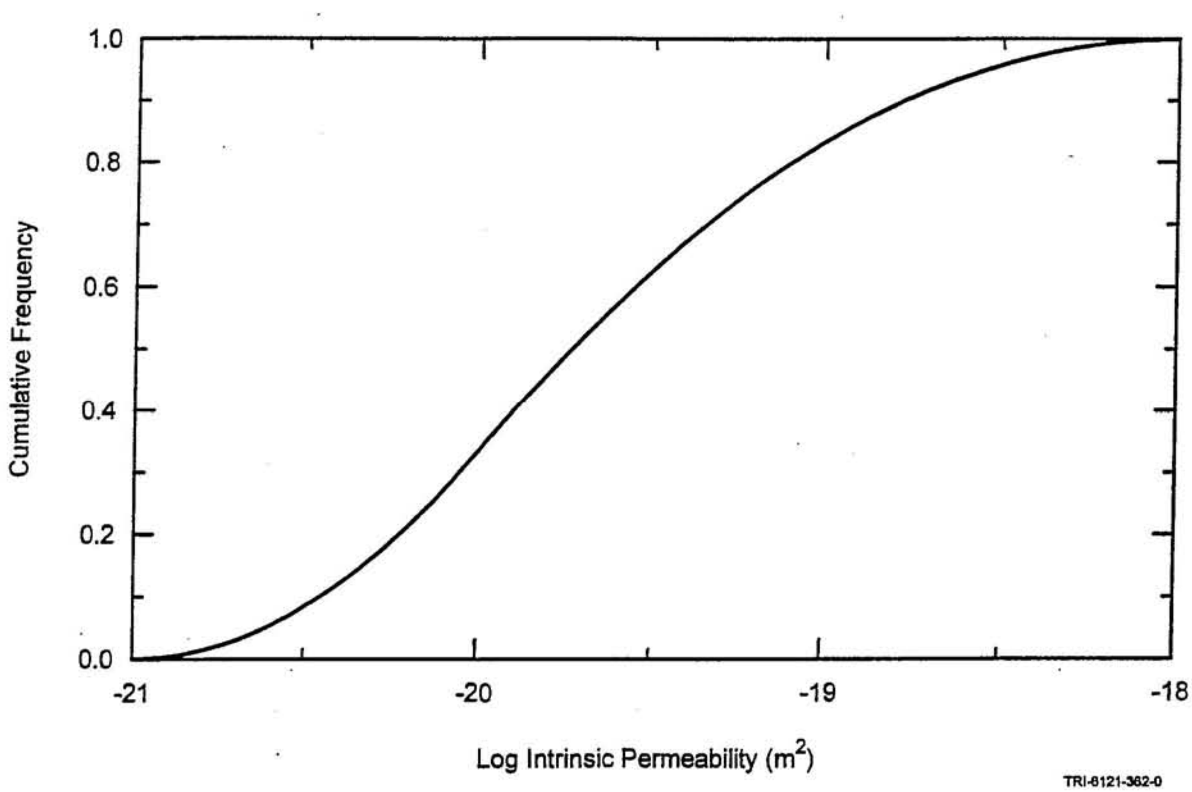
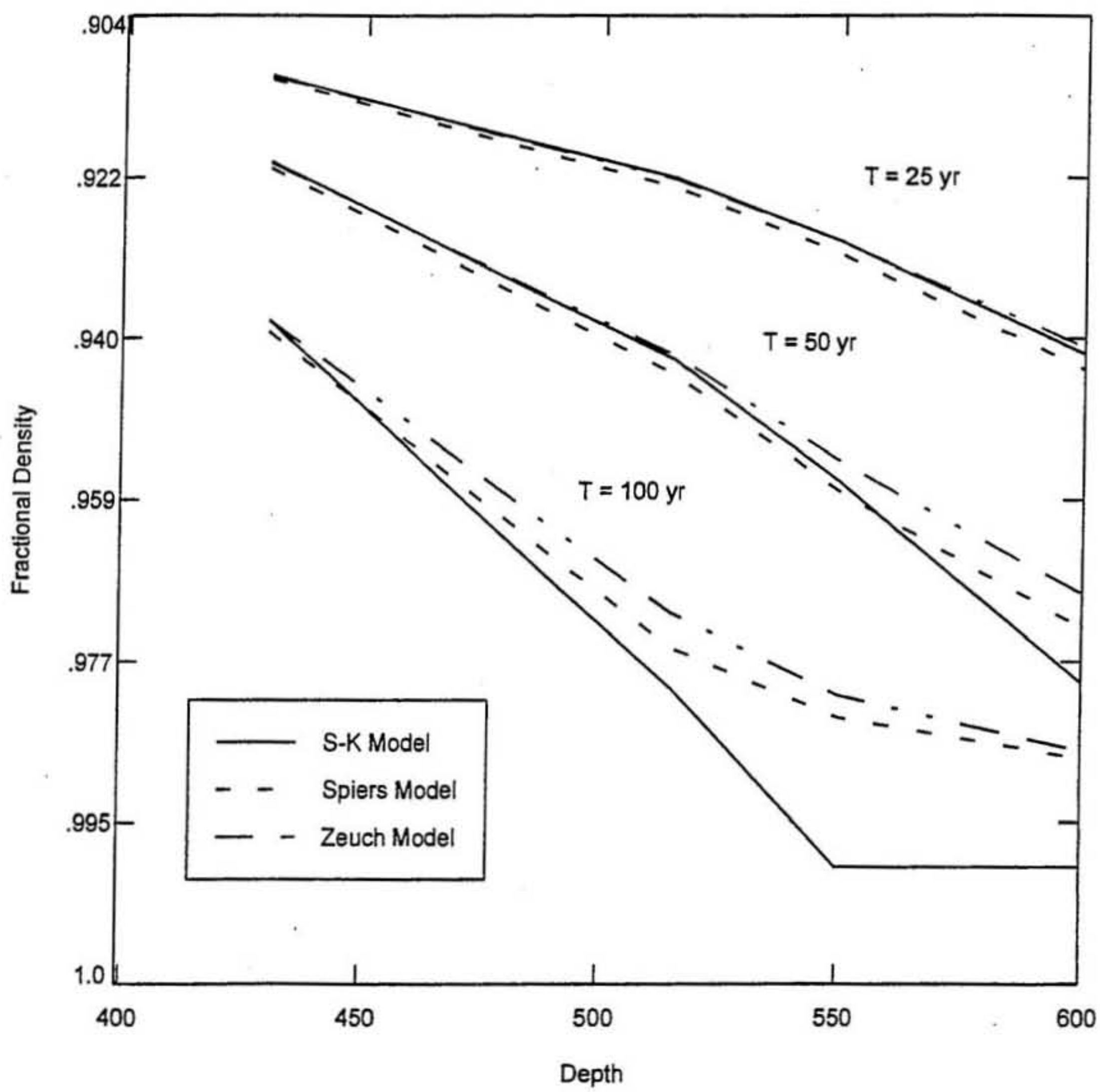


Figure I2A-5
Asphalt permeability cumulative frequency distribution function

1 

2 Figure I2A-6
3 Fractional density of the consolidating salt column

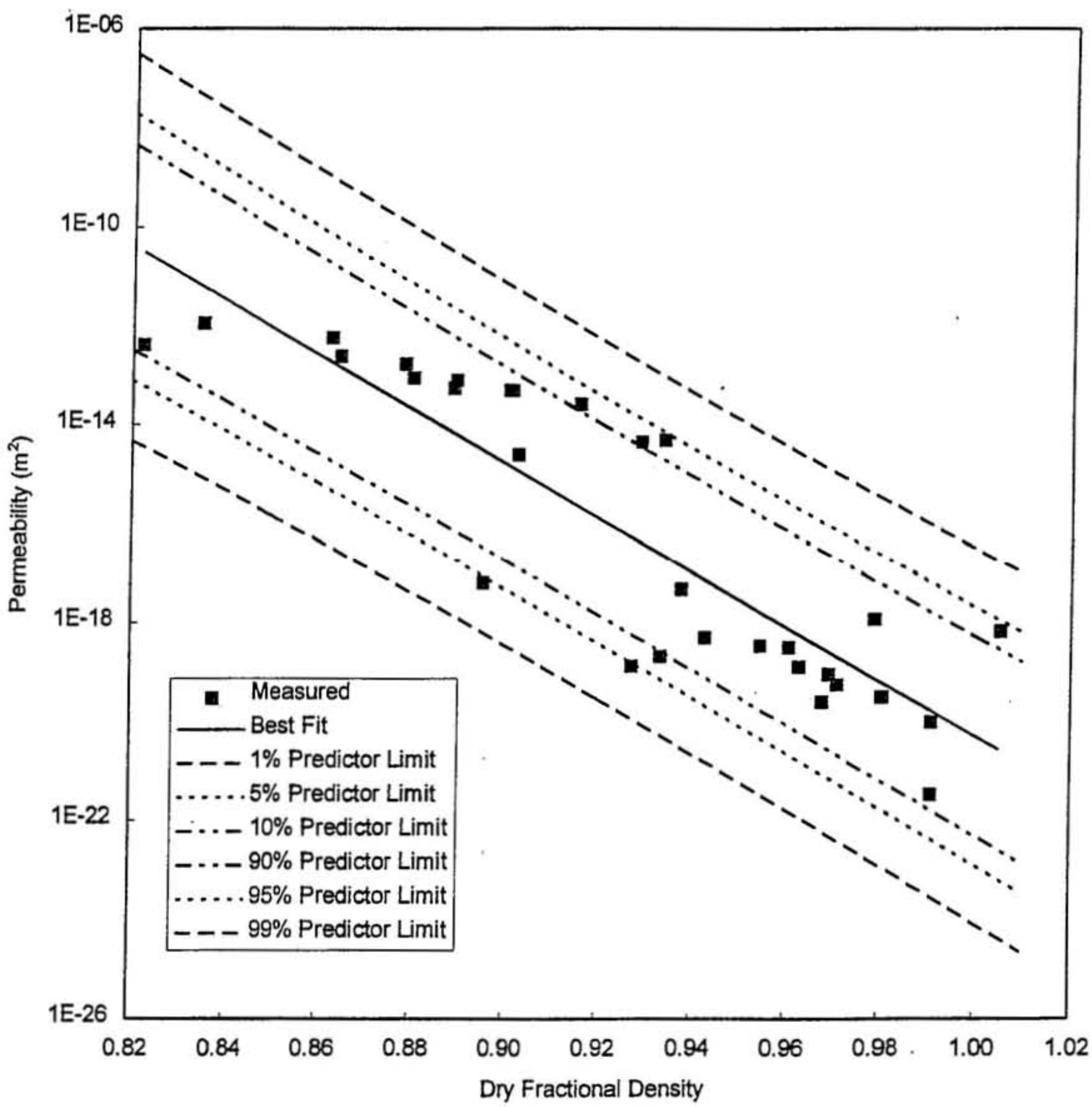


Figure I2A-7
Permeability of consolidated crushed salt as a function of fractional density

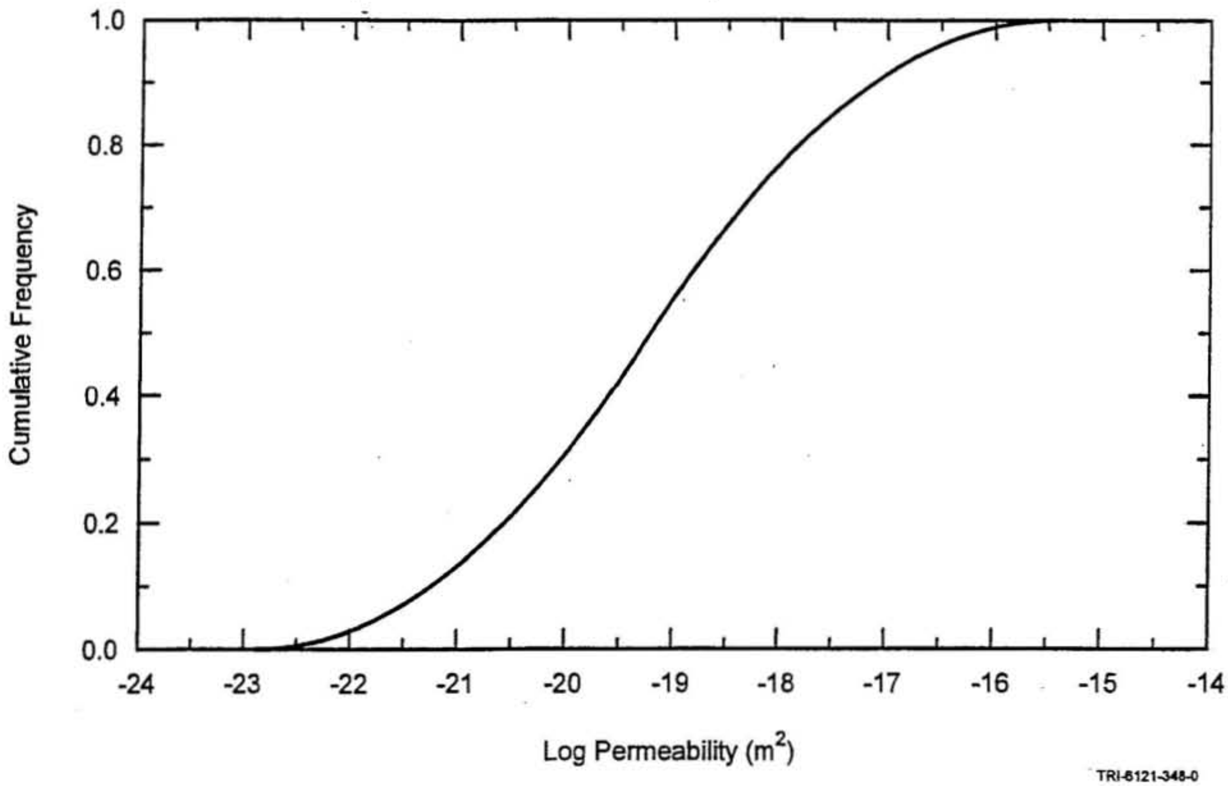


Figure I2A-8
Compacted salt column permeability cumulative frequency distribution function at seal midpoint 100 years following closure

APPENDIX I2
APPENDIX B

SHAFT SEALING CONSTRUCTION PROCEDURES

SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

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APPENDIX I2
APPENDIX B

SHAFT SEALING CONSTRUCTION PROCEDURES

SHAFT SEALING SYSTEM COMPLIANCE SUBMITTAL DESIGN REPORT

Appendix B Abstract

This appendix describes equipment and procedures used to construct the shaft seals as specified in Permit Attachment I2. Existing or reasonably modified construction equipment is specified, standard mining practices are applied, and a general schedule is provided at the end of this appendix. This appendix describes the following activities:

- pre-sealing activities for the sub-surface and surface,
- construction and operation of a multi-deck stage,
- installation of special concrete (sumps, shaft station monoliths, and concrete plugs),
- installation of compacted clay columns,
- emplacement and dynamic compaction of WIPP salt,
- installation of neat asphalt and asphaltic mastic mix,
- grouting of concrete plugs and the country rock behind existing shaft liners,
- removal of portions of the existing shaft liners, and
- emplacement of compacted earthen fill.

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Contents

Figures

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B1. Introduction

This appendix describes construction specifications for placement of shaft seal materials. Flexibility is incorporated in construction specifications to facilitate placement of several different material types. Engineering materials used to seal the full length of the shaft include earthen fill, compacted clay, tamped crushed salt, asphalt, concrete, and a combination of concrete and asphalt in concrete-asphalt waterstops. Appendix A of Permit Attachment I2 provides details of the materials. A full-length shaft seal of this type has never before been constructed; however, application of available technology and equipment, standard construction practices, and common materials provides confidence that the system can be placed to satisfy the design requirements.

A primary feature of the construction specification is development of a work platform from which seal materials are placed. Although the proposed multi-deck stage (galloway) proposed here is engineered specifically for shaft sealing operations, it is similar to stages used for construction of shafts. Inherently flexible, the multi-deck stage facilitates several construction methods required for the various materials specified for the shaft seal system. It provides an assembly of a slickline and header for transport of flowable materials from the surface to the placement horizon. A crane device is attached to the base of the stage to facilitate compaction, and an avenue through the stage provides a means to transport bulk material. It is understood that procedures specified here may change during the tens of years preceding construction as a result of equipment development, additional testing, or design changes. Further, it is acknowledged that the construction methods specified are not the only methods that could place the seal materials successfully.

A few assumptions are made for purposes of evaluating construction activities. These assumptions are not binding, but are included to assist discussion of general operational scenarios. For example, four multi-deck stages are specified, one for each shaft. This specification is based on shaft-sinking experience, which indicates that because of the wear encountered, it is advisable to replace rather than rebuild stages. However, much of the equipment on the multi-deck stage is reused. For scheduling purposes, it is assumed that sealing operations are conducted in two of the four shafts simultaneously. The Air Intake and Exhaust Shafts are sealed first, and the Waste and Salt Handling Shafts are sealed last. With this approach, shaft sealing will require about six and a half years, excluding related work undertaken by the WIPP Operating Contractor. Sealing the shafts sequentially would require approximately eleven and a half years. To facilitate discussion of scheduling and responsibilities, it is assumed that sealing operations will be conducted by a contractor other than the WIPP Operating Contractor.

Years from now, when actual construction begins, it is probable that alternatives may be favored. Therefore, construction procedures note alternative methods in recognition that changes are likely and that the construction strategy is sufficiently robust to accommodate alternatives. This appendix contains both general and very specific information. It begins with a discussion of general mobilization in Section 2. Details of the multi-deck construction stage are provided in Section 3. Section 4 contains descriptions of the construction activities. Information presented here is supplemented by several engineering drawings and sketches contained in Appendix E. The topical information and the level of provided detail substantiate the theory that reliable shaft seal construction is possible using available technology and materials.

B2. Project Mobilization

The duty descriptions that follow are for discussion purposes. The discussions do not presuppose contractual arrangements, but simply identify tasks necessary for shaft seal construction.

B2.1 Subsurface

Prior to initiation of sealing activities, the WIPP Operating Contractor will remove installations and equipment on the repository level. A determination of items removed will be made before construction begins. Such removal would include, but is not limited to, gates and fences at the shaft; equipment such as winches, ventilation fans, pipelines; and communication and power cables. Additionally, the following items will be removed from the shafts:

- cables, counterweights, and sheaves;
- existing waterlines; and
- electrical cables not required for sealing operations.

The following equipment will be stored near the shaft on the repository level by the Sealing Contractor prior to initiation of sealing activities:

- a concrete header, hopper, and pump;
- a concrete pump line to distribute concrete; and
- an auxiliary mine fan and sufficient flexible ventilation tubing to reach work areas required for installation of the shaft station concrete monolith.

The subsurface will be prepared adequately for placement of the shaft station monolith. Determination of other preparatory requirements may be necessary at the time of construction.

B2.2 Surface

The Operating Contractor will remove surface facilities such as headframes, hoists, and buildings to provide clear space for the Sealing Contractor. Utilities required for sealing activities (e.g., air compressors, water, electrical power and communication lines) will be preserved. The Sealing Contractor will establish a site office and facilities required to support the construction crews, including a change house, lamp room, warehouse, maintenance shop, and security provisions. Locations will be selected and foundations constructed for headframes, multi-deck stage winches, man/equipment hoist, and exhaust fan. A drawing in Appendix E (Sketch E-4) depicts a typical headframe and associated surface facilities. The hoist and winches will be enclosed in suitable buildings; utilities and ventilation ducting will be extended to the shaft collar. The large ventilation fan located near the collar is designed to exhaust air through the rigid ventilation duct, resulting in the movement of fresh air down the shaft. Air flow will be sufficient to support eight workers to the depth of the repository level. The following facilities will be procured and positioned near the shaft collar:

- a concrete batch plant capable of weighing, batching, and mixing the concrete to design specifications;
- a crushing and screening plant to process WIPP salt and local soil;
- an insulated and heated pug mill, asphalt pump, asphalt storage tank, and other auxiliary equipment; and
- pads, silos, and structures to protect sealing materials from the weather.

The Sealing Contractor will construct a temporary structural steel bulkhead over the shaft at the surface. The bulkhead will be sufficiently strong to support the weight of the multi-deck stage, which will be constructed on it. When the multi-deck stage is completed, the headframe will be erected. The headframe (depicted in Appendix E, Sketch E-3) will be built around the multi-deck stage, and a mobile crane will be required during fabrication. When the headframe is completed, cables for hoisting and lowering the multi-deck stage will be installed. Cables will run from the three winches, over the sheaves in the headframe, down and under the sheaves on the multi-deck stage, and up to anchors in the headframe. The headframe will be sufficiently high to permit the multi-deck stage to be hoisted until the lowest component is 3.05 m (10 ft) above surface. This will facilitate slinging equipment below the multi-deck stage and lowering it to the work surface, as well as activities required at the collar during asphalt emplacement.

The multi-deck stage will be lowered to clear the collar, allowing the installation of compressed-air-activated steel shaft collar doors, which will serve as a safety device, permitting safe access to the man cage and bucket, while preventing objects from falling down the shaft. Following installation of these doors, workers will utilize the multi-deck stage to traverse the shaft from the collar to the repository horizon, inspecting it for safety hazards and making any necessary repairs. After this inspection, the multi-deck stage will return to the surface.

B2.3 Installation of Utilities

In preparation for placement of shaft seal materials, requisite utilities will be outfitted for operations. The multi-deck stage will descend from the collar to the repository horizon. As added assurance against unwanted water, a gathering system similar to the one currently in place at the bottom of the concrete liner will be installed and moved upward as seal emplacement proceeds. Water collected will be hoisted to the surface for disposal. Additionally, any significant inflow will be located and minimized by grouting. After installation of the water gathering system, the following utilities will be installed from surface to the repository horizon by securely fastening them to the shaft wall:

- 5.1-cm steel waterline with automatic shut-off valves every 60 m;
- 10.2-cm steel compressed-air line;
- power, signal, and communications cables;

- 15.2 cm steel slickline and header; and
- a rigid, cylindrical, ventilation duct, which would range from 107 cm in diameter in the three largest shafts to 91 cm in diameter in the Salt Handling Shaft.

B3. Multi-Deck Stage

The multi-deck stage (galloway) provides a work platform from which all sealing operations except placement of asphalt are conducted. The concept of using a multi-deck stage is derived from similar equipment commonly employed during shaft sinking operations. Plan and section views of conceptual multi-deck stages are shown in Appendix E, Sketches E-1 and E-2. The construction decks specified here are modified from typical shaft sinking configurations in two important ways to facilitate construction. Conceptual illustrations of these two modifications are displayed in Figures I2B-1 and I2B-2. Figure I2B-1 illustrates the multi-deck performing dynamic compaction of salt. Figure I2B-2 illustrates the multi-deck stage configured for excavation of the kerf required for the asphalt waterstop in Salado salt.

A device called a polar crane mounted below the lower deck can be configured for either dynamic compaction or salt excavation. The crane can rotate 360º horizontally by actuating its geared track drive. Its maximum rotational speed will be approximately two revolutions per minute. The crane can be controlled manually or by computer (computerized control will swiftly position the tamper in the numerous drop positions required for dynamic compaction). When excavation for the concrete-asphalt waterstops is required, the tamper, electromagnet, and cable used for dynamic compaction will be removed, and a custom salt undercutter will be mounted on the polar crane trolley. Geared drives on the crane, trolley, and undercutter will supply the force required for excavation. In addition to the special features noted above and shown in Figures I2B-1 and I2B-2, the multi-deck stage has the following equipment and capabilities:

- Maximum hoisting/lowering speed is approximately 4.6 m (15 ft) per minute.
- A cable, electromagnet, and tamper will be attached to the polar crane during dynamic compaction. The cylindrical tamper consists of A-36 carbon steel plates bolted together with high-tensile-strength steel bolts. It is hoisted and dropped by the polar crane using the electromagnet. The tamper will be mechanically secured to the polar crane before personnel are allowed under it.
- Range-finding lasers will facilitate the accurate positioning of the multi-deck stage above the work surface and allow the operator to determine when the surface is sufficiently level. The distance indicated by each laser will be displayed on a monitor at the crane control station.
- Flood lights and remotely controlled closed-circuit television equipment will enable the crane operator to view operations below the multi-deck stage on a monitor.
- Fold-out floor extensions that accommodate the variance in shaft diameter between the unlined and lined portions of the shaft will be provided for safety.
- A cutout in each deck, combined with a removable section of the polar crane track, will permit stage movement without removal of the rigid ventilation duct (which is fastened to the shaft wall).

The multi-deck stage is equipped with many of the features found on conventional shaft sinking stages, such as:

- three independent hoisting/lowering cables,
- man and material conveyances capable of passing through the multi-deck stage and accessing the working surface below,
- a jib crane that can be used to service the working surface below,
- removable safety screens and railings, and
- centering devices.

Three sets of double locking devices are provided to secure the multi-deck stage to the shaft wall. A suitable factor of safety for these locking devices is judged to be 4. The area of the grips securing the deck is calculated from static principles:

$$FS = \mu(Co)(A)/W \qquad \text{(B-1)}$$

where:

FS	=	factor of safety
μ	=	steel/salt friction coefficient = 0.15 (see Table 20.1 in McClintock and Aragon, 1966; and Van Sambeek, 1988)
Co	=	compressive strength of WIPP salt, which varies from 172 kg/cm^2 to 262 kg/cm^2 (Van Sambeek, 1988)
W	=	total vertical weight
A	=	total gripper pad surface area.

Manipulating the equation to solve for required area, applying a factor of safety of 4, selecting the heaviest work stage (753,832 kg) and the minimum compressive strength value for salt (assuming that the locking pressure equals the minimum compressive strength of salt), the following gripper surface area (A) is:

A = 4(753,832 kg)/0.15(172 kg/cm^2) = 11,416.5 cm^2, and each of the six gripper pads would be 1902.8 cm^2.

As designed, each gripper pad area is 2167.2 cm^2, resulting in a factor of safety (FS) of 4.56. Additionally, although tension in the hoisting cables is relaxed while the multi-deck stage is in the locked configuration, the cables are still available to hold the work-deck, should the locking devices fail.

B4. Placement of Sealing Materials

Construction activities include placement of materials in three basic ways: (1) by slickline (e.g., concrete and asphalt), (2) by compaction (e.g., salt and earthen fill), and (3) by physical placement (e.g., clay blocks). Materials will be placed at various elevations using identical procedures. Because placement procedures generally are identical regardless of elevation, they will be described only once. Where differences occur, they will be identified and described. In general, placement of shaft seal elements is described from bottom to top.

B4.1 Concrete

Concrete is used as a seal material for several different components, such as the existing sumps in the Salt Handling Shaft and the Waste Shaft, the shaft station monoliths, concrete plugs, and concrete-asphalt waterstops. Existing sumps are shown in Appendix E, Drawings SNL-007, Sheets 6 and 21. Shaft station monoliths are shown in Drawings SNL-007, Sheets 6, 11, 16, and 21. Concrete plugs are depicted on Drawings SNL-007, Sheets 4, 5, 9, 10, 14, 15, 19, and 20. Lower, middle, and upper concrete-asphalt waterstops are shown in Drawing SNL-007, Sheet 22. Construction material for all concrete members will be Salado Mass Concrete (SMC).

As specified, all SMC will be mixed on surface to produce a product possessing the characteristics defined in Appendix A. Concrete will be transferred to its placement location within the shaft via slickline and header. The slickline (shown in Figure I2B-1) is a steel pipe fastened to the shaft wall. Vertical drops as great as 656 m to the repository horizon are required. Such concrete transport and construction are common in mining applications. For example, a large copper mine in Arizona is placing concrete at a depth of 797 m using this procedure. A header attached to the bottom of the slickline is designed to absorb kinetic energy generated by the falling material. The header, a steel pipe slightly larger in diameter than the slickline and made of thicker steel, diverts the flow 45°, absorbing most of the impact. Because the drop generates considerable force, the header will be securely supported by a reinforced steel shelf bolted to the shaft wall. A flexible hose, in sections approximately 3 m long and joined by quick-connect fittings, will be attached to the header.

B4.1.1 Shaft Station Monolith

Construction of the shaft station monoliths is preceded by filling two existing sumps with SMC. Initially, sufficient hose will be used to convey the concrete to the bottom of the sump. The discharge will remain below the concrete surface during placement to minimize air entrainment. Sections of hose will be withdrawn and removed as the SMC rises to the floor of the repository horizon in a continuous pour. Subsequent to filling the sump, arrangements will be made to place the concrete monolith.

A small mine fan will be located above the rigid suction-duct inlet to ensure a fresh air base. Masonry block forms will be constructed at the extremities of the shaft station monolith in the drifts leading from the station. Temporary forms, partially filling the opening, will be erected at the shafts to facilitate the placement of the outermost concrete. These temporary forms will permit access necessary to ensure adequate concrete placement. SMC will be transported via the slickline to the header, which will discharge into a hopper feeding the concrete pump, and the pump will be attached to the pumpcrete line. The pumpcrete line, suspended in cable slings near the back of the drifts, will be extended to the outer forms. A flexible hose, attached to the end of the pumpcrete line, will be used by workers to direct emplacement. The pumpcrete line will be withdrawn as emplacement proceeds toward the shaft.

When the concrete has reached the top of the temporary forms, they will be extended to seal the openings completely, and two 5-cm-diameter polyvinyl chloride (PVC) pipes will be incorporated in the upper portion of each form. Both pipes will be situated in a vertical plane oriented on the long axis of the heading and inclined away from the station at approximately 70° to the horizontal. The upper end of the top pipe will extend to just below the back, and the upper end of the lower pipe will be located just below that of the top pipe. SMC will be injected through the lower pipe until return is obtained from the upper pipe, ensuring that the heading has been filled to the back. The header will then be moved to a position in the shaft above the designed elevation at the top of the shaft station monolith and supported by a bracket bolted to the shaft wall. After the outer concrete has achieved stability, the temporary interior forms may be removed. Equipment no longer required will be slung below the multi-deck stage and hoisted to surface for storage and later use. The station and shaft will be filled to design elevation with concrete via the slickline, header, and flexible hose. The slickline is cleaned with spherical, neoprene swabs (“pigs”) that are pumped through the slickline, header, and hose.

B4.1.2 Concrete-Asphalt Waterstops

Lower, middle, and upper concrete-asphalt waterstops in a given shaft are identical and consist of two SMC sections separated by an asphalt waterstop. Before the bottom member of the lower concrete component is placed, the multi-deck stage will be raised into the headframe; the polar crane will be mounted below the lower deck; and the salt undercutter will be mounted on the crane trolley. The multi-deck stage will then return to the elevation of the concrete component. Two undercutter bars will be used to make the necessary excavations for upper, middle, and lower asphalt-concrete waterstops and the concrete plug above the Salado Formation. Notches for the plugs will be excavated using a short, rigid cutter bar (length less than half the radius). The kerf for the asphalt waterstop will be excavated using a long cutter bar that can excavate the walls to a depth of one shaft radius. These operations will be conducted as required as seal placement proceeds upward.

The lower concrete member (and all subsequent concrete entities) will be placed via the slickline, header, and flexible hose, using the procedure outlined for the shaft station monolith. Construction of vertical shaft seals provides the ideal situation for minimizing interface permeability between the rock and seal materials. Concrete will flow under its own weight to provide intimate contact. A tight cohesive interface was demonstrated for concrete in the small-scale seal performance tests (SSSPTs). The SSSPT concrete plugs were nearly impermeable without grouting. However, interface grouting is usually performed in similar construction, and it will be done here in the appropriate locations.

B4.1.3 Concrete Plugs

An SMC plug, keyed into the shaft wall, is situated a few meters above the upper Salado contact in the Rustler Formation. A final SMC plug is located a few meters below surface in the Dewey Lake Redbeds. This plug is emplaced within the existing shaft liner using the same construction technique employed for the concrete-asphalt waterstops.

B4.2 Clay

B4.2.1 Salado and Rustler Compacted Clay Column

Blocks of sodium bentonite clay, precompacted to a density of 1.8 to 2.0 g/cm^3, will be the sealing material. This density has been achieved at the WIPP using a compaction pressure of 492.2 kg/cm^2 in a machine designed to produce adobe blocks (Knowles and Howard, 1996). Blocks are envisioned as cubes, 20.8 cm on the edge, weighing approximately 18 kg, a reasonable weight for workers to handle. The bentonite blocks will be compacted at the WIPP in a new custom block-compacting machine and will be stored in controlled humidity to prevent desiccation cracking. Blocks will be transported from surface in the man cage, which will be sized to fit through the circular “bucket hole” in the multi-deck stage. The conveyance will be stacked with blocks to a height of approximately 1.8 m.

Installation will consist of manually stacking individual blocks so that all interfaces are in contact. Block surfaces will be moistened with a spray of potable water as the blocks are placed to initiate a minor amount of swelling, which will ensure a tight fit and a decrease in permeability. Peripheral blocks will be trimmed to fit irregularities in the shaft wall and placed as close to the wall as possible. Trimmed material will be manually removed with a vacuum. Dry bentonite will be manually tamped into remaining voids in each layer of blocks. This procedure will be repeated throughout the clay column. The multi-deck stage will, in all cases, be raised and utilities removed to the surface as emplacement of sealing materials proceeds upward.

Dynamic compaction construction is an alternative method of clay emplacement that could be considered in the detailed design. Dynamic compaction materials being considered are:

- sodium bentonite/fine silica sand, and
- highly compressed bentonite pellets.

Boonsinsuk et al. (1991) developed and tested a dynamic (drop hammer) method for a relatively large diameter (0.5-m) hole, simulated with a steel cylinder, that gave very good results on 1 : 1 dry mass mixtures of sodium bentonite and sand, at a moisture content of 17% to 19%. The alternatives have the advantages of simplifying emplacement.

B4.3 Asphalt

Asphalt, produced as a distillate of petroleum, is selected as the seal material because of its longevity, extremely low permeability, history of successful use as a shaft lining material, and its ability to heal if deformed. Shielded from ultraviolet radiation and mixed with hydrated lime to inhibit microbial degradation, the longevity of the asphalt will be great. Emplaced by tremie line at the temperature specified, the material will be fluid and self-leveling, ensuring complete contact with the salt.

Construction of an asphalt column using heated asphalt will introduce heat to the surrounding salt. The thermal shock and heat dissipation through the salt has not been studied in detail.

Performance of the asphalt column may be enhanced by the introduction of the heat that results from acceleration of creep and healing of microfractures. If, upon further study, the thermomechanical effects are deemed undesirable or if an alternative construction method is preferred at a later date, asphalt can readily be placed as blocks. Asphalt can “cold flow” to fill gaps, or the seams between blocks can be filled with low-viscosity material.

B4.3.1 Concrete-Asphalt Waterstops

Electrically insulated, steel grated flooring will be constructed over the shaft at the surface. A second, similar flooring will be built in the shaft 3 m below the first. These floors will be used only during the emplacement of asphalt and asphaltic mastic mix (AMM) and will be removed at all other times. A 12.7-cm ID/14-cm OD, 4130 steel pipe (tremie line) in 3-m lengths will be electrically equipped for impedance heating, then insulated and suspended in the shaft from slips (pipe holding devices) situated on the upper floor. The tremie line cross-sectional area is smallest at the shoulder of the top thread, where tensional yield is 50,000 kg; the line weight is 20.8 kg/m. Heavier weights are routinely suspended in this manner in the petroleum and mining industries.

Neat, AR-4000-graded petroleum-based asphalt cement will be the sealing material for asphalt waterstops. Neat asphalt from the refinery will be delivered to the WIPP at approximately 80°C in conventional, insulated refinery trucks and pumped into a heated and insulated storage tank located near the shaft. The multi-deck stage will be hoisted into the headframe and mechanically secured for safety. Asphalt, heated to 180°C ±5°, will be pumped down the shaft to the fill elevation through the heated tremie line. Viscosity of the neat asphalt for the waterstops will be sufficiently low to allow limited penetration of the DRZ. Installation of asphalt in each of the concrete-waterstops is identical.

As the pipe is lowered, workers on the lower deck will attach the wiring required for heating circuits and apply insulation. Workers on the top deck will install flanged and electrically insulated couplings as required (the opening in the slip bowl will be large enough to permit the passage of these couplings). Properly equipping and lowering the pipe should progress at the rate of one section every 10 minutes. The lower asphalt waterstop requires approximately 607 m of pipe for a casing weight of 12,700 kg. Additionally, electrical wire and insulation will weigh about 7250 kg for a total equipped tremie line weight of 20,000 kg. Therefore, the safety factor for the tremie line is 50,000 kg/20,000 kg, or 2.5.

To minimize air entrainment, the lower end of the tremie line will be immersed as much as 1 m during hot asphalt emplacement. Therefore, the lower 3 m of casing will be left bare (to simplify cleaning when emplacement has been completed).

Initially the tremie line will be lowered until it contacts the concrete plug (immediately underlying the excavation for the waterstop) and then raised approximately 0.3 m. Asphalt emplacement will proceed as follows:

- The impedance heating system will be energized, heating the tremie line to 180°C ±5°, and the asphalt in the storage tank will be heated to approximately 180°C ±5°.

- Heated, neat asphalt will be pumped down the tremie line at a rate approximating 13 L/min. This low rate will ensure that the asphalt flows across the plug from the insertion point, completely filling the excavation and shaft to the design elevation.
- The tremie line will be raised 3 m and cleaned by pumping a neoprene swab through it with air pressure. Impedance heating will be stopped, and the line will be allowed to cool. When cool, the line will be hoisted, stripped, cleaned, disassembled, and stored for future use.

Sealing operations will be suspended until the air temperature at the top of the asphalt has fallen to approximately 50°C for the comfort of the workers when they resume activity at the fill horizon. Temperature will be determined by lowering a remotely read thermometer to an elevation approximately 3 m above the asphalt at the center of the shaft. The temperature of the asphalt at the center of the shaft will be 50°C in about a month, but active ventilation should permit work to resume in about two weeks (see calculations in Appendix D of Appendix I2 in the permit application, which is not included in the Permit).

When sufficient cooling has occurred, workers will descend in the multi-deck stage and cover the hot asphalt with an insulating and structural material such as fiber-reinforced shotcrete, as illustrated in Figure I2B-3. To accomplish this, they will spray cementitious shotcrete containing fibrillated polypropylene fibers (for added tensional strength), attaining a minimum thickness of approximately 0.6 m.

B4.3.2 Asphaltic Mastic Mix Column

Asphaltic mastic mix (AMM) for the column will be prepared on surface in a pug mill. Viscosity of the AMM can be tailored to provide desired properties such as limited migration into large fractures.

- AMM will be prepared by mixing the ingredients in the pug mill, which has been heated to 180°C ±5°. The mix will be pumped from the pug mill through the tremie line to the emplacement depth. AMM is self-leveling at this temperature, and its hydrostatic head will ensure intimate contact with the shaft walls.
- Pumping rate will be approximately 200 L/min for efficiency, because of the larger volume (approximately 1,224,700 L in the Air Intake Shaft). To facilitate efficient emplacement and avoid air entrainment, the tremie line will not be shortened until the mix has filled 6 vertical meters of the shaft. Back pressure (approximately 0.84 kg/cm^2) resulting from 6 m of AMM above the discharge point will be easily overcome from surface by the hydraulic head.

After 6 vertical meters of AMM have been placed:

- Impedance heating current will be turned off and locked out (the hot line will drain completely).
- To prevent excessive back pressure resulting from AMM above the insertion point, the line will be disconnected from the pump and hoisted hot. Two sections will be stripped, removed, cleaned with a “pig,” and stacked near the shaft.
- Electrical feed will be adjusted (because of the decreased resistance of the shortened line).
- The tremie line will be reconnected to the pump.
- The impedance heating system will be energized.
- When the temperature of the line has stabilized at 180ºC ±5º, pumping will resume.

This procedure will be followed until the entire column, including the volume computed to counteract 0.9 m of vertical shrinkage (calculations in Appendix D of Appendix I2 in the permit application), has been placed. The line will be disconnected from the pump and cleaned by pumping “pigs” through it with air pressure. It will then be hoisted, stripped, removed in 3-m sections, and stacked on surface for reuse.

Sealing operations will be suspended following removal of the tremie line, and ventilation will be continuous to speed cooling. The column will shrink vertically but maintain contact with the shaft walls as it cools. When the air temperature at 3 m above the asphalt has cooled sufficiently, workers will descend on the multi-deck stage and cover the hot asphalt with fibercrete as described for the concrete-asphalt waterstop (Section B4.3.1) and illustrated in Figure I2B-3.

Note: Near the top of the Salado Formation, portions of the concrete liner key, chemical seal rings, and concrete and steel shaft liners will be removed. Liner removal will occur before emplacement of AMM. For safety, exposed rock will be secured with horizontal, radial rock bolts and cyclone steel mesh. A range-finding device, fastened to the shaft wall approximately 3 m above the proposed top of the asphaltic column, will indicate when the hot AMM reaches the desired elevation. A remotely read thermometer, affixed to the shaft wall approximately 2 m above the proposed top of the column, will show when the air temperature has fallen sufficiently to resume operations. The intake of the rigid ventilation duct will be positioned approximately 3 m above the proposed top of the column, and ventilation will be continuous throughout emplacement and cooling of the asphaltic column. After the multi-deck stage has been hoisted into the headframe and mechanically secured for safety, emplacement of AMM will proceed.

B4.4 Compacted Salt Column

Crushed, mine-run salt, dynamically compacted against intact Salado salt, is the major long-term shaft seal element. As-mined WIPP salt will be crushed and screened to a maximum particle dimension of 5 mm. The salt will be transferred from surface to the fill elevation via the slickline and header. A flexible hose attached to the header will be used to emplace the salt, and a calculated weight of water will be added. After the salt has been nominally leveled, it will be dynamically compacted. Dynamic compaction consists of compacting material by dropping a tamper on it and delivering a specified amount of energy. The application of three times Modified Procter Energy (MPE) to each lift (one MPE equals 2,700,000 Joules/m^3) will result in compacting the salt to 90% of the density of in-place rock salt.

Approximately 170 vertical meters of salt will be dynamically compacted. Dynamic compaction was validated in a large-scale demonstration at Sandia National Laboratories during 1995. As-mined WIPP salt was dynamically compacted to 90% density of in-place rock salt in a cylindrical steel chamber simulating the Salt Handling Shaft (Ahrens and Hansen, 1995). Depth of compaction is greater than that achieved by most other methods, allowing the emplacement of thicker lifts. For example, dropping the 4.69 metric ton tamper 18 m (as specified below) results in a compaction depth of approximately 4.6 m, allowing emplacement of lifts 1.5-m high. Most other compaction methods are limited to lifts of 0.3 m or less. Lift thickness will be increased and drop height decreased for the initial lift above the concrete plug at the base of the salt column to ensure that the concrete is not damaged. Drop height for the second and third lifts will be decreased as well. Although the tamper impact is thereby reduced, three MPE will be delivered to the entire salt column.

If lifts are 1.5-m thick, the third lift below the surface will receive additional densification during compaction of overlying lifts, and this phenomenon will proceed up the shaft. Construction will begin by hoisting the multi-deck stage to the surface and attaching the cable, electromagnet, and tamper to the hoist on the polar crane. The multi-deck assembly will be lowered to the placement elevation, and moisture content of the crushed and screened salt will be calibrated. Then the salt will be conveyed at a measured rate via a weighbelt conveyor to a vibrator-equipped hopper overlying the 15.2-cm ID slickline. The salt will pass down the slickline and exit a flexible hose connected to the header. A worker will direct the discharge so that the upper surface of the lift is nominally level and suitable for dynamic compaction. A second worker will add potable water, in the form of a fine spray, to the salt as it exits the hose. Water volume will be electronically controlled and coordinated with the weight of the salt to achieve the desired moisture content.

The initial lift above the SMC will be 4.6 m, and drop height will be 6 m. This increased lift thickness and reduced drop height are specified to protect the underlying SMC plug from damage and/or displacement from tamper impact. Compaction depth for a drop height of 6 m is approximately 3.7 m. Ultimately, the tamper will be dropped six times in each position, resulting in a total of 132 drops per lift in the larger shafts. The drop pattern is shown in Figure I2B-4. A salt lift 1.5 m high will then be placed and leveled. Following compaction of the initial lift, the multi-deck stage will be positioned so the base of the hoisted tamper is 10 m above the surface of the salt.

The multi-deck stage will then be secured to the shaft walls by activating hydraulically powered locking devices. Hydraulic pressure will be maintained on these units when they are in the locked position; in addition, a mechanical pawl and ratchet on each pair will prevent loosening. The safety factor for the locking devices has been calculated to be approximately 4.5. After locking, tension in the hoisting cables will be relaxed, and centering rams will be activated to level the decks. Prior to positioning the stage, tension will be applied to the hoisting cables; the centering rams will be retracted; and the locking devices will be disengaged.

The work deck will be hoisted until the base of the retracted tamper is 23 m above the surface of the salt, where it will be locked into position and leveled as described above. This procedure, repeated throughout the salt column, allows emplacement and compaction of three lifts (1.5-m thick) per multi-deck stage move. Depth of compaction for a drop height of 18 m is approximately 4.6 m. Therefore the third lift below the fill surface will receive a total of 9 MPE (274,560 m kg/m^3), matching the energy applied in the successful, large-scale demonstration.

The compactive effect expands laterally as it proceeds downward from the base of the tamper and will effectively compact the salt into irregularities in the shaft wall, as demonstrated in the large-scale demonstration. Although other techniques could be used, dynamic compaction was selected because it is simple, can be used in the WIPP shafts, and has been demonstrated (Hansen and Ahrens, 1996).

The tamper will be dropped from the hoisted position by turning off the power to the electromagnet. Immediately upon release, the crane operator will "chase" the tamper by lowering the electromagnet at twice hoisting speed; the magnet will engage the tamper, allowing it to be hoisted for the subsequent drop. Initially, the tamper will be dropped in positions that avoid impact craters caused by preceding drops. The surface will then be leveled manually and the tamper dropped in positions omitted during the previous drop series.

Experience gained during the large-scale salt compaction demonstration indicated that a considerable volume of dust is generated during the emplacement of the salt, but not during dynamic compaction. However, because the intake of the rigid vent duct is below the multi-deck stage, workers below the stage will wear respirators during emplacement. They will be the only workers affected by dust during dynamic compaction.

The Air Intake Shaft will require 22 drop positions (Figure I2B-4). Application of one MPE requires six drops in each position, for a total of 132 drops per lift. Three MPE, a total of 396 drops per lift, will be applied to all salt. After each compaction cycle, the salt surface will be leveled manually and the tamper will be dropped in positions omitted in the preceding drop series. Two lifts, each 1.8 m high, will then be sequentially placed, leveled, and compacted with two MPE, using a 6-m drop height.

Dynamic compaction ensures a tight interface. Salt compacted during the large-scale dynamic compaction demonstration adhered so tenaciously to the smooth interior walls of the steel compaction chamber that grinders with stiff wire wheels were required for its removal.

B4.5 Grout

Ultrafine sulfate-resistant cementitious grout (Ahrens et al., 1996) is selected as the sealing material. Specifically developed for use at the WIPP, and successfully demonstrated in an in situ test, the hardened grout has a permeability of 1×10^{-21} m^2. It has the ability to penetrate fractures smaller than 6 microns and is being used for the following purposes:

- to seal many of the microfractures in the DRZ and ensure a tight interface between SMC and the enclosing rock, and
- to solidify fractured rock behind existing concrete shaft liners, prior to removal of the liner (for worker safety).

The interface between concrete plugs in the Salado Formation (and one in the Rustler Formation, a short distance above the Salado) will be grouted. A 45º downward-opening cone of reverse circulation diamond drill holes will be collared in the top of the plugs, drilled in a spin pattern (see Figure I2B-5), and stage grouted with ultrafine cementitious grout at 3.5 kg/cm^2 below lithostatic pressure. Stage grouting consists of:

- drilling and grouting primary holes, one at a time;
- drilling and grouting secondary holes, one at a time, on either side of the primary holes that accepted grout; and
- (if necessary) drilling and grouting tertiary holes on either side of secondary holes that accepted grout.

Note: For safety, all liner removal tasks will be accomplished from the bottom deck. In areas where the steel liner is removed, it will be cut into manageable pieces with a cutting torch and hoisted to the surface for disposal. Mechanical methods will be employed to clean and roughen the existing concrete shaft liner before placing the Dewey Lake SMC plug in the shafts.

The work sequence will start 3 m below the lower elevation of liner removal. A 45° upward-opening cone of grout injection holes, drilled in a "spin" pattern (Figure I2B-6), will be drilled to a depth subtending one shaft radius on a horizontal plane. These holes will be stage grouted as described in Section 4.5. Noncoring, reverse circulation, diamond drill equipment will be used to avoid plugging fractures with fine-grained diamond drill cuttings. Ultrafine cementitious grout will be mixed on the surface, transferred via the slickline to the upper deck of the multi-deck stage, and injected at 3.5 kg/cm^2 gage below lithostatic pressure to avoid hydrofracturing the rock. Grout will be transferred in batches, and after each transfer, a "pig" will be pumped through the slickline and header to clean them. Grouting will proceed upward from the lowest fan to the highest. Recent studies conducted in the Air Intake Shaft (Dale and Hurtado, 1996) show that this hole depth exceeds that required for complete penetration of the Disturbed Rock Zone (DRZ). Maximum horizontal spacing at the ends of the holes will be 3 m.

The multi-deck stage will then be raised 3 m and a second fan, identical to the first, will be drilled and grouted. This procedure will continue, with grout fans 3 m apart vertically, until the highest fan, located 3 m above the highest point of liner removal, has been drilled and grouted. Ultrafine cementitious grout was observed to penetrate more than 2 m in the underground grouting experiment conducted at the WIPP in Room L-3 (Ahrens and Onofrei, 1996).

When grouting is completed, the multi-deck stage will be lowered to the bottom of the liner removal section and a hole will be made through the concrete liner. This hole, approximately 30 cm in diameter, will serve as "free-face" to which the liner will be broken. Similar establishment and utilization of free face is a common practice in hard rock mining (e.g., the central drill hole in a series drilled into the rock to be blasted is left empty and used as free-face to which explosives in adjacent holes break the rock). Radial, horizontal percussion holes will be drilled on a 30-cm grid (or less, if required), covering the liner to be removed. Hydraulic wedges, activated in these holes, will then break out the liner, starting adjacent to the free face and progressing away from it, from the bottom up. Broken fragments of the concrete liner will fall to the fill surface below.

A mucking "claw," suspended from the trolley of the polar crane, will collect the broken concrete and place it in the bucket for removal to the surface. As many as three buckets can be used to speed this work.

B4.6 Compacted Earthen Fill

Local soil, screened to a maximum particle dimension of 13 mm, will be placed and compacted to inhibit the migration of surficial water into the shaft cross section. Such movement is further decreased by a 12-m high SMC plug at the top of the Dewey Lake Redbeds.

B4.6.1 Lower Section

Emplacement of the compacted earthen fill will proceed as follows:

- Moisture content of the screened soil will be determined.
- The soil will then be transferred via the slickline, header, and flexible hose from surface to the fill elevation. The moisture content optimal for compaction will be achieved using the same procedure as described for compacted salt (Section B4.4). The soil will be emplaced in lifts 1.2 m high (depth of compaction is approximately 3.7 m) and dynamically compacted using a drop height of 18.3 m.
- The fill will be dynamically compacted until its hydraulic conductivity to water is nominally equivalent to that of the surrounding formation.

This procedure will continue until the lower section has been emplaced and compacted. Care will be exercised at the top of the column to ensure that all soil receives sufficient compaction.

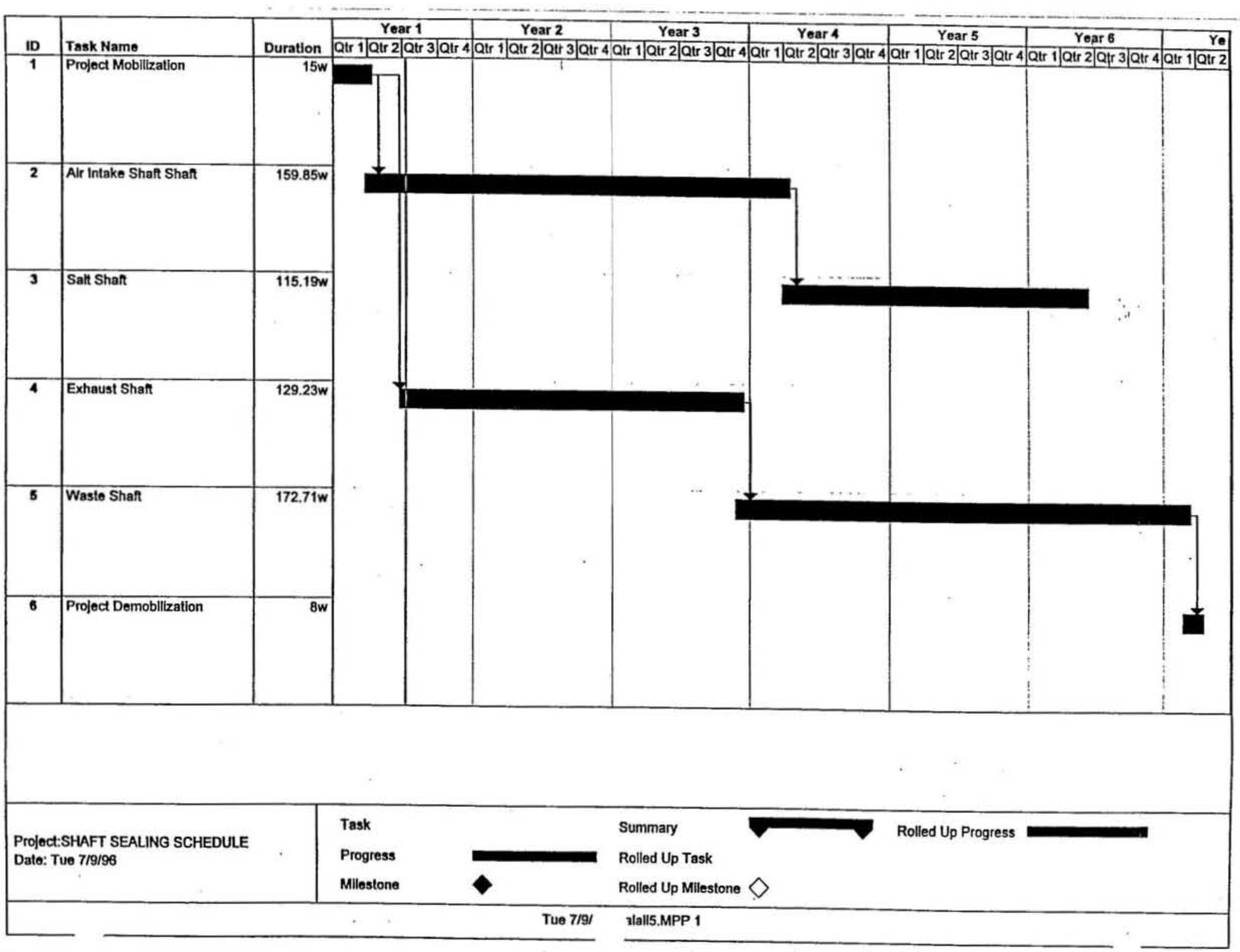
B4.6.2 Upper Section

The upper section contains insufficient room to employ dynamic compaction. Therefore the screened soil, emplaced as described above, will be compacted by vibratory-impact sheepsfoot roller, vibratory sheepsfoot roller, or a walk-behind vibratory-plate compactor. Because of the limited compaction depth of this equipment, lifts will be 0.3 m high. The top of the fill will be coordinated with the WIPP Operating Contractor to accommodate plans for decommissioning surface facilities and placing markers.

B4.7 Schedule

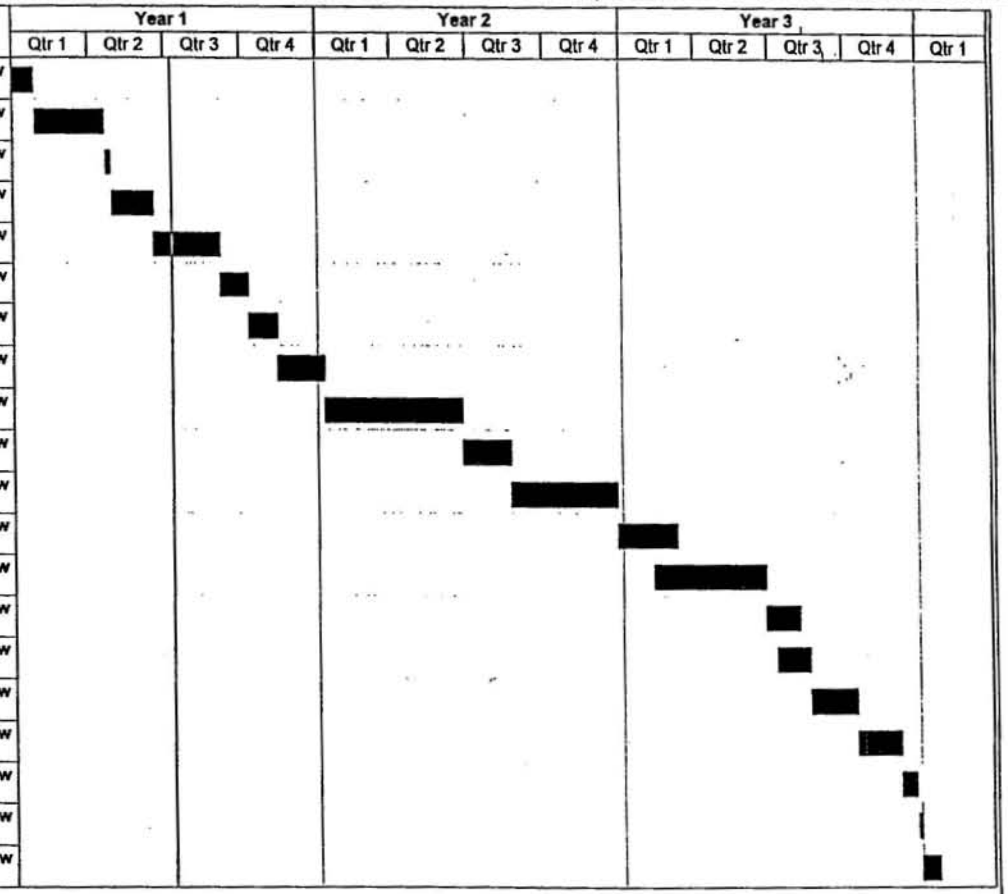
Preliminary construction schedules are included on the following pages. The first schedule is a concise outline of the total construction schedule. It is followed by individual schedules for each shaft. The first schedule in each shaft series is a truncated schedule showing the major milestones. The truncated schedules are followed by detailed construction schedules for each shaft. These schedules indicate that it will take approximately six and a half years to complete the shaft sealing operations, assuming two shafts are simultaneously sealed.

SEALING SCHEDULE - ALL SHAFTS


ID
Task Name
Duration
Year 1
Year 2
Year 3
Year 4
Year 5
Year 6
Ye
Qtr 1 Qtr 2 Qtr 3 Qtr 4
1 Project Mobilization 15w
2 Air Intake Shaft Shaft 159.85w
3 Salt Shaft 115.19w
4 Exhaust Shaft 129.23w
5 Waste Shaft 172.71w
6 Project Demobilization 8w
Project:SHAFT SEALING SCHEDULE
Date: Tue 7/9/96
Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
Tue 7/9/
alall5.MPP 1

SEALING SCHEDULE – AIR INTAKE SHAFT

ID	Task Name	Duration
1	Mobilization	4w
3	Plant Set-up	12w
5	Inspect & Scale Shaft-2151'	1w
7	Install Construction Utilities	7.17w
9	Drill & Grout Lining	11.5w
11	Shaft Station Monolith-37'	4.78w
15	Lower Salado Compacted Clay Column-93.5'	4.96w
17	Lower Concrete-Asphalt Waterstop-50'	8.25w
26	Compacted Salt Column-563.5'	23.58w
28	Middle Concrete-Asphalt Waterstop-50'	8.25w
37	Upper Salado Compacted Clay Column-344'	18.24w
39	Upper Concrete-Asphalt Waterstop-50'	10.25w
48	Asphalt Column-138.3'	19.41w
56	Concrete Plug-20'	5.99w
61	Remove Concrete Shaft Lining	5.71w
63	Rustler Compacted Clay Column-234.7'	8.36w
65	Compacted Earthen Fill-473'	7.59w
67	Concrete Plug-40'	2.96w
71	Compacted Earthen Fill-57'	0.65w
73	Demobilization	3.2w



Project: AIR INTAKE SHAFT
SEALING SCHEDULE
Date: Tue 7/9/96

Task | Summary | Rolled Up Progress
Progress | Rolled Up Task
Milestone | Rolled Up Milestone ◇

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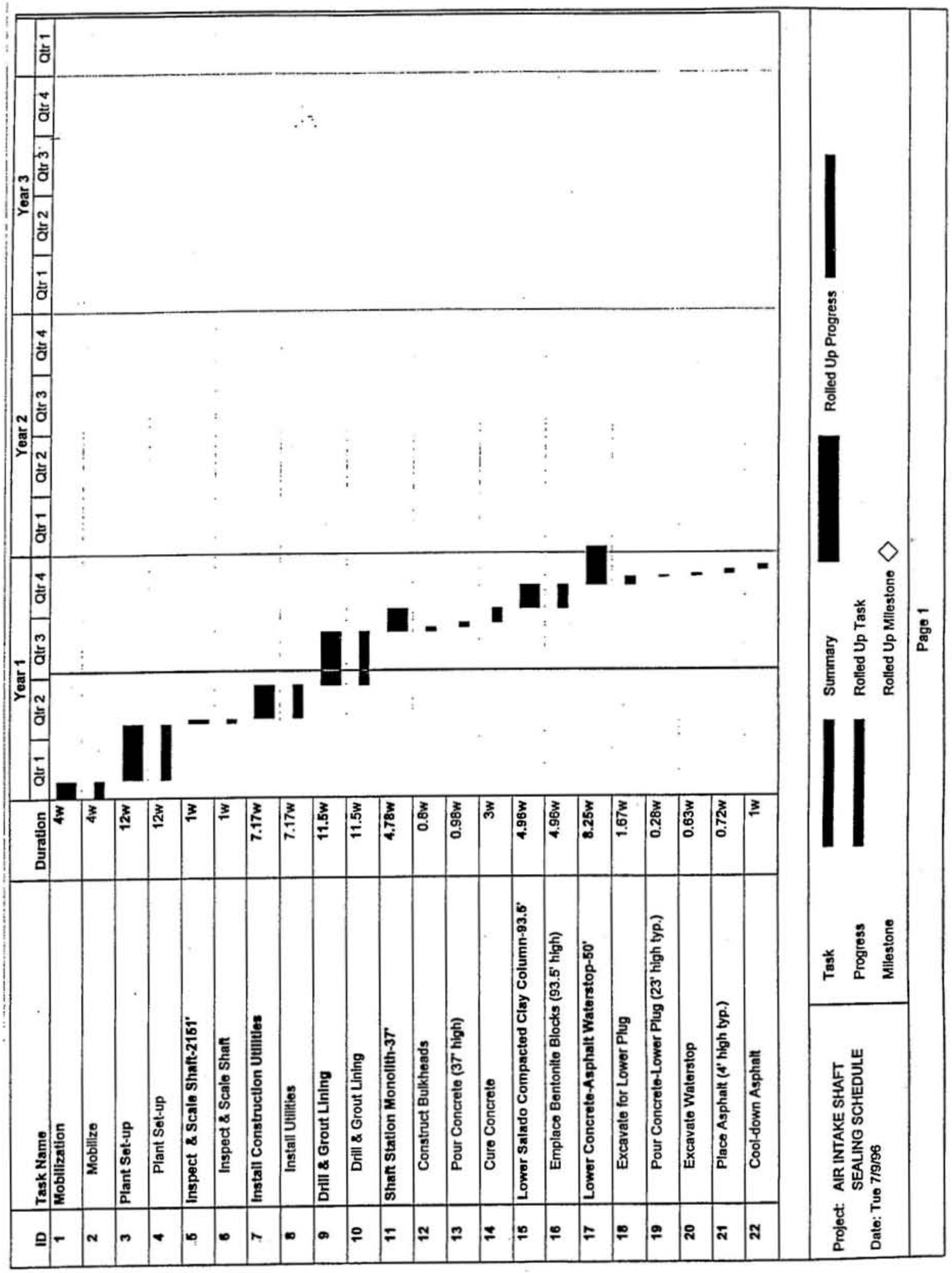
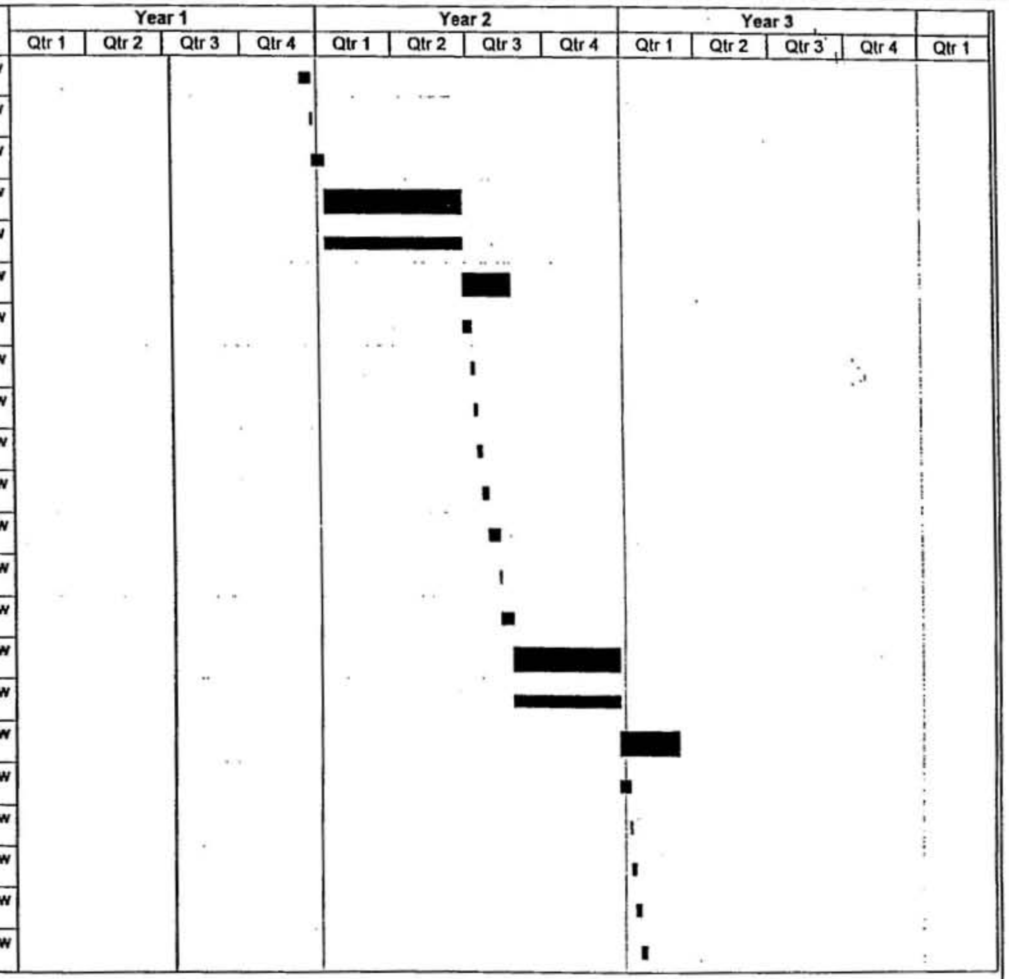


ID	Task Name	Duration
1	**Mobilization**	4w
2	Mobilize	4w
3	**Plant Set-up**	12w
4	Plant Set-up	12w
5	**Inspect & Scale Shaft-2151'**	1w
6	Inspect & Scale Shaft	1w
7	**Install Construction Utilities**	7.17w
8	Install Utilities	7.17w
9	**Drill & Grout Lining**	11.5w
10	Drill & Grout Lining	11.5w
11	**Shaft Station Monolith-37'**	4.78w
12	Construct Bulkheads	0.8w
13	Pour Concrete (37' high)	0.98w
14	Cure Concrete	3w
15	**Lower Salado Compacted Clay Column-93.5'**	4.96w
16	Emplace Bentonite Blocks (93.5' high)	4.96w
17	**Lower Concrete-Asphalt Waterstop-50'**	8.25w
18	Excavate for Lower Plug	1.67w
19	Pour Concrete-Lower Plug (23' high typ.)	0.28w
20	Excavate Waterstop	0.63w
21	Place Asphalt (4' high typ.)	0.72w
22	Cool-down Asphalt	1w

1

ID	Task Name	Duration
23	Excavate for Upper Plug	1.67w
24	Pour Concrete-Upper Plug (23' high typ.)	0.28w
25	Cure Concrete	2w
26	**Compacted Salt Column-563.5'**	**23.58w**
27	Emplace & Compact Crushed/Screened Salt	23.58w
28	**Middle Concrete-Asphalt Waterstop-50'**	**8.25w**
29	Excavate for Lower Plug	1.67w
30	Pour Concrete-Lower Plug	0.28w
31	Excavate Waterstop	0.63w
32	Place Asphalt	0.72w
33	Cool-down Asphalt	1w
34	Excavate for Upper Plug	1.67w
35	Pour Concrete-Upper Plug	0.28w
36	Cure Concrete	2w
37	**Upper Salado Compacted Clay Column-344'**	**18.24w**
38	Emplace Bentonite Blocks	18.24w
39	**Upper Concrete-Asphalt Waterstop-50'**	**10.25w**
40	Excavate for Lower Plug	1.67w
41	Pour Concrete-Lower Plug	0.28w
42	Excavate Waterstop	0.63w
43	Place Asphalt	0.72w
44	Cool-down Asphalt	1w

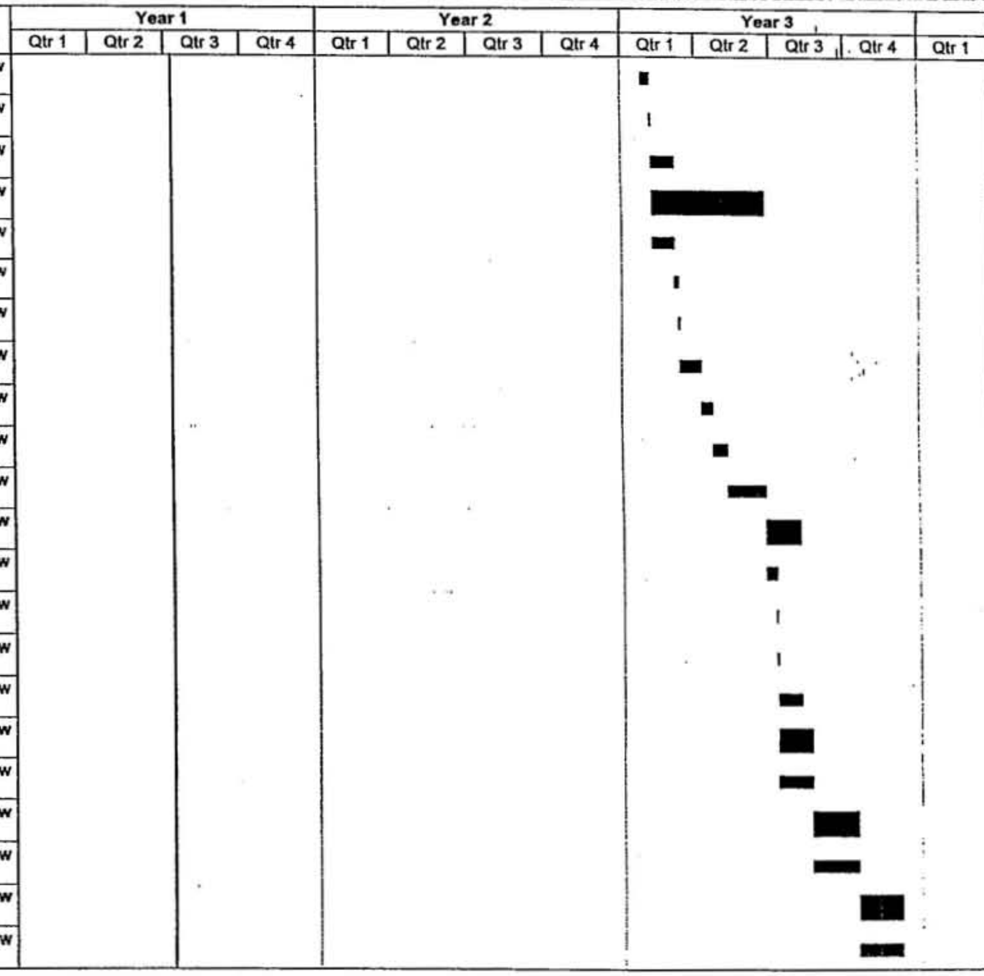


Project: AIR INTAKE SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task | Summary | Rolled Up Progress
Progress | Rolled Up Task
Milestone | Rolled Up Milestone ◇

2

ID	Task Name	Duration
45	Excavate for Upper Plug	1.67w
46	Pour Concrete-Upper Plug	0.28w
47	Cure Concrete	4w
48	**Asphalt Column-138.3'**	**19.41w**
49	Remove Lining in Key	3.76w
50	Remove Chemical Seal Rings	0.6w
51	Mobilize to Emplace Asphalt	0.3w
52	Asphalt in Salt Section	3.62w
53	Asphalt in Lower Lined Section	1.93w
54	Complete Asphalt Emplacement	2.77w
55	Cool-down Asphalt	6.43w
56	**Concrete Plug-20'**	**5.99w**
57	Remove Concrete Lining & Rock	1.65w
58	Remove Liner Plate	0.13w
59	Pour Concrete(20' high)	0.21w
60	Cure Concrete	4w
61	**Remove Concrete Shaft Lining**	**5.71w**
62	Remove 86' of lining--4 zones	5.71w
63	**Rustler Compacted Clay Column-234.7'**	**8.36w**
64	Emplace & Compact Bentonite(234.7' high)	8.36w
65	**Compacted Earthen Fill-473'**	**7.59w**
66	Emplace & Compact Earthen Fill(473' high)	7.59w



Project: AIR INTAKE SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task | Summary | Rolled Up Progress
Progress | Rolled Up Task
Milestone | Rolled Up Milestone ◇

Page 3

ID	Task Name	Duration
67	Concrete Plug-40'	2.96w
68	Clean Existing Surface	0.6w
69	Pour Concrete(40' high)	0.36w
70	Cure Concrete	2w
71	Compacted Earthen Fill-57'	0.65w
72	Emplace & Compact Earthen Fill (57' high)	0.65w
73	Demobilization	3.2w
74	Demob	3.2w

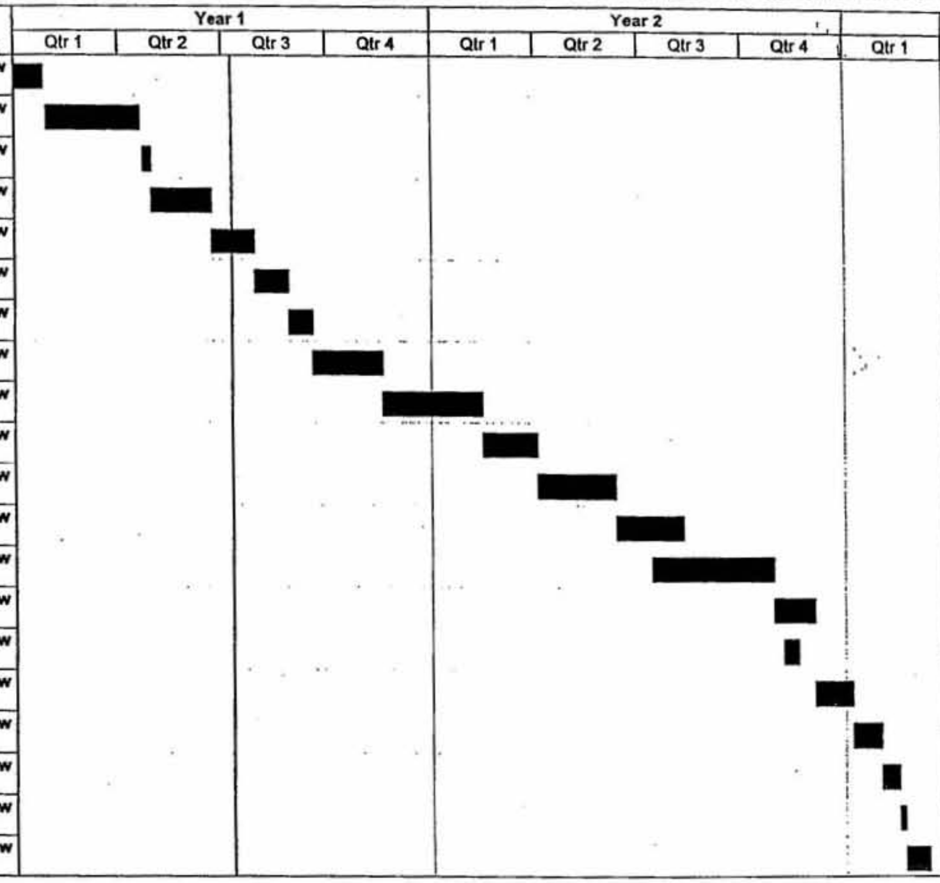
Project: AIR INTAKE SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone ◇
Rolled Up Progress

14

SEALING SCHEDULE - SALT HANDLING SHAFT

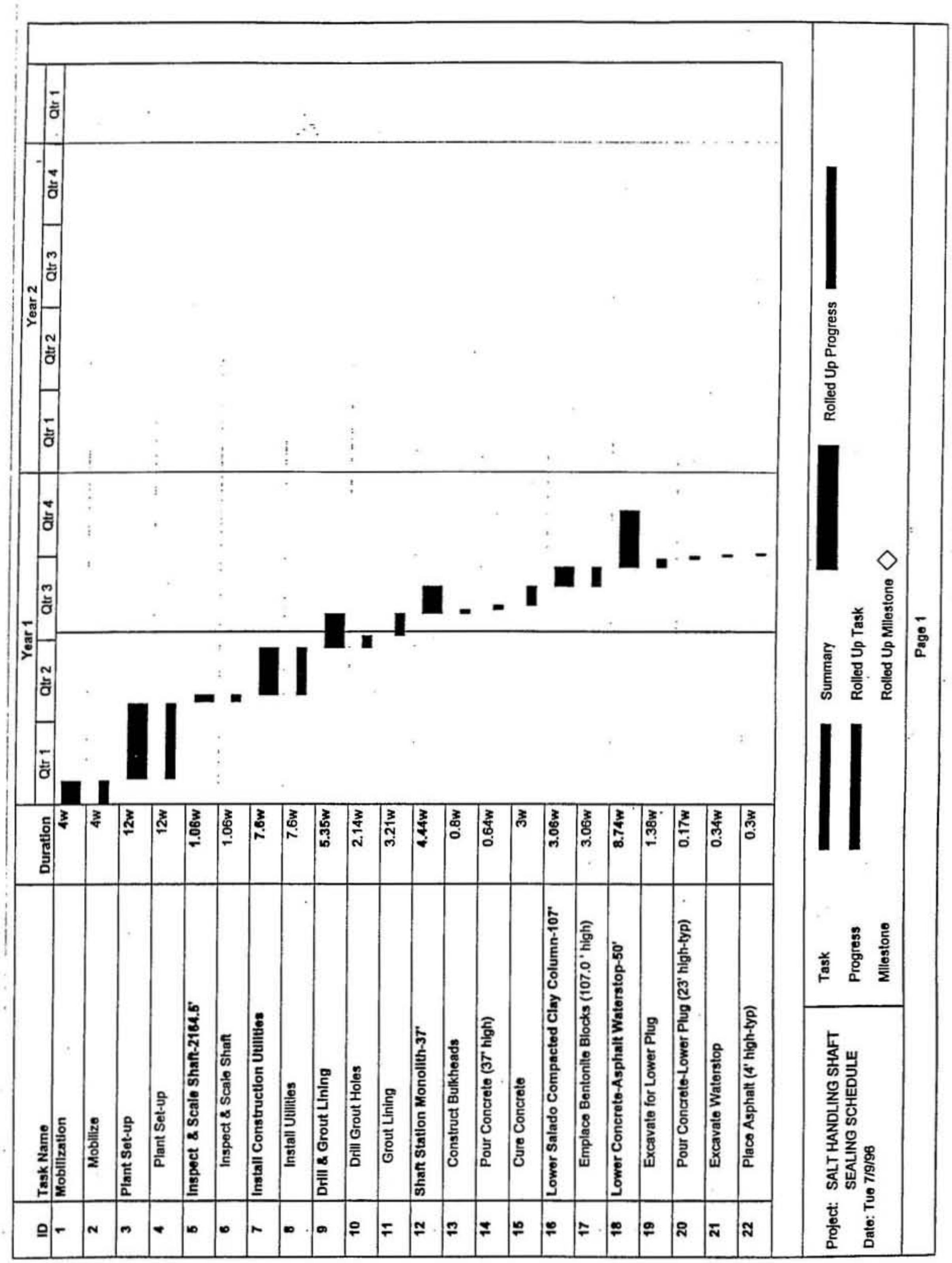
ID	Task Name	Duration
1	Mobilization	4w
3	Plant Set-up	12w
5	Inspect & Scale Shaft-2164.5'	1.06w
7	Install Construction Utilities	7.6w
9	Drill & Grout Lining	5.35w
12	Shaft Station Monolith-37'	4.44w
16	Lower Salado Compacted Clay Column-107'	3.06w
18	Lower Concrete-Asphalt Waterstop-50'	8.74w
27	Compacted Salt Column-560'	12.67w
29	Middle Concrete-Asphalt Waterstop-50'	6.74w
38	Upper Salado Compacted Clay Column-335'	9.58w
40	Upper Concrete-Asphalt Waterstop-50'	8.74w
49	Asphalt Column-140'	15.33w
57	Concrete Plug-20'	5.32w
61	Remove Concrete Shaft Lining	1.9w
63	Rustler Compacted Clay Column-234'	4.81w
65	Compacted Earthen Fill-449'	3.65w
67	Concrete Plug-40'	2.45w
71	Compacted Earthen Fill-92.5'	0.65w
73	Demobilization	3w



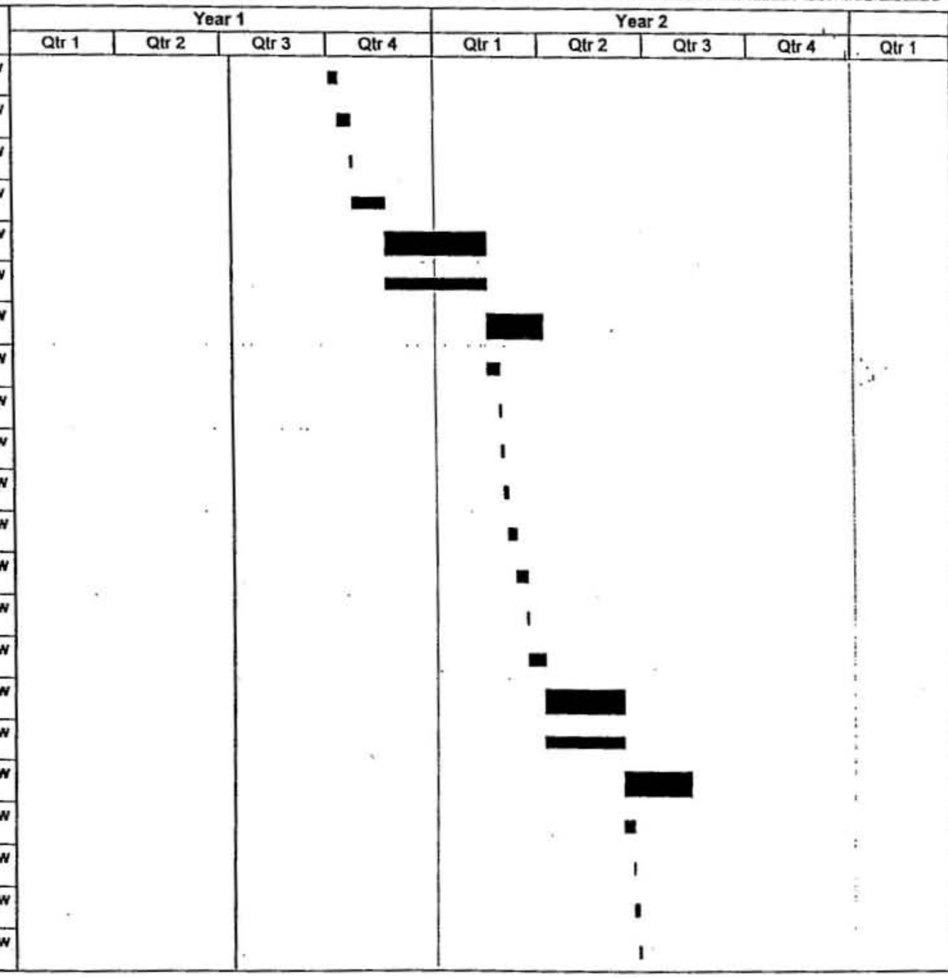
Project: SALT HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone ◇ | Rolled Up Progress

1


ID
Task Name
Duration
Year 1
Year 2
Qtr 1
Qtr 2
Qtr 3
Qtr 4
1 Mobilization 4w
2 Mobilize 4w
3 Plant Set-up 12w
4 Plant Set-up 12w
5 Inspect & Scale Shaft-2164.5' 1.06w
6 Inspect & Scale Shaft 1.06w
7 Install Construction Utilities 7.6w
8 Install Utilities 7.6w
9 Drill & Grout Lining 5.35w
10 Drill Grout Holes 2.14w
11 Grout Lining 3.21w
12 Shaft Station Monolith-37' 4.44w
13 Construct Bulkheads 0.8w
14 Pour Concrete (37' high) 0.64w
15 Cure Concrete 3w
16 Lower Salado Compacted Clay Column-107' 3.06w
17 Emplace Bentonite Blocks (107.0' high) 3.06w
18 Lower Concrete-Asphalt Waterstop-50' 8.74w
19 Excavate for Lower Plug 1.38w
20 Pour Concrete-Lower Plug (23' high-typ) 0.17w
21 Excavate Waterstop 0.34w
22 Place Asphalt (4' high-typ) 0.3w
Project: SALT HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96
Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
Page 1

ID	Task Name	Duration
23	Cool-down Asphalt	1w
24	Excavate for Upper Plug	1.38w
25	Pour Concrete-Upper Plug (23' high-typ)	0.17w
26	Cure Concrete	4w
27	**Compacted Salt Column-560'**	12.67w
28	Emplace & Compact Crushed/Screened Salt	12.67w
29	**Middle Concrete-Asphalt Waterstop-50'**	8.74w
30	Excavate for Lower Plug	1.38w
31	Pour Concrete-Lower Plug	0.17w
32	Excavate Waterstop	0.34w
33	Place Asphalt	0.3w
34	Cool-down Asphalt	1w
35	Excavate for Upper Plug	1.38w
36	Pour Concrete-Upper Plug	0.17w
37	Cure Concrete	2w
38	**Upper Salado Compacted Clay Column-335'**	9.58w
39	Emplace Bentonite Blocks	9.58w
40	**Upper Concrete-Asphalt Waterstop-50'**	8.74w
41	Excavate for Lower Plug	1.38w
42	Pour Concrete-Lower Plug	0.17w
43	Excavate Waterstop	0.34w
44	Place Asphalt	0.3w



Project: SALT HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task — Progress — Milestone — Summary — Rolled Up Task — Rolled Up Milestone ◇ — Rolled Up Progress

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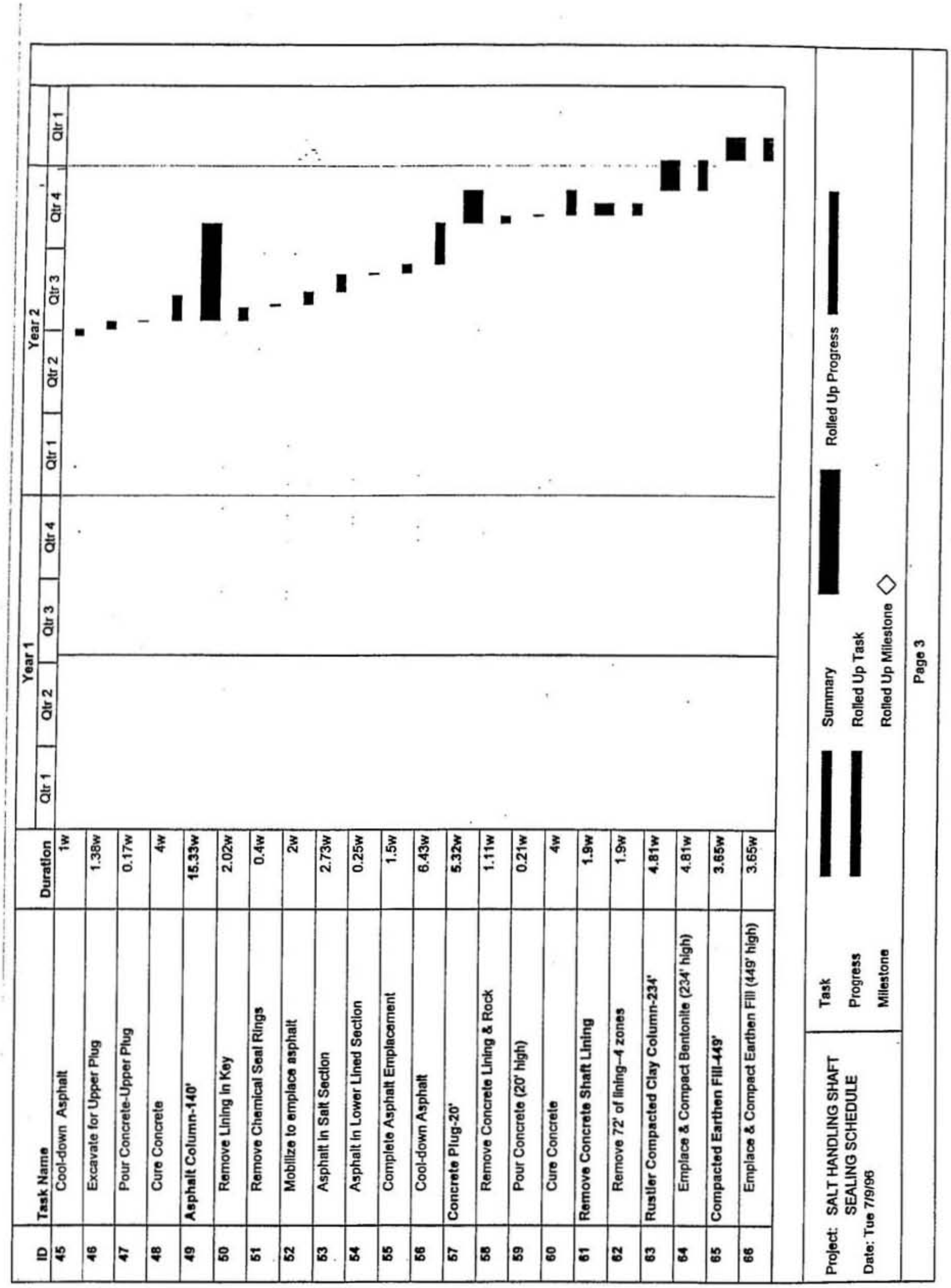

ID
Task Name
Duration
Year 1
Year 2
Qtr 1
Qtr 2
Qtr 3
Qtr 4
45 Cool-down Asphalt 1w
46 Excavate for Upper Plug 1.38w
47 Pour Concrete-Upper Plug 0.17w
48 Cure Concrete 4w
49 Asphalt Column-140' 15.33w
50 Remove Lining in Key 2.02w
51 Remove Chemical Seal Rings 0.4w
52 Mobilize to emplace asphalt 2w
53 Asphalt in Salt Section 2.73w
54 Asphalt in Lower Lined Section 0.25w
55 Complete Asphalt Emplacement 1.5w
56 Cool-down Asphalt 6.43w
57 Concrete Plug-20' 5.32w
58 Remove Concrete Lining & Rock 1.11w
59 Pour Concrete (20' high) 0.21w
60 Cure Concrete 4w
61 Remove Concrete Shaft Lining 1.9w
62 Remove 72' of lining--4 zones 1.9w
63 Rustler Compacted Clay Column-234' 4.81w
64 Emplace & Compact Bentonite (234' high) 4.81w
65 Compacted Earthen Fill-449' 3.65w
66 Emplace & Compact Earthen Fill (449' high) 3.65w
Project: SALT HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96
Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
Page 3

1

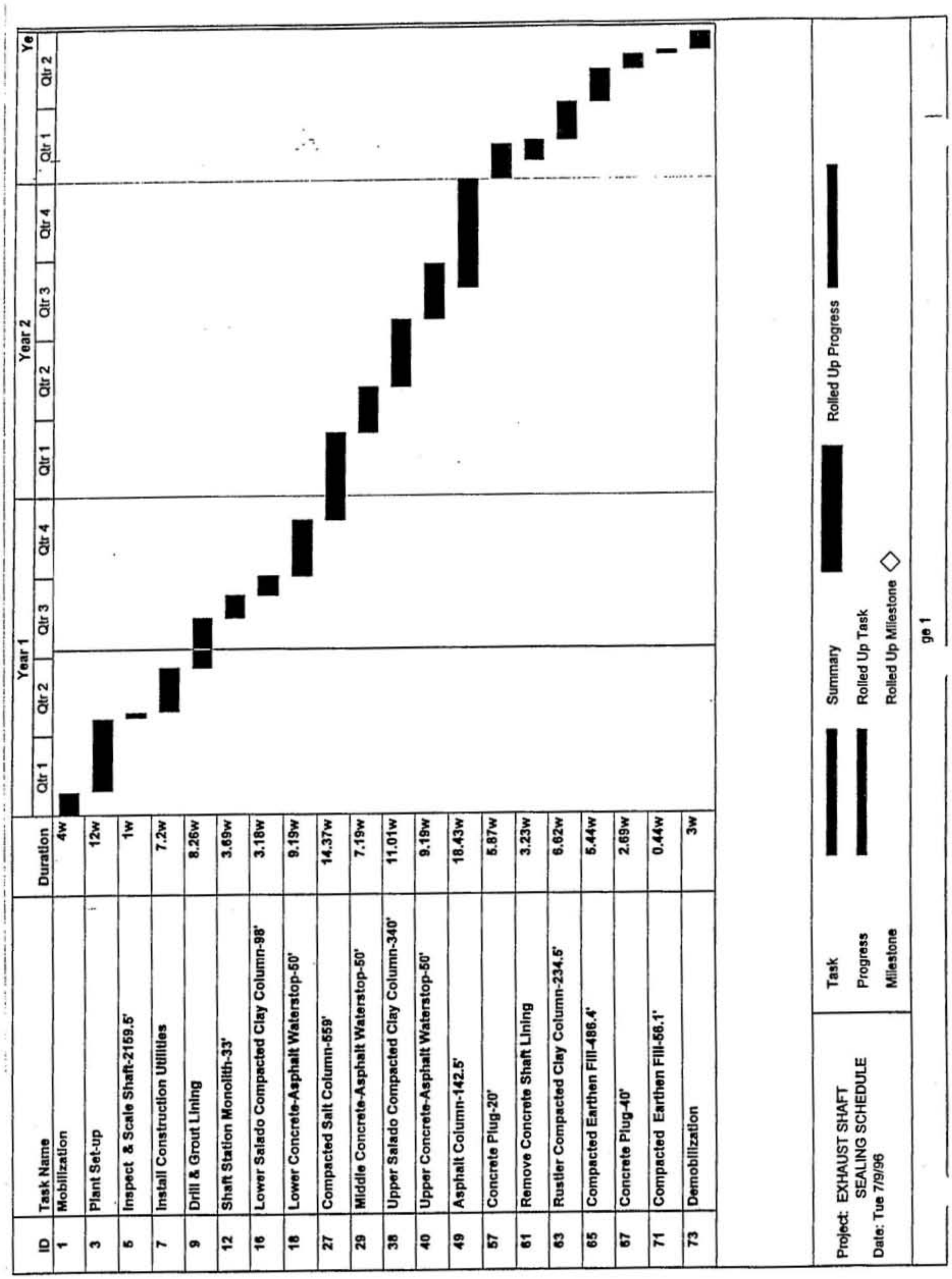
ID	Task Name	Duration	Year 1 Qtr 1	Year 1 Qtr 2	Year 1 Qtr 3	Year 1 Qtr 4	Year 2 Qtr 1	Year 2 Qtr 2	Year 2 Qtr 3	Year 2 Qtr 4	Qtr 1
67	**Concrete Plug-40'**	2.45w									
68	Clean Existing Surface	0.34w									
69	Pour Concrete	0.11w									
70	Cure Concrete	2w									
71	**Compacted Earthen Fill-92.5'**	0.65w									
72	Emplace & Compact Earthen Fill (92.5'high)	0.65w									
73	**Demobilization**	3w									
74	Demob	3w									

Project: SALT HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

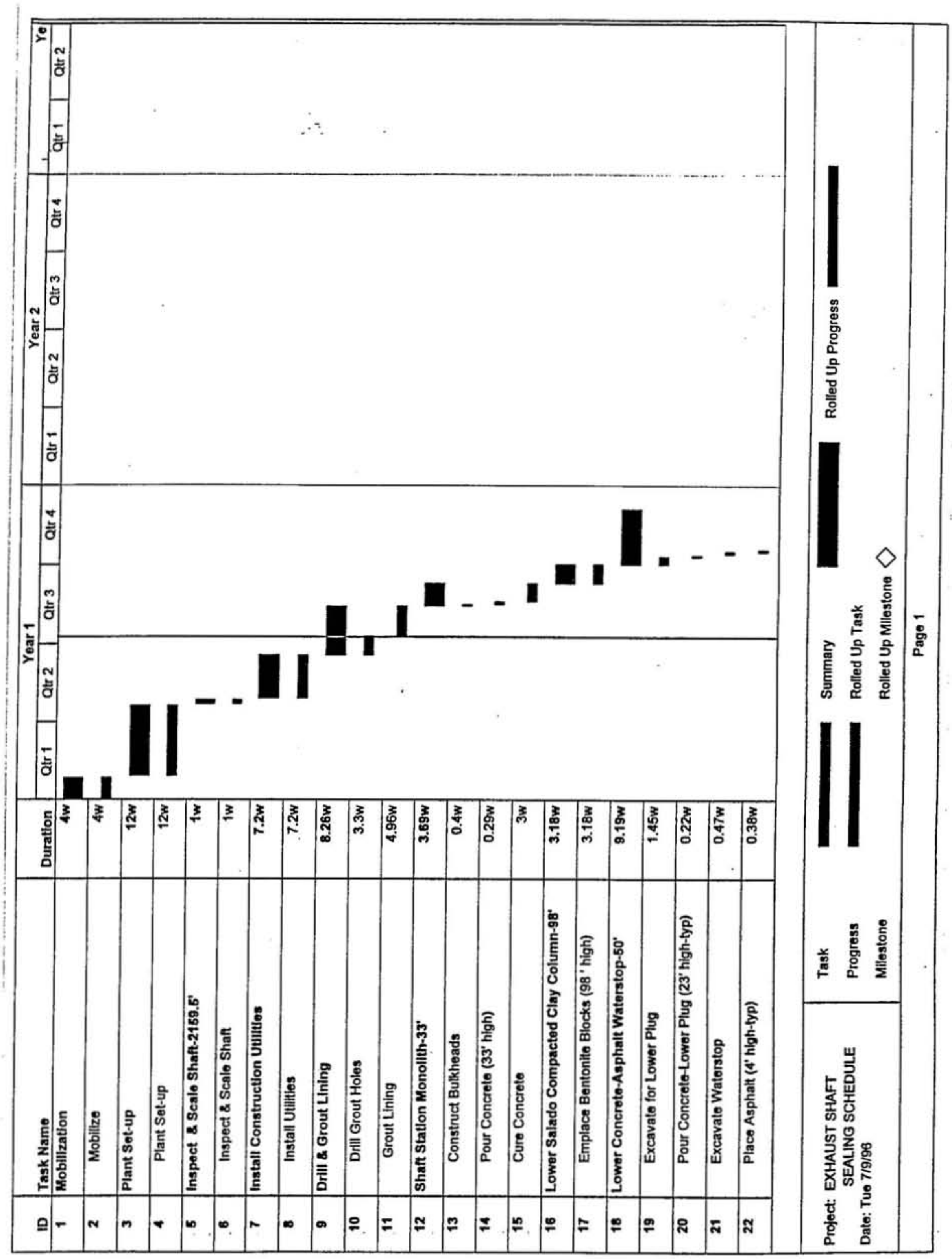
Legend		
Task	Summary	Rolled Up Progress
Progress	Rolled Up Task	
Milestone	Rolled Up Milestone ◇	

4

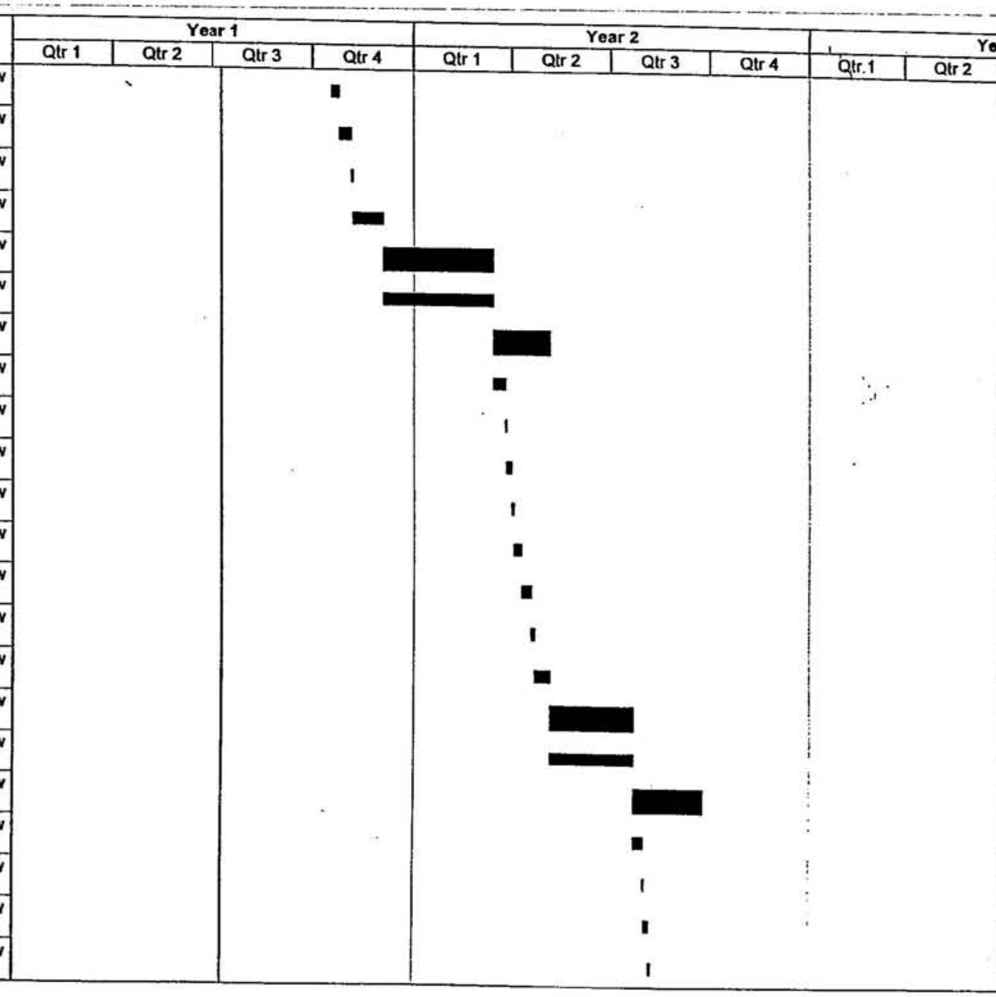
SEALING SCHEDULE - EXHAUST SHAFT


ID
Task Name
Duration
Year 1
Qtr 1
Qtr 2
Qtr 3
Qtr 4
Year 2
Qtr 1
Qtr 2
Qtr 3
Qtr 4
Qtr 1
Qtr 2
Ye
1 Mobilization 4w
3 Plant Set-up 12w
5 Inspect & Scale Shaft-2159.5' 1w
7 Install Construction Utilities 7.2w
9 Drill & Grout Lining 8.26w
12 Shaft Station Monolith-33' 3.69w
16 Lower Salado Compacted Clay Column-98' 3.18w
18 Lower Concrete-Asphalt Waterstop-50' 9.19w
27 Compacted Salt Column-559' 14.37w
29 Middle Concrete-Asphalt Waterstop-50' 7.19w
38 Upper Salado Compacted Clay Column-340' 11.01w
40 Upper Concrete-Asphalt Waterstop-50' 9.19w
49 Asphalt Column-142.5' 18.43w
57 Concrete Plug-20' 5.87w
61 Remove Concrete Shaft Lining 3.23w
63 Rustler Compacted Clay Column-234.5' 6.62w
65 Compacted Earthen Fill-486.4' 5.44w
67 Concrete Plug-40' 2.69w
71 Compacted Earthen Fill-56.1' 0.44w
73 Demobilization 3w
Project: EXHAUST SHAFT
SEALING SCHEDULE
Date: Tue 7/9/96
Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
ge 1

1


ID
Task Name
Duration
Year 1
Year 2
Ye
Qtr 1
Qtr 2
Qtr 3
Qtr 4
1 Mobilization 4w
2 Mobilize 4w
3 Plant Set-up 12w
4 Plant Set-up 12w
5 Inspect & Scale Shaft-2159.5' 1w
6 Inspect & Scale Shaft 1w
7 Install Construction Utilities 7.2w
8 Install Utilities 7.2w
9 Drill & Grout Lining 8.26w
10 Drill Grout Holes 3.3w
11 Grout Lining 4.96w
12 Shaft Station Monolith-33' 3.69w
13 Construct Bulkheads 0.4w
14 Pour Concrete (33' high) 0.29w
15 Cure Concrete 3w
16 Lower Salado Compacted Clay Column-98' 3.18w
17 Emplace Bentonite Blocks (98 ' high) 3.18w
18 Lower Concrete-Asphalt Waterstop-50' 9.19w
19 Excavate for Lower Plug 1.45w
20 Pour Concrete-Lower Plug (23' high-typ) 0.22w
21 Excavate Waterstop 0.47w
22 Place Asphalt (4' high-typ) 0.38w
Project: EXHAUST SHAFT
SEALING SCHEDULE
Date: Tue 7/9/96
Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
Page 1

ID	Task Name	Duration
23	Cool-down Asphalt	1w
24	Excavate for Upper Plug	1.45w
25	Pour Concrete-Upper Plug (23' high-typ)	0.22w
26	Cure Concrete	4w
27	**Compacted Salt Column-559'**	14.37w
28	Emplace & Compact Crushed/Screened Salt	14.37w
29	**Middle Concrete-Asphalt Waterstop-50'**	7.19w
30	Excavate for Lower Plug	1.45w
31	Pour Concrete-Lower Plug	0.22w
32	Excavate Waterstop	0.47w
33	Place Asphalt	0.38w
34	Cool-down Asphalt	1w
35	Excavate for Upper Plug	1.45w
36	Pour Concrete-Upper Plug	0.22w
37	Cure Concrete	2w
38	**Upper Salado Compacted Clay Column-340'**	11.01w
39	Emplace Bentonite Blocks(340' high)	11.01w
40	**Upper Concrete-Asphalt Waterstop-50'**	9.19w
41	Excavate for Lower Plug	1.45w
42	Pour Concrete-Lower Plug	0.22w
43	Excavate Waterstop	0.47w
44	Place Asphalt	0.38w



Project: EXHAUST SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task | Summary | Rolled Up Progress
Progress | Rolled Up Task
Milestone | Rolled Up Milestone ◇

2

1

ID	Task Name	Duration
45	Cool-down Asphalt	1w
46	Excavate for Upper Plug	1.45w
47	Pour Concrete-Upper Plug	0.22w
48	Cure Concrete	4w
49	**Asphalt Column-142.5'**	**18.43w**
50	Remove Lining in Key	3.15w
51	Remove Chemical Seal Rings	0.5w
52	Mobilize to Emplace Asphalt	2w
53	Asphalt in Salt Section	2.64w
54	Asphalt in Lower Lined Section	1.44w
55	Complete Asphalt Emplacement	2.27w
56	Cool-down Asphalt	6.43w
57	**Concrete Plug-20'**	**5.87w**
58	Remove Concrete Lining & Rock	1.7w
59	Pour Concrete (20' high)	0.17w
60	Cure Concrete	4w
61	**Remove Concrete Shaft Lining**	**3.23w**
62	Remove 84' of lining—4 zones	3.23w
63	**Rustler Compacted Clay Column-234.5'**	**6.62w**
64	Emplace & Compact Bentonite(234.5' high)	6.62w
65	**Compacted Earthen Fill-486.4'**	**5.44w**
66	Emplace & Compact Earthen Fill(486.4' high	5.44w

Timeline: Year 1 (Qtr 1, Qtr 2, Qtr 3, Qtr 4), Year 2 (Qtr 1, Qtr 2, Qtr 3, Qtr 4), Ye (Qtr 1, Qtr 2)

Project: EXHAUST SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task | Summary | Rolled Up Progress
Progress | Rolled Up Task
Milestone | Rolled Up Milestone ◇

Page 3

ID	Task Name	Duration	Year 1 Qtr 1	Year 1 Qtr 2	Year 1 Qtr 3	Year 1 Qtr 4	Year 2 Qtr 1	Year 2 Qtr 2	Year 2 Qtr 3	Year 2 Qtr 4	Ye Qtr 1	Ye Qtr 2
67	**Concrete Plug-40'**	**2.69w**										
68	Clean Existing Surface	0.47w										
69	Pour Concrete	0.22w										
70	Cure Concrete	2w										
71	**Compacted Earthen Fill-56.1'**	**0.44w**										
72	Emplace & Compact Earthen Fill (56.1'high)	0.44w										
73	**Demobilization**	**3w**										
74	Demob	3w										

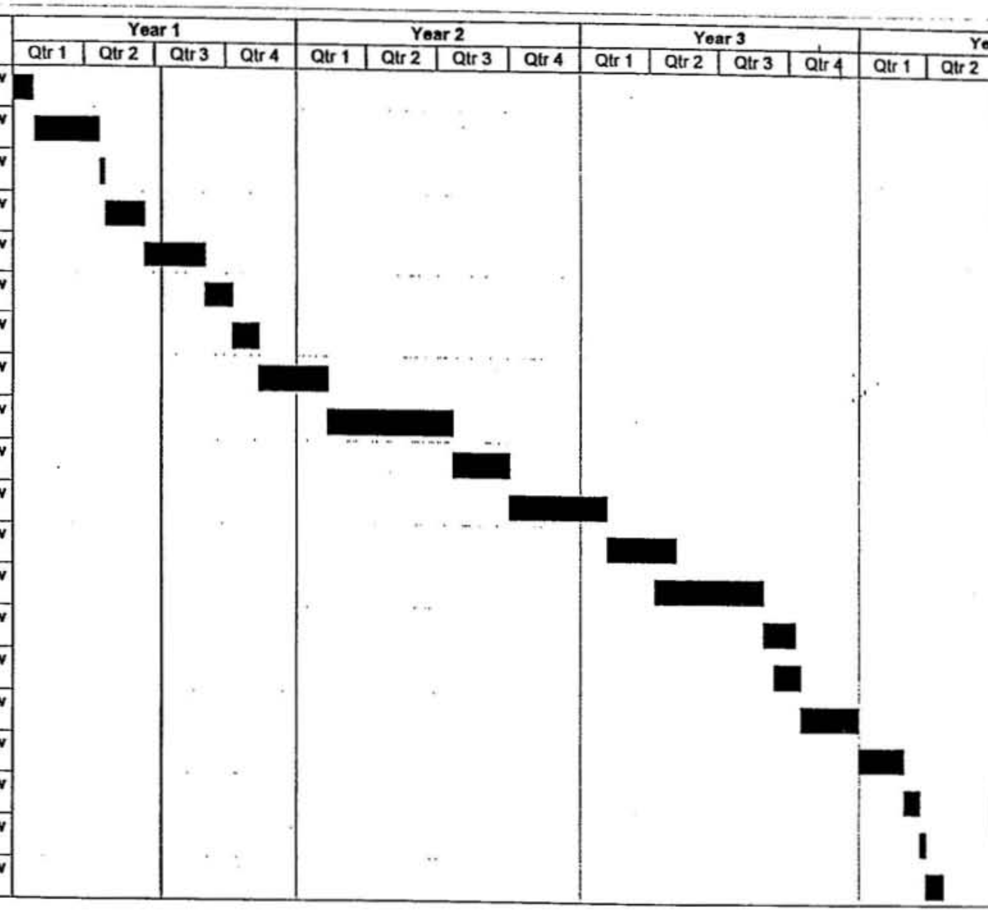
Project: EXHAUST SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task | Summary | Rolled Up Progress
Progress | Rolled Up Task
Milestone | Rolled Up Milestone ◇

14

SEALING SCHEDULE - WASTE SHAFT

ID	Task Name	Duration
1	Mobilization	4w
3	Plant Set-up	12w
5	Inspect & Scale Shaft-2159.5'	1w
7	Install Construction Utilities	7.2w
9	Drill & Grout Lining	11.21w
12	Shaft Station Monolith-37'	5.17w
16	Lower Salado Compacted Clay Column-96'	5.01w
18	Lower Concrete-Asphalt Waterstop-50'	12.57w
27	Compacted Salt Column-555.5'	22.87w
29	Middle Concrete-Asphalt Waterstop-50'	10.57w
38	Upper Salado Compacted Clay Column-351.5'	17.86w
40	Upper Concrete-Asphalt Waterstop-50'	12.57w
49	Asphalt Column-142.3'	20.71w
57	Concrete Plug-20'	5.98w
61	Remove Concrete Shaft Lining	5.07w
63	Rustler Compacted Clay Column-234.7'	10.99w
65	Compacted Earthen Fill-447'	8.25w
67	Concrete Plug-40'	3.04w
71	Compacted Earthen Fill-61.5'	1.14w
73	Demobilization	3.5w

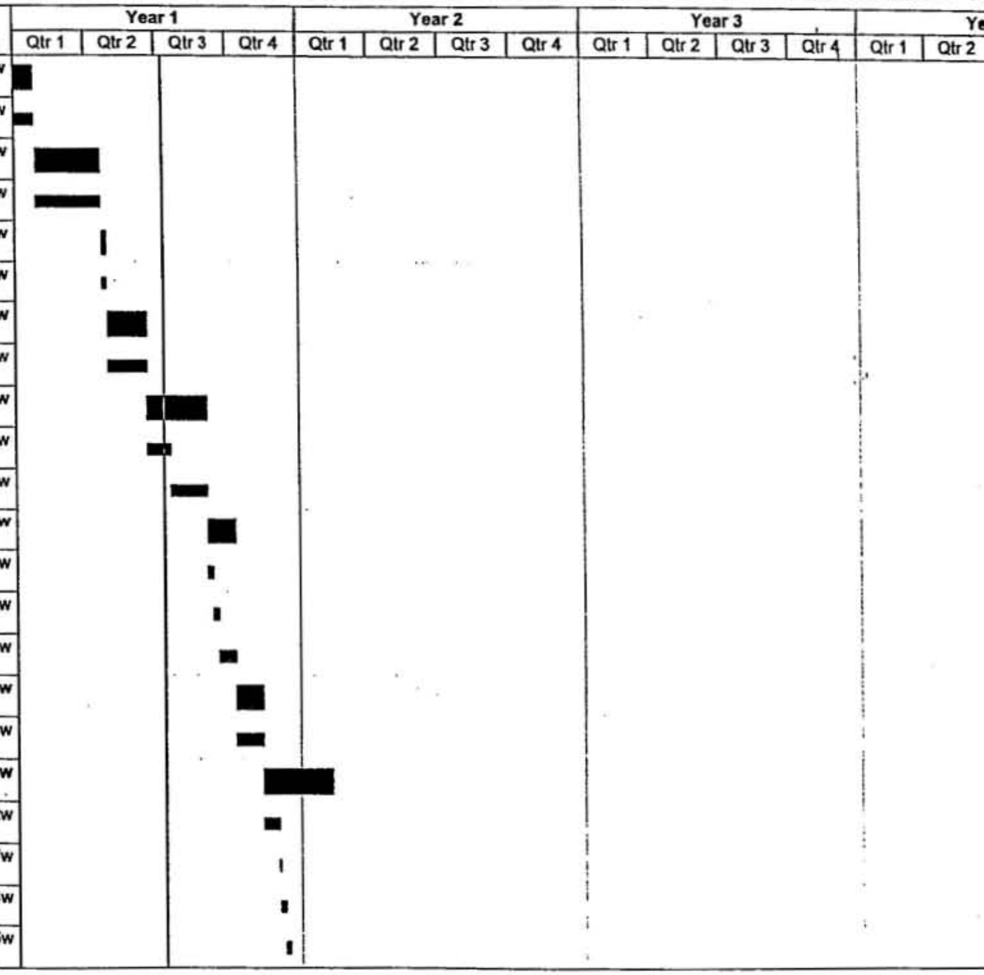


Project: WASTE HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone ◇
Rolled Up Progress

1

ID	Task Name	Duration
1	**Mobilization**	**4w**
2	Mobilize	4w
3	**Plant Set-up**	**12w**
4	Plant Set-up	12w
5	**Inspect & Scale Shaft-2159.5'**	**1w**
6	Inspect & Scale Shaft	1w
7	**Install Construction Utilities**	**7.2w**
8	Install Utilities	7.2w
9	**Drill & Grout Lining**	**11.21w**
10	Drill Grout Holes	4.48w
11	Grout Lining	6.73w
12	**Shaft Station Monolith-37'**	**5.17w**
13	Construct Bulkheads	1w
14	Pour Concrete (37' high)	1.17w
15	Cure Concrete	3w
16	**Lower Salado Compacted Clay Column-96'**	**5.01w**
17	Emplace Bentonite Blocks (96 ' high)	5.01w
18	**Lower Concrete-Asphalt Waterstop-50'**	**12.57w**
19	Excavate for Lower Plug	2.72w
20	Pour Concrete-Lower Plug (23' high-typ)	0.27w
21	Excavate Waterstop	0.84w
22	Place Asphalt (4' high-typ)	0.75w



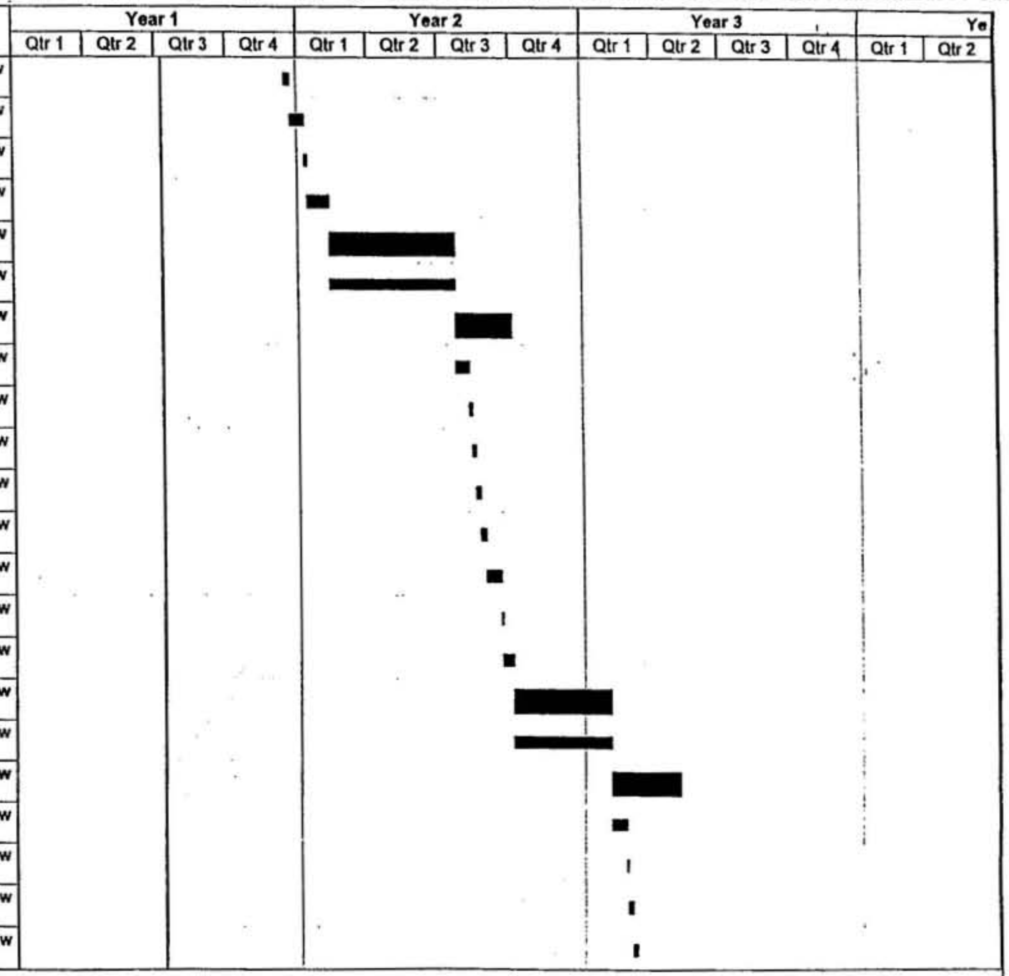
Project: WASTE HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task — Summary — Rolled Up Progress
Progress — Rolled Up Task
Milestone — Rolled Up Milestone ◇

Page 1

1

ID	Task Name	Duration
23	Cool-down Asphalt	1w
24	Excavate for Upper Plug	2.72w
25	Pour Concrete-Upper Plug (23' high-typ)	0.27w
26	Cure Concrete	4w
27	**Compacted Salt Column-555.5'**	**22.87w**
28	Emplace & Compact Crushed/Screened Salt	22.87w
29	**Middle Concrete-Asphalt Waterstop-50'**	**10.57w**
30	Excavate for Lower Plug	2.72w
31	Pour Concrete-Lower Plug	0.27w
32	Excavate Waterstop	0.84w
33	Place Asphalt	0.75w
34	Cool-down Asphalt	1w
35	Excavate for Upper Plug	2.72w
36	Pour Concrete-Upper Plug	0.27w
37	Cure Concrete	2w
38	**Upper Salado Compacted Clay Column-351.5'**	**17.86w**
39	Emplace Bentonite Blocks(351.5' high)	17.86w
40	**Upper Concrete-Asphalt Waterstop-50'**	**12.57w**
41	Excavate for Lower Plug	2.72w
42	Pour Concrete-Lower Plug	0.27w
43	Excavate Waterstop	0.84w
44	Place Asphalt	0.75w



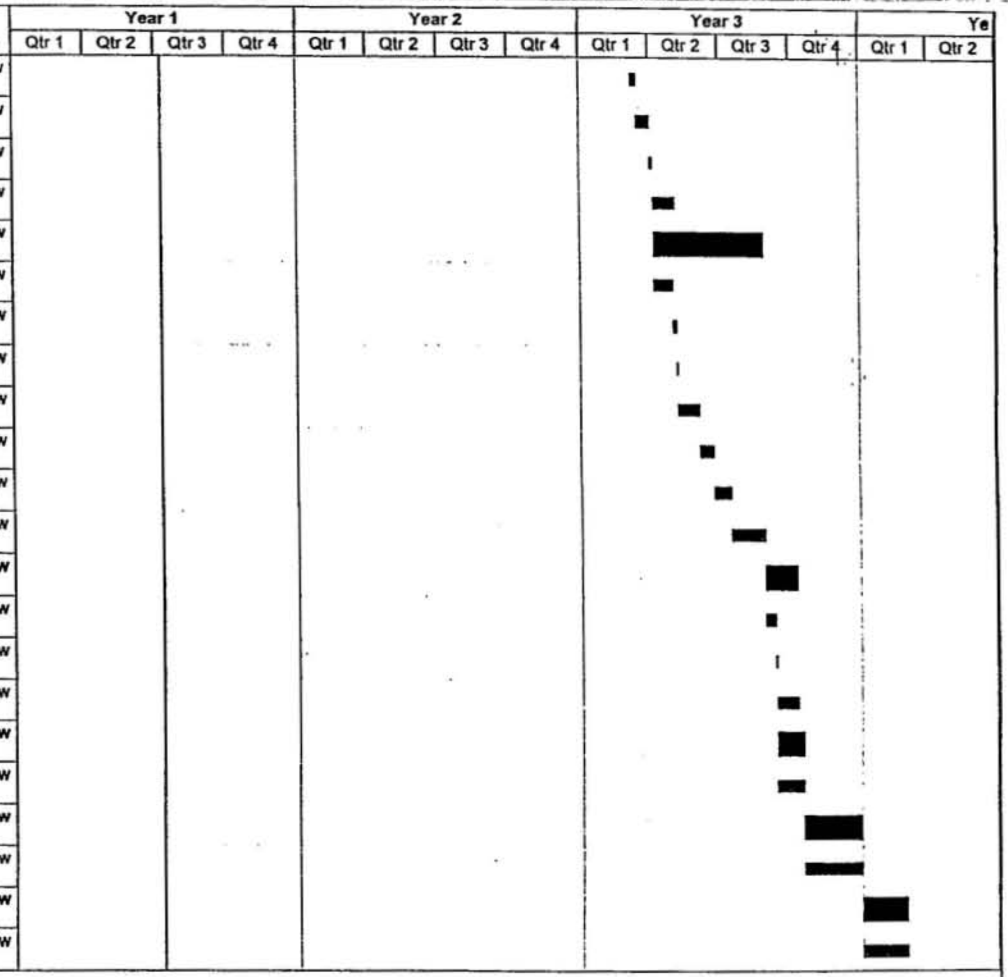
Project: WASTE HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task | Summary | Rolled Up Progress
Progress | Rolled Up Task
Milestone | Rolled Up Milestone ◇

12

1

ID	Task Name	Duration
45	Cool-down Asphalt	1w
46	Excavate for Upper Plug	2.72w
47	Pour Concrete-Upper Plug	0.27w
48	Cure Concrete	4w
49	**Asphalt Column-142.3'**	**20.71w**
50	Remove Lining in Key	3.8w
51	Remove Chemical Seal Rings	0.6w
52	Mobilize to emplace asphalt	0.3w
53	Asphalt in Salt Section	4.01w
54	Asphalt in Lower Lined Section	2.33w
55	Complete Asphalt Emplacement	3.24w
56	Cool-down Asphalt	6.43w
57	**Concrete Plug-20'**	**5.98w**
58	Remove Concrete Lining & Rock	1.73w
59	Pour Concrete (20' high)	0.25w
60	Cure Concrete	4w
61	**Remove Concrete Shaft Lining**	**5.07w**
62	Remove 84' of lining—4 zones	5.07w
63	**Rustler Compacted Clay Column-234.7'**	**10.99w**
64	Emplace & Compact Bentonite (234.7' high)	10.99w
65	**Compacted Earthen Fill-447'**	**8.25w**
66	Emplace & Compact Earthen Fill (447' high)	8.25w



Project: WASTE HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone ◇ | Rolled Up Progress

Page 3

ID	Task Name	Duration
67	**Concrete Plug-40'**	**3.04w**
68	Clean Existing Surface	0.64w
69	Pour Concrete	0.4w
70	Cure Concrete	2w
71	**Compacted Earthen Fill-61.5'**	**1.14w**
72	Emplace & Compact Earthen Fill (61.5' high)	1.14w
73	**Demobilization**	**3.5w**
74	Demob	3.5w

Timeline columns: Year 1 (Qtr 1, Qtr 2, Qtr 3, Qtr 4), Year 2 (Qtr 1, Qtr 2, Qtr 3, Qtr 4), Year 3 (Qtr 1, Qtr 2, Qtr 3, Qtr 4), Ye (Qtr 1, Qtr 2)

Project: WASTE HANDLING SHAFT SEALING SCHEDULE
Date: Tue 7/9/96

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone ◇
Rolled Up Progress

4

B5. References

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FIGURES

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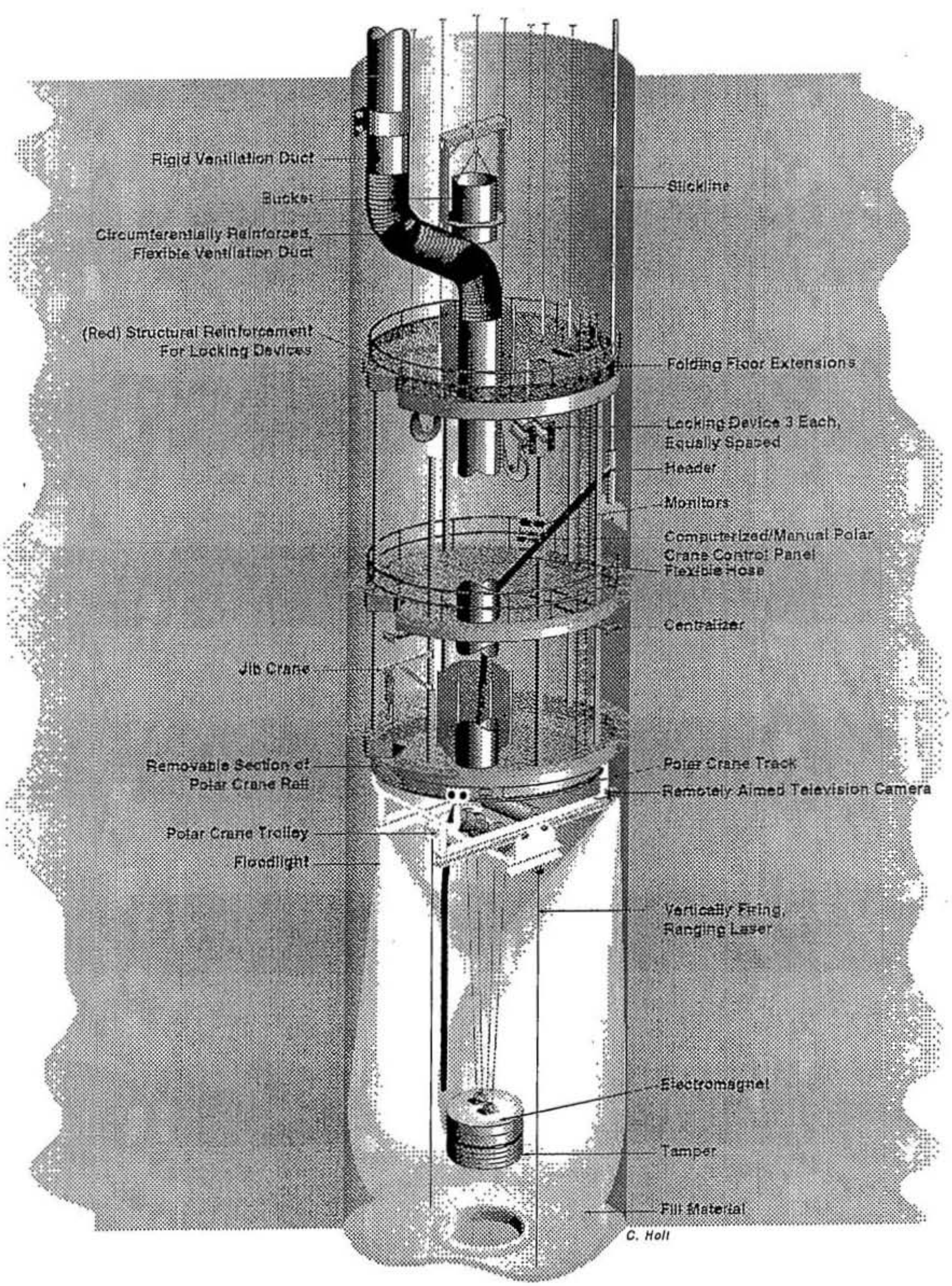
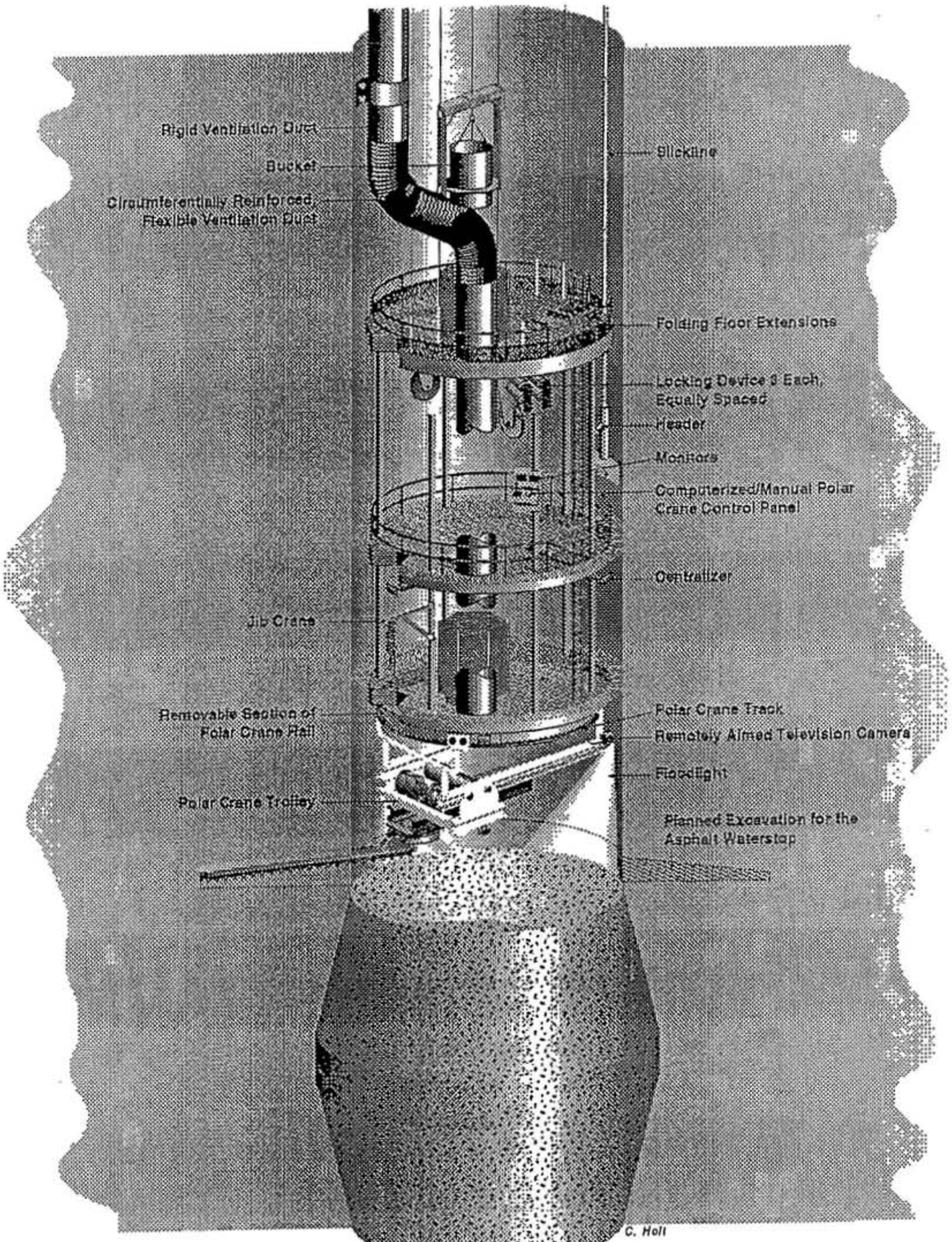


Figure I2B-1
Multi-deck stage illustrating dynamic compaction



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2 Figure I2B-2
3 Multi-deck stage illustrating excavation for asphalt waterstop

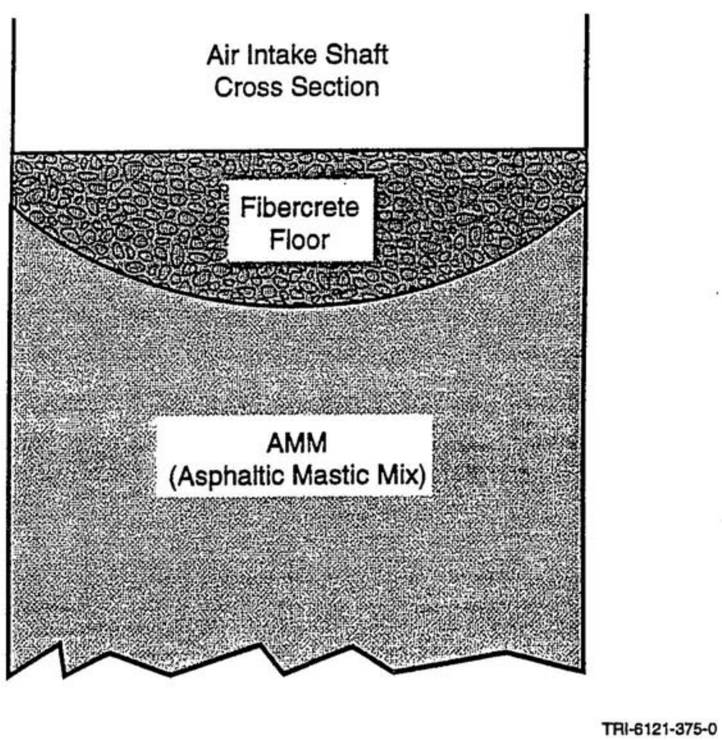

Figure I2B-3
Typical fibercrete at top of asphalt

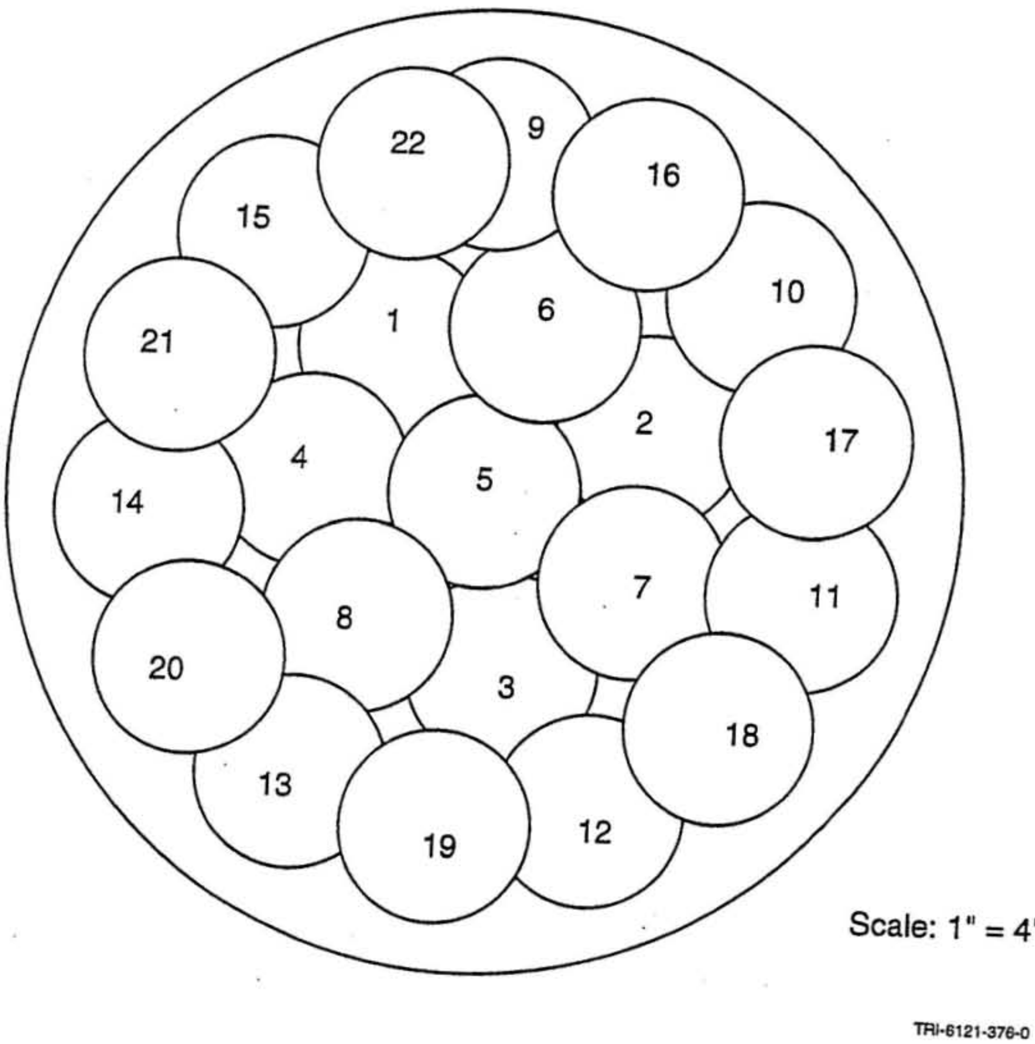

Figure I2B-4
Drop pattern for 6-m-diameter shaft using a 1.2-m-diameter tamper

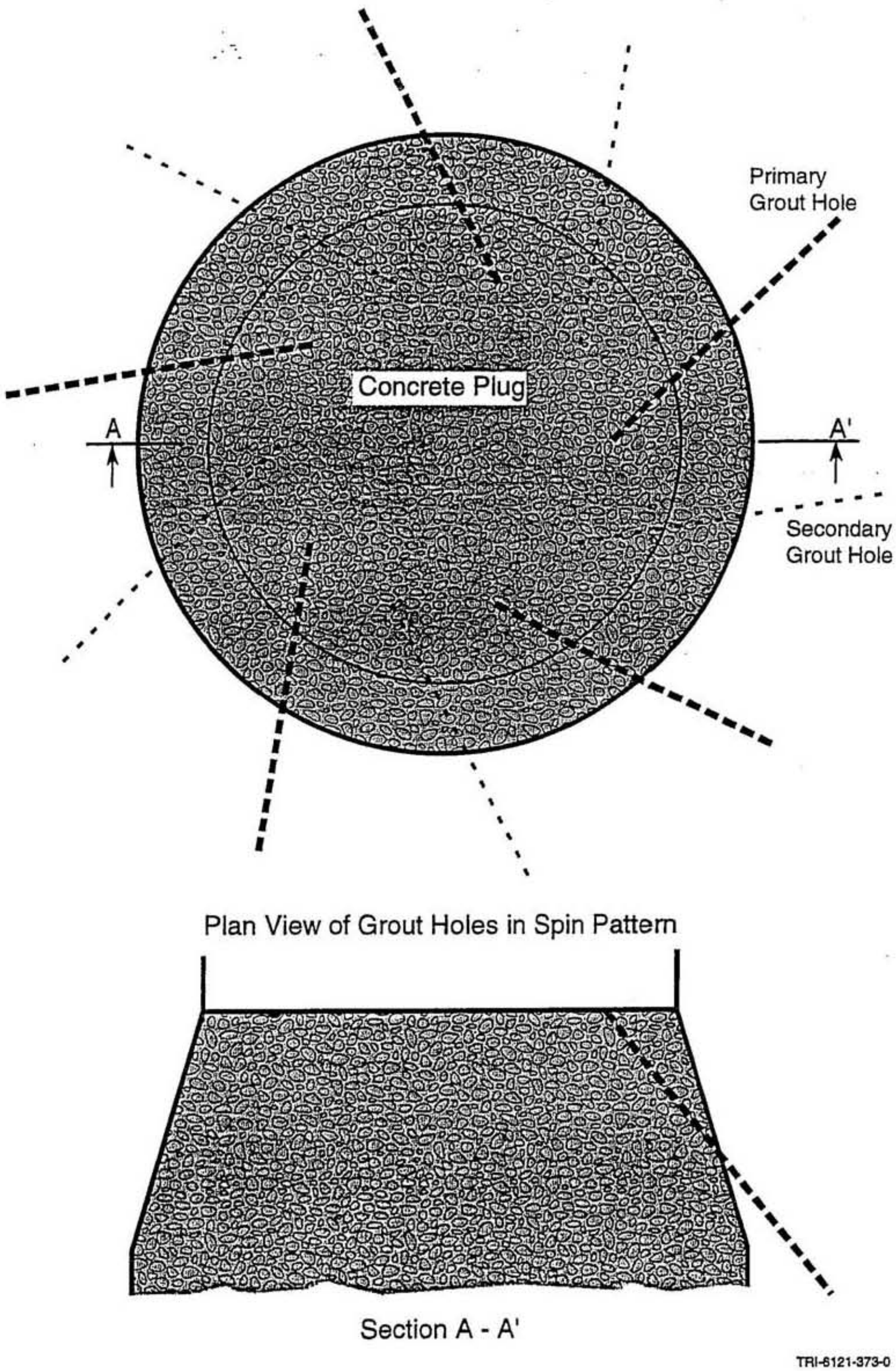

Figure I2B-5
Plan and section views of downward spin pattern of grout holes

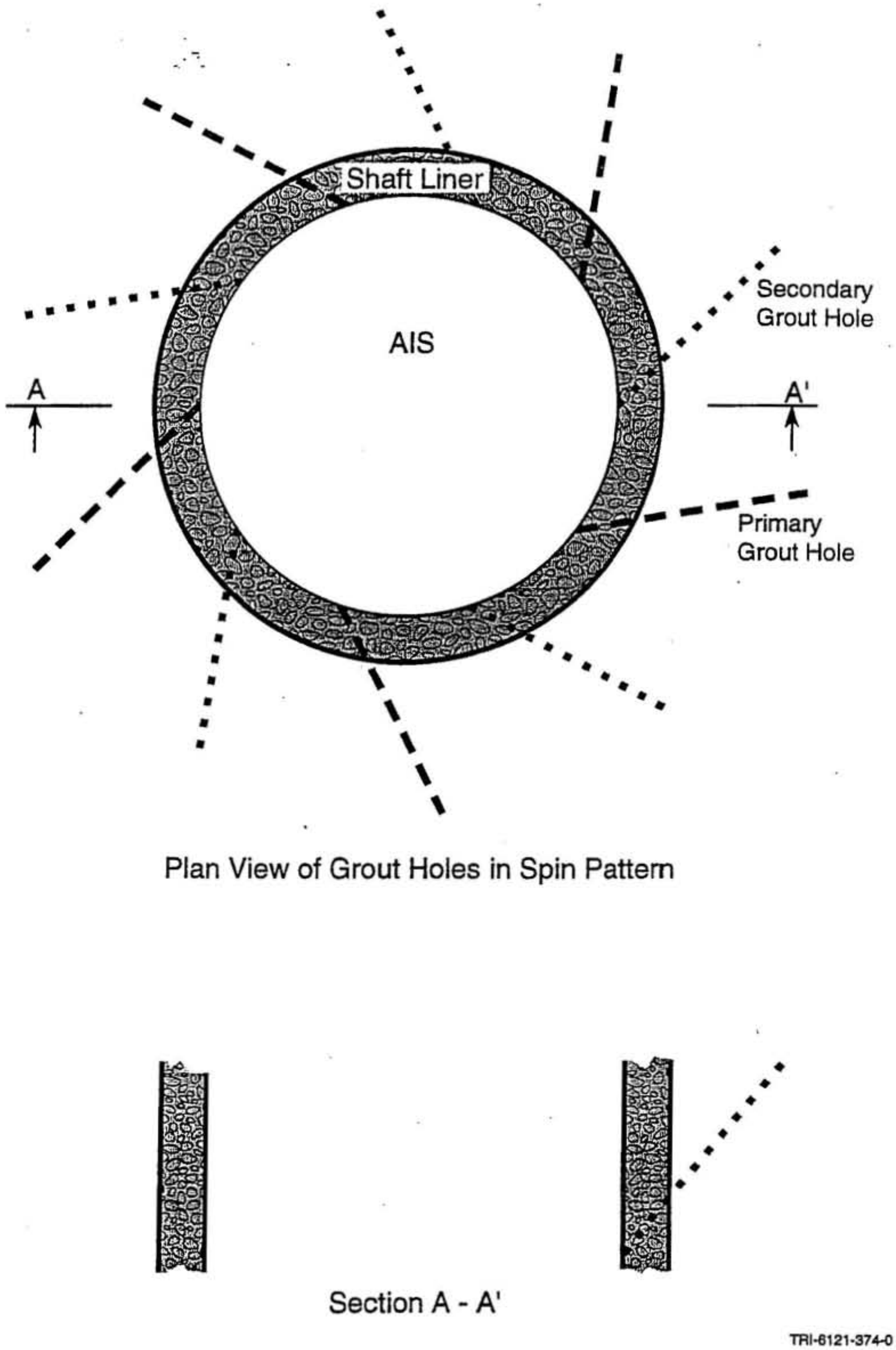

Figure I2B-6
Plan and section views of upward spin pattern of grout holes

APPENDIX I2
APPENDIX E

DESIGN DRAWINGS

SHAFT SEALING SYSTEM
COMPLIANCE SUBMITTAL DESIGN REPORT

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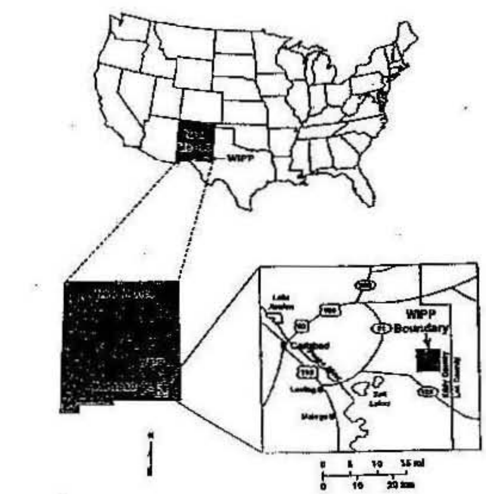
WASTE ISOLATION PILOT PLANT

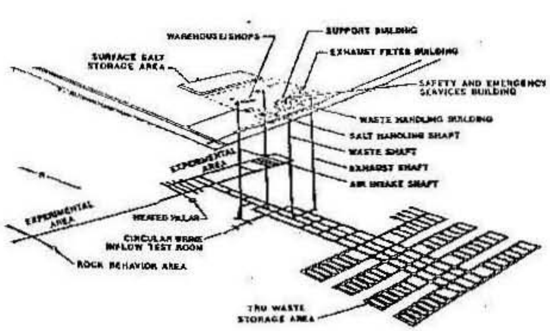
CARLSBAD, NM

SHAFT SEALING SYSTEM DESIGN



DESIGN DRAWINGS

WIPP LAYOUT



DRAWING NUMBER	TITLE
SNL-007 1 OF 28	WIPP SHAFT SEALING SYSTEM SHAFT LOCATION PLAN, ABBREVIATIONS, GENERAL NOTES AND LEGEND
SNL-007 2 OF 28	WIPP SHAFT SEALING SYSTEM NEAR-SURFACE/RUSTLER FORMATIONS WASTE SHAFT STRATIGRAPHY & AS-BUILT ELEMENTS
SNL-007 3 OF 28	WIPP SHAFT SEALING SYSTEM SALADO FORMATION WASTE SHAFT STRATIGRAPHY & AS-BUILT ELEMENTS
SNL-007 4 OF 28	WIPP SHAFT SEALING SYSTEM NEAR-SURFACE/RUSTLER FORMATIONS WASTE SHAFT STRATIGRAPHY & SEALING SUBSYSTEM PROFILE
SNL-007 5 OF 28	WIPP SHAFT SEALING SYSTEM SALADO FORMATION WASTE SHAFT STRATIGRAPHY & SEALING SUBSYSTEM PROFILE
SNL-007 6 OF 28	WIPP SHAFT SEALING SYSTEM WASTE SHAFT SHAFT STATION MONOLITH
SNL-007 7 OF 28	WIPP SHAFT SEALING SYSTEM NEAR-SURFACE/RUSTLER FORMATIONS AIR INTAKE SHAFT STRATIGRAPHY & AS-BUILT ELEMENTS
SNL-007 8 OF 28	WIPP SHAFT SEALING SYSTEM SALADO FORMATION AIR INTAKE SHAFT STRATIGRAPHY & AS-BUILT ELEMENTS
SNL-007 9 OF 28	WIPP SHAFT SEALING SYSTEM NEAR-SURFACE/RUSTLER FORMATIONS AIR INTAKE SHAFT STRATIGRAPHY & SEALING SUBSYSTEM PROFILE
SNL-007 10 OF 28	WIPP SHAFT SEALING SYSTEM SALADO FORMATION AIR INTAKE SHAFT STRATIGRAPHY & SEALING SUBSYSTEM PROFILE
SNL-007 11 OF 28	WIPP SHAFT SEALING SYSTEM AIR INTAKE SHAFT SHAFT STATION MONOLITH
SNL-007 12 OF 28	WIPP SHAFT SEALING SYSTEM NEAR-SURFACE/RUSTLER FORMATIONS EXHAUST SHAFT STRATIGRAPHY & AS-BUILT ELEMENTS
SNL-007 13 OF 28	WIPP SHAFT SEALING SYSTEM SALADO FORMATION EXHAUST SHAFT STRATIGRAPHY & AS-BUILT ELEMENTS
SNL-007 14 OF 28	WIPP SHAFT SEALING SYSTEM NEAR-SURFACE/RUSTLER FORMATIONS EXHAUST SHAFT STRATIGRAPHY & SEALING SUBSYSTEM PROFILE
SNL-007 15 OF 28	WIPP SHAFT SEALING SYSTEM SALADO FORMATION EXHAUST SHAFT STRATIGRAPHY & SEALING SUBSYSTEM PROFILE
SNL-007 16 OF 28	WIPP SHAFT SEALING SYSTEM EXHAUST SHAFT SHAFT STATION MONOLITH
SNL-007 17 OF 28	WIPP SHAFT SEALING SYSTEM NEAR-SURFACE/RUSTLER FORMATIONS SALT HANDLING SHAFT STRATIGRAPHY & AS-BUILT ELEMENTS
SNL-007 18 OF 28	WIPP SHAFT SEALING SYSTEM SALADO FORMATION SALT HANDLING SHAFT STRATIGRAPHY & AS-BUILT ELEMENTS
SNL-007 19 OF 28	WIPP SHAFT SEALING SYSTEM NEAR-SURFACE/RUSTLER FORMATIONS SALT HANDLING SHAFT STRATIGRAPHY & SEALING SUBSYSTEM PROFILE
SNL-007 20 OF 28	WIPP SHAFT SEALING SYSTEM SALADO FORMATION SALT HANDLING SHAFT STRATIGRAPHY & SEALING SUBSYSTEM PROFILE
SNL-007 21 OF 28	WIPP SHAFT SEALING SYSTEM SALT HANDLING SHAFT SHAFT STATION MONOLITH
SNL-007 22 OF 28	WIPP SHAFT SEALING SYSTEM CONCRETE-ASPHALT WATERSTOP IN SALADO FORMATION
SNL-007 23 OF 28	WIPP SHAFT SEALING SYSTEM ASPHALT COLUMN
SNL-007 24 OF 28	WIPP SHAFT SEALING SYSTEM UPPER AND LOWER SALADO COMPACTED CLAY COLUMNS
SNL-007 25 OF 28	WIPP SHAFT SEALING SYSTEM COMPACTED SALT COLUMN
SNL-007 26 OF 28	WIPP SHAFT SEALING SYSTEM CONCRETE PLUG
SNL-007 27 OF 28	WIPP SHAFT SEALING SYSTEM RUSTLER COMPACTED CLAY COLUMN
SNL-007 28 OF 28	WIPP SHAFT SEALING SYSTEM COMPACTED EARTHEN FILL AND CONCRETE PLUG

E-3

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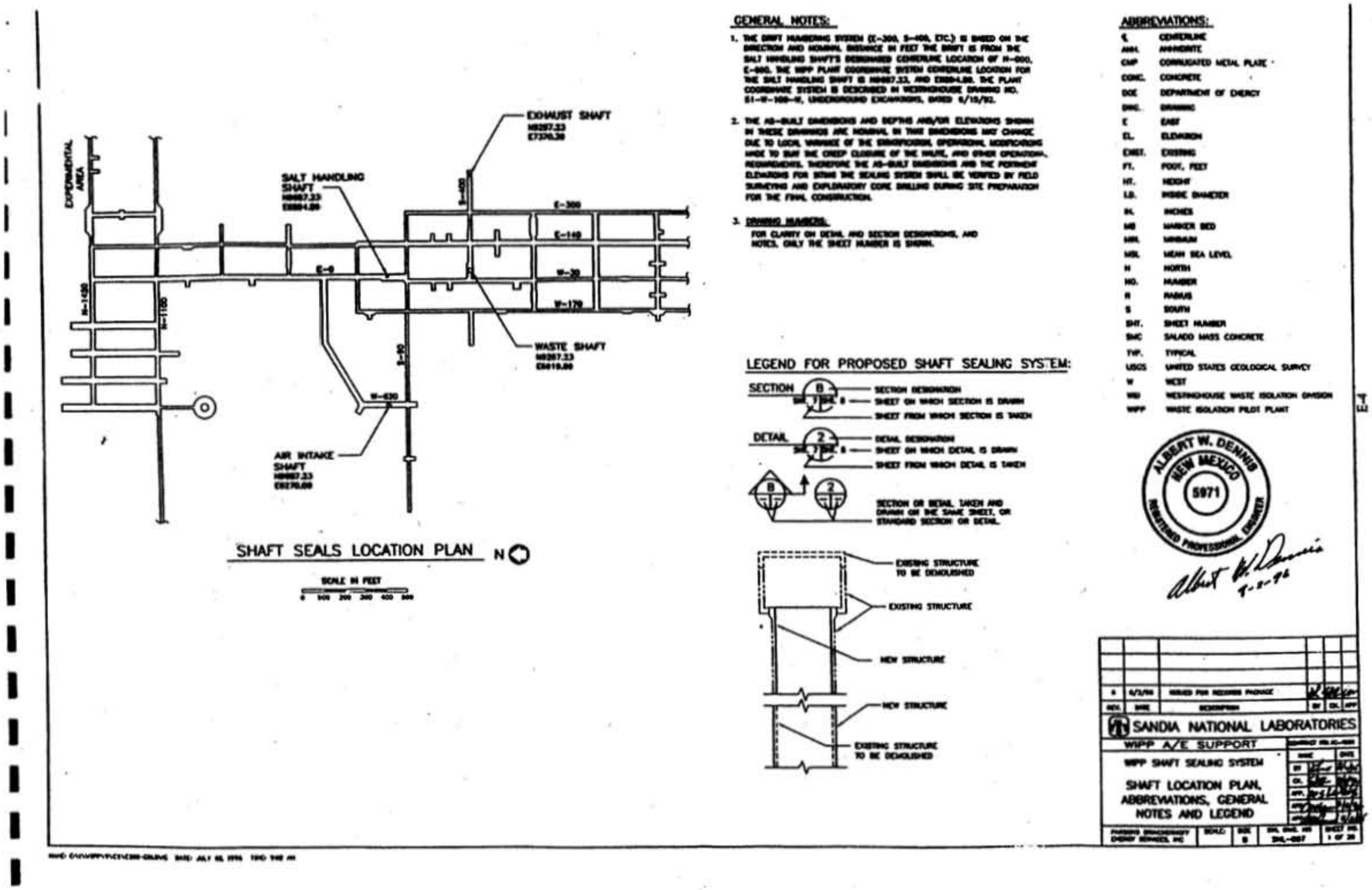
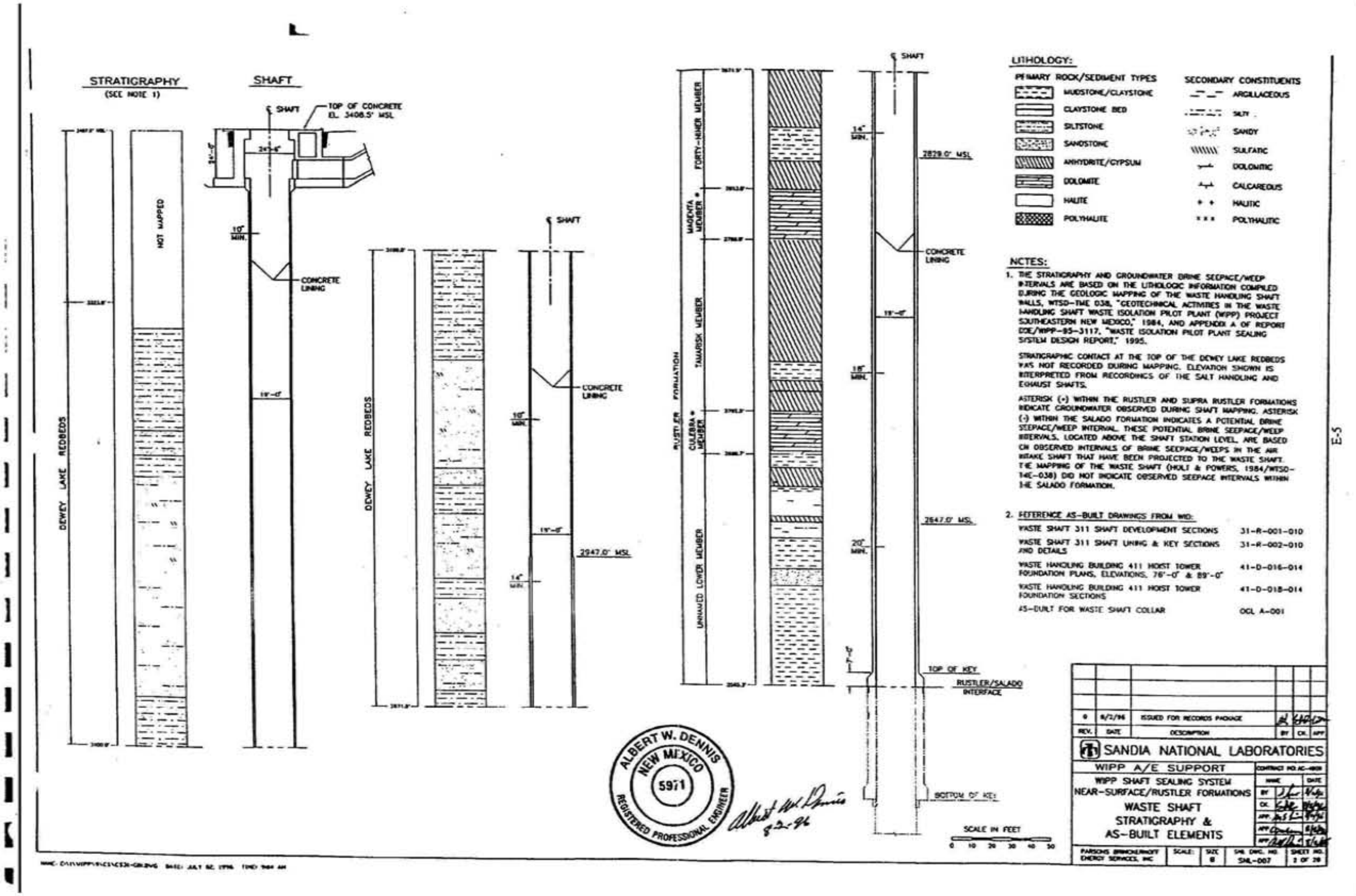
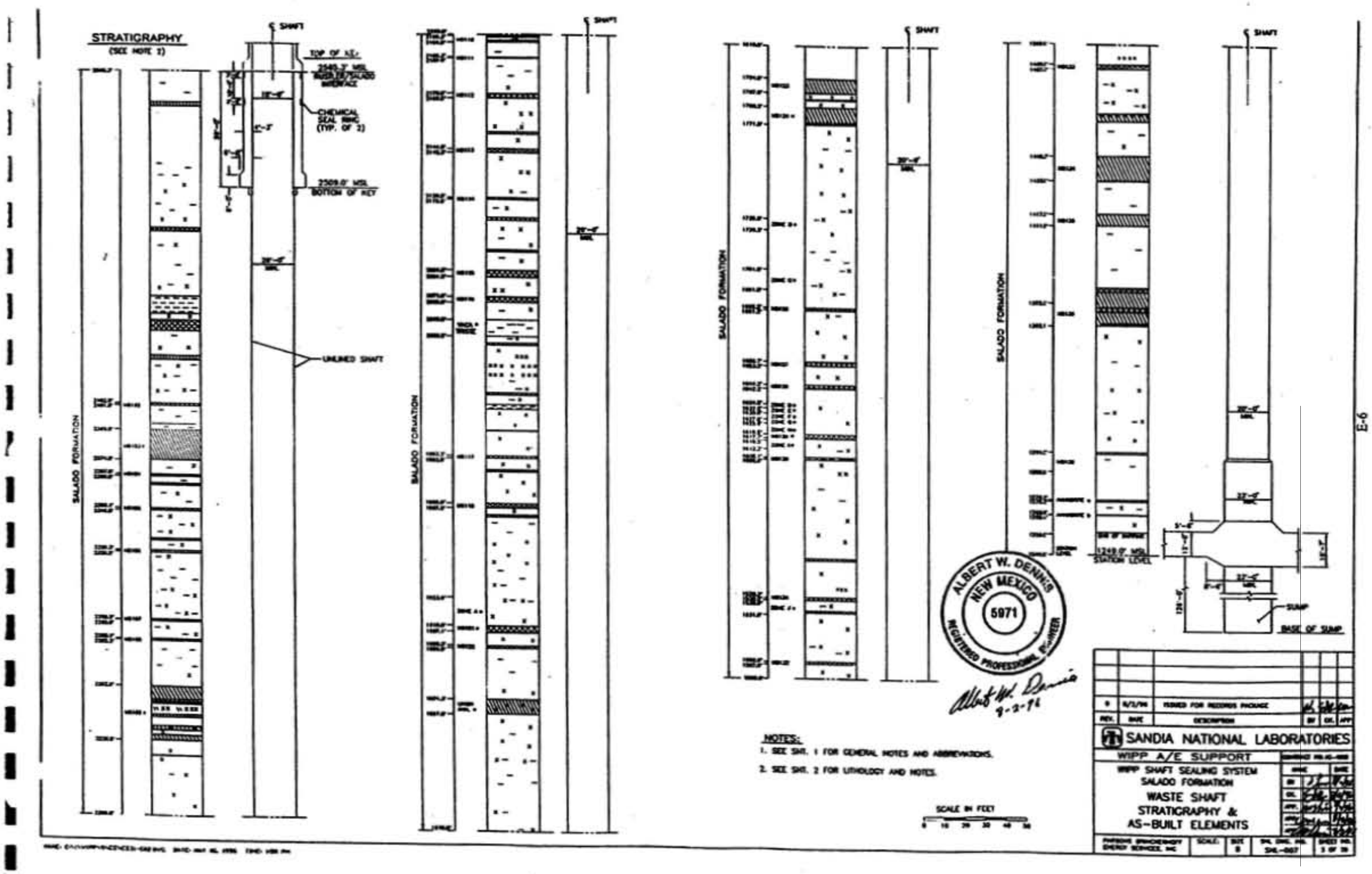


1 Shaft Location Plan, Abbreviations, General Notes and Legend Sheet 1 of 28



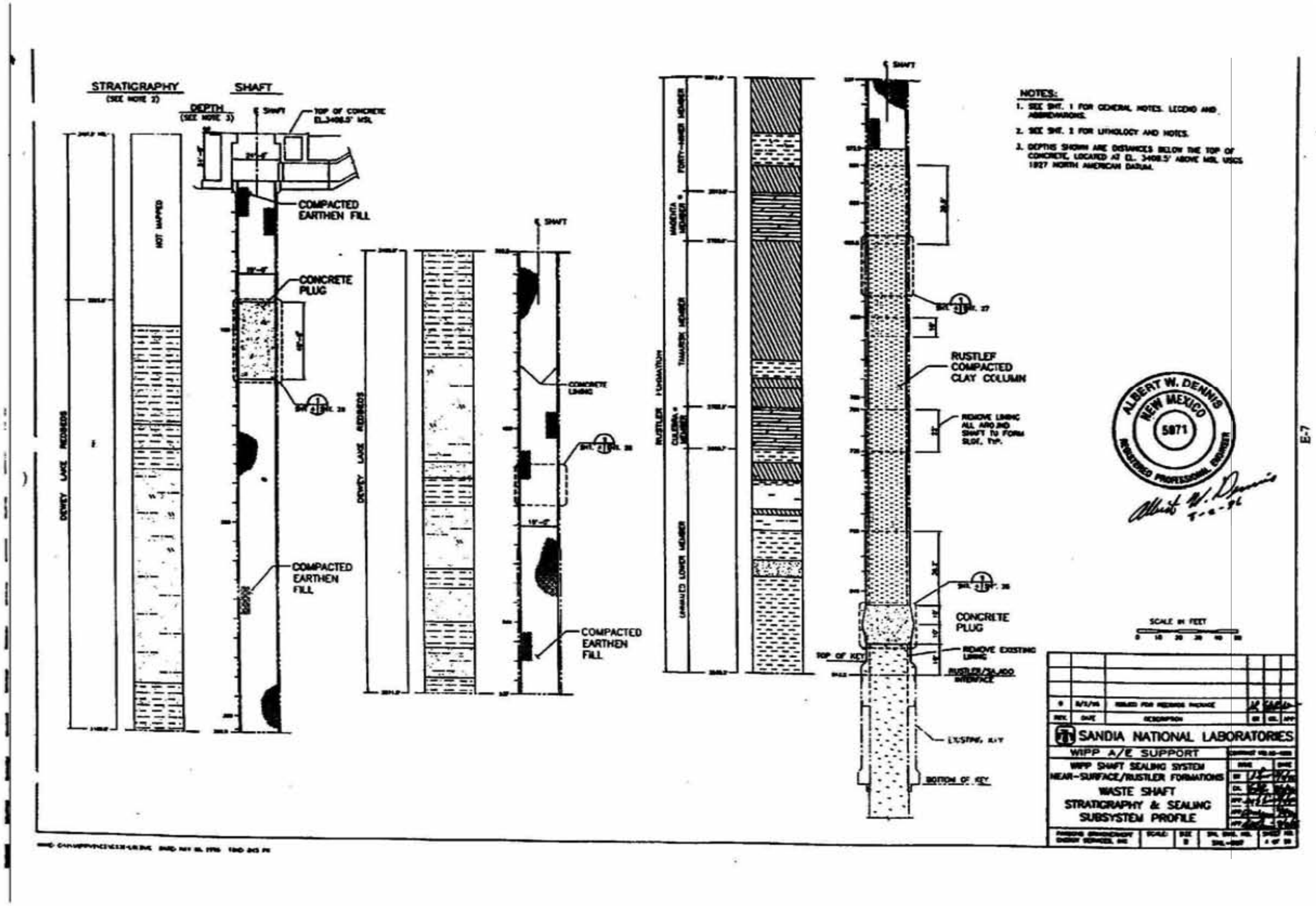
1 Near-Surface/Rustler Formations Waste Shaft Stratigraphy and AS-Built Elements Sheet 2 of 28



Salado Formation Waste Shaft Stratigraphy and AS-Built Elements

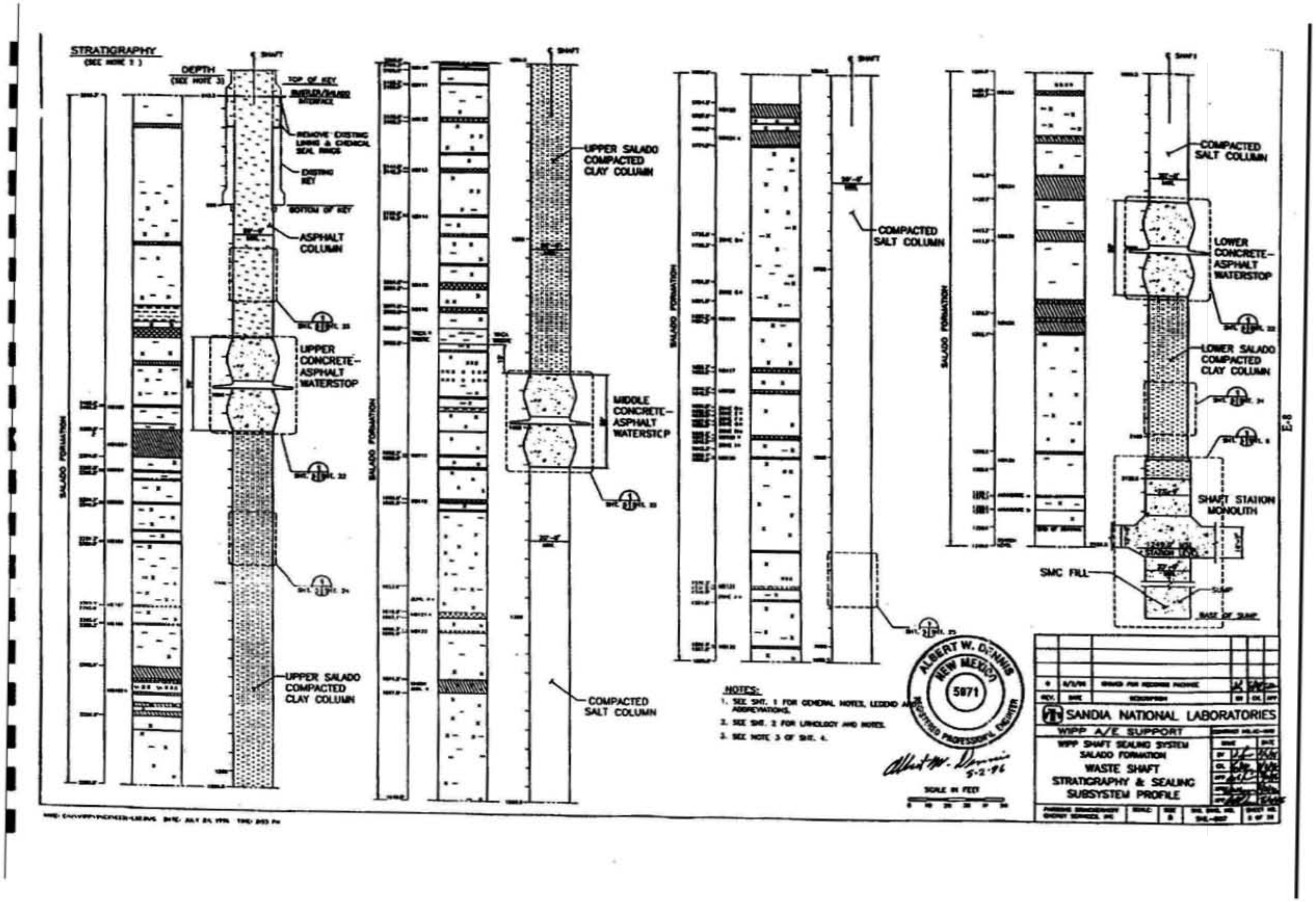
Sheet 3 of 28

1

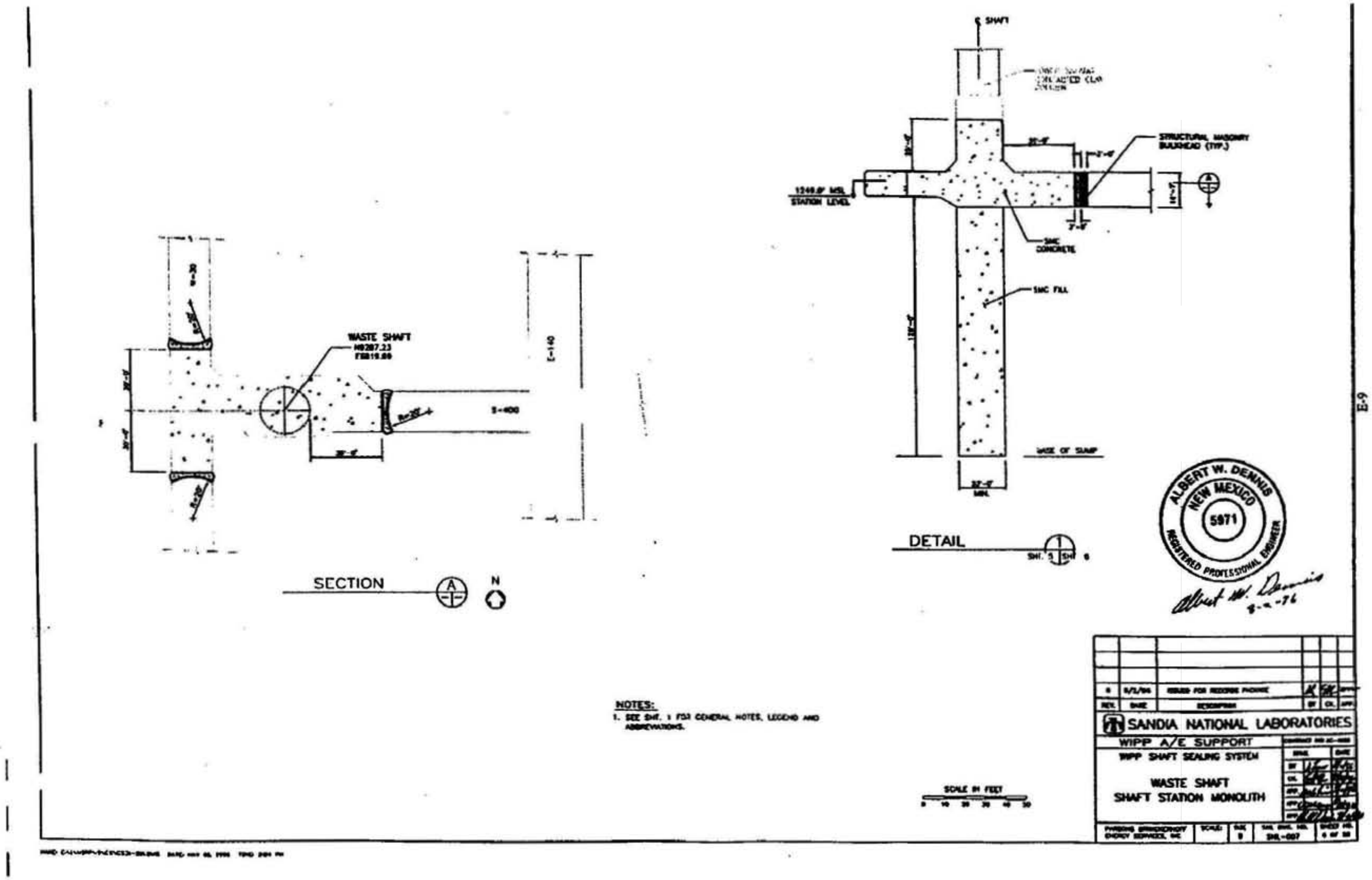


Near-Surface/Rustler Formations Waste Shaft Stratigraphy and Sealing Subsystem Profile

Sheet 4 of 28

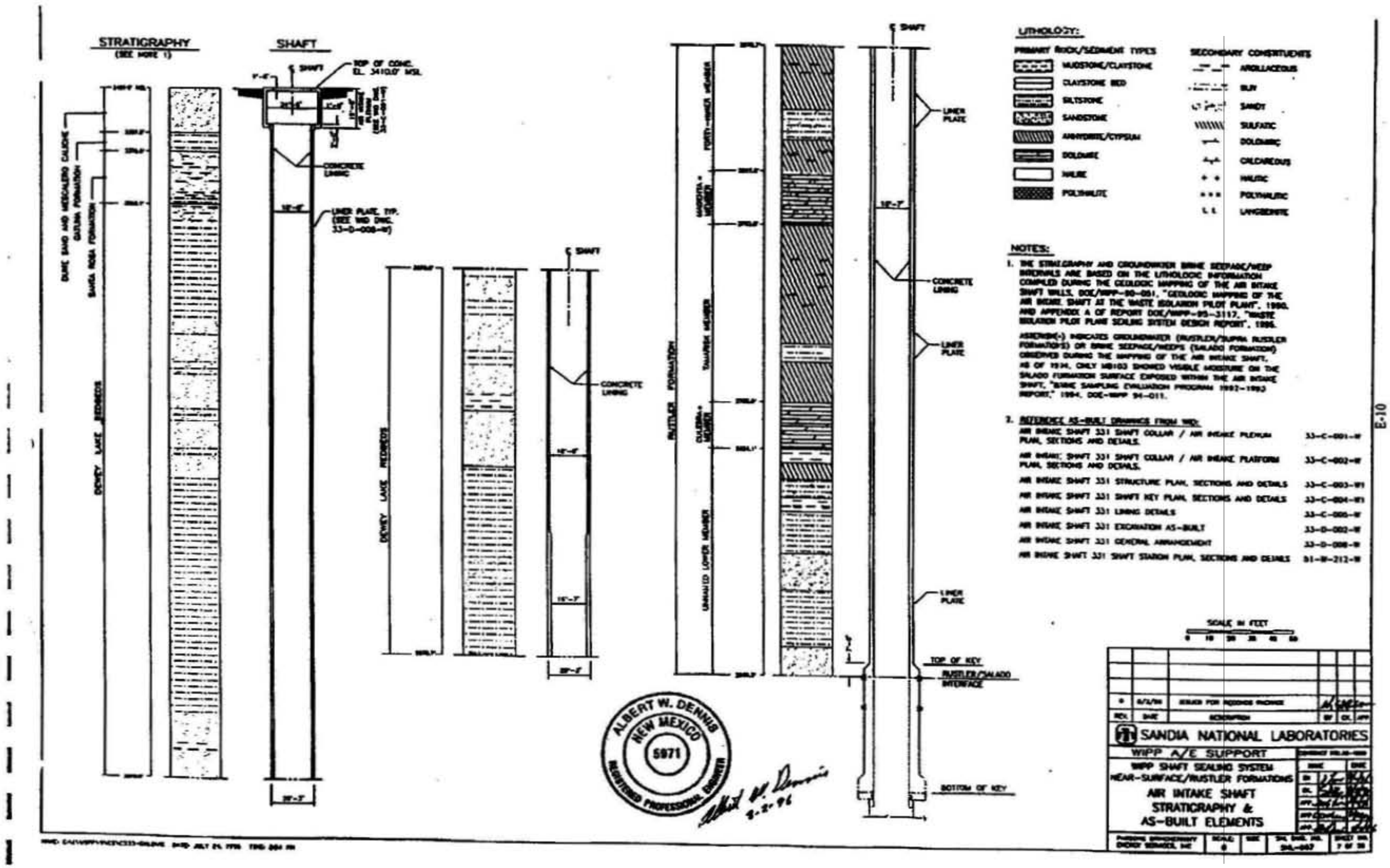


Salado Formation Waste Shaft Stratigraphy and Sealing Subsystem Profile Sheet 5 of 28



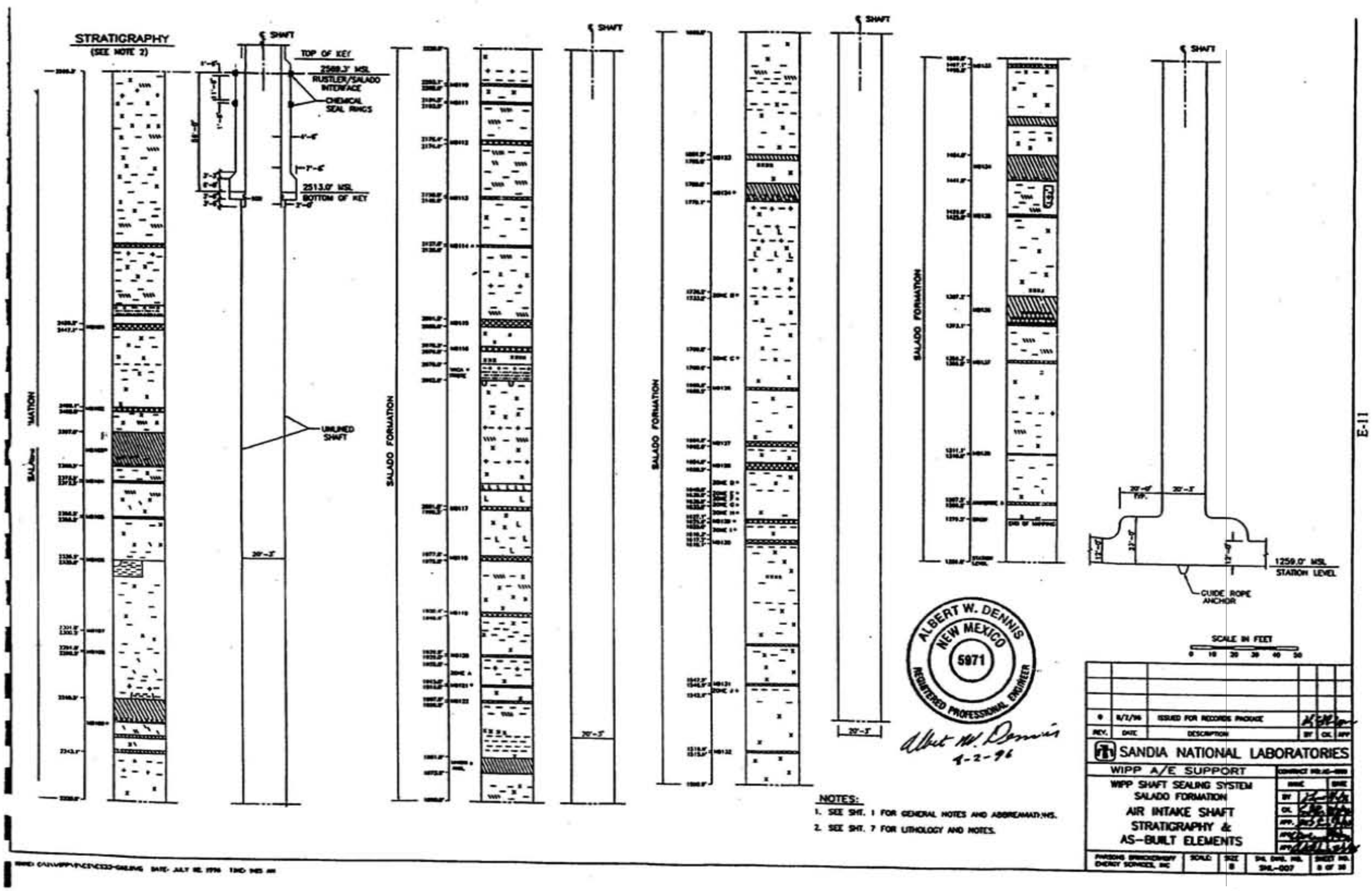
Waste Shaft Station Monolith

Sheet 6 of 28



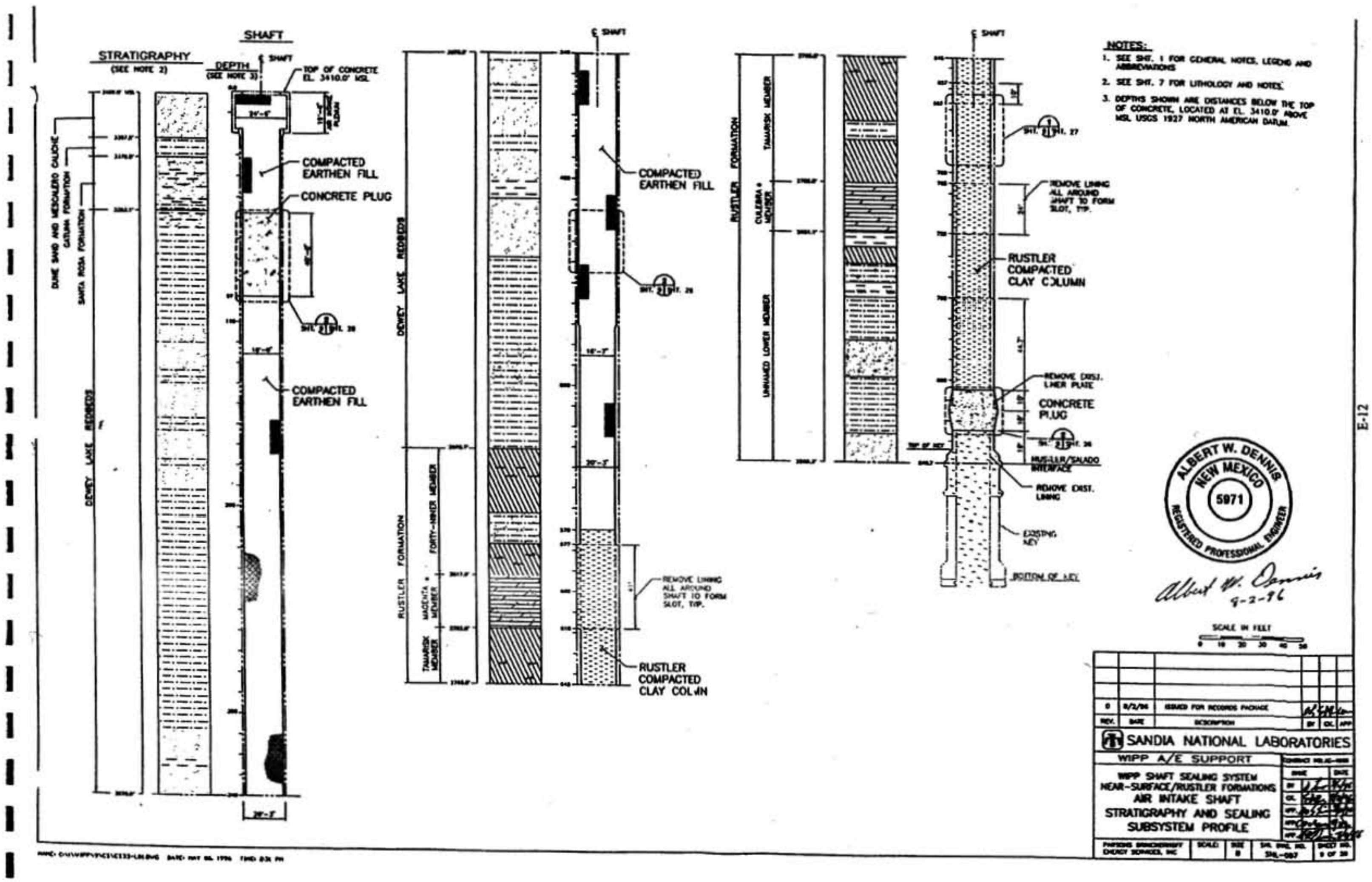
Near-Surface / Rustler Formations Air Intake Shaft Stratigraphy and AS-Built Elements

Sheet 7 of 28



Salado Formation Air Intake Shaft Stratigraphy and AS-Built Elements

Sheet 8 of 28



Near-Surface / Rustler Formations Air Intake Shaft Stratigraphy and Sealing Subsytem Profile   Sheet 9 of 28

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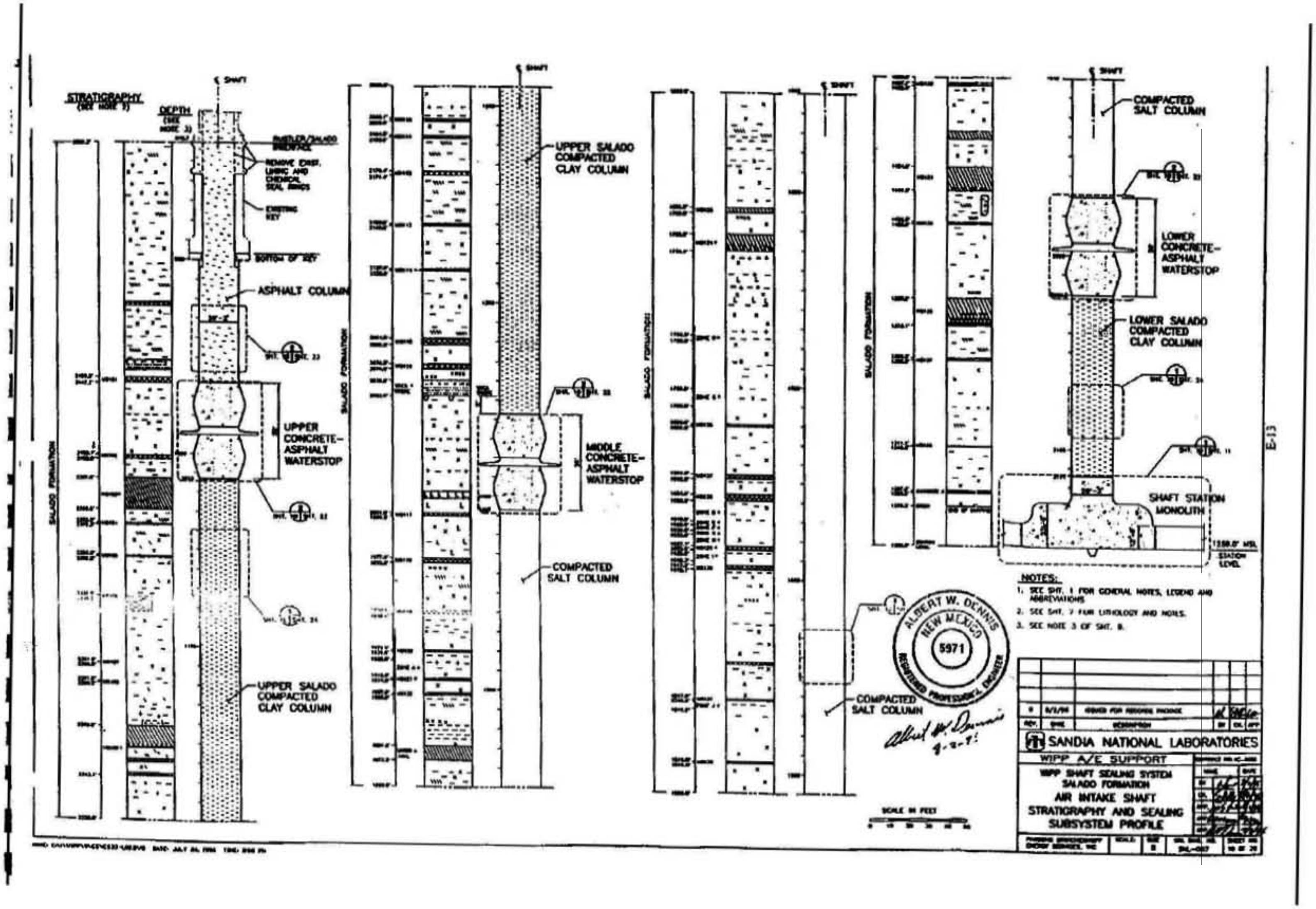

Salado Formation Air Intake Shaft Stratigraphy and Sealing Subsytem Profile Sheet 10 of 28

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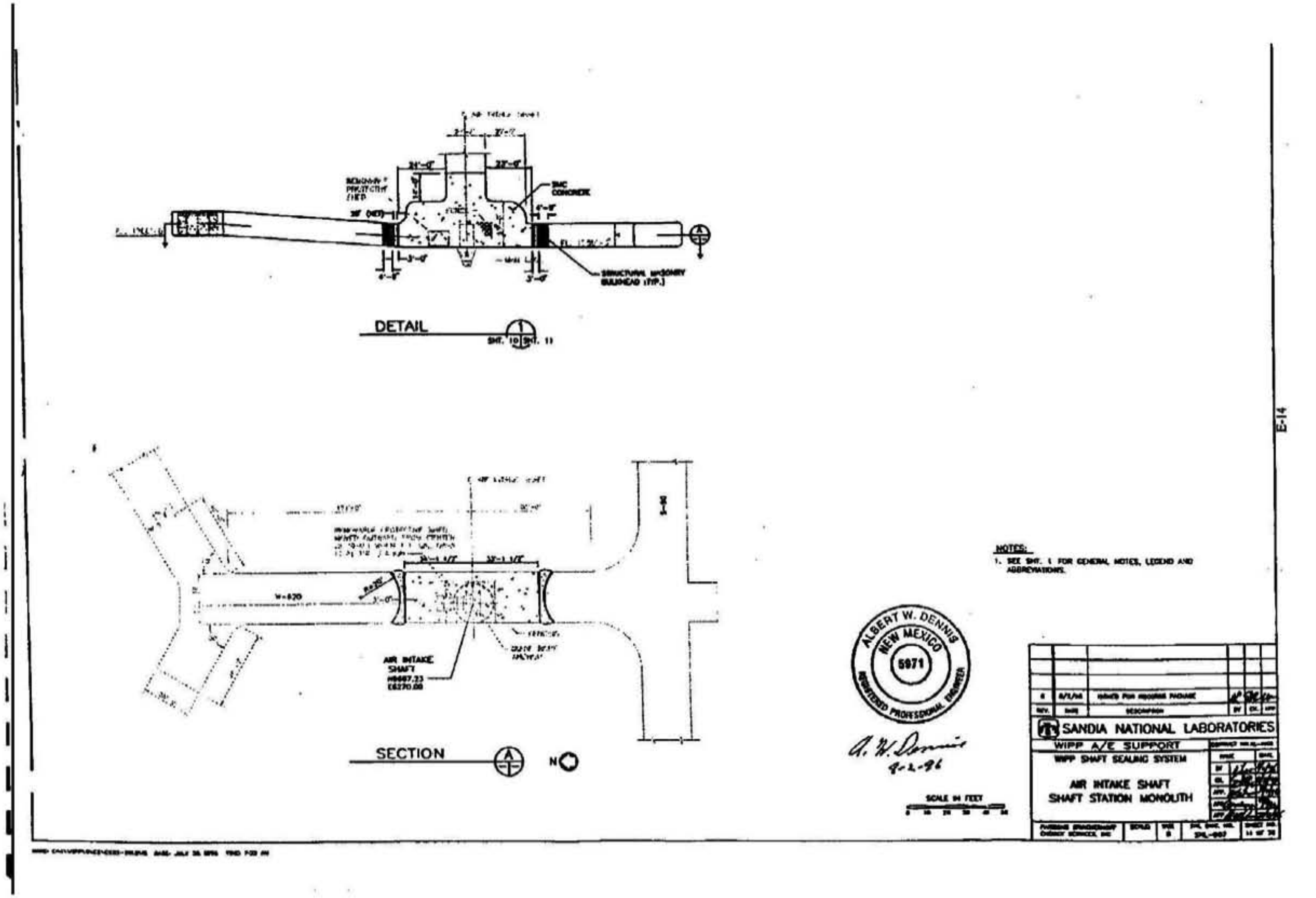
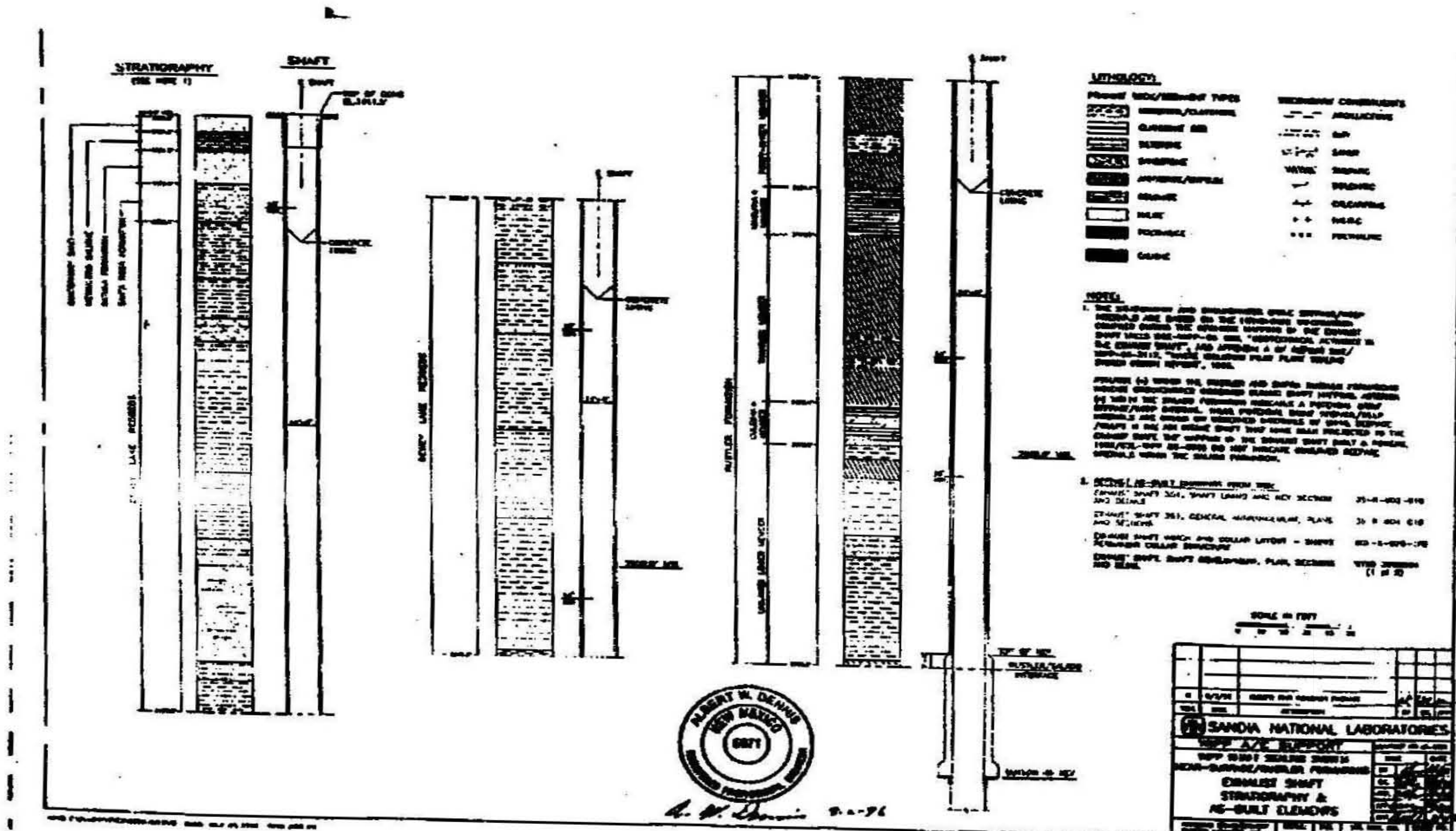
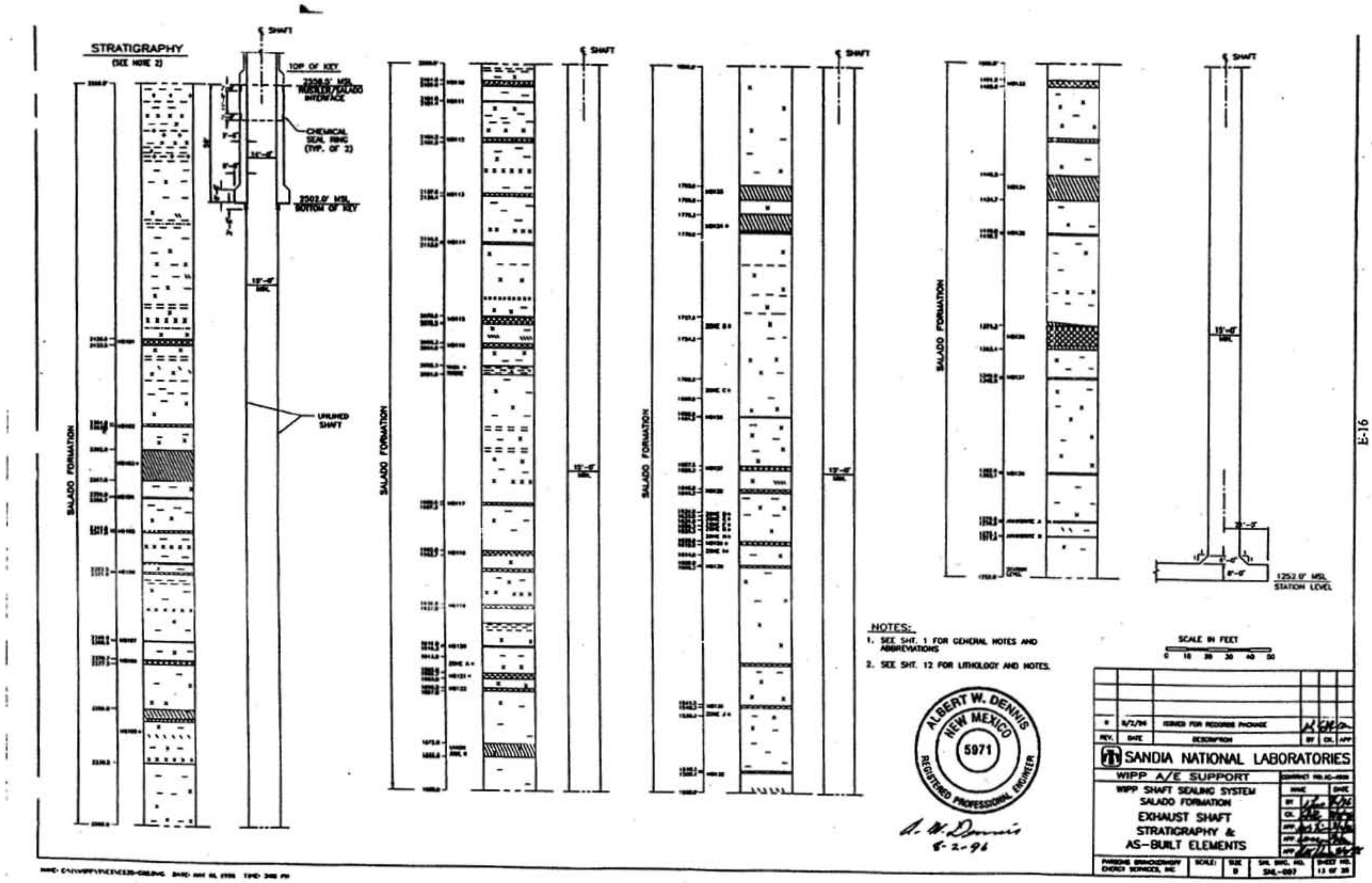


1 Air Intake Shaft Station Monolith Sheet 11 of 28

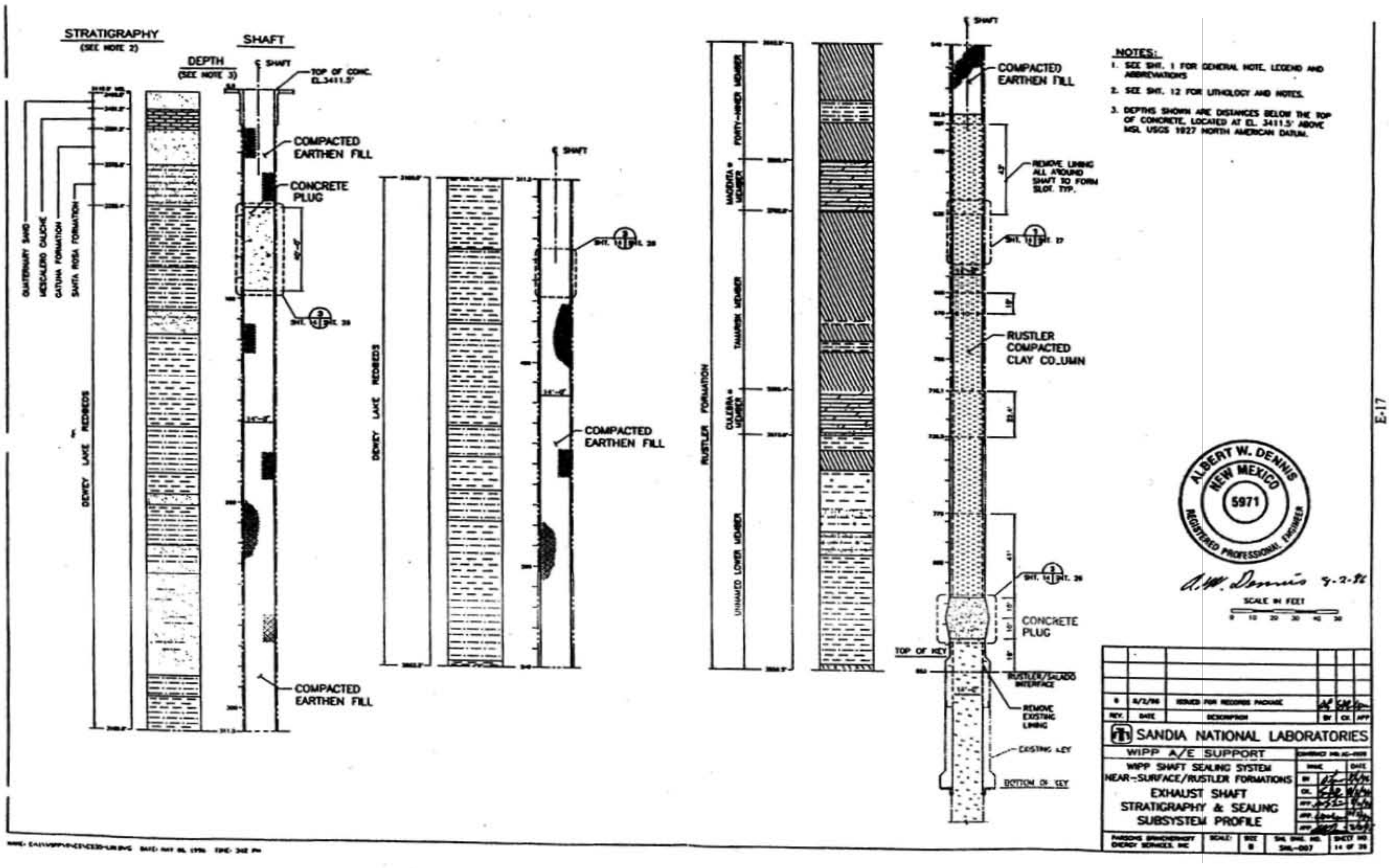


1 Near-Surface / Rustler Formations Exhaust Shaft Stratigraphy and AS-Built Elements Sheet 12 of 28



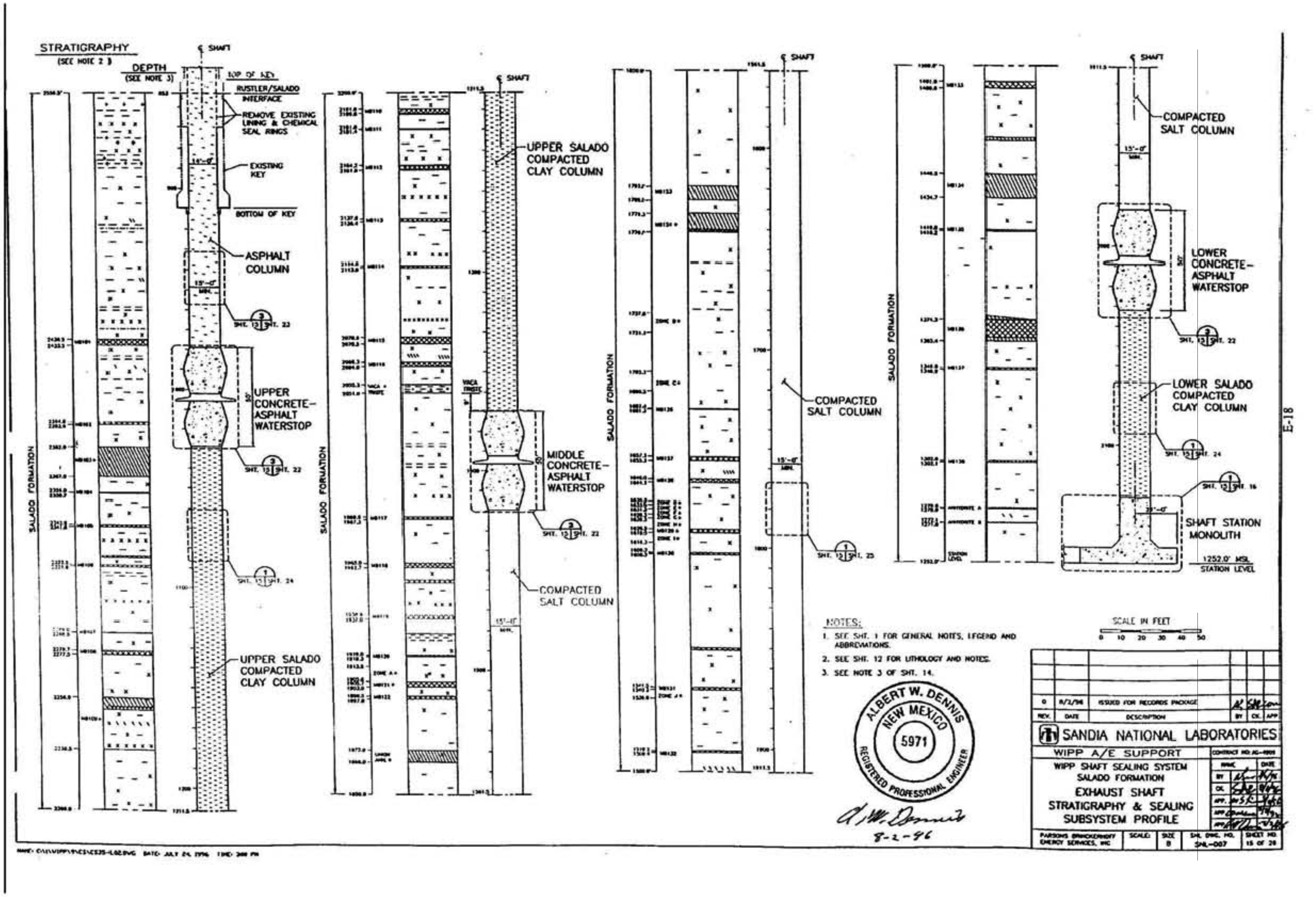
Salado Formation Exhaust Shaft Stratigraphy and AS-Built Elements

Sheet 13 of 28

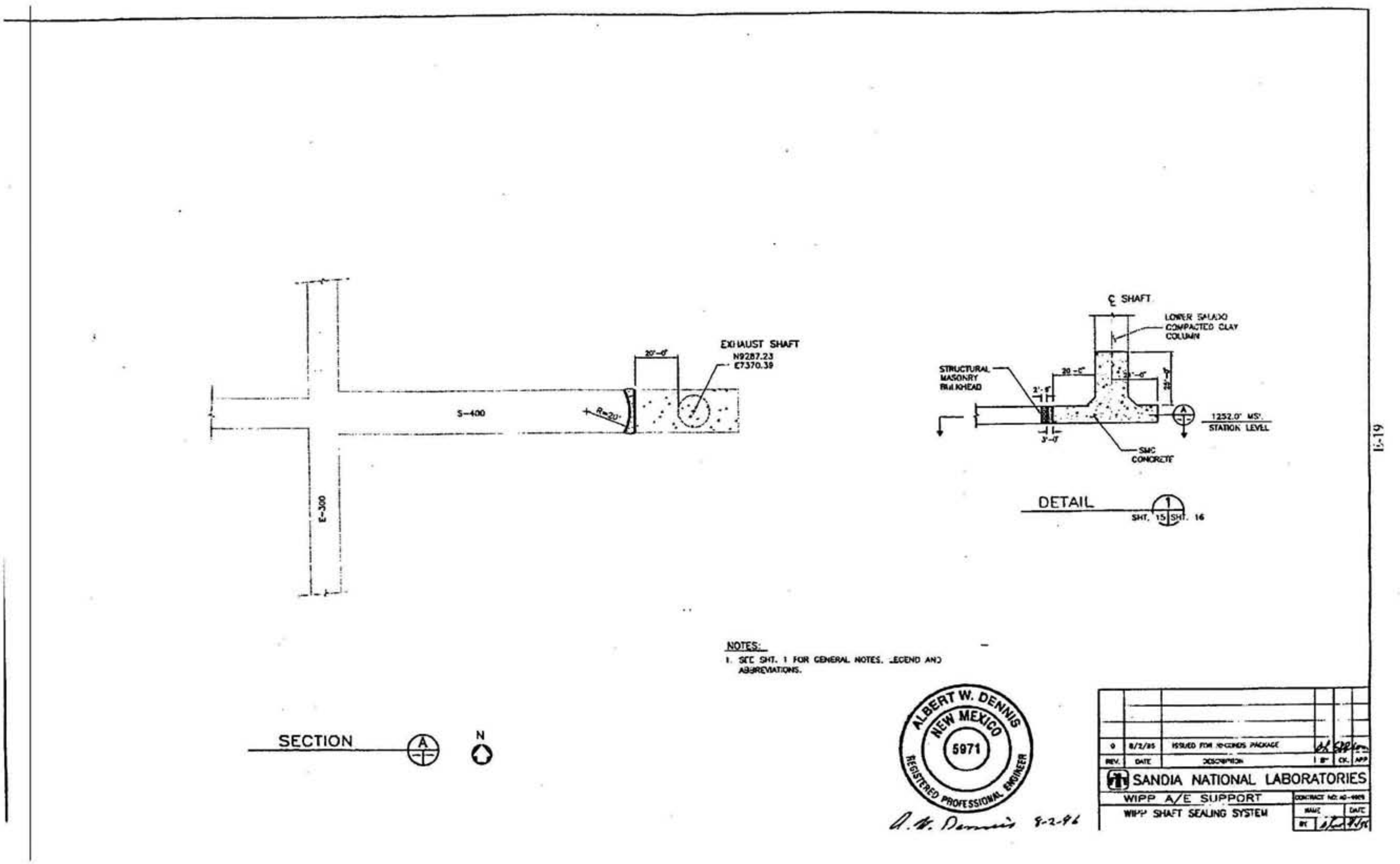


Near-Surface / Rustler Formations Exhaust Shaft Stratigraphy and Sealing Subsystem Profile

Sheet 14 of 28



Salado Formation Exhaust Shaft Stratigraphy and Sealing Subsystem Profile Sheet 15 of 28



Exhaust Shaft Station Monolith

Sheet 16 of 28

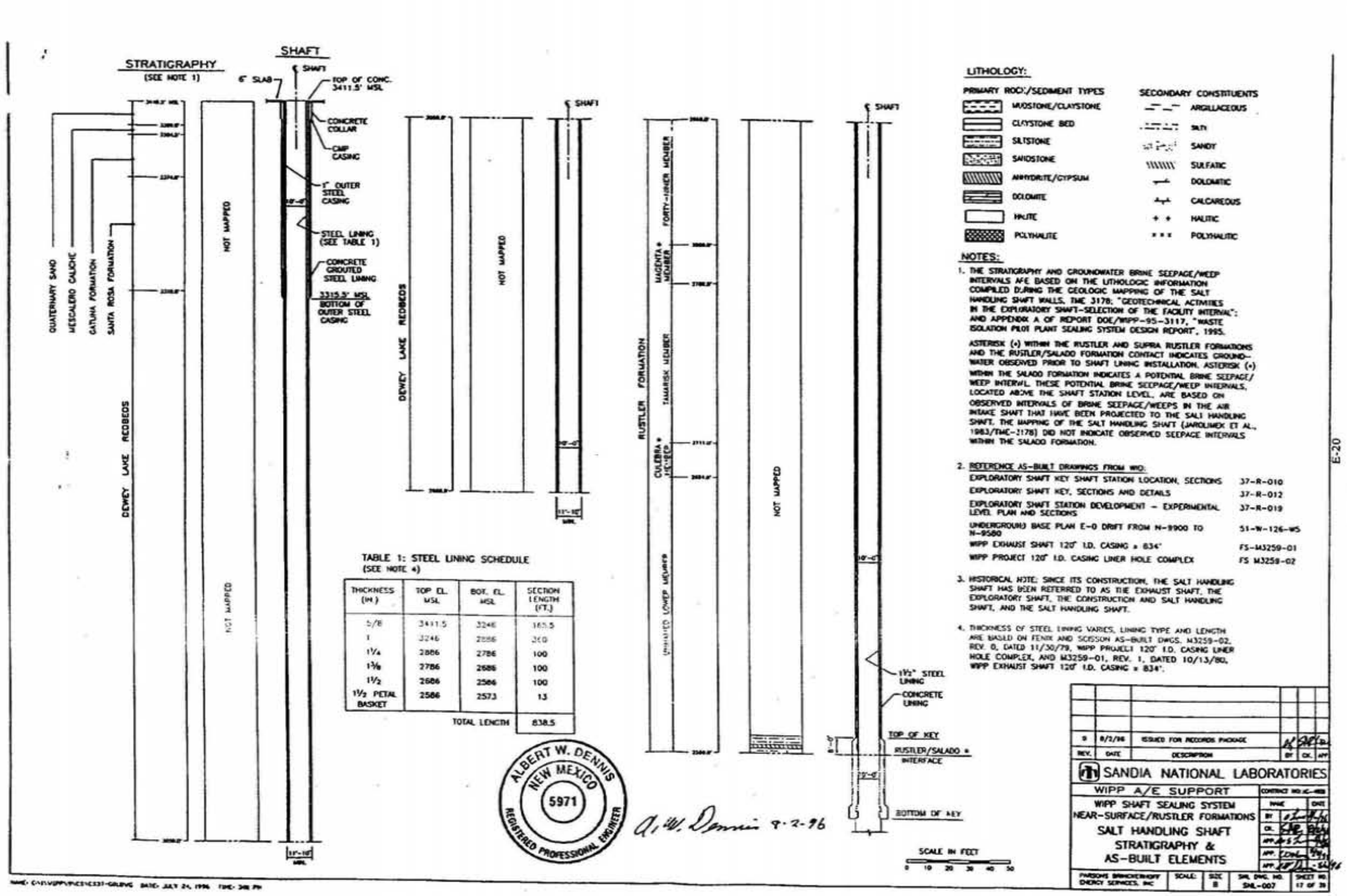
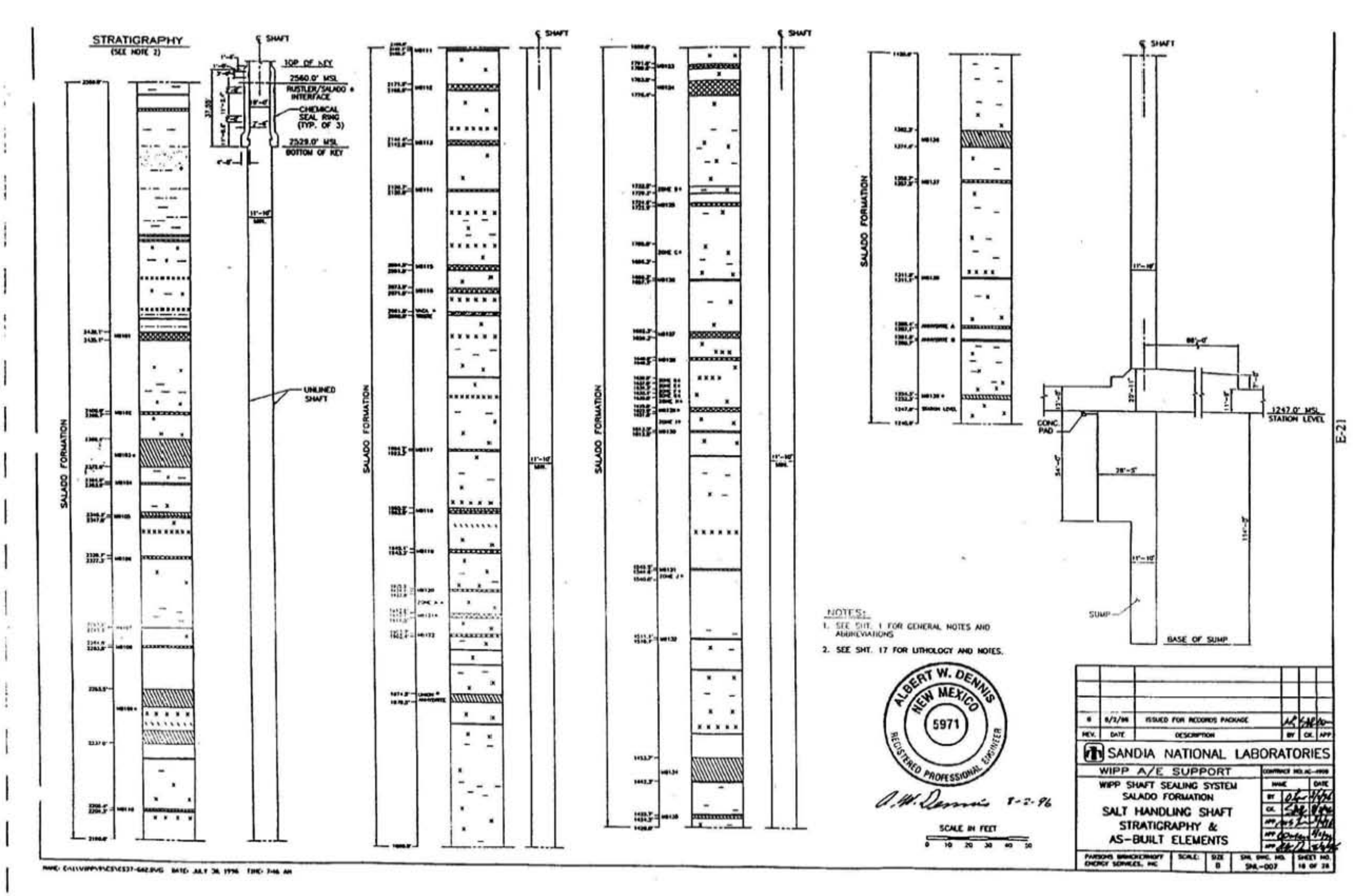


TABLE 1: STEEL LINING SCHEDULE
(SEE NOTE 4)

THICKNESS (IN.)	TOP EL. MSL	BOT. EL. MSL	SECTION LENGTH (FT.)
5/8	3411.5	3246	165.5
1	3246	2886	360
1¼	2886	2786	100
1⅜	2786	2686	100
1½	2686	2586	100
1½ PETAL BASKET	2586	2573	13
		TOTAL LENGTH	838.5

Near-Surface / Rustler Formations Salt Handling Shaft Stratigraphy and AS-Built Elements Sheet 17of 28

1



Salado Formation Salt Handling Shaft Stratigraphy and AS-Built Elements

Sheet 18 of 28

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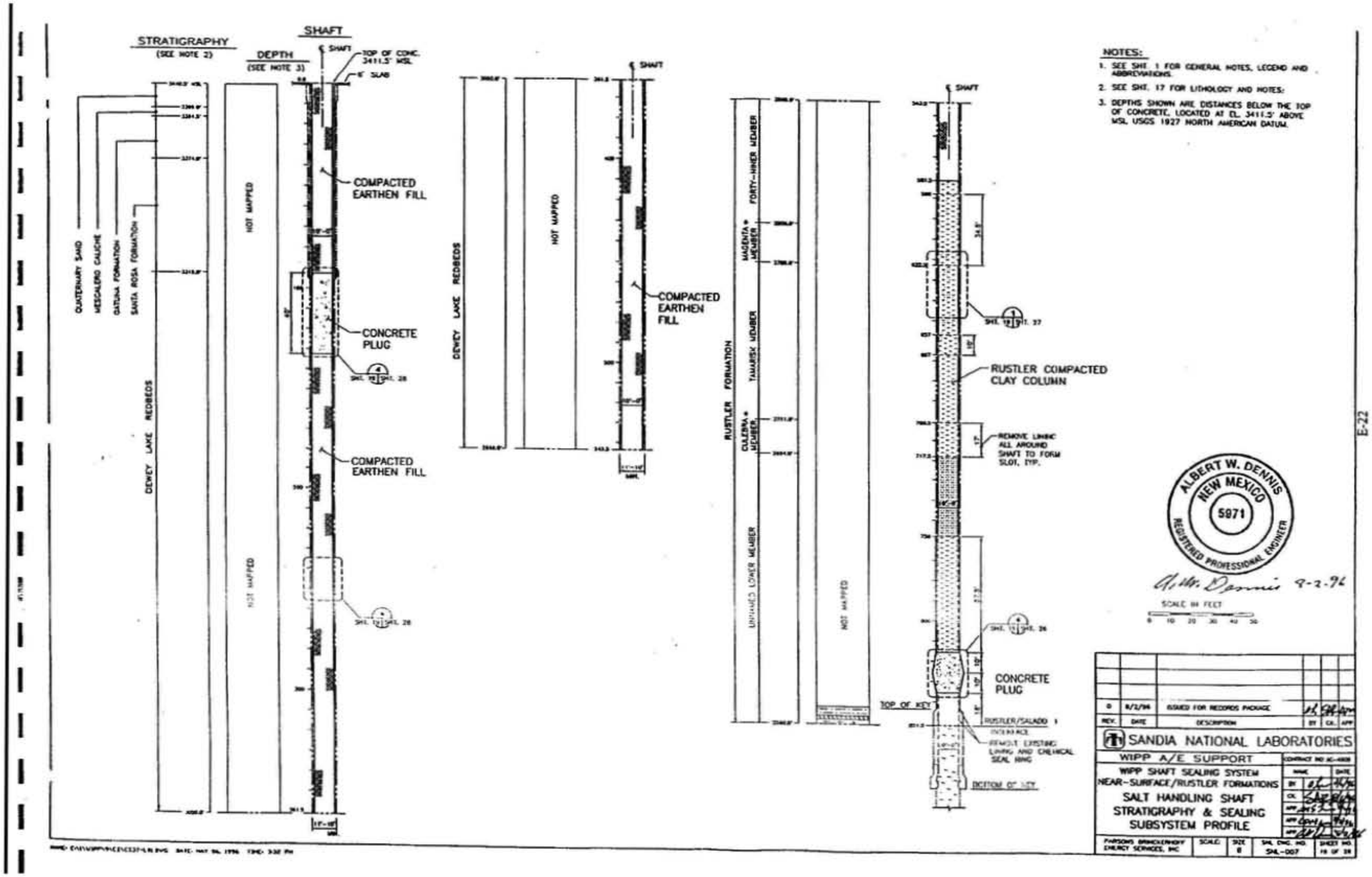
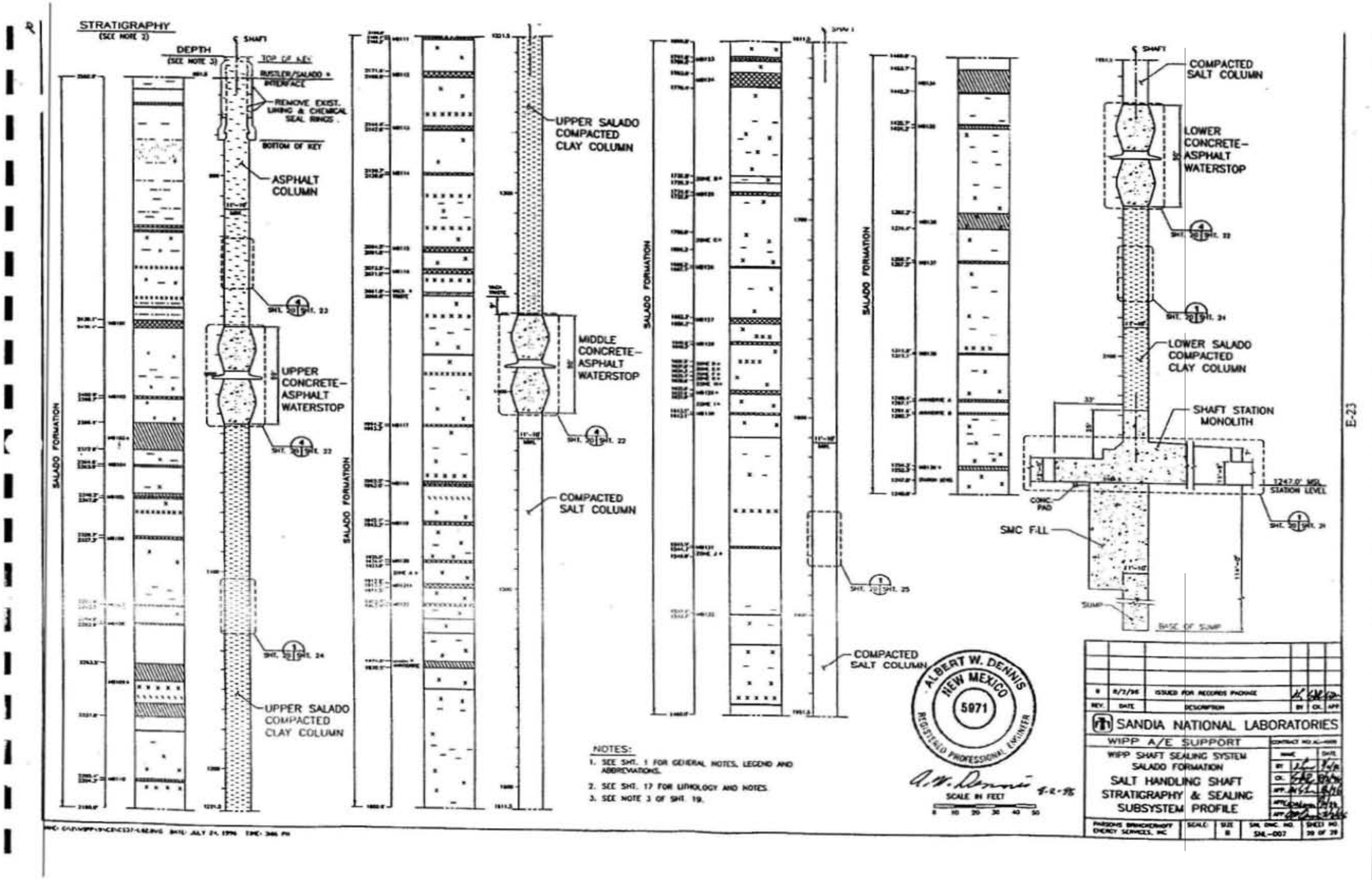
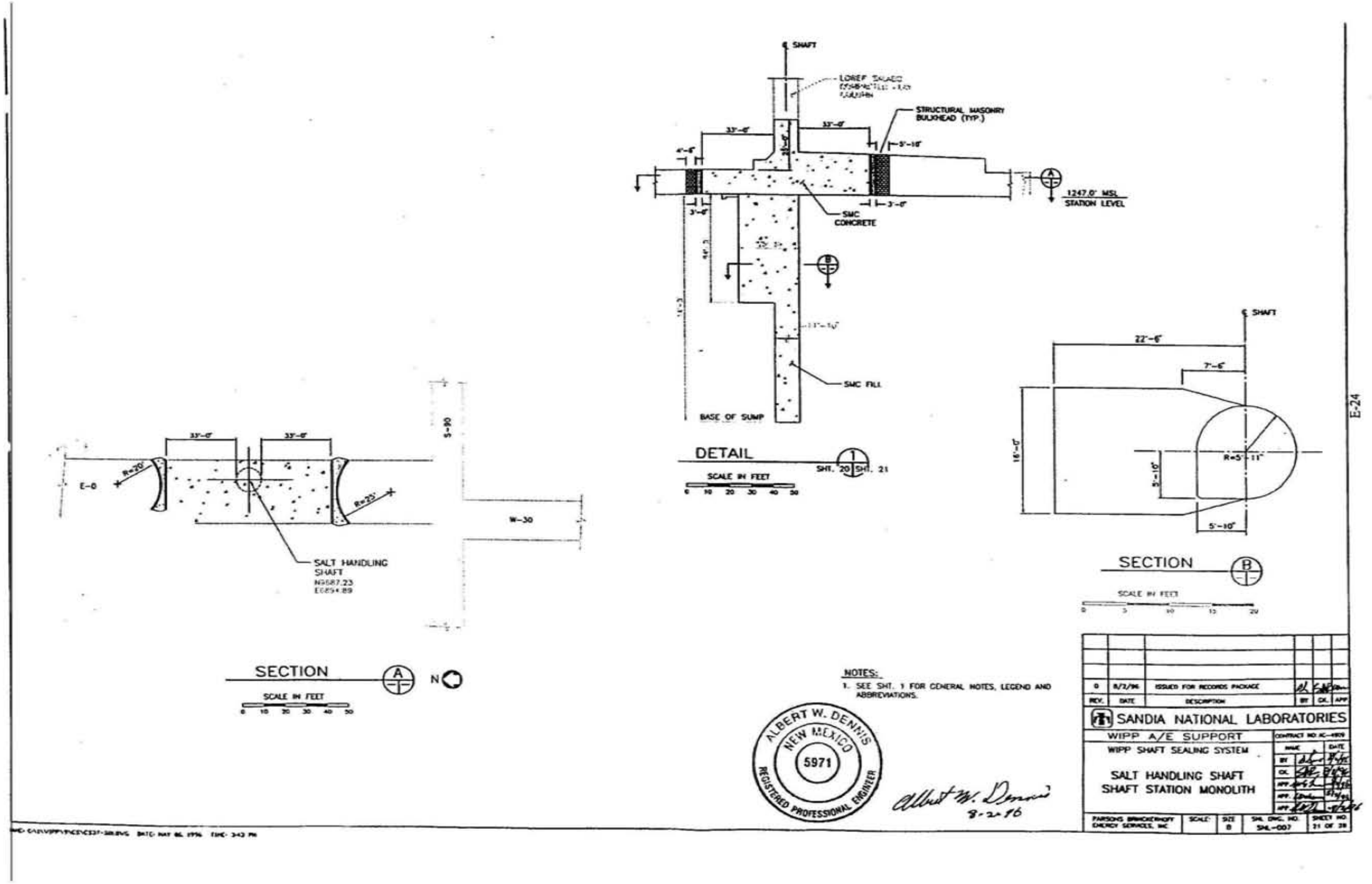


Near-Surface / Rustler Formations Salt Handling Shaft Stratigraphy and Sealing Subsystem Profile Sheet 19 of 28



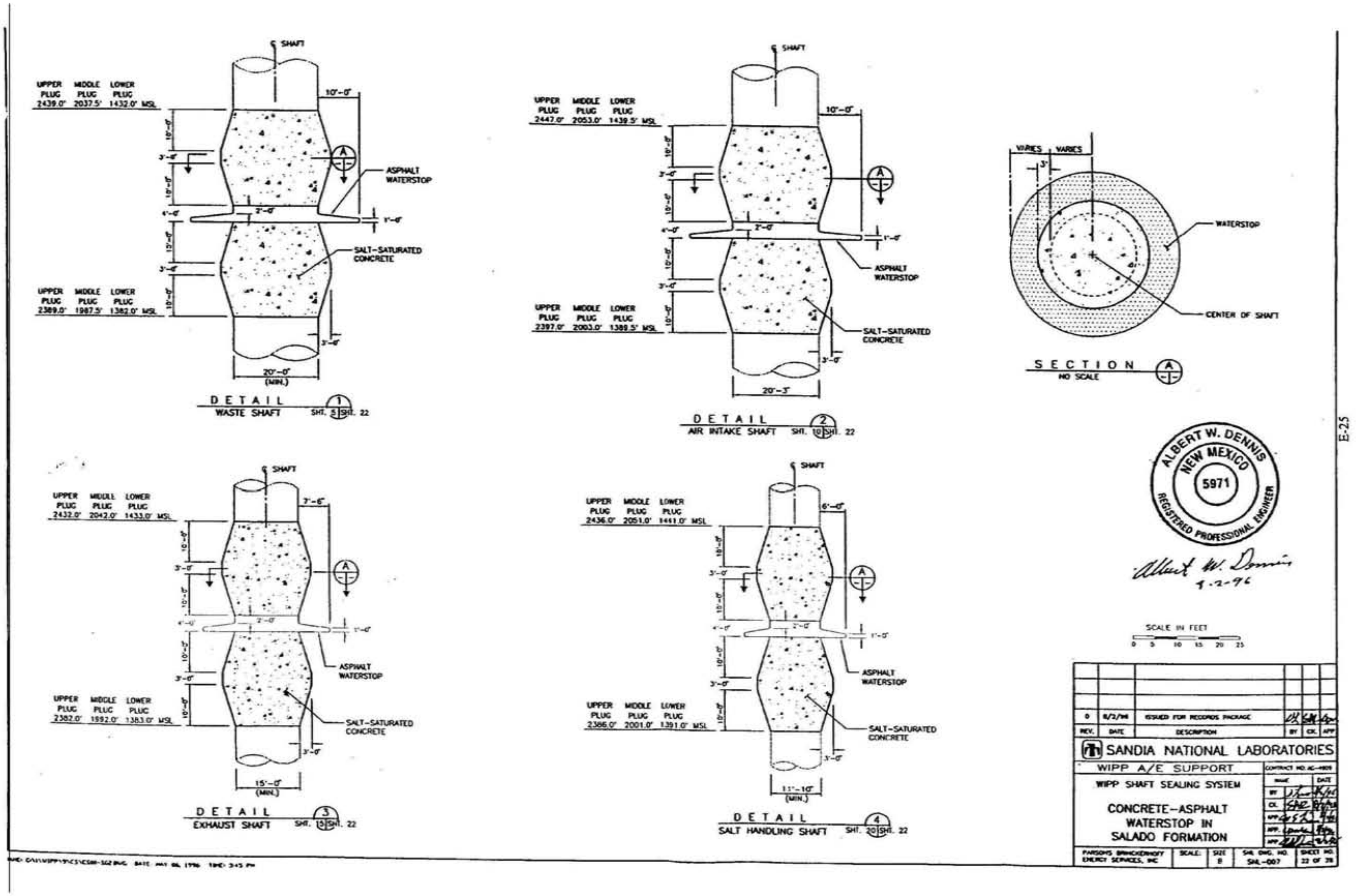
Salado Formation Salt Handling Shaft Stratigraphy and Sealing Subsystem Profile

Sheet 20 of 28



Salt Handling Shaft Shaft Station Monolith

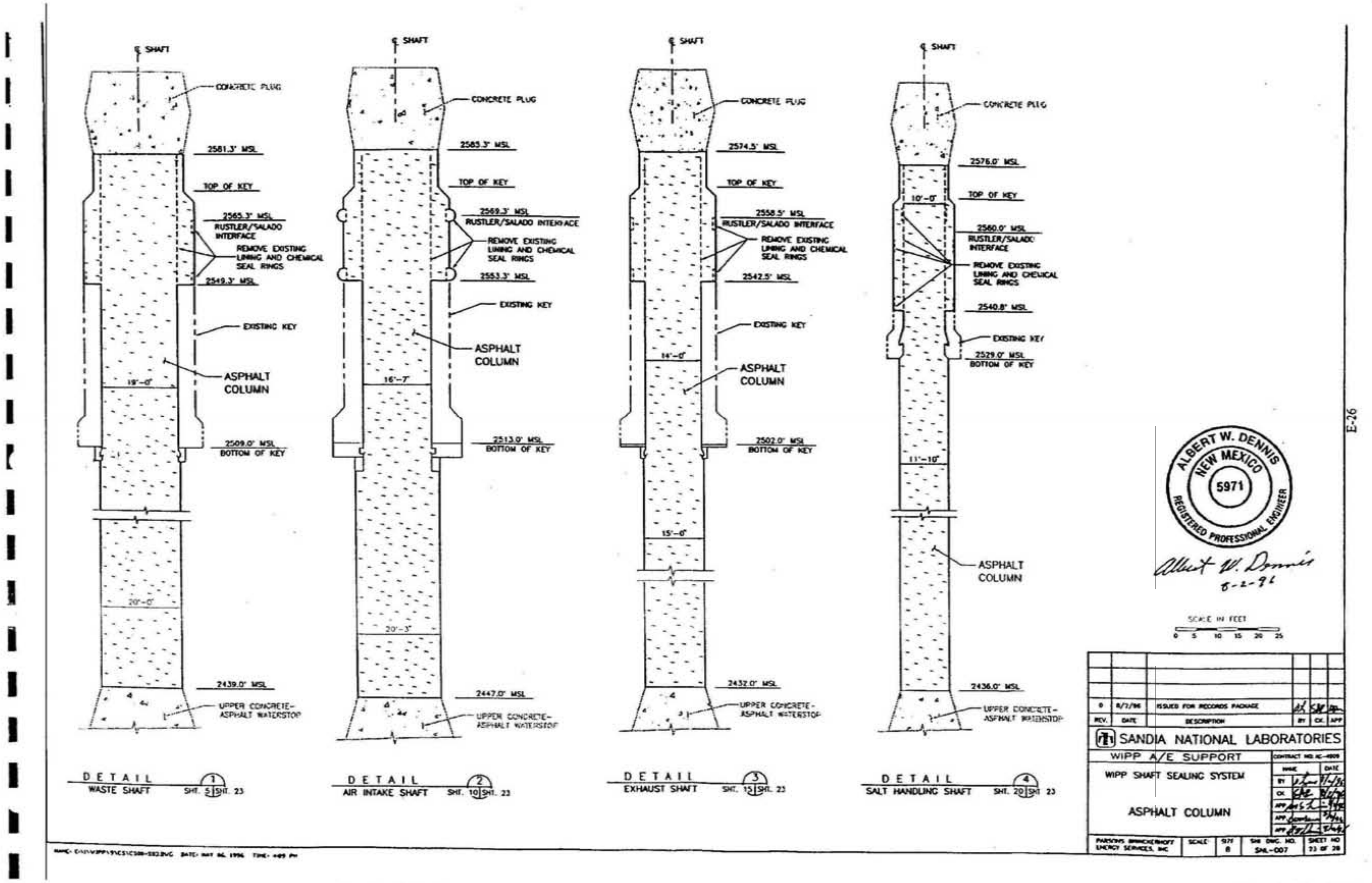
Sheet 21 of 28



Concrete-Asphalt Water Stop in Salado Formation

Sheet 22 of 28

1



Asphalt Column

Sheet 23 of 28

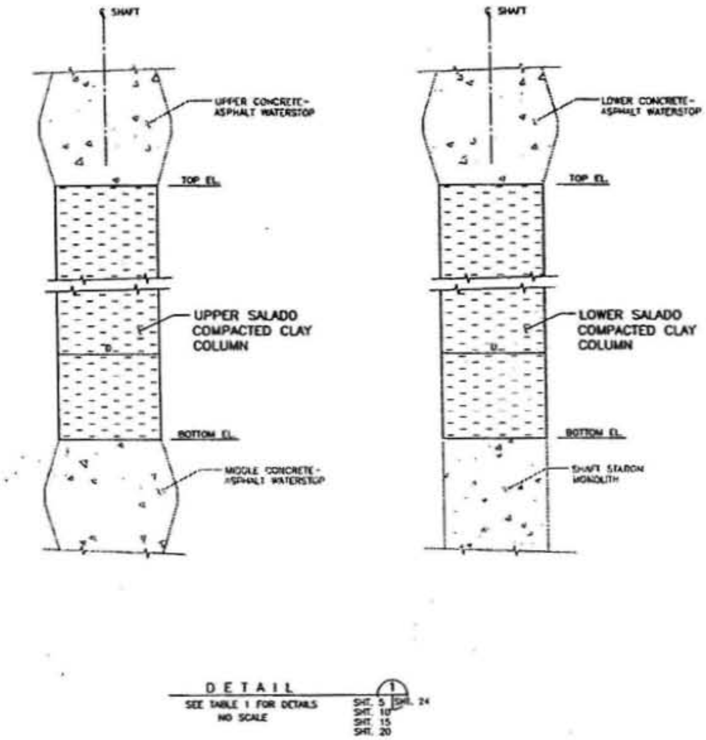
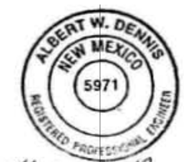


TABLE 1

SHAFT	NOMINAL SHAFT DIAMETER D	UPPER SALADO COMPACTED CLAY COLUMN			LOWER SALADO COMPACTED CLAY COLUMN		
		TOP EL. (FT. MSL)	BOTTOM EL. (FT. MSL)	TOTAL HT. (FT.)	TOP EL. (FT. MSL)	BOTTOM EL. (FT. MSL)	TOTAL HT. (FT.)
WASTE	20'-0"	2389.0	2037.5	351.5	1382.0	1286.0	96.0
AIR INTAKE	20'-3"	2397.0	2053.0	344.0	1389.5	1296.0	93.5
EXHAUST	15'-0"	2382.0	2042.0	340.0	1383.0	1285.0	98.0
SALT HANDLING	11'-10"	2386.0	2051.0	335.0	1391.0	1284.0	107.0

E-27



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SHEET NO. 24 OF 28

1

Upper and Lower Salado Compacted Clay Columns

Sheet 24 of 28

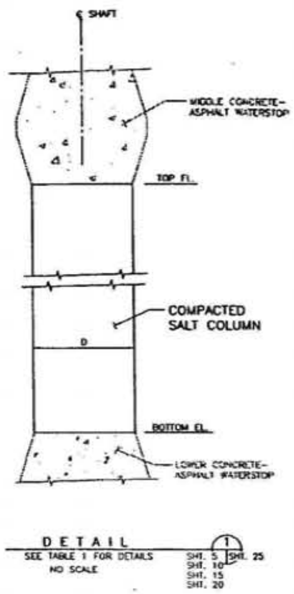

TABLE 1

SHAFT	NOMINAL SHAFT DIAMETER D	COMPACTED SALT COLUMN		
		TOP EL. (FT. MSL)	BOTTOM EL. (FT. MSL)	TOTAL HT. (FT.)
WASTE	20'-0"	1987.5	1432.0	555.5
AIR INTAKE	20'-3"	2003.0	1439.5	563.5
EXHAUST	15'-0"	1992.0	1433.0	559.0
SALT HANDLING	11'-10"	2001.0	1441.0	560.0

E-28

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Compacted Salt Column

Sheet 25 of 28

WIPP Shaft Sealing System Concrete Plug

Drawing SNL 007 26 of 28 not currently available. Drawing is not displayed in the Permit.

WIPP Shaft Sealing System Plug Sheet 26 of 28

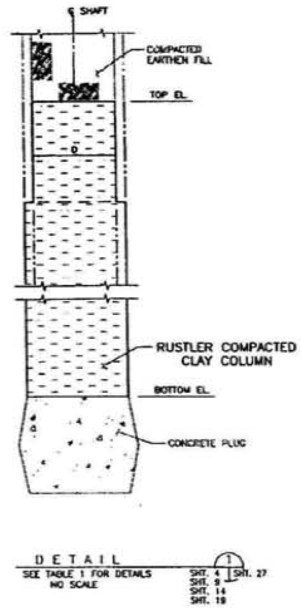

TABLE 1

SHAFT	NOMINAL SHAFT DIAMETER D	RUSTLER COMPACTED CLAY COLUMN		
		TOP EL. (FT. MSL)	BOTTOM EL. (FT. MSL)	TOTAL HT. (FT.)
WASTE	19'-0"	2836.0	2601.3	234.7
AIR INTAKE	16'-7"	2840.0	2605.3	234.7
EXHAUST	14'-0"	2829.0	2594.5	234.5
SALT HANDLING	10'-0"	2830.0	2596.0	234.0

E-30

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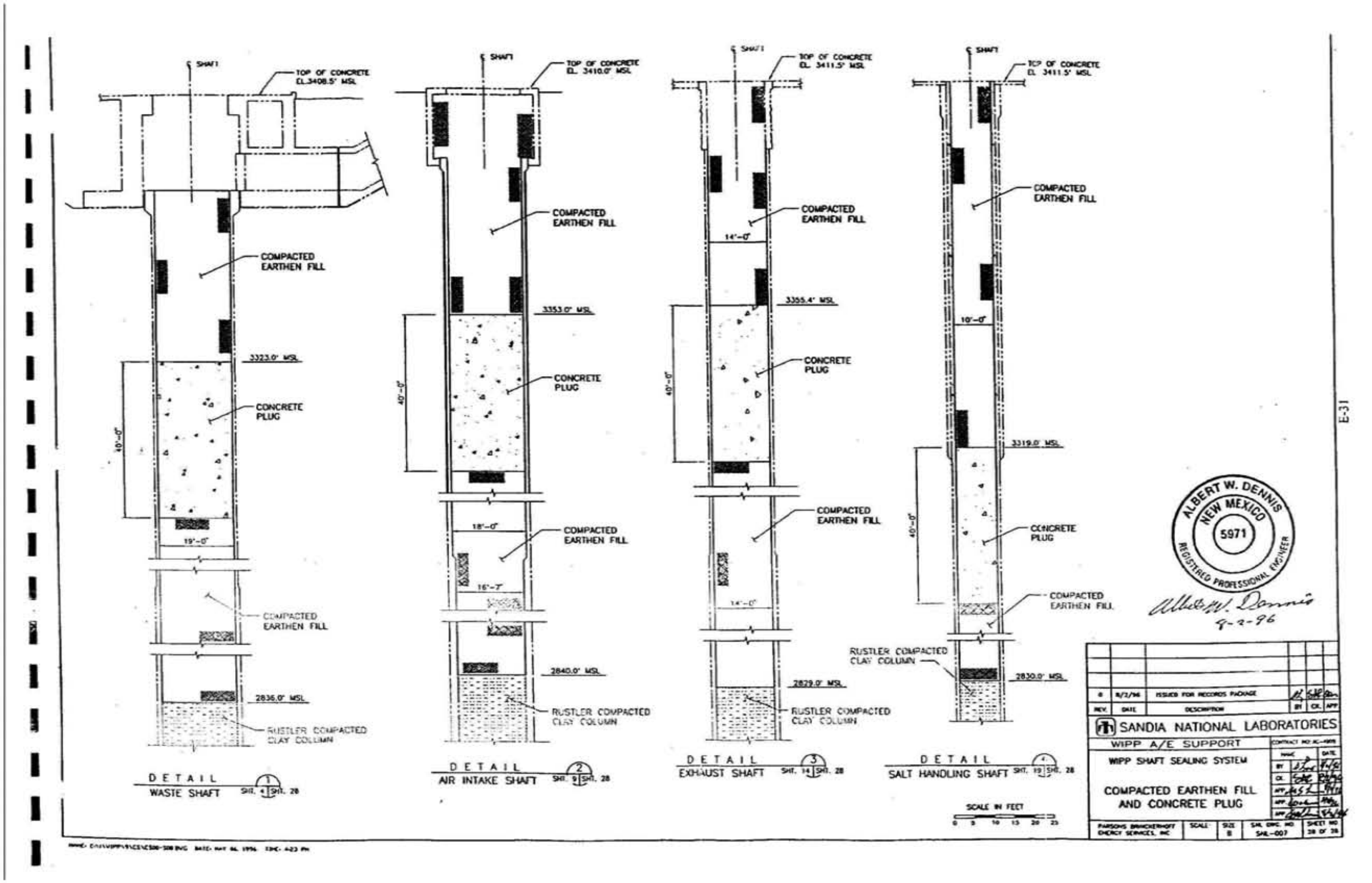
RUSTLER COMPACTED CLAY COLUMN
SNL-007
27 OF 28

Rustler Compacted Clay Cloumn

Sheet 27 of 28



Compacted Earthen Fill and Concrete Plug

Sheet 28 of 28

WASTE ISOLATION PILOT PLANT

CARLSBAD, NM

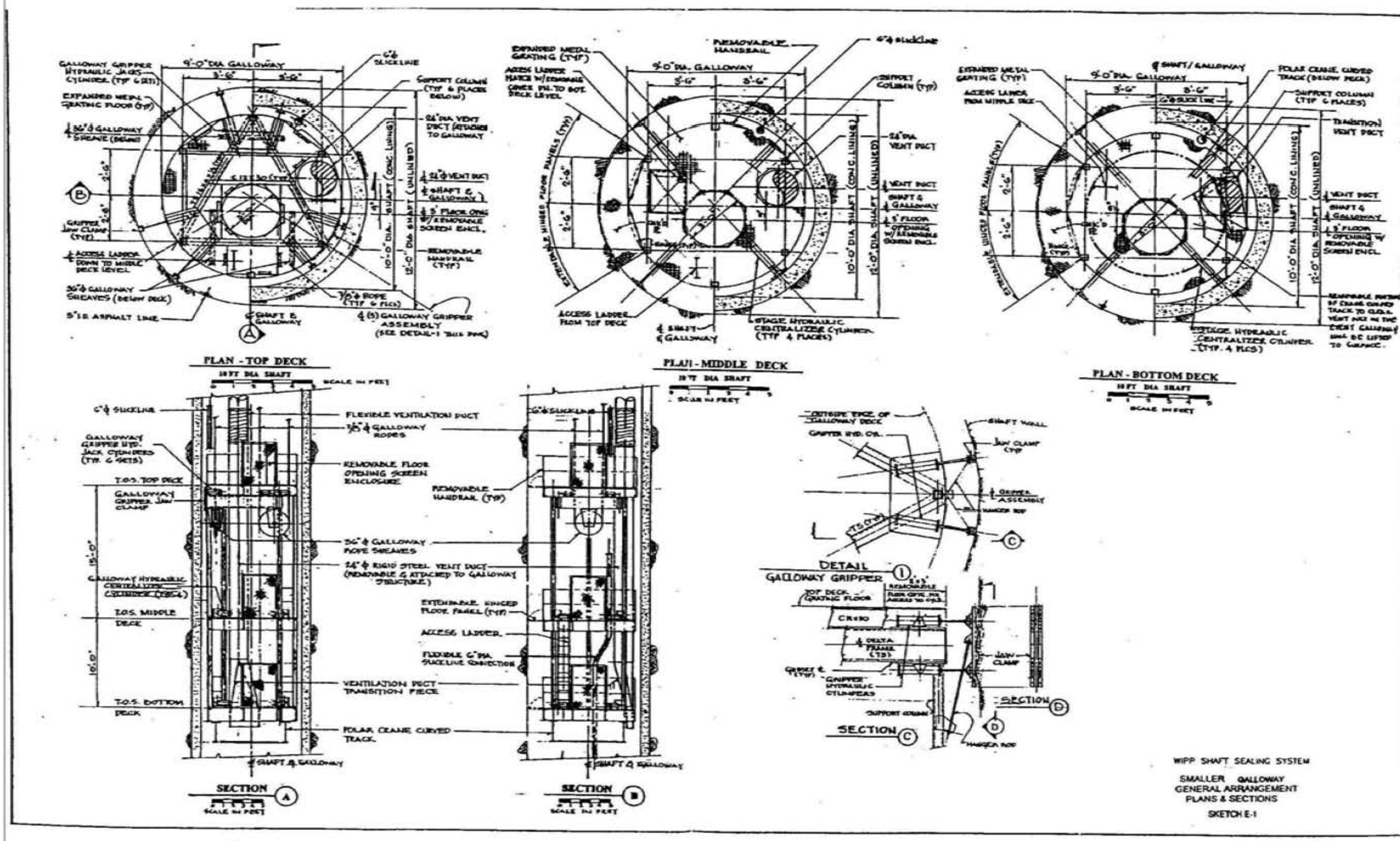
SHAFT SEALING SYSTEM DESIGN

EQUIPMENT AND CONSTRUCTION SKETCHES

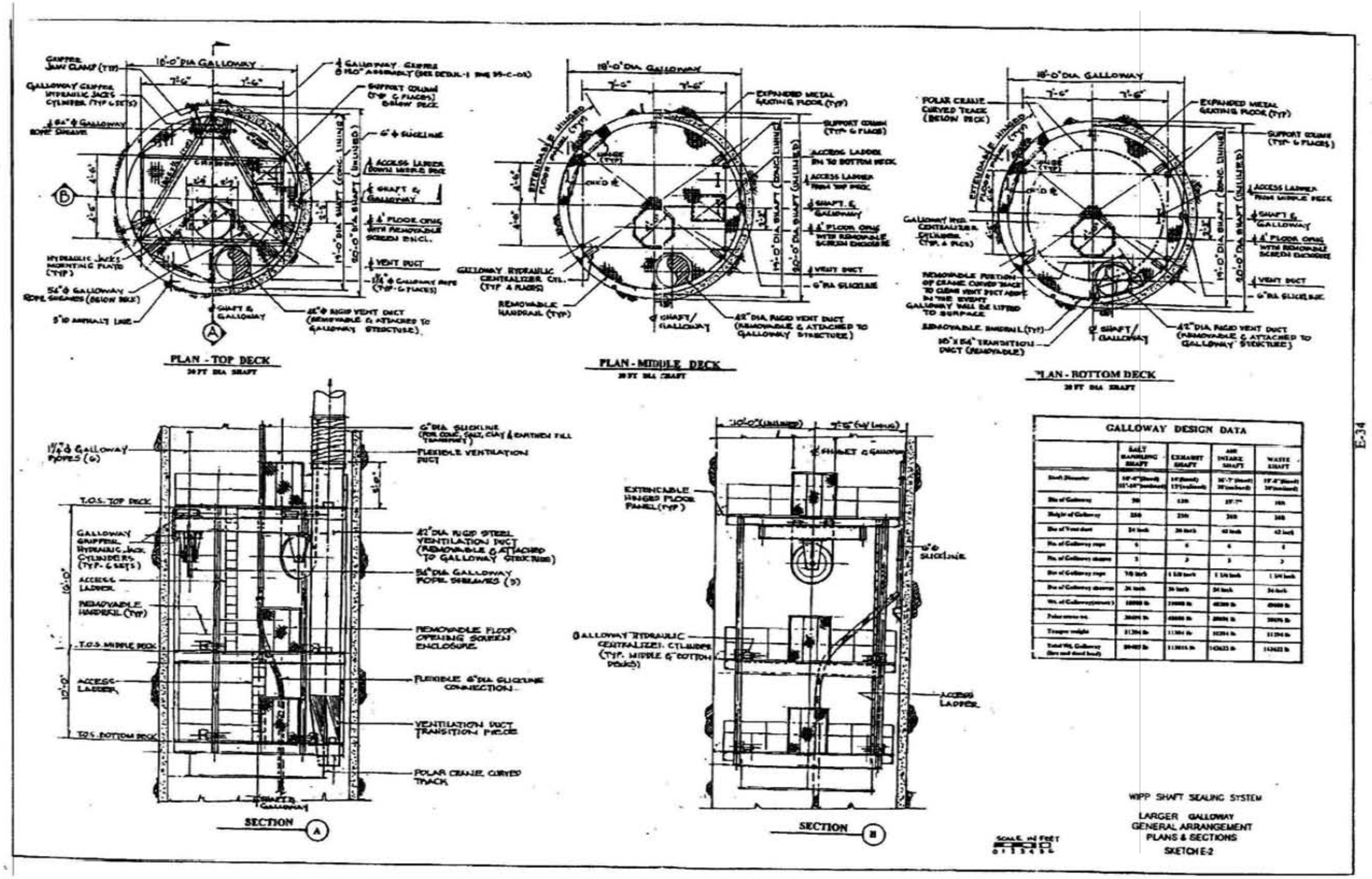
DRAWING NUMBER	TITLE
SKETCH E-1	WIPP SHAFT SEALING SYSTEM SMALLER GALLOWAY GENERAL ARRANGEMENT PLANS AND SECTIONS
SKETCH E-2	WIPP SHAFT SEALING SYSTEM LARGER GALLOWAY GENERAL ARRANGEMENT PLANS AND SECTIONS
SKETCH E-3	WIPP SHAFT SEALING SYSTEM TYPICAL HEADFRAME PLANS AND SECTIONS
SKETCH E-4	WIPP SHAFT SEALING SYSTEM PERSPECTIVE HEADFRAME AND ASSOCIATED SURFACE FACILITIES

E-32

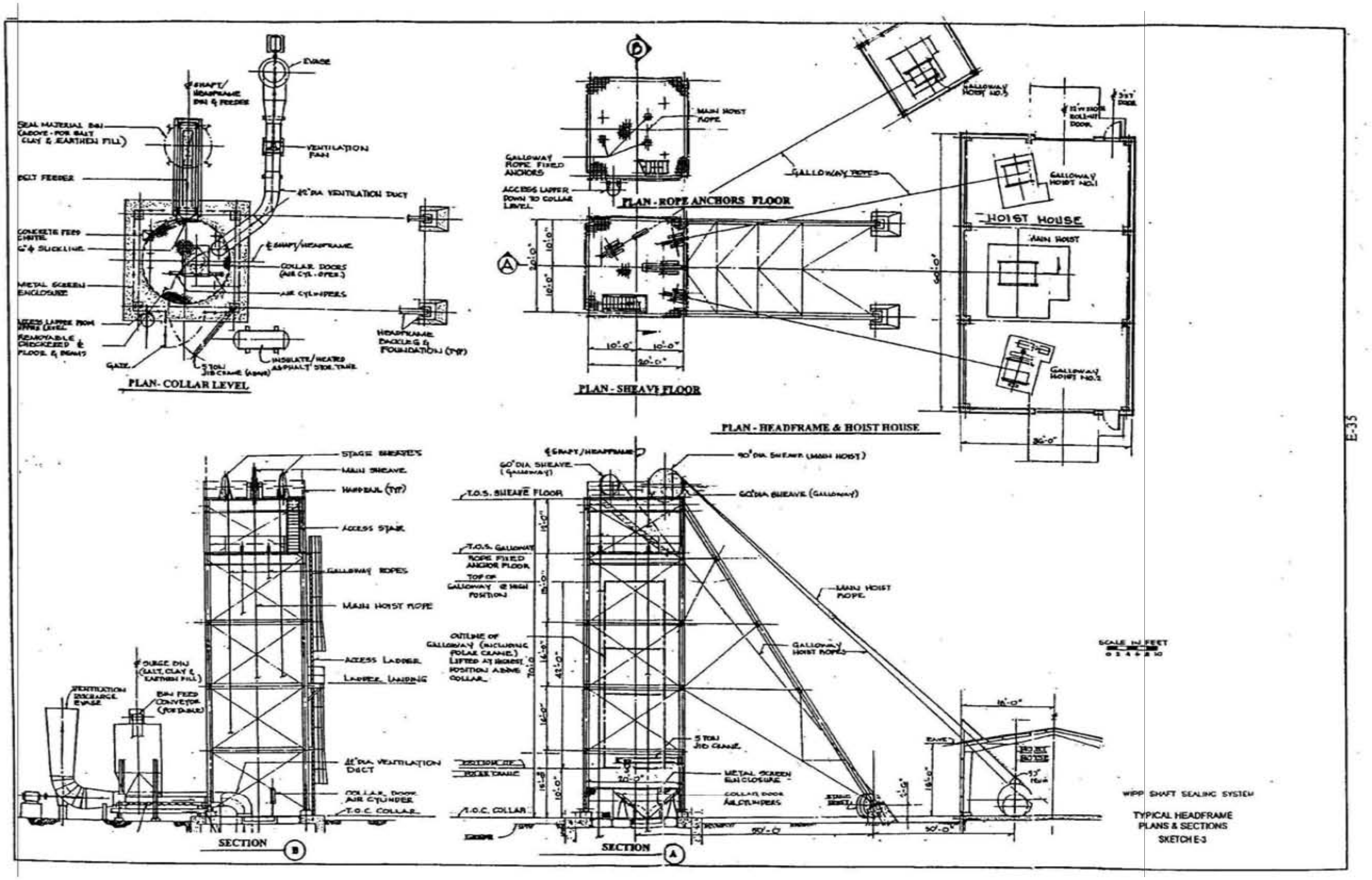
1 List of Sketches



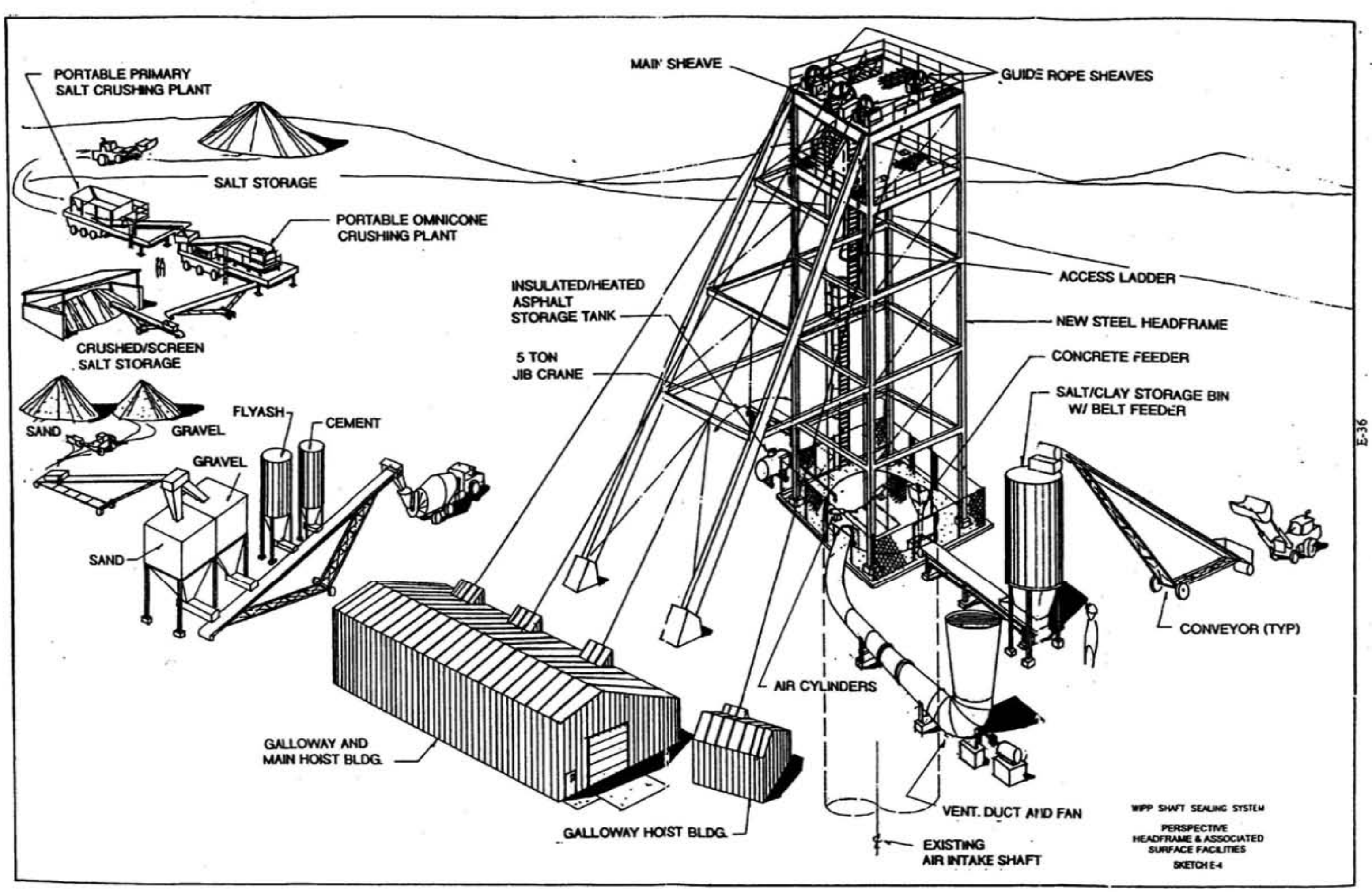
WIPP Shaft Sealing System Smaller Galloway Genral Arrangement Plans and Sections



WIPP Shaft Sealing System Larger Galloway General Arrangement Plans and Sections



1 WIPP Shaft Sealing System Typical Headframe Plans and Sections



1 WIPP Shaft Sealing System Typical Headframe and Associated Surface Faclities

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Waste Isolation Pilot Plant
Shaft Sealing System
Compliance Submittal Design Report

Volume 2 of 2:
Appendix E

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ABSTRACT

This is the second volume of a two-volume report describing a shaft sealing system design for the Waste Isolation Pilot Plant. This appendix contains detailed drawings of the shaft sealing system and its components.

APPENDIX I3

RADIOLOGICAL SURVEYS TO INDICATE POTENTIAL HAZARDOUS WASTE RELEASES

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APPENDIX I3

RADIOLOGICAL SURVEYS TO INDICATE POTENTIAL HAZARDOUS WASTE RELEASES

TABLE OF CONTENTS

List of Tables

APPENDIX I3

RADIOLOGICAL SURVEYS TO INDICATE POTENTIAL HAZARDOUS WASTE RELEASES

I3-1 Purpose

Within the Resource Conservation and Recovery Act (**RCRA**) Permit for the Waste Isolation Pilot Plant (**WIPP**), radiological monitoring is used to determine whether a potential release of hazardous constituents has occurred. This method is used in addition to the visual examinations and container inspections mandated by the RCRA.

I3-2 Definition

This Permit Attachment describes procedures for performing radiological surveys to indicate the potential for hazardous waste releases from containers by virtue of detection of a radioactive constituent release. These procedures assume the potential co-release of hazardous and radioactive materials and applies to all releases except the release of volatile organic compounds (**VOC**) from transuranic (**TRU**) mixed waste containers. Radiological surveys are used to indicate the potential presence or absence of hazardous waste constituents based on the presence or absence of radioactivity. Radiological surveys do not provide any assessment with regard to concentration, since these surveys do not actually detect hazardous waste constituents.

I3-3 Discussion

Radiological surveys provide the WIPP facility with a very sensitive method of indicating the potential release of non-VOC hazardous waste constituents through the use of surface sampling (swipes) and radioactivity counting. This approach depends on the nature of the hazardous waste portion of the TRU mixed waste, the nature of the TRU mixed waste, and the nature of the spills. The sections below discuss each of these factors.

I3-3a Nature of the Hazardous Waste Portion of TRU Mixed Waste

Based on the waste codes listed in the Part A (Permit Attachment O) and discussed in the WIPP Waste Analysis Plan (Permit Attachment B), the hazardous waste constituents in WIPP TRU mixed waste consist mainly of EPA F-coded solvents and metals that exhibit the toxicity characteristic. The TRU mixed wastes that are to be shipped to the WIPP facility for disposal have been placed into waste categories based on their physical and chemical properties. Waste category information is summarized in Table I3-1 with emphasis on the process that generated the waste. The waste generating processes can be described in five general categories:

1. Wastes (such as combustible waste) that result from cleaning and decontamination activities in which items such as towels and rags become contaminated simultaneously with hazardous constituents and radioactivity. In these cases, the hazardous constituent and the radioactive constituent are intimately mixed, both on the rag or towel used for

cleaning and as residuals on the surface of the object being cleaned. These waste forms are not homogeneous in nature; however, they are generated in a fashion that ensures that the hazardous and radioactive contaminants coexist throughout the waste matrix.

2. Wastes generated when materials that contain metals that are believed to exhibit the toxicity characteristic become contaminated with radioactivity as the result of plutonium operations (leaded rubber, some glass, and metal waste are typical examples). These materials may also become contaminated with solvents during decontamination or plutonium recovery activities.

3. A class of processes where objects that are not metals are used in plutonium processes and become contaminated with radioactivity. They are subsequently cleaned with solvents to recover plutonium. Surfaces of these objects (such as graphite, filters, and glass) are contaminated with both radioactive constituents and hazardous constituents.

4. Waste generating processes involving foundry operations where impurities are removed from plutonium. These impurities may result in the deposition of toxicity characteristic metals on the surfaces of objects, such as firebrick, ceramic crucibles, pyrochemical salts, and graphite, which are contaminated with residual quantities of radioactivity.

5. In all of the process waste categories in the second half of the attached table, the hazardous constituent and the radioactivity are physically mixed together as a result of the treatment process. In these wastes, the release of any portion of the waste matrix will involve both the hazardous waste and the radioactive waste components, because the treatment process generates a relatively homogeneous waste form.

Some waste forms only contain radioactive contamination on the surface, because they are not the result of a treatment process or are not porous in form. These include glass, leaded rubber, metals, graphite, ceramics, firebricks, and plastics. In theory, a hazardous waste release could occur if the interiors of these materials became exposed and were involved in a release or spill. Such an occurrence is not likely during operations, because no activities are planned or anticipated that would result in the breaking of these materials to expose fresh surfaces.

Based on the information in the attached table and the discussion above, hazardous constituent releases could potentially occur in only one of two forms: 1) VOC and 2) particulate resulting from the catastrophic failure of a container. Mechanisms that can initiate releases in these forms are discussed subsequently. Regardless of how the release occurs, the nature of the waste and the processes that generated it is such that the radioactive and hazardous components are intimately mixed. A release of one without the other is not likely, except for releases of VOCs from containers.

I3-3b Nature of the TRU Mixed Waste

TRU mixed waste is defined as transuranic waste which is also a hazardous waste. The processes responsible for the radioactivity in the waste are, for the most part, the same processes responsible for making it a hazardous waste. Therefore, the TRU mixed waste forms are described in terms of both classes of waste (radioactive and hazardous). The Permit Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (**TSDF-WAC**) in Module II places limits on the waste that can be shipped to the WIPP facility based on the characteristics of the waste form. According to the TSDF-WAC, certain waste forms with specific characteristics are not allowed at the WIPP facility. Liquid waste is one waste form that is not allowed. Other limitations include, but are not limited to, a prohibition on pyrophoric materials, corrosive materials, ignitable waste, and compressed gases. Furthermore, TRU waste must contain 100 nanocuries or more of transuranic elements per gram of waste, which means that the radioactive component of the waste will always be present within the waste in significant concentrations. The TSDF-WAC limitations and restrictions are provided to ensure that any waste form received at the WIPP facility is stable and can be managed safely.

One benefit of waste form restrictions, such as no liquids, is that they limit the kinds of releases that could occur to those that would be readily detectable through visual inspection (i.e., large objects that fall out of ruptured containers) or through the use of radiation monitoring either locally or within the adjacent area to detect materials that have escaped from containers.

I3-3c Nature of the Releases

The WIPP facility will handle only sealed containers of waste and derived waste. The practice of handling sealed containers minimizes the opportunity for releases or spills. For the purposes of safety analysis (DOE 1997), it was assumed that releases and spills during operations occur by either of two mechanisms: 1) surface contamination and 2) accidents.

Surface contamination is documented in the WIPP Safety Analysis Report (**SAR**) (DOE 1997) to be the only credible source of contamination external to the containers during normal operations. Surface contamination is assumed to be caused by waste management activities at the generator site that result in the contamination of the outside of a waste container. Contamination would most likely be particulates (dirt or dust) that would be deposited during generator-site handling/loading activities. This contamination may not be detected by visible inspections. Surface contamination is monitored upon arrival at the WIPP facility through the use of swipes and radiation monitoring equipment, as specified in WIPP Procedure WP 12-HP1100, "Radiological Surveys" (DOE, 1995) (included in Permit Attachment P). WP 12-HP1100 is a technical procedure that provides specific methods and guidance for performing surface contamination and dose rate surveys of items, equipment, and areas, but does not cover the monitoring of personnel. Detection using radioactivity is very sensitive and allows for the detection of contamination that may not be visible on the surface of the container. This exceeds the capability required by the RCRA, which is generally limited to inspections that detect only visible evidence of spills or leaks. RCRA-required inspections are specified in Permit Module III.

Releases due to accidents are modeled in the WIPP SAR. Significant accidents within the waste handling process are assumed to result in the release of radioactive contaminants and VOCs. Radioactive releases are detectable using surface-sampling (swipe) techniques.

I3-4 Application of Radiological Surveys

Radiological surveys apply to many situations calling for sampling or monitoring to indicate the potential for nonvolatile releases. This includes initial sampling for surface radiological contamination upon receipt, sampling for contamination during waste handling activities, sampling for contamination during decommissioning, sampling for contamination during packaging for off-site shipment, and sampling to demonstrate the effectiveness of decontamination activities that follow a release or spill and retrieval. Radiation monitoring and sampling are mandated by DOE Orders and provide an immediate indication of a release or spill, even when they are not visibly detectable. A release or spill involving hazardous constituents (except VOCs) will also likely involve a release or spill of radioactivity, based on the processes that generated the waste and the physical form of the waste. These processes mixed the hazardous and radioactive components, as described in Table I3-1, to the extent that detection of the radioactive component can indicate the potential that the hazardous component is also present. Radiological surveys to indicate the potential for hazardous waste releases will be performed as specified in the following sections.

I3-4a TRU Mixed Waste Processing

Tables I3-2 and I3-3 specify the various steps in the process of receiving and disposing containers of CH and RH TRU mixed waste, respectively, where radiological surveys will be performed by the Permittees. WIPP Procedure WP 12-HP1100 (Permit Attachment P) provides the detailed description of methods and equipment used when performing surface contamination surveys, dose rate surveys, and large area wipes.

I3-4b TRU Mixed Waste Releases

The RCRA Contingency Plan (Permit Attachment F) specifies actions required by the Permittees in the event of spills or leaking or punctured containers of CH and RH TRU mixed waste. Following completion of decontamination efforts, the Permittees will perform hazardous material sampling to confirm the removal of hazardous waste constituents.

I3-4c Decontamination Activities at Closure

The Closure Plan (Permit Attachment I, Section I-1e(2)) specifies decontamination activities required by the Permittees at closure. Following completion of decontamination efforts, the Permittees will perform hazardous material sampling to confirm removal of hazardous waste constituents.

TABLES

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TABLE I3-1
SUMMARY OF WASTE GENERATION PROCESSES AND WASTE FORMS

Waste Category	Hazardous Waste Codes	Description of Processes	Description of Waste Form
Combustibles	F001, F002, F003, D008, D019	Cloth and paper wipes are used to clean parts and wash down gloveboxes. Wood and plastic parts are removed from gloveboxes after they are cleaned. Lead may occur as shielding tape or as minor noncombustible waste in this category.	Materials such as metals may retain traces of organics left on surfaces that were cleaned. Waste may remain on the cloth and paper that was used for cleaning or for wiping up spills.
Graphite		Graphite molds, which may contain impurities of metals, are scraped and cleaned with solvents to remove the recoverable plutonium.	Surfaces may retain residual solvents. Lead may be used as shielding or may be an impurity in the graphite.
Filters	F001, F002	Filters are used to capture radioactive particulate in air streams associated with numerous plutonium operations and to filter particulate from aqueous streams.	Filter media may retain organic solvents that were present in the air or liquid streams.
Benelex® and Plexiglas®	F001, F002, D008	Materials are used in gloveboxes as neutron absorbers. The glovebox assembly often includes leaded glass. All surfaces may be wiped down with solvents to remove residual plutonium.	Surfaces may retain residual solvents from wiping operations. Leaded glass may also be present.
Firebrick and Ceramic Crucibles	F001, F002, F005, D006, D007, D008	Firebrick is used to line plutonium processing furnaces. Ceramic crucibles are used in plutonium analytical laboratories. Both may contain metals as surface contaminants.	Metals deposited during plutonium refining or analytical operations could remain as residuals on surfaces. Surfaces may retain residual solvents.
Leaded Rubber	D008	Leaded rubber includes lead oxide impregnated materials such as gloves and aprons.	The leaded rubber could potentially exhibit the toxicity characteristic.
Metal	F001, F002, D008	Metals range from large pieces removed from equipment and structures to nuts, bolts, wire, and small parts. Many times, metal parts will be cleaned with solvents to remove residual plutonium.	Solvents may exist on the surfaces of metal parts. The metals themselves potentially exhibit the toxicity characteristic.
Glass	F001, F002, D006, D007, D008, D009	Glass includes Raschig rings removed from processing tanks, leaded glass removed from gloveboxes, and miscellaneous laboratory glassware.	Solvents may exist as residuals on glass surfaces and in empty containers. The leader glass may exhibit the toxicity characteristic.
Inorganic Wastewater	F001-F003, D006-D009,	Sludge is vacuum filtered and stabilized with cement or other	Traces of solvents and heavy metals may be contained in the

TABLE I3-1
SUMMARY OF WASTE GENERATION PROCESSES AND WASTE FORMS

Waste Category	Hazardous Waste Codes	Description of Processes	Description of Waste Form
Treatment Sludge	P015	appropriate sorbent prior to packaging.	treated sludge which is in the form of a solid dry monolith, highly viscous gel-like material, or dry crumbly solid.
Organic Liquid and Sludge	F001, F003	Organic liquids such as oils, solvents, and lathe coolants are immobilized through the use of various solidification agents or sorbent materials.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.
Solidified Liquid	F001, F003, D006, D008	Liquids that are not compatible with the primary treatment processes and have to be batched. Typically these liquids are solidified with portland or magnesium cement.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.
Inorganic Process Solids and Soil	F001, F002, F003, D008	Solids that cannot be reprocessed or process residues from tanks, firebrick fines, ash, grit, salts, metal oxides, and filter sludge. Typically solidified with portland or gypsum-based cements.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.
Pyrochemical Salts	D007	Molten salt is used to purify plutonium and americium. After the radioactive metals are removed, the salt is discarded.	Residual metals may exist in the salt depending on impurities in the feedstock.
Cation and Anion Exchange Resins	D008	Plutonium is sorbed on resins and is eluted and precipitated.	Feed solutions may contain traces of solvents or metals depending on the preceding process.

TABLE I3-2
RADIOLOGICAL SURVEYS DURING CH TRU MIXED WASTE PROCESSING

Step in CH TRU Mixed Waste Processing	Surface Contamination Survey	Dose Rate Survey	Large Area Wipes [a]
Contact Handled Package Outer Containment Assembly (**OCA**) lid interior and top of Inner Containment Vessel (**ICV**) lid	X		X
Contact Handled Package quick connect and vent port	X		
As ICV lid is raised		X	
ICV lid interior and top of payload	X		X
Payload assembly, guide tubes, standard waste box (**SWB**) connecting devices	X		
As payload assembly is raised, including bottom of payload		X	
After placement of payload on facility pallet	X		X

[a] Surface contamination surveys of Contact Handled Packages are performed in accordance with Procedure WP 12-1100 (Permit Attachment P), which stipulates that all such work be performed under a Radiation Work Permit (**RWP**). The RWP will only stipulate large area wipes when necessary and not as a routine measure.

TABLE I3-3
RADIOLOGICAL SURVEYS DURING RH TRU MIXED WASTE PROCESSING

Step in RH TRU Mixed Waste Processing	Surface Contamination Survey	Dose Rate Survey
Exterior of cask on arrival at WIPP	X	X
During removal of impact limiters on RH-TRU 72-B cask	X	X
During removal of outer lid closure from RH-TRU 72-B cask	X	X
During removal of inner lid closure from RH-TRU 72-B cask	X	
During removal of upper impact limiter on the CNS 10-160B cask	X	X
After removal of upper impact limiter on the CNS 10-160B cask	X	X
After removal of the CNS 10-160B cask from the lower impact limiter	X	X
After transfer of the CNS 10-160B cask lid into the Hot Cell	X	
During transfer of waste drum carriages into the Hot Cell	X	
During transfer of waste into the facility canister in the Hot Cell	X	
During transfer of the waste canister from the RH-TRU 72-B cask to the facility cask	X	
Interior of shipping cask inside the RH Bay after unloading of waste canister or drums	X	
Exterior of shield plug subsequent to final canister emplacement		X
Interior of facility cask after completion of waste emplacement	X	

CHAPTER J

POST-CLOSURE PLAN

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CHAPTER J

POST-CLOSURE PLAN

TABLE OF CONTENTS

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CHAPTER J

POST-CLOSURE PLAN

Introduction

This Permit Attachment contains the Post-Closure Plan, which describes activities required to maintain the Waste Isolation Pilot Plant (**WIPP**) after completion of facility closure. Since the current plans for operations extend over several decades, the Permittees will periodically reapply for an operating permit in accordance with Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (**20.4.1 NMAC**), Subpart 900 (incorporating 40 CFR §270.10(h)).

This plan was submitted to the New Mexico Environment Department (**NMED**) in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(13)) and the U.S. Environmental Protection Agency (**EPA**). The Post-Closure Plan includes the implementation of institutional controls to limit access and groundwater monitoring to assess disposal system performance. Until final closure is complete and has been certified in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.115), a copy of the approved Post-Closure Plan and all approved revisions will be on file at the WIPP facility and will be available to the Secretary of the NMED or the EPA Region VI Administrator upon request.

J-1 Post-Closure Plan

The post-closure care period begins after completion of closure of the first underground hazardous waste disposal unit (**HWDU**) and continues for thirty (30) years after final closure of the facility. The post-closure care period may be shortened or lengthened by the Secretary of the NMED, based on evidence that human health and the environment are being protected or are at risk. During the post-closure period, the WIPP shall be maintained in a manner that complies with the environmental performance standards applicable to the facility. During this period, the Permittees will employ active institutional controls as necessary.

This post-closure plan focuses on activities following final facility closure. However, some discussion of post-closure following panel closure is warranted since some panel closures will occur long before final facility closure. As discussed in Attachment I (Closure Plan), Section I-1e(1), panel closures have been designed to require no post-closure maintenance. The Permittees have defined a post-closure care program for closed panels that has three aspects. These are routine inspection of the openings in the vicinity of the closures, the sampling of ventilation air for harmful constituents, and a Volatile Organic Compound Monitoring Program. The rules of the Mine Safety Health Administration drive the implementation of the first two programs. These rules require that underground mines monitor air quality to assure good breathing air whenever personnel are underground and that mine operators provide safe ground conditions for personnel in areas that require access. Routine monitoring of the openings in the access ways to panels will be continued and these openings will be maintained for as long as access into them is needed. This includes continued reading of installed geomechanical instrumentation, sounding the areas, visual inspection and maintenance activities such as scaling, mining, or bolting as required and as described in Permit Attachment M2. In addition, all areas in the underground that are occupied by personnel are checked prior to each day's work activities for accumulations of harmful gases, including methane. Action levels for increasing ventilation to areas that show high levels of harmful gases are specified as described in Permit Attachment F.

These monitoring programs will be carried out during the period between the closure of the first panel and the initiation of final facility closure for the underground facility. The Permittees have prepared a Volatile Organic Compound Monitoring Plan (**VOCMP**) which will be implemented to confirm that the annual average concentration of volatile organic compounds (**VOCs**) in the air emissions from the underground HWDUs do not exceed the VOC concentrations of concern listed in Module IV and Permit Attachment N, Table N-3.1. The VOCMP is provided in Attachment N. The VOCMP includes monitoring design, sampling and analysis procedures and quality assurance objectives. This plan is required to demonstrate compliance with 20.4.1.500 and .900 NMAC (incorporating 40 CFR §264.602 and §270.23(a)(2)).

The Permittees will collect air samples upstream of all open and closed panels, and down stream of Panel 1 beginning just prior to waste emplacement and proceeding until after certification of the closure of the last underground HWDU.

The VOCMP uses EPA Compendium Method TO-15. The Permittees have had success with TO-15 at the WIPP if care is taken in placing the sampler to avoid high dust and if stringent cleaning requirements are imposed for the clean canisters. This is necessary because of the extremely low concentrations that are being monitored. The Permittees are evaluating the use of the Fourier Transform Infra-Red (**FTIR**) technique for monitoring VOCs at WIPP. This method is being used successfully at other locations and has recently been approved by the EPA for measuring the concentration of VOCs in the headspace gases of drums of TRU waste. If FTIR becomes viable, the monitoring plan will be revised and the revisions will be submitted to the NMED for approval prior to implementation.

The VOCMP will be implemented under a Quality Assurance Plan that conforms to the document entitled "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations". Quality Assurance criteria required for the target analytes are presented in Table N-4 in Permit Attachment N. Definitions of these criteria are given in Permit Attachment N along with a discussion of other requirements of the Quality Assurance Program including sample handling, calibration, analytical procedures, data reduction, validation and reporting, performance and system audits, preventive maintenance, and corrective actions.

J-1a Post-Closure Plan after Final Facility Closure

A number of regulations deal with the period of time that begins once the WIPP has undergone final facility closure and decommissioning. Under 40 CFR Part 191, the period consists of an active control period and a passive control period; only one hundred (100) years of the active control period can be used in performance assessment. The Land Withdrawal Act (LWA) of 1992 requires that the Department of Energy (DOE) prepare and submit a post-decommissioning land management plan. 20.4.1.500 NMAC (incorporating 40 CFR §264.117) requires post-closure care, including monitoring, security, and control of property use. Because of the numerous regulations, the Permittees have prepared a single strategy for post-closure management of the WIPP. This strategy consists of three elements: 1) active controls, 2) monitoring, and 3) passive controls. Only the first and second elements occur within the post-closure period covered by this permit.

J-1a(1) Active Institutional Controls

Once a facility is decommissioned, positive actions (referred to as "active institutional controls") will be taken to assure proper maintenance and monitoring. The EPA, in 40 CFR §191.14(a) has specified that active controls will be maintained for as long as practicable and that no more than one hundred (100) years of active institutional control can be assumed in predictions of long-term performance. This assumption assures that future protection and control does not rely on positive actions by future generations.

The Permittees' active institutional control program has a primary objective of addressing all applicable requirements, including restoring the WIPP site as nearly as possible to its original condition, and thereby equalizing any preference over other areas for development by humans in the future. Restoration of the WIPP site includes any necessary remedial actions or cleanup of releases resulting from decommissioning. In addition, as part of the active institutional control program implemented under 40 CFR §194.14(a), the Permittees will implement monitoring systems suitable for assessing disposal system performance if such monitoring is feasible.

The Permittees will implement the active institutional control program as described in more detail below:

Identification of Active Institutional Control Measures

A detailed explanation of the active institutional controls selected by the Permittees as part of this first step is provided in Permit Attachment J1 (WIPP Active Institutional Controls). This is the Permittees' reference design for active institutional controls. The reference design will be reviewed periodically and updated by the Permittees as appropriate during WIPP disposal operations. The ongoing review and evaluation ensure that the active institutional controls implemented are appropriate for the conditions that may exist at that time. The Permittees will review the reference design prior to implementation and all affected regulatory agencies will be consulted as part of this review. If updating the reference design proposes any changes in the Post-Closure Plan as described in this permit, the Permittees shall apply for a permit modification to include those changes, or submit the reference design and revised Post-Closure Plan as part of a routine permit renewal application, as required by 20.4.1.500 NMAC (incorporating 40 CFR 264.118(d)).

As part of the active institutional controls program, the Permittees have developed a set of active institutional controls which will be implemented. These are as follows:

- A fence line shall be established to control access to the repository's footprint area (the waste disposal area projected to the surface). A standard wire fence shall be erected along the perimeter of the repository surface footprint. The fence shall have gates placed approximately midway along each of the four sides.

- An unpaved roadway along the perimeter of the barbed wire fence shall be constructed to provide ready vehicle access to any point around the fenced perimeter, to facilitate inspection and maintenance of the fence line, and to permit visual observation of the repository footprint to the extent permitted by the lay of the land. This roadway shall connect to the paved south access road.

- To ensure visual notification, the fence line shall be posted with signs having as a minimum, a legend reading "Danger—Unauthorized Personnel Keep Out" and a warning against entering the area without specific permission of the Permittees.

- Contractual arrangements shall be developed to ensure that periodic inspection and necessary corrective maintenance is conducted on the fence line, its associated warning signs, and the roadway. The Permittees will maintain control over all contractual work and will maintain, in the operating record, the results of all inspections and maintenance activities.

- Through direct Permittee staffing support and/or contractual arrangements, procedures shall be established to provide routine periodic patrols and surveillances of the protected area by personnel trained in security surveillance and investigation.

- Mitigating actions will be taken to address any abnormal conditions[1] identified during periodic surveillance and inspections.

- Reports of activities associated with the post-disposal active access controls shall be prepared in accordance with regulatory requirements for submittal to the appropriate regulatory and legislative authority.

Details on meeting these criteria are found in Permit Attachment J1.

<u>Preparation of a Post-Decommissioning Land Management Plan</u>

Section 13(b) of the LWA requires the DOE to prepare and submit a plan for managing the land withdrawal area after decommissioning the WIPP facility. This plan will include a description of both the active and passive institutional controls that will be imposed after decommissioning is complete. This plan will be prepared in consultation with the Department of Interior and the state

[1] "Abnormal conditions" include any natural or human-caused conditions which could affect the integrity of Active Institutional controls required by the Permit or which could affect compliance of the WIPP with applicable RCRA standards.

of New Mexico. If the land management plan proposes any changes in the Post-Closure Plan as described in this permit, the Permittees shall apply for a permit modification to include those changes, or submit the land management plan and revised Post-Closure Plan as part of a routine permit renewal application, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.118(d)).

Preparation of the Active Institutional Control Plan

An active institutional control plan will be initiated prior to actual plant closure, and will contain all the information needed to implement the active and passive institutional controls for the WIPP facility. Active institutional control planning will be based on the reference design and will take into account the most current information regarding the facility and its vicinity and will make use of state-of-the-art materials and techniques. This plan will include acceptable decontamination levels, sampling and analysis plans, and QA/QC specifications. If such future plan contains provisions different from those in this Post-Closure Plan or Permit Attachment J1 (Active Institutional Controls), the Permittees shall submit a request for modification of the Post-Closure Plan and the WIPP Permit. The changes must be approved and made part of the revised Permit before the changes are implemented, in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.118(d)).

Implementation of Active Institutional Control Measures

Most of the active institutional control measures, such as long-term site monitoring and site remedial actions, will be implemented simultaneously with facility closure. However, it may be possible to implement some measures earlier. For example, salt disposal may begin prior to final plant closure. Reclamation and restoration of unused disturbed surface areas has already begun. Guarding and maintenance activities, which are already in place, could evolve into an appropriate type of post-closure activity, subject to appropriate modifications of the Permit.

J-1a(2) Monitoring

Post-closure groundwater monitoring will involve a continuation of the monitoring plan in Permit Attachment L as described in Module V. The sampling frequency may be changed to biannually after final facility closure is complete by modification of the Permit as approved by the Secretary of the NMED in accordance with 20.4.1.901.B NMAC (incorporating 40 CFR §270.42). In addition, the final target analyte list specified in Permit Attachment L may be changed by permit modification based on final volume of waste.

J-2 Notices Required for Disposal Facilities

J-2a Post-Closure Certification

Within sixty (60) days of completion of the post-closure care period after final facility closure, the Permittees will submit to the Secretary of the NMED, via registered mail, a certification that post-closure care was performed in accordance with the specifications of the approved post-closure plan. The certification will be signed by the Permittees and by an independent New Mexico registered professional engineer. Documentation supporting the independent registered engineer’s certification and a copy of the certification will be furnished to the Secretary of the NMED.

J-2b Post-Closure Notices

Within sixty (60) days after certification of closure of each underground HWDU or final facility closure, the Permittees will submit to the Secretary of the NMED, and to the Eddy County government or other applicable local government agencies, a record of the type, location, and quantity of hazardous wastes disposed of in each underground HWDU as required in 20.4.1.500 NMAC (incorporating 40 CFR §264.119).

APPENDIX J1

ACTIVE INSTITUTIONAL CONTROLS DURING POST-CLOSURE

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APPENDIX J1

ACTIVE INSTITUTIONAL CONTROLS DURING POST-CLOSURE

TABLE OF CONTENTS

List of Figures

Acronyms

CH	contact-handled
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
LWA	Land Withdrawal Act
SWB	standard waste box
TRU	transuranic
WIPP	Waste Isolation Pilot Plant

APPENDIX J1

ACTIVE INSTITUTIONAL CONTROLS DURING POST-CLOSURE

Introduction

Under the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.118(b), the following activities identified as active institutional controls during post-closure are incorporated into the Post-Closure Plan.

The post-closure requirements of this permit include 20.4.1.500 NMAC, incorporating:

- 40 CFR §264.117(a)(1), which requires that

  "Post-closure care for each hazardous waste management unit subject to the requirements of §264.117 through 264.120 must begin after completion of closure of the unit and continue for 30 years after that date..."

- 40 CFR §264.601, which requires that

  "A miscellaneous unit must be...maintained and closed in a manner that will ensure protection of human health and the environment..."

- and 40 CFR §264.603, which requires that

  "A miscellaneous unit that is a disposal unit must be maintained in a manner that complies with §264.601 during the post-closure care period."

The containment requirements for a disposal system for transuranic (**TRU**) radioactive wastes are defined in Title 40 CFR §191.13 (U.S. Environmental Protection Agency [**EPA**] 1993). 40 CFR §191.14 is titled Assurance Requirements. With regard to the active institutional controls aspect of Assurance Requirements, 40 CFR §191.14 states the following:

> "To provide the confidence needed for long-term compliance with the requirements of §191.13, disposal of spent fuel or high-level or transuranic wastes shall be conducted in accordance with the following provisions... (a) Active institutional controls over disposal sites should be maintained for as long a period of time as is practicable after disposal; however, performance assessments that assess isolation of the wastes from the accessible environment shall not consider any contribution from active institutional controls for more than 100 years after disposal... "

40 CFR §191.12 states the following:

> "Active institutional controls mean:
> 1) controlling access to a disposal site by any means other than passive institutional controls,

2) performing maintenance operations or remedial actions at a site,
3) controlling or cleaning up releases from a site, or
4) monitoring parameters related to disposal system performance."

Purpose: This Permit Attachment describes the design of a system that the Permittees will implement for compliance with the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.118(b)) and 40 CFR §191.14(a) to control access to the Waste Isolation Pilot Plant (**WIPP**) disposal site and implement maintenance and remedial actions pertaining to the site access controls. In addition, this Permit Attachment addresses the scheduling process for control of inspection, maintenance, and periodic reporting related to long-term monitoring. Long-term monitoring addresses the monitoring of disposal system performance, as required by 40 CFR §191.14(b), and environmental monitoring, in accordance with this Permit and the Consultation and Cooperation Agreement between the U.S. Department of Energy (**DOE**) and the state of New Mexico. The scheduling process will also address evaluation of testing activities related to the permanent marker system design contained within the passive institutional controls (not required by this permit).

Implementation of active institutional controls at the WIPP will commence when final facility closure is achieved, as specified in Module II and Permit Attachment I. Implementation of active institutional controls marks the transition from the active life of the facility (which ends upon certification of closure) to the post-closure care period, as specified in 20.4.1.500 NMAC (incorporating 40 CFR §264 Subpart G). The Permittees will continue the imposition of active institutional controls under this Permit until NMED approves the post-closure certification specified in Module VI and Permit Attachment J.

Decommissioning activities include decontamination and site restoration. The decontamination effort will be completed prior to sealing of the shafts to allow disposal of all derived waste (radioactive and/or mixed waste derived from TRU/TRU-mixed waste received at the WIPP) into the repository. The implementation of active institutional controls upon certification of facility closure will prevent human intrusion into the repository. The Permittees' restoration efforts will return the land disturbed by the WIPP activities to a stable ecological state that will assimilate with the surrounding undisturbed ecosystem. Necessary exceptions to returning the site to its full pre-WIPP condition include measurements associated with long-term monitoring.

Scope: The active institutional control requirements include a means of controlling access to the site of the repository's surface footprint (the repository area projected to the surface) and maintenance, including corrective actions, for access control system components. Active control of access to the site will be exercised by the Permittees for the duration of the post-closure care period. Although the Permittees are only required to maintain active institutional controls until approval of the post-closure certification by NMED, the Permittees will continue active institutional controls for at least one hundred (100) years after final facility closure to satisfy other regulatory requirements. Control of access will prevent intrusion into the disposed waste by deep drilling or mining for natural resources. This Permit Attachment also specifies a process for scheduling activities related to the long-term monitoring of the repository. Some of the activities supporting the monitoring programs will be initiated during the active life of the facility to establish databases. These activities are planned to continue beyond closure through the time after removal of the site structures and return of the land disturbed by the WIPP activities to a stable ecological state that will assimilate with the surrounding undisturbed ecosystem. Long-term monitoring requirements will be necessarily integrated with efforts toward returning the land to a stable ecological state.

Background: The WIPP was sited and designed as a research and development facility to demonstrate the safe disposal of radioactive wastes. The wastes are derived from DOE defense-related activities. Specifically, the mission of the WIPP project is to conduct research, demonstration, and siting studies relevant to the permanent disposal of TRU wastes. Most of these wastes will be contaminated with hazardous constituents, making them mixed wastes.

The LWA addresses the disposal phase of the WIPP project, the period following closure of the site, and the removal of the surface facilities. The LWA set aside 10,240 acres (4,144 hectares) located in Eddy County, 26 miles (42 kilometers) east of Carlsbad, New Mexico, as the WIPP site. A 277-acre (112-hectare) portion within the 10,240 acres (4,144 hectares) is bounded by a barbed wire fence. This fenced area contains the surface facilities and the mined salt piles for the WIPP site. Figure J1-1 is a cutaway illustrating the spatial relationship of the surface facilities and the underground repository.

Upon receipt of the necessary certifications and permits from the EPA and the New Mexico Environment Department, the Permittees will begin disposal of contact-handled (**CH**) and remote-handled (**RH**) TRU and TRU mixed waste in the WIPP. This waste emplacement and disposal phase will continue until the regulated capacity of the repository of 6,200,000 cubic feet (175,588 cubic meters) of TRU and TRU mixed waste has been reached, and as long as the Permittees comply with the requirements of the Permit. For the purposes of this Permit Attachment, this time period is assumed to be 25 years. The waste will be shipped from DOE facilities across the country in specially designed transportation containers certified by the Nuclear Regulatory Commission. The transportation routes from these facilities to the WIPP have been predetermined. The CH TRU mixed waste will be packaged in 55-gallon (208-liter), 85-gallon (320-liter), 100-gallon (379-liter) steel drums, standard waste boxes (**SWBs**), and/or ten drum overpacks (**TDOPs**). An SWB is a steel container having a free volume of approximately 65 cubic feet (1.8 cubic meters). Figure J1-2 shows the general arrangement of a seven-pack of drums and an SWB as received in a Contact-Handled Package. RH TRU mixed waste inside a Remote-Handled Package is contained in one or more of the allowable containers described in Permit Attachment M1.

Upon receipt and inspection of the waste containers in the waste handling building, the containers will be moved into the repository 2,150 feet (655 meters) below the surface. The containers will then be transported to a disposal room. (See Figure J1-1 for room and panel arrangement.) The initial seven disposal rooms are in Panel 1. Panel 1 is the first of eight panels planned to be excavated. Special supports and ground control corrective actions have been implemented in Panel 1 to ensure its stability. Upon filling an entire panel, that panel will be closed to isolate it from the rest of the repository and the ventilation system. During the period of time it takes to fill a given panel, an additional panel will be excavated. Sequential excavation of

Panels 2 through 8 will ensure that these individual panels remain stable during the entire time a panel is being filled with waste. Ground control maintenance and evaluation with appropriate corrective action will be required to ensure that Panels 9 and 10 (ventilation and access drifts in the repository) remain stable.

Decontamination of the WIPP facility will commence with a detailed radiation survey of the entire site. Contaminated areas and equipment will be evaluated and decontaminated in accordance with applicable requirements. Where decontamination efforts identify areas that meet clean closure standards for permitted container storage units and are below radiological release criteria, routine dismantling and salvaging practices will determine the disposition of the material or equipment involved. Material and equipment that do not meet these standards and criteria will be emplaced in the access entries (Panels 9 and/or 10). Upon completion of emplacement of the contaminated facility material, the entries will be closed and the repository shafts will be sealed. Final repository closure includes sealing the shafts leading to the repository. Figure J1-3 illustrates the shaft sealing arrangement. Certification of closure will end disposal operations and initiate the post-closure care period for implementation of active institutional controls.

J1.1 Active Institutional Controls

Active institutional controls during post-closure consist of three elements:

- controlling access to a disposal site,
- performing maintenance operations or remedial actions at a site, and
- controlling or cleaning up releases from a site.

The LWA has removed the WIPP site from public use as a site for mining and other types of mineral resource extraction. Since any type of exploration activity would require authorization, the issuance of approval to intrude upon the repository is precluded by the LWA. The existence of the LWA as law permits meeting the requirements of the first element above by implementing low technology barriers. These barriers include a posted fence and active surveillance at a frequency that denies sufficient time for an individual or organization to intrude into the repository undetected using today’s drilling technology. Maintenance and remedial actions at the WIPP site will be conducted by the Permittees at the time of implementing the access controls for the site. The control or cleanup of releases from the site will be conducted as part of the operational program prior to sealing of the shafts. This is necessary to ensure that all derived waste is disposed of within the repository prior to shaft sealing.

The Permittees shall maintain the access controls. This requirement includes the maintenance and corrective actions necessary to ensure that the fence and patrol requirements (surveillance) are met. The active institutional controls to be implemented by the Permittees after final closure are the following:

1. A fence line will be established to control access to the repository footprint area on the surface. A standard four-strand (three barbed and one unbarbed, in accordance with the Bureau of Land Management specifications) wire fence will be erected along the perimeter of the repository surface footprint. To provide access to the repository footprint during construction of the berm (which may be built in multiple sections simultaneously), the fence will have gates placed approximately midway along each of the four sides. these gates will remain locked with access controlled by the Permittees. The western gate will be 20 feet (6 meters) wide. The remaining three gates will each be 16 feet (4.9 meters) wide. Additional fencing will be constructed where appropriate for remote locations that are used for disposal system monitoring. Such fences will meet the same construction specifications as the repository footprint perimeter fence.

2. Unpaved roadways 16 feet (4.9 meters) wide will be established along the perimeter of the barbed wire fence as well as along the WIPP site boundary. These roadways will be constructed so as to provide ready vehicle access to any point around the fenced perimeter and the site boundary. These roadways will facilitate inspection and maintenance of the fenceline and will allow visual observation of the repository footprint and the site boundary to the extent permitted by the lay of the land. These roadways will connect to the paved south access road. Roads to remote sites will also be constructed and maintained where appropriate.

3. The fence line will be posted with signs having, as a minimum, a legend reading "Danger—Unauthorized Personnel Keep Out" (20.4.1.500 NMAC (incorporating 40 CFR §264.14[c])) and warning against entering the area without specific permission of the Permittees. The legend must be written in English and Spanish. The signs must be legible from a distance of at least 25 feet (7.6 meters). The size of the visual warning and the spacing of the warning signs will be sufficiently large and close to ensure that one or more of the signs can be seen from any approach prior to an individual actually making contact with the fence line. In no case will the spacing be greater than 300 feet (91.5 meters).

4. The Permittees will ensure that periodic inspection and expedited corrective maintenance are conducted on the fence line, its associated warning signs, and roadways.

5. The Permittees will provide for routine periodic patrols and surveillance of all areas controlled by or under the authority of the Permittees by personnel trained in security surveillance and investigation.

6. The Permittees will implement the periodic monitoring requirements of the long-term monitoring system.

7. The Permittees will submit a Permit modification request for any proposed modifications to the active institutional controls appropriate for access control, as specified in 20.4.1.900 NMAC (incorporating 40 CFR 270.42).

8. The Permittees will immediately take appropriate action to address abnormal conditions identified during periodic surveillance and inspections. Abnormal conditions include any natural or human-caused conditions which would affect the integrity of the active institutional controls.

9. Reports addressing activities associated with the performance of the active access controls after final closure will be prepared periodically according to applicable requirements by the Permittees for submittal to the appropriate regulatory and legislative authorities.

J1.1.1 Repository Footprint Fencing

Access to an area approximately 2,780 feet by 2,360 feet (875 meters by 720 meters) will be controlled by a four-strand barbed wire fence. A single gate will be included along each side of the fence for access. These gates will remain locked with access controlled by the Permittees. Around the perimeter of the fence, an unpaved roadway 16 feet (4.9 meters) wide will be cut to allow for patrolling of the perimeter. Figure J1-4 is an illustration of the fence line in relation to the repository footprint. Patrolling of the perimeter is based upon the need to ensure that no mining or well drilling activity is initiated that could threaten the integrity of the repository.

Fencing off an area larger than the disposal area footprint would not significantly reduce the risk of intrusion but would interfere with cattle grazing established prior to the LWA. The LWA states that the Secretary of Energy can allow grazing to continue where it was established prior to enactment of the LWA. Based upon current drilling technologies, discussions with local well drilling organizations, and observation of well drilling activities in the WIPP vicinity, it typically requires at least two to three days for a driller to set up a deep drilling rig and commence actual drilling operations. Attaining the 2,150-foot (655-meter) depth that would approach the repository horizon takes at least another week to 10 days. Based upon current drilling practices, patrolling the fenced area two to three times weekly would identify any potential drilling activity well before any breach of the repository could occur. Therefore, the perimeter fence will be patrolled three times weekly after final closure.

Construction of access control systems using higher technology than described is not required. Likewise, continuous surveillance whether human or electronic is not required.

J1.1.2 Surveillance Monitoring

The Permittees will conduct periodic surveillance of the site and the repository footprint during the post-closure period. Unpaved roadways around the WIPP site boundary and around the repository footprint will facilitate such surveillance. Contractual arrangements with a local organization such as the Eddy County Sheriff’s Department may be established which would provide some distinct advantages. Among the advantages are the following:

- deputies are trained in patrol and surveillance activities,

- deputies are authorized to arrest members of the general public who are found to be violating trespassing laws,
- the liability associated with apprehension, attempted apprehension, or circumstances arising from attempts would remain with the Sheriff's Department, and
- the general area to be patrolled is already a part of the Sheriff's area of responsibility.

Surveillance will consist of drive-by patrolling around the fenced perimeter a minimum of three times per week. In the course of the patrol, particular note will be taken of the fence integrity. In addition, the locked condition of each gate will be checked to ensure that gate integrity is maintained and there is no evidence of tampering. Surveillance will also include visual observation of the entire enclosed area for any signs of human activity. Additionally, surveillance patrols will be conducted around the site boundary's perimeter for signs of unauthorized human activities. A routine summary of each month's surveillance activity will be prepared documenting the date and time of each patrol and any unusual circumstances that may have been observed. This surveillance routine will continue throughout the post-closure care period.

J1.1.3 Maintenance and Remedial Actions

Anticipated maintenance and remedial action issues during the post-closure care period are minimal and should encompass such issues as

- fence and road maintenance,
- repair of any damage that occurs,
- response to evidence of potential erection of drilling equipment, and
- response to unauthorized entry into prohibited areas.

The Permittees will provide maintenance services within a reasonable time after the need is identified during routine patrolling activity. Any observed vandalism or unauthorized entry will be investigated and action will be taken as the circumstances warrant.

J1.1.4 Control and Clean-up of Releases

The decontamination process and disposal of the derived waste will be completed prior to sealing the shafts and final facility closure. With the location of the WIPP repository at 2,150 feet (655 meters) below the surface and with panels closed and shafts sealed, the potential for releases of radioactive material or hazardous constituents following the sealing of the shafts is precluded. There will be no credible pathway for releases from the repository other than human intrusion. Routine patrols in accordance with access control requirements will preclude human intrusion into the repository during the post-closure period.

J1.1.5 Groundwater Monitoring

Groundwater monitoring is the only monitoring program required by the Permit that will be conducted throughout the post-closure care period. The post-closure groundwater monitoring requirements are specified in Permit Module VI and Permit Attachment L.

J1.2 Additional Post-Closure Activities

With the certification of closure of WIPP and return of the land disturbed by the WIPP activities to a stable ecological state that will assimilate with the surrounding undisturbed ecosystem, continuous occupancy of the site for operational and security purposes will cease. Any additional activities will be imposed through the Post-Closure Care Permit issued by NMED after certification of closure.

J1.3 Quality Assurance

The quality assurance and quality control plan will be applied to the procurement of materials for and the erection of the fencelines enclosing the repository footprint. In particular, quality control inspection of the placement and tensioning of the barbed wire and chain link fabric will be applied and utilized to provide reasonable assurance that the fencing structures will function during the post-closure care period with normal maintenance.

Quality assurance and quality control will also be applied to the sampling and analyses supporting the environmental monitoring program. Contractors collecting samples and laboratories conducting analyses for the Permittees shall be qualified in accordance with guidelines prescribed in the most current edition of the Permittees’ quality assurance program document at the time that the contracts are awarded.

References

EPA (U.S. Environmental Protection Agency). 1993. 40 CFR Part 191 Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste; Final Rule. *Federal Register*, Vol. 58, No. 242, pp. 66398-66416, December 20, 1993. Office of Radiation and Indoor Air, Washington, D.C.

U.S. Congress. 1992. Waste Isolation Pilot Plant Land Withdrawal Act. Public Law 102-579, 106 Stat. 4777, October 1992. 102nd Congress, Washington, D.C.

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FIGURES

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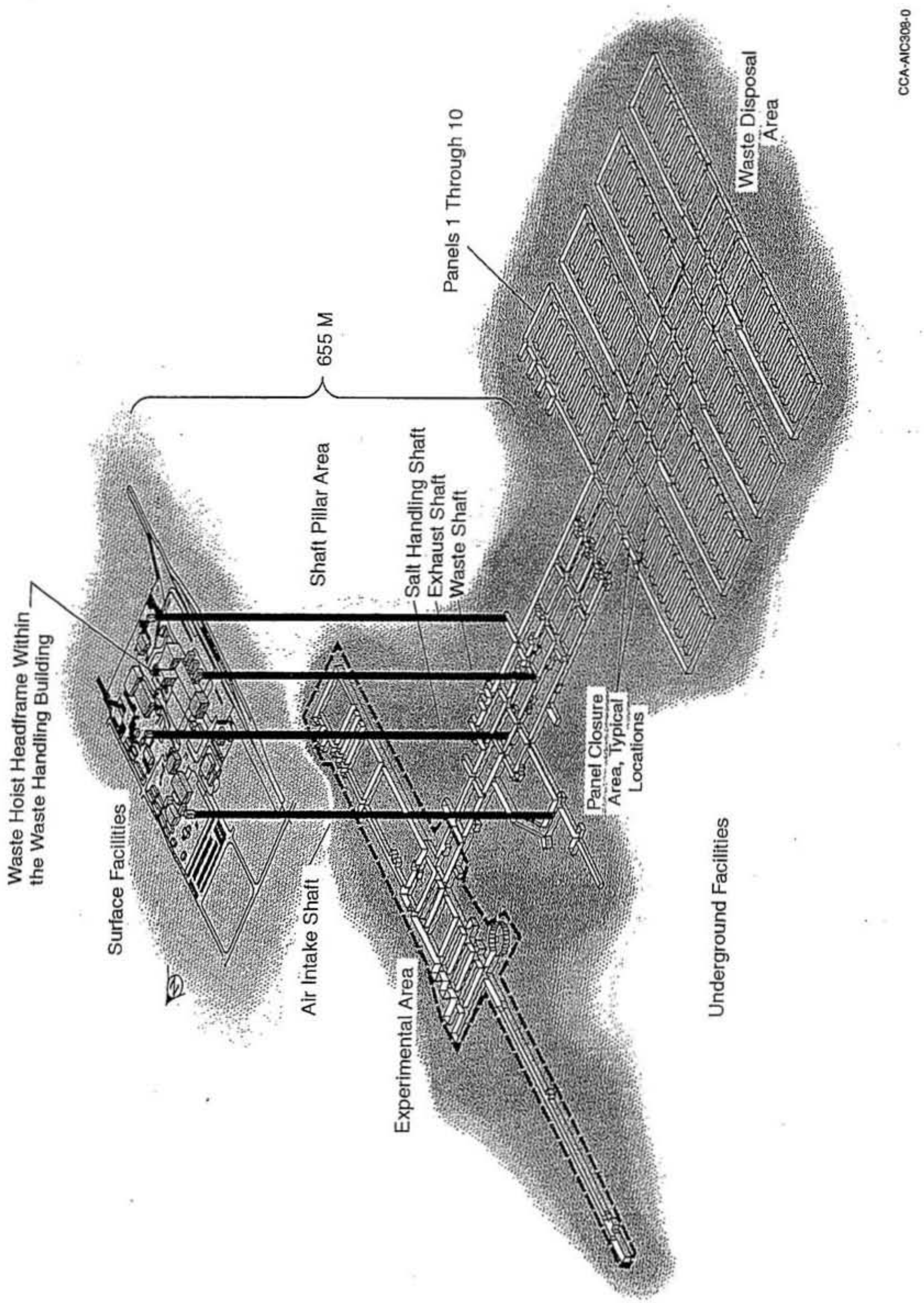


Figure J1-1
Spatial View of WIPP Surface and Underground Facilities

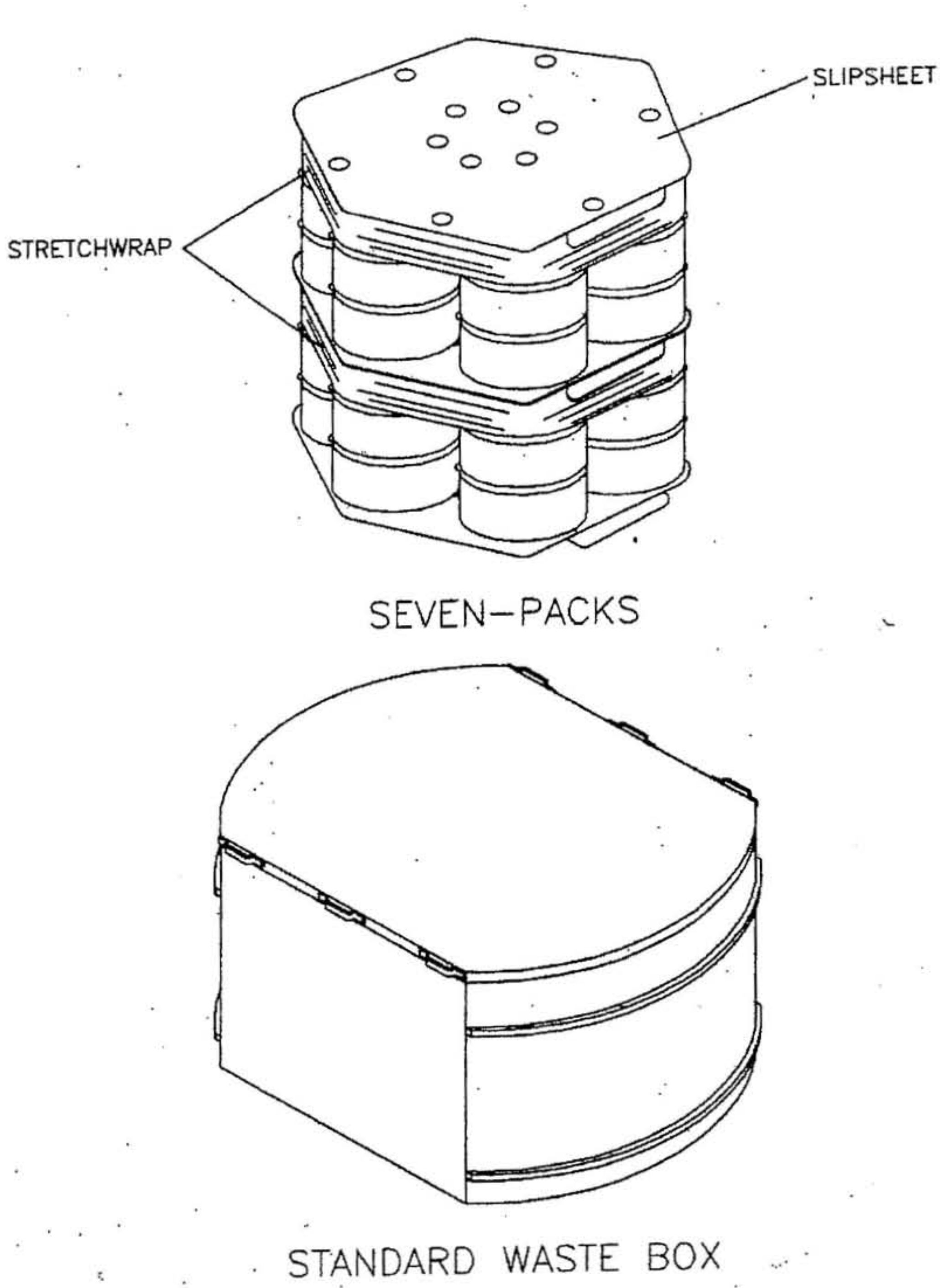
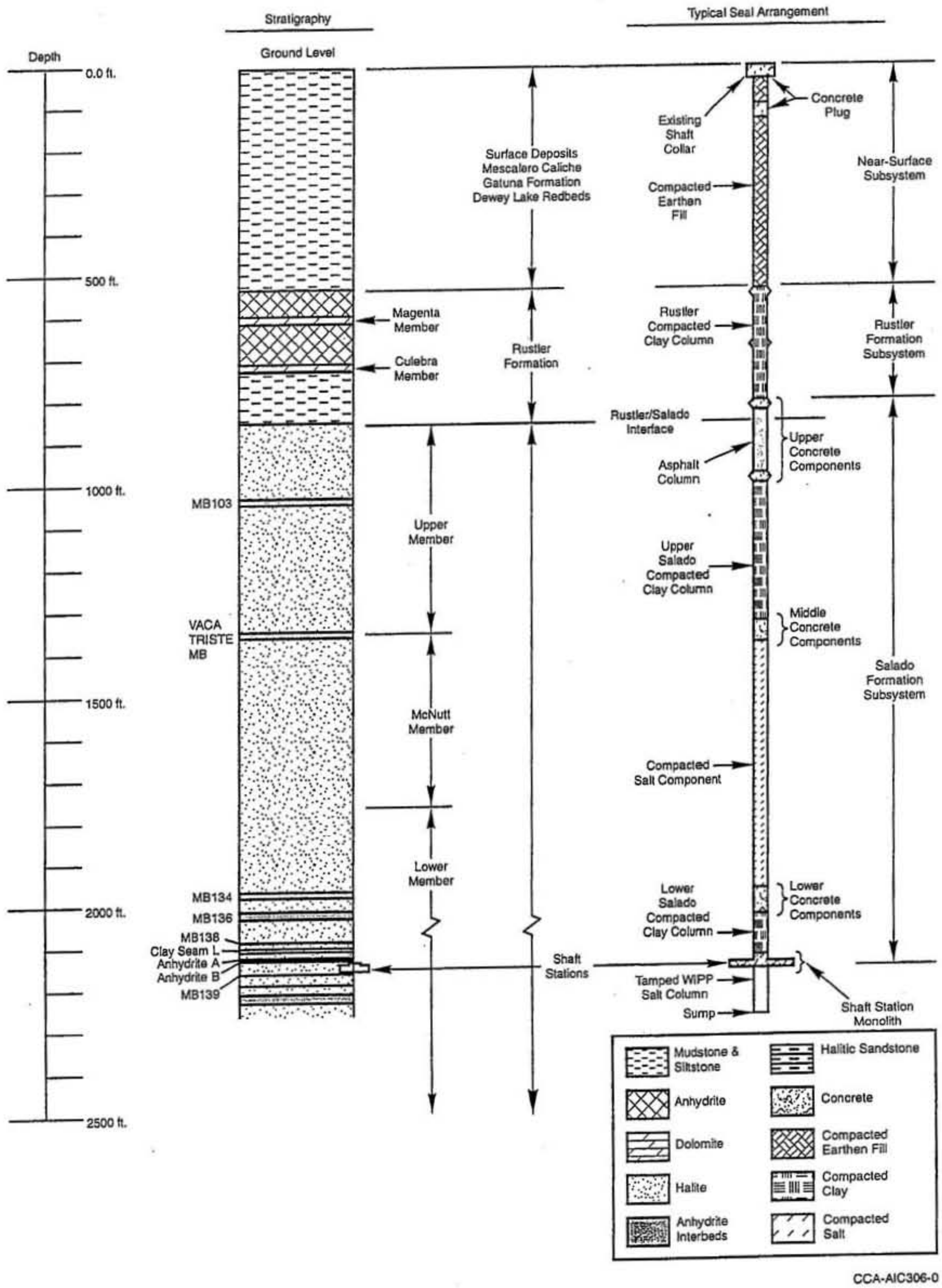


Figure J1-2
Standard Waste Box and Seven-Pack Configuration



1

2 Figure J1-3
3 Typical Shaft Sealing System

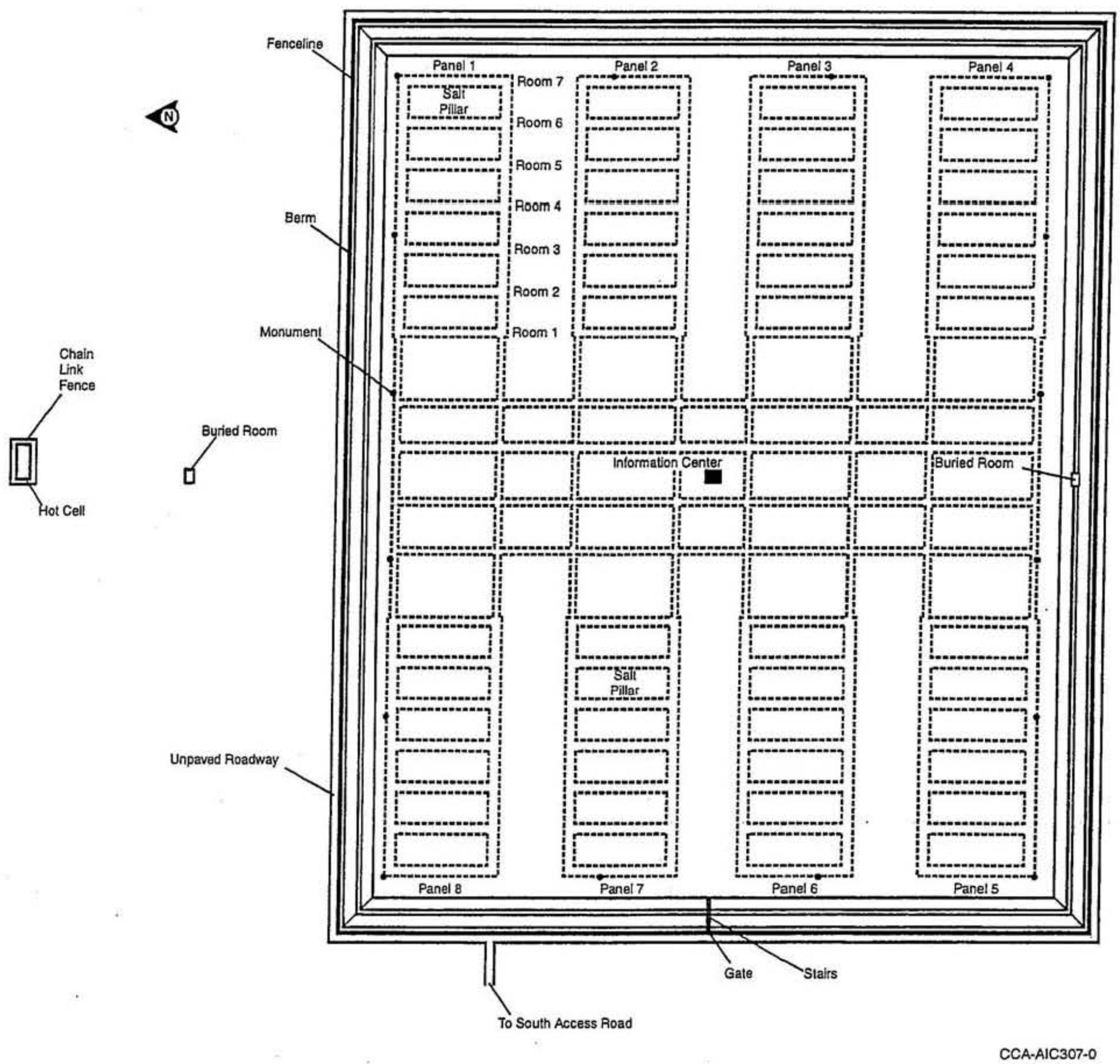


Figure J1-4
Perimeter Fenceline and Roadway

CHAPTER K

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CHAPTER K

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CHAPTER L

WIPP GROUND-WATER DETECTION MONITORING PROGRAM PLAN

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CHAPTER L

WIPP GROUND-WATER DETECTION MONITORING PROGRAM PLAN

TABLE OF CONTENTS

List of Tables

List of Figures

List of Abbreviations/Acronyms

ASER	Annual Site Environmental Report
AR/VR	Approval/Variation Request
Bell Canyon	Bell Canyon Formation
bgs	below ground surface
Castile	Castile Formation
cm	centimeter(s)
Culebra	Culebra Member of the Rustler Formation
CofC	Chain of Custody
°C	degree(s) Celsius
%C	percent completeness
DI	deionized
DMP	Detection Monitoring Program
DOE	U.S. Department of Energy
DQO	data quality objectives
EM	Environmental Monitoring
EPA	U.S. Environmental Protection Agency
ES&H	Environment, Safety, and Health Department
FEIS	Final Environmental Impact Statement
ft	foot (feet)
ft^2	square foot (square feet)
g/cm^3	gram per cubic centimeter
GWSP	Groundwater Surveillance Program
HWDU	hazardous waste disposal unit(s)
km	kilometer(s)
km^2	square kilometer(s)
$lb/in.^2$	pound(s) per square inch
LCS	laboratory control samples
LD	limit of detection
LWA	Land Withdrawal Act
m	meter(s)
M&DC	monitoring and data collection
m^2	square meter(s)
mg/L	milligram(s) per liter
mi	mile(s)
mi^2	square mile(s)
MOC	Management and Operating Contractor
MPa	megapascal(s)
mV	millivolt(s)
NIST	National Institute for Standards and Technology
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
PRS	Project Records Services

QA	Quality Assurance
QA/QC	quality assurance/quality control
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	request for analysis
RIDS	Records Inventory and Disposition Schedule
RPD	relative percent difference
Rustler	Rustler Formation
%R	percent recovery
Salado	Salado Formation
SC	specific conductance
SOP	Standard Operating Procedure
STLB	sample tracking logbook
TDS	total dissolved solids
TOC	total organic carbon
TOX	total organic halogens
TRU	transuranic
TSDF	treatment, storage, and disposal facilities
TSS	total suspended solids
VOC	volatile organic compound
WIPP	Waste Isolation Pilot Plant
WLMP	WIPP Groundwater Level Monitoring Program
WQSP	Water Quality Sampling Program
µg/L	microgram(s) per liter
µm	micrometers

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CHAPTER L

WIPP GROUND-WATER DETECTION MONITORING PROGRAM PLAN

L-1 Introduction

The Waste Isolation Pilot Plant (**WIPP**) is a geologic repository for the disposal of transuranic (**TRU**) waste. The disposal horizon is located 2,150 feet (ft) (655 meters [m]) below the land surface in the bedded salt of the Salado Formation (hereinafter referred to as the Salado). At WIPP, water-bearing units occur both above and below the disposal horizon. Ground-water monitoring of the uppermost aquifer below the facility is not proposed at WIPP because that water-bearing unit (the Bell Canyon Formation) is not considered a credible pathway for a release from the repository. This is because the repository horizon and water-bearing sandstones of the Bell Canyon Formation are separated by over 2000 ft (610 m) of very low-permeability evaporite sediments (Appendices E1 and D6 of the RCRA Part B Permit Application (DOE, 1997b)). No natural credible pathway has been established for contaminant transport to aquifers below the repository horizon, as there is no hydrologic communication between the repository and underlying aquifer. The U.S. Environmental Protection Agency (**EPA**) concluded in 1990 that natural vertical communication does not exist based on their review of numerous studies (EPA, 1990). Furthermore, drilling boreholes for ground-water monitoring through the Salado and the Castile Formation (hereinafter referred to as the Castile) into the Bell Canyon aquifer would compromise the isolation properties of the repository medium.

Disposal of TRU mixed waste in the WIPP facility is subject to regulation under Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1, Subpart V (20.4.1.500 NMAC). As required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601), the Permittees shall demonstrate that the environmental performance standards for a miscellaneous unit, which are applied to the hazardous waste disposal units (**HWDUs**) in the underground, will be met.

Ground-water monitoring at WIPP in the past has focused on the Culebra member of the Rustler Formation (hereinafter referred to as the Culebra) because it represents the most significant hydrologic contaminant migration pathway to the accessible environment. The Culebra is the most significant water-bearing unit lying above the repository. Modeling of ground-water movement in the Culebra, based on the concept of a ground-water basin, is discussed in detail in Appendix D6, Section D6-2a(1), of the WIPP RCRA Part B Permit Application (DOE, 1997b).

The WIPP site is located in Eddy County in southeastern New Mexico (Figure L-1) within the Pecos Valley section of the southern Great Plains physiographic province (Powers et al., 1978). The site is 26 miles (mi) (42 kilometers [km]) east of Carlsbad, New Mexico in an area known as Los Medaños (the dunes). Los Medaños is a relatively flat, sparsely inhabited plateau with little water and limited land uses.

The WIPP site (Figure L-2) consists of 16 sections of Federal land in Township 22 South, Range 31 East. The 16 sections of Federal land were withdrawn from the application of public land laws by the WIPP Land Withdrawal Act (**LWA**), Public Law 102-579. The WIPP LWA transferred the responsibility for the administration of the 16 sections from the Department of Interior, Bureau of Land Management, to the U.S. Department of Energy (**DOE**). This law specified that mining and drilling for purposes other than support of the WIPP project are prohibited within this 16 section area with the exception of Section 31. Oil and gas drilling activities are restricted in Section 31 from the surface down to 6,000 feet.

This monitoring plan addresses requirements for sample collection, ground-water surface elevation monitoring, ground-water flow direction, data management, and reporting of ground-water monitoring data. It also identifies analytical parameters selected to assess ground-water quality, and establishes personnel responsibilities for the WIPP ground-water detection monitoring program (**DMP**). Because quality assurance is an integral component of the ground-water sampling, analysis, and reporting process, quality assurance/quality control (**QA/QC**) elements and associated data acceptance criteria are included in this plan.

Instructions for performing field activities that will be conducted in conjunction with this sampling and analysis plan are provided in field operating procedures, referenced throughout this plan. Procedures are required for each aspect of the ground-water sampling process, including ground-water surface elevation measurement, ground-water flow direction, sampling equipment installation and operation, field water-quality measurements, and sample collection. These procedures prescribe proper field sampling techniques. Samples will be collected by trained personnel under the supervision and direction of qualified engineers, scientists, or other technical personnel.

L-1a Geologic and Hydrologic Characteristics

L-1a(1) Geology

The WIPP site is situated within the Delaware Basin, which is part of the larger Permian Basin, located in the south-central region of North America. During the Permian period, which came to a close about 245 million years ago, ancient seas covered the basin. Their later evaporation resulted in the deposition of a thick sequence of evaporites. Appendix D6 of the WIPP RCRA Part B Permit Application (DOE, 1997b) presents a detailed discussion of the regional geologic history. Three major evaporite-bearing formations were deposited in the Delaware Basin (see Figures L-3 and L-4):

- The Castile, which formed through evaporation of the Permian Sea, consists of interbedded anhydrites and halite. Its upper boundary is at a depth of about 2,825 ft (861 m) below ground surface (**bgs**), and its thickness at the WIPP facility is 1,250 ft (381 m) (see Appendix D6 of the WIPP RCRA Part B Permit Application (DOE, 1997b)).

- The repository is located in the Salado, which overlies the Castile and resulted from prolonged desiccation that produced predominantly halite, with some carbonates, anhydrites, and clay seams. Its upper boundary is at a depth of about 850 ft (259 m) bgs, and it is about 2,000 ft (610 m) thick in the repository area (see Appendix D6 of the WIPP RCRA Part B Permit Application (DOE, 1997b)).

- The Rustler Formation (hereinafter referred to as the Rustler) was deposited in a lagoonal environment during a major freshening of the basin and consists of carbonates, anhydrites, and halites. Its beds consist of clay and anhydrite and contain small amounts of brine. The Rustler's upper boundary is about 500 ft (152 m) bgs, and it ranges up to 350 ft (107 m) in thickness in the area (see Appendix D6 of the WIPP RCRA Part B Permit Application (DOE, 1997b)).

These evaporite-bearing formations lie between two other formations significant to the geology and hydrology of the WIPP site. The Dewey Lake overlying the Rustler is dominated by nonmarine sediments and consists almost entirely of mudstone, claystone, siltstone, and interbedded sandstone (Appendix D6 of the WIPP RCRA Part B Permit Application (DOE, 1997b)). This formation forms a 500-ft- (152-m) thick barrier of fine-grained sediments that retard the downward percolation of water into the evaporite units below.[1] The Bell Canyon Formation (hereinafter referred to as the Bell Canyon)—the first water-bearing unit below the repository (Appendix D6 of the WIPP RCRA Part B Permit Application (DOE, 1997b))—is confined by the thick evaporite sequences of the Castile above. It consists of 1,200 ft (366 m) of interbedded sandstone, shale, and siltstone.

The Salado was selected to host the WIPP repository for several reasons. First, it is regionally extensive, underlying an area of more than 36,000 square mi (mi^2) (93,240 square kilometers [km^2]). Second, its permeability is extremely low. Third, salt behaves mechanically in a plastic manner under pressure (the pressure at the disposal horizon is more than 2,000 pounds per square inch [$lb/in.^2$] or 13.8 megapascals [MPa]) and eventually moves to fill any opening (referred to as creep). Fourth, any fluid remaining in small fractures or openings is saturated with salt, is incapable of further salt dissolution, and has probably remained in place for millions of years. Finally, the Salado lies between the Rustler and the Castile (Figure L-5), which contain very low permeability layers that help confine and isolate waste within and keep water outside of the WIPP repository (Appendix D6 of the WIPP RCRA Part B Permit Application (DOE, 1997b)).

L-1a(2) <u>Ground-water Hydrology</u>

The general hydrogeology of the area surrounding the WIPP facility is described in this section starting with the first geologic unit below the Salado. Appendix D6 of the WIPP RCRA Part B Permit Application (DOE, 1997b) provides more detailed discussions of the local and regional hydrogeology. Relevant hydrological parameters for the various rock units above the Salado at WIPP are summarized in Table L-1.

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[1] While there may be some uncertainty over the amount of vertical recharge occurring within the Rustler, the issue is only of significance to long-term performance calculations in which releases from the repository occur through the creation of a migration pathway resulting from drilling (inadvertently) in the WIPP area. The consequences of vertical recharge are bounded in the modeling by assuming that under future climate conditions (which are assumed to be cooler and wetter), the ground-water surface elevation (water table) raises near ground surface, at which time the water table tends to mimic topography.

L-1a(2)(i) The Castile

The Castile is a basin-filling evaporite sequence of sediments surrounded by the Capitan Reef. The Castile represents a major regional ground-water aquitard that effectively prevents upward migration of water from the underlying Bell Canyon. Fluid present in the Castile is very restricted because evaporites do not readily maintain pore space, solution channels, or open fractures at depth. Drill-stem tests conducted in the Castile during construction of the WIPP facility found its permeability to be lower than detection limits; however, the hydraulic conductivity has been conservatively estimated to be less than 10^{-8} ft (3×10^{-9} m) per day. A description of the Castile brine reservoirs outside the WIPP area is provided in Appendix D6 of the RCRA Part B Permit Application (DOE, 1997b).

L-1a(2)(ii) The Salado

The Salado is an evaporite sequence that filled the remainder of the Delaware Basin and lapped extensively over the Capitan Reef and the back-reef sediments beyond. The Salado consists of approximately 2,000 ft (610 m) of bedded halite, with interbeds or seams of anhydrite, clay, and polyhalite. It acts hydrologically as a regional confining bed. The porosity of the Salado is very low and interconnected pores are probably nonexistent in halite at the depth of the disposal horizon. Fluids associated with the Salado occur mainly as very small fluid inclusions in the halite crystals and also occur between crystal boundaries (interstitial fluid) of the massive crystalline salt formation; fluids also occur in clay seams and anhydrite beds. Permeabilities measured from the surface in the area of the WIPP facility range from 0.01 to 25 microdarcies. The most reliable value, 0.3 microdarcy, was obtained from well DOE-2. The results of permeability testing at the disposal horizon are within the range of 0.001 to 0.01 microdarcy. As a comparison, the permeability of the Salado is roughly a thousand times less than that of a lower clay liner required of surface impoundments and landfills, assuming similar thicknesses.

L-1a(2)(iii) The Rustler

The Rustler has been the subject of extensive characterization activities because it contains the most transmissive hydrologic units overlying the Salado (specifically, the Culebra Member, hereafter referred to as the Culebra). Within the Rustler, five members have been identified. Of these, the Culebra is the most transmissive and has been the focus of most of the Rustler hydrologic studies.

The Culebra is the first continuous water-bearing zone above the Salado and is up to approximately 30 ft (9 m) thick. Water in the Culebra is usually present in fractures and is confined by overlying gypsum or anhydrite and underlying clay and anhydrite beds. The hydraulic gradient within the Culebra in the area of the WIPP facility is approximately 20 ft per mi (3.8 m per km) and becomes much flatter south and southwest of the site (Figure L-6). Culebra transmissivities in the Nash Draw range up to 1,250 square ft (ft^2) (116 square m [m^2]) per day; closer to the WIPP facility, they are as low as 0.007 to 74 ft^2 (0.00065 to 7.0 m^2) per day. The Culebra is hydrologically confined.

The two primary types of field tests that are being used to characterize the flow and transport characteristics of the Culebra are hydraulic tests and tracer tests.

The hydraulic tests consist of pump, injection, and slug testing of wells across the study area (e.g., Beauheim, 1987a). The most detailed hydraulic test data exist for the WIPP hydropads (e.g., H-19). The hydropads generally comprise a network of three or more wells located within a few tens of meters of each other. Long-term pumping tests have been conducted at hydropads H-3, H-11, and H-19 and at well WIPP-13 (Beauheim, 1987b, 1987c). These pumping tests provided transient pressure data both at the hydropad and over a much larger area. Tests often included use of automated data-acquisition systems, providing high-resolution (in both space and time) data sets. In addition to long-term pumping tests, slug tests and short-term pumping tests have been conducted at individual wells to provide pressure data that can be used to interpret the transmissivity at that well (Beauheim, 1987a). (Additional short-term pumping tests have been conducted in the Water Quality Sampling Program (**WQSP**) wells [Stensrud, 1995]). Detailed cross-hole hydraulic testing has recently been conducted at the H-19 hydropad (Kloska et al., 1995).

The hydraulic tests are designed to yield pressure data for estimation of hydrologic characteristics such as transmissivity, permeability, and storativity. The pressure data from long-term pumping tests and the interpreted transmissivity values for individual wells are used for input to flow modeling. Some of the hydraulic test data and interpretations are also important for the interpretation of transport characteristics. For instance, the permeability values interpreted from the hydraulic tests at a given hydropad are needed for interpretations of tracer test data at that hydropad.

There is strong evidence that the permeability of the Culebra varies spatially and varies sufficiently that it cannot be characterized with a uniform value or range over the region of interest to WIPP. The transmissivity of the Culebra varies spatially over six orders of magnitude from east to west in the vicinity of WIPP (see Figure D6-30 in the RCRA Part B Permit Application). Over the site, Culebra transmissivity varies over three to four orders of magnitude. Figure D6-30 shows variation in transmissivity in the Culebra in the WIPP region. Transmissivities have been calculated at 1×10^{-3} square feet per day (1×10^{-9} square meters per second) at well P-18 east of the WIPP site to 1×10^{3} square feet per day (1×10^{-3} square meters per second) at well H-7 in Nash Draw.

Transmissivity variations in the Culebra are believed to be controlled by the relative abundance of open fractures rather than by primary (that is, depositional) features of the unit. Lateral variations in depositional environments were small within the mapped region, and primary features of the Culebra show little map-scale spatial variability, according to Holt and Powers, 1988. Direct measurements of the density of open fractures are not available from core samples because of incomplete recovery and fracturing during drilling, but observation of the relatively unfractured exposures in the WIPP shafts suggests that the density of open fractures in the Culebra decreases to the east. Qualitative correlations have been noted between transmissivity and several geologic features possibly related to open-fracture density, including (1) the distribution of overburden above the Culebra, (2) the distribution of halite in other members of the Rustler, (3) the dissolution of halite in the upper portion of the Salado, and (4) the distribution of gypsum fillings in fractures in the Culebra.

Measured matrix porosities of the Culebra vary from 0.03 to 0.30. Fracture porosity values have not been measured directly, but interpreted values from tracer tests at the H-3, H-6, and H-11 hydropads vary from 5×10^{-4} to 3×10^{-3}. Data are insufficient to determine whether the average porosity of the matrix and fractures varies significantly on a regional scale.

Geochemical and radioisotope characteristics of the Culebra have been studied. There is considerable variation in ground-water geochemistry in the Culebra. The variation has been described in terms of different hydrogeochemical facies that can be mapped in the Culebra. A halite-rich hydrogeochemical facies exists in the region of the WIPP site and to the east, approximately corresponding to the regions in which halite exists in units above and below the Culebra, and in which a large portion of the Culebra fractures are gypsum filled. An anhydrite-rich hydrogeochemical facies exists west and south of the WIPP site, where there is relatively less halite in adjacent strata and where there are fewer gypsum-filled fractures. Radiogenic isotopic signatures suggest that the age of the ground water in the Culebra is on the order of 10,000 years or more (see, for example, Lambert, 1987; Lambert and Carter, 1987; and Lambert and Harvey, 1987).

The radiogenic ages of the Culebra ground water and the geochemical differences provide information potentially relevant to the ground-water flow directions and ground-water interaction with other units and are important constraints on conceptual models of ground-water flow. Previous conceptual models of the Culebra (see for example, Chapman, 1986; Chapman, 1988; LaVenue et al., 1990) have not been able to consistently relate the hydrogeochemical facies, radiogenic ages, and flow constraints (that is, transmissivity, boundary conditions, etc.) in the Culebra.

However, the Permittees have proposed a new conceptualization of ground-water flow that could explain observed geochemical facies and ground-water flow patterns. The new conceptualization, referred to as the ground-water basin model, offers a three dimensional approach to treatment of Supra-Salado rock units, and assumes vertical leakage (albeit very slow) between rock units of the Rustler exists (where hydraulic head is present).

Flow in the Culebra is considered transient. This differs from previous interpretations, wherein no-flow was assumed between Rustler units. The model assumes that the ground-water system is dynamic and is responding to the drying of climate that has occurred since the late Pleistocene period. The Permittees assumed that recharge rates during the late Pleistocene period were sufficient to maintain the water table near land surface, but has since dropped significantly. Therefore, the impact of local topography on ground-water flow was greater during wetter periods, with discharge from the Rustler to the west; flow is dominated by more regional topographic effects during drier times, with flow to a more southerly direction.

Four hydrogeochemical facies within the Culebra in the WIPP area (DOE, 1997a) have been identified:

- Zone A - saline (2-3 molal) NaCl brines, Mg/Ca ratio of 1.2 to 2;
- Zone B - dilute (<0.1 molal) $CaSO_4$ - rich ground water;
- Zone C - variable composition (0.3-1.6 molal); Mg/Ca ratio 0.3 to 1.2; and
- Zone D - high salinities (3-7 molal); K/Na weight ratios (0.2).

Facies A ground-water flow is slow, has not changed over the last 14,000 years, and probably recharged more than 600,000 years ago. Vertical leakage occurs to Facies A, and both lateral and vertical ground-water flow rates are extremely low. Facies B occurs in an area with greater vertical fracturing in the Culebra, and therefore exhibits more vertical infiltration and more rapid lateral flow in the Culebra. Flow in Facies B is currently to the south (it may mix with Facies C water to the southeast) but was more toward the west during wetter climates; vertical infiltration from the Dewey Lake to the Culebra Facies B is assumed by the Permittees to have occurred during wetter climates in an area south of the WIPP site. Facies C water was not diluted to create Facies B water. Facies C occurs “in between” Facies A and B, and ground-water flow entered the Culebra prior to the climate change (to drier conditions) 14,000 years ago. Facies C ground-water flow is to the south at WIPP, where the Permittees theorized that it joins with a small amount of Facies A solute being transported from the east. Ground-water flow rate in Facies C is faster than in A but slower than in B, and the proposed recharge area from the Dewey Lake to the Culebra was to the northeast of the WIPP site. Facies C ground water infiltrated into the Dewey Lake and then interacted with anhydrite and halite along its path to the Culebra, wherein it mixed with smaller amounts of Facies A water. the Permittees concluded that the presence of anhydrite within Rustler units does not preclude slow downward infiltration (DOE, 1997a).

Previously, the Permittees and others believed the geochemistry of Culebra ground water was inconsistent with flow directions. This was based on the premise that Facies C water must transform to facies B water (e.g. become “fresher”), which is inconsistent with the observed flow direction. It is now believed that the observed geochemistry and flow directions can be explained with different recharge areas and Culebra travel paths (DOE, 1997a).

Head distribution in the Culebra (see Figure D6-31 in the RCRA Part B Permit Application (DOE, 1997b)) is consistent with ground-water basin modeling results indicating that the generalized ground-water flow direction in the Culebra is currently north to south. However, the fractured nature of the Culebra, coupled with variable fluid densities, can cause localized flow patterns to differ from general flow patterns.

Ground-water levels in the Culebra in the WIPP region have been measured for several decades. Water-level rises have been observed in the WIPP region and are possibly related to recovery from impacts caused by shaft installation, response to potash effluent discharge, or are unexplained, as discussed below. The extent of water-level rise observed at a particular well depends on several factors, but the proximity of the observation point to the potential cause of the water-level rise appears to be a primary factor.

In the vicinity of the WIPP site, water-level rises are believed to be caused by recovery from drainage into the shafts. Drainage into shafts has been reduced by a number of grouting programs over the years, most recently in 1993 around the Air Intake Shaft. Northwest of the site, in and near Nash Draw, water levels appear to fluctuate in response to effluent discharge from potash mines. Correlation of water-level fluctuation with potash mine discharge, however, cannot be proven definitively because sufficient data on the timing and volumes of discharge are not available. Water-level rises in the vicinity of the H-9 hydropad, about 6.5 miles south of the site, are thought to be caused by neither WIPP activities nor potash mining discharge. They remain unexplained. The Permittees continue to monitor ground-water levels throughout the region.

Inferences about vertical flow directions in the Culebra have been made from well data collected by the Permittees. Beauheim (1987a) reported flow directions towards the Culebra from both the underlying unnamed lower member of the Rustler and the overlying Magenta member of the Rustler over the WIPP site, indicating that the Culebra acts as a drain for the units around it. This is consistent with results of ground-water basin modeling. Recent simulations to enhance the conceptual understanding of the geohydrology of the Rustler can be found in Corbet and Knupp, 1996.

Use of water from the Culebra in the WIPP area is quite limited because of its varying yields and high salinity. The Culebra is not used for water supply in the immediate WIPP site vicinity. Its nearest use is approximately 7 mi (11 km) southwest of the WIPP facility, where salinity is low enough to allow its use for livestock watering (shown, for example, as Well H-8 in Figure L-7). However, the Permittees identified the Culebra as potential aquifer in the Compliance Certification Application (DOE, 1996b). Because of this, the Culebra will be the focus of future ground-water monitoring at WIPP as it is also the most transmissive continuous water-bearing zone at WIPP and is the most likely pathway for contaminant migration.

L-2 General Regulatory Requirements

Because geologic repositories such as the WIPP facility are defined under the Resource Conservation and Recovery Act (**RCRA**) as land disposal facilities and as miscellaneous units, the ground-water monitoring requirements of 20.4.1.500 NMAC (incorporating 40 CFR §§264.600 through 264.603) shall be addressed. 20.4.1.500 NMAC (incorporating 40 CFR §§264.90 through 264.101) applies to miscellaneous unit treatment, storage, and disposal facilities (**TSDF**) only if ground-water monitoring is needed to satisfy 20.4.1.500 NMAC (incorporating 40 CFR §§264.601 through 264.603) environmental performance standards.

The New Mexico Environment Department (**NMED**) has concluded that ground-water monitoring in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264 Subpart F) at WIPP is necessary to meet the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §§264.601 through 264.603).

L-3 WIPP Ground-water Detection Monitoring Program (DMP)—Overview

L-3a Scope

The Permittees have established a RCRA "Ground-water Detection Monitoring Program (DMP) Plan" to define and protect ground-water resources at WIPP. One of the objectives of the WIPP DMP is to establish, by means of ground-water sampling and analysis, an accurate and representative ground-water database that is scientifically defensible and demonstrates regulatory compliance. In addition, the DMP will be used to determine background or existing conditions of ground-water quality and quantity, including ground-water surface elevation and direction of flow, around the WIPP facility area.

This plan governs all ground-water sampling events conducted to meet the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §§264.90 through 264.101), and ensures that all such data are gathered in accordance with these and other applicable requirements. The ground-water quality data generated by monitoring activities will provide a comprehensive background database against which future analytical results can be compared during the DMP.

Ground-water monitoring at WIPP has been historically conducted by several programs including the WIPP Site Characterization Program, the WIPP WQSP, and recently the WIPP Ground-water Surveillance Program (**GWSP**). Ground-water quality and ground-water surface elevation data have been collected by these programs for over 12 years at WIPP. Data from the WQSP wells (which are widely distributed across the area, see Figure L-8) will be used to continually define changes in the area's potentiometric surface and ground-water flow directions. New monitoring wells included in the WIPP GWSP (WQSP wells 1-6a) were constructed to the specifications provided in the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (EPA, 1986) and constitute the RCRA ground-water monitoring network specified in this DMP as required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.90 through 264.101). These wells are being used to establish background ground-water quality, ground-water surface elevations and flow directions in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §§264.97(f) and (g) and 264.98(e)). Justification for the locations of these wells (3 upgradient and 4 downgradient) is presented below.

L-3b Current WIPP DMP

The WQSP wells 1 through 6a constitute the RCRA DMP for WIPP (Figure L-9 and Permit Attachment O, Figure A2-3) during detection monitoring as required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.90 through 264.101). This monitoring plan is a continuation of the current WIPP GWSP, and these wells will serve as the monitoring locations during background water-quality characterization and the RCRA DMP (Figure L-9 and Permit Attachment O, Figure A2-3).

Wells WQSP-1, WQSP-2, and WQSP-3 were located directly upgradient of the WIPP shaft area. The locations of the three upgradient wells were selected to be representative of the flow vectors of ground water moving downgradient onto the WIPP site. Figure 34 of Davies, 1989, shows the simulation of direction and magnitude of ground-water flow. The upgradient wells were located based on the flow vectors resulting from this model simulation. The original WQSP observation wells, as well as those in the RCRA DMP, have been and will continue to be used as piezometer wells to support collection of ground-water surface elevation and ground-water flow modeling data to demonstrate regulatory compliance. Well location surveys for each of the seven wells were performed by the Permittees' survey personnel using the State Plane Coordinates-North American Datum Model 27 method. Results of the surveys are on file with the New Mexico State Engineers Department along with the associated extraction permits for each well.

WQSP-4, WQSP-5, and WQSP-6 were located downgradient of the WIPP shaft area in concert with the flow vectors shown by this model simulation. WQSP-6a was installed in the Dewey Lake Formation at the WQSP-6 location to assess ground-water conditions at this location. All three Culebra downgradient wells (WQSP-4, 5, and 6) were sited based on the greatest velocity magnitude of ground-water flow leaving the shaft area as shown on Figure 34 of Davies, 1989, and upgradient of the WIPP LWA boundary. WQSP-4 was also specifically located to monitor the zone of higher transmissivity around wells DOE-1 and H-11, which may represent faster flow path away from the WIPP shaft area to the LWA boundary (DOE, 1996b).

The Culebra has been selected for the focus of the DMP due to it being regionally extensive and exhibiting the most significant transmissivity of the water-bearing units at WIPP. The Culebra has been extensively studied during all past hydrologic characterization programs and found to be the most likely hydrologic pathway to the accessible environment or compliance point for any potential contamination.

The compliance point is defined in 20.4.1.500 NMAC (incorporating 40 CFR §264.95) as the vertical plane immediately downgradient of the hazardous waste management unit area (i.e., at the downgradient footprint of the WIPP repository). Permit Module V specifies the point of compliance as "the vertical surface located at the hydraulically downgradient limit of the Underground HWDUs that extends to the Culebra Member of the Rustler Formation." The RCRA ground-water monitoring network was not installed immediately downgradient of this plane. However, because the Underground HWDUs at WIPP are Subpart X units, and due to the relatively unique containment and transport aspects of the site, monitoring at the proposed locations will allow for detection of releases prior to release of these contaminants to the general public at the LWA boundary.

The DMP wells were located to intercept flow vectors downgradient away from the WIPP shafts area based on current density corrected potentiometric surfaces (Figure L-9). Based on natural contours of the potentiometric surface (Figure L-9) the selected well placement locations are downgradient of the general flow direction from the shaft area. Transport modeling of contaminant migration throughout the Culebra to the Land Withdrawal Act boundary suggests that travel times could be on the order of thousands of years if, under worst case conditions, hazardous constituents could migrate from the sealed repository. If contaminants were to migrate from the disposal facility, they would be detected by the DMP wells located midway between the shafts and LWA such that samples from wells could detect these contaminants long before they could reach the LWA boundary.

Potentiometric surfaces and ground-water flow directions defined prior to large-scale pumping in the WIPP area and the excavation of WIPP shafts suggests that flow was generally to the south-southeast from the waste disposal and shaft areas (Mercer, 1983; Davies, 1989). Recent (December 1996) potentiometric surface maps of the Culebra adjusted for density differences show very similar characteristics (Figure L-9). WQSP-4, WQSP-5, and WQSP-6 have been located downgradient of the waste emplacement areas according to present-day adjusted potentiometric surfaces.

Potentiometric surfaces that have not been corrected for density differences and that contain transient relics of previous pumping-drawdown events do not reflect accurate natural ground-water flow directions and should not be used to assess the adequacy of ground-water monitoring locations. Previous potentiometric surface maps showing a potentiometric low and hydrologic gradient toward the area between WQSP-3 and WQSP-4 had not been adjusted to freshwater head equivalents, and had also been influenced by the long-term pumping at well H-19. Hence, some historic maps may not represent natural Culebra flow directions or gradients, and appropriateness of the RCRA monitoring network cannot be definitively evaluated using these data.

L-3b(1) DMP Well Construction Specification

L-3b(1)(i) WQSP-1

Well WQSP-1 was drilled between September 13 and 16, 1994, to a total depth of 737 ft (225 m) bgs. The borehole was drilled through the Culebra and extends 15 ft (5 m) into the unnamed lower member of the Rustler. The well was drilled to a depth of 693 ft (211 m) bgs using compressed air as the drilling fluid. The interval from 693 to 737 ft (225 to 211 m) bgs (the total depth) was drilled using air mist with a foaming agent as the drilling fluid. WQSP-1 was drilled to 695.6 ft (212 m) bgs using a 9⅞-in. drill bit and was cored from 695.6 to 737 ft (212 to 225 m) bgs using a 5¼-in. core bit to cut 4-in.- (0.1-m) diameter core. After coring, WQSP-1 was reamed to 9⅞ in. (0.3 m) in diameter to total depth. WQSP-1 was cased from the surface to 737 ft (224.6 m) bgs with 5-in. (0.1-m) (0.28-in. [0.7-centimeter (cm)] wall) blank fiberglass casing with in-line 5-in.- (0.1-m) diameter fiberglass 0.02-in. (0.1-cm) slotted screen across the Culebra interval from 702 to 727 ft (214 to 222 m) bgs. The annulus between the borehole wall and the casing/screen is packed with sand from 640 to 651 ft (195 to 198 m) bgs and with 8/16 Brady gravel from 651 to 737 ft (198 to 225 m) bgs. Based on core log results, the Culebra is located from 699 to 722 ft (213 to 220 m) bgs (see Figure L-10).

L-3b(1)(ii) WQSP-2

Well WQSP-2 was drilled between September 6 and 12, 1994, to a total depth of 846 ft (257.9 m) bgs. The borehole was drilled through the Culebra and extends 12.3 ft (3.7 m) into the unnamed lower member of the Rustler. The well was drilled to a depth of 800 ft (244 m) bgs with a 9⅞-in. drill bit using compressed air as the drilling fluid. The interval from 800 to 846 ft (244 to 258 m) bgs (the total depth) was drilled with a 5¼-in. core bit to cut 4-in.- (0.1-m) diameter core using air mist with a foaming agent as the drilling fluid. After coring, WQSP-2 was reamed to 9⅞ in. (0.3 m) in diameter to total depth. WQSP-2 was cased from the surface to 846 ft (258 m) bgs with 5-in. (0.1-m) (0.28-in. [0.7-cm] wall) blank fiberglass casing with in-line 5-in.- (0.1-m) diameter fiberglass 0.02-in. (0.1-cm) slotted screen across the Culebra interval from 811 to 836 ft (247 to 255 m) bgs. The annulus between the borehole wall and the casing/screen is packed with sand from 790 to 793 ft (241 to 242 m) bgs and with 8/16 Brady gravel from 793 to 846 ft (242 to 258 m) bgs. Based on core log results, the Culebra is located from 810.1 to 833.7 ft (247 to 254 m) bgs (see Figure L-11).

L-3b(1)(iii) WQSP-3

Well WQSP-3 was drilled between October 21 and 26, 1994, to a total depth of 880 ft (268 m) bgs. The borehole was drilled through the Culebra and extends 10 ft (3.1 m) into the unnamed lower member of the Rustler. The well was drilled to a depth of 880 ft (268 m) bgs using compressed air as the drilling fluid. The borehole was cleaned using air mist with a foaming agent. WQSP-3 was drilled to 833 ft (254 m) bgs using a 9⅞-in. drill bit and was cored from 833 to 879 ft (254 to 268 m) bgs using a 5¼-in. core bit to cut 4-in.- (0.1-m) diameter core. After coring, WQSP-3 was reamed to 9⅞ in. (0.3 m) in diameter to total depth of 880 ft (268 m) bgs. WQSP-3 was cased from the surface to 880 ft (268 m) bgs with 5-in. (0.1-m) (0.28-in. [0.7-cm] wall) blank fiberglass casing with in-line 5-in.- (0.1-m) diameter fiberglass 0.02-in. (0.1-cm) slotted screen across the Culebra interval from 844 to 869 ft (257 to 265 m) bgs. The annulus between the borehole wall and the casing/screen is packed with sand from 827 to 830 ft (252 to 253 m) bgs and with 8/16 Brady gravel from 830 to 880 ft (253 to 268 m) bgs. Based on core log results, the Culebra is located from 844 to 870 ft (257 to 265 m) bgs (see Figure L-12).

L-3b(1)(iv) WQSP-4

Well WQSP-4 was drilled between October 5 and 10, 1994, to a total depth of 800 ft (244 m) bgs. The borehole was drilled through the Culebra and extends 9.2 ft (2.8 m) into the unnamed lower member of the Rustler. The well was drilled to a depth of 740 ft (226 m) bgs with a 9⅞-in. drill bit using compressed air as the drilling fluid. The interval from 740.5 to 798 ft (225.7 to 243 m) bgs was cored with a 5¼-in. (0.13-m) core bit to cut 4-in.- (0.1-m) diameter core using air mist with a foaming agent as the drilling fluid. After coring, WQSP-4 was reamed to 9⅞ in. (0.3 m) in diameter to total depth of 800 ft (244 m) bgs. WQSP-4 was cased from the surface to 800 ft (244 m) bgs with 5-in. (0.1-m) (0.28-in. [0.7-cm] wall) blank fiberglass casing with in-line 5-in.- (0.1-m) diameter fiberglass 0.02-in. (0.1-cm) slotted screen across the Culebra interval from 764 to 789 ft (233 to 241 m) bgs. The annulus between the borehole wall and the casing/screen is packed with sand from 752 to 755 ft (229 to 230 m) bgs and with 8/16 Brady gravel from 755 to 800 ft (230 to 244 m) bgs. Based on core log results, the Culebra is located from 766 to 790.8 ft (233 to 241 m) bgs (see Figure L-13).

L-3b(1)(v) WQSP-5

Well WQSP-5 was drilled between October 12 and 19, 1994, to a total depth of 681 ft (208 m) bgs. The borehole was drilled through the Culebra and extends into the unnamed lower member of the Rustler. The well was drilled to a depth of 676 ft (206 m) bgs using compressed air as the drilling fluid. The borehole was cleaned using air mist with a foaming agent. WQSP-5 was drilled to 648 ft (198 m) bgs using a 9⅞-in. drill bit and was cored from 648 to 676 ft (198 to 206 m) bgs using a 5¼-in. core bit to cut 4-in.- (0.1-m) diameter core. After coring, WQSP-5 was reamed to 9⅞ in. (0.3 m) in diameter to total depth of 681 ft (208 m) bgs. WQSP-5 was cased from the surface to 681 ft (208 m) bgs with 5-in. (0.1-m) (0.28-in. [0.7-cm] wall) blank fiberglass casing with in-line 5-in.- (0.1-m) diameter fiberglass 0.02-in. (0.1-cm) slotted screen across the Culebra interval from 646 to 671 ft (197 to 205 m) bgs. The annulus between the borehole wall and the casing/screen is packed with sand from 623 to 626 ft (190 to 191 m) bgs and with 8/16 Brady gravel from 626 to 681 ft (191 to 208 m) bgs. Based on core log results, the Culebra is located from 648 to 674.4 ft (198 to 205.6 m) bgs (see Figure L-14).

L-3b(1)(vi) WQSP-6

Well WQSP-6 was drilled between September 26 and October 3, 1994, to a total depth of 616.6 ft (187.9 m) bgs. The borehole was drilled through the Culebra and extends 9.7 ft (3 m) into the unnamed lower member of the Rustler. The well was drilled to a depth of 367 ft (112 m) bgs using compressed air as the drilling fluid. The interval from 367 to 616 ft (112 to 188 m) bgs (the total depth) was drilled using brine as the drilling fluid. WQSP-6 was drilled to 568 ft (173 m) 4-in.- (0.1-m) ft bgs using a 9⅞-in. drill bit and was cored from 568 to 616 ft (173 to 188 m) bgs using a 5¼-in. core bit to cut 4-in.- (0.1-m) diameter core. After coring, WQSP-6 was reamed to 9⅞ in. (0.3 m) in diameter to total depth of 616.6 ft (188 m) bgs. WQSP-6 was cased from the surface to 616.6 ft (188 m) bgs with 5-in. (0.1-m) (0.28-in. [0.7-cm] wall) blank fiberglass casing with in-line 5-in.- (0.1-m) diameter fiberglass 0.02-in. (0.1-cm) slotted screen across the Culebra interval from 581 to 606 ft (177 to 185 m) bgs. The annulus between the borehole wall and the casing/screen is packed with sand from 567 to 570 ft (173 to 173.7 m) bgs and with 8/16 Brady gravel from 570 to 616.6 ft (174 to 188 m) bgs. Based on core log results, the Culebra is located from 582 to 606.9 ft (177 to 185 m) bgs (see Figure L-15).

L-3b(1)(vii) WQSP-6A

Well WQSP-6A was drilled between October 31 and November 1, 1994, to a total depth of 225 ft (69 m) bgs. It is located immediately west of WQSP-6. The borehole was drilled through a water-producing zone in the Dewey Lake Redbeds that had been previously encountered while drilling well WQSP-6. The well was drilled to a depth of 225 ft (69 m) bgs using compressed air as the drilling fluid. The borehole was cleaned using air mist with a foaming agent. WQSP-6A was drilled to 160 ft (49 m) bgs using a 9⅞-in. drill bit and was cored from 160 to 220 ft (49 to 67 m) bgs using a 5¼-in. core bit to cut 4-in.- (0.1-m) diameter core. After coring, WQSP-6A was reamed to 9⅞ in. (0.3 m) in diameter to total depth of 225 ft (69 m) bgs. WQSP-6A was cased from the surface to 225 ft (69 m) bgs with 5-in. (0.1-m) (0.28-in. [0.7-cm] wall) blank fiberglass casing with in-line 5-in.- (0.1-m) diameter fiberglass 0.02-in. (0.1-cm) slotted screen from 190 to 215 ft (58 to 66 m) bgs. The annulus between the borehole wall and the casing/screen is packed with sand from 172 to 175 ft (52 to 53 m) bgs and with 8/16 Brady gravel from 175 to 225 ft (53 to 69 m) bgs (see Figure L-16).

L-4 Monitoring Program Description

The WIPP DMP has been designed to meet the ground-water monitoring requirements of 20.4.1.500 NMAC (incorporating 40 CFR §§264.90 through 264.101). The following sections of the monitoring plan specify the components of the DMP.

L-4a Monitoring Frequency

The seven RCRA monitoring wells have been sampled on a semiannual basis since their installation in 1995 to establish background ground-water quality in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §§264.97 and 264.98). This has included at least two full rounds of 20.4.1.500 NMAC (Incorporating 40 CFR §264) Appendix IX analysis for samples from each of the proposed RCRA detection monitoring wells. In addition, ground-water samples were collected from the DMP wells (from March 1997 until waste emplacement) at a frequency of four sample replicates collected semiannually from each well for the indicator parameters of pH, specific conductance (**SC**), total organic carbon (**TOC**), and total organic halogen (**TOX**) to further establish background ground-water quality until detection monitoring in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.98) becomes applicable. A total of four rounds of Appendix IX analysis will be conducted for samples from each well for use in background ground-water quality determinations.

Detection monitoring will start when the Permittees emplace waste and continue through the post-closure phase as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.90[c]). During detection monitoring, one sample and one sample duplicate will be collected semiannually from each well in the RCRA detection monitoring network. As shown in Table L-2, the DMP will continue to collect ground-water quality samples for all seven wells on a semiannual basis during the life of the DMP. 20.4.1.500 NMAC (incorporating 40 CFR §264.97[g][2]) provides that an alternate sampling frequency to that provided in 20.4.1.500 NMAC (incorporating 40 CFR §264.98) may be proposed by the Permittees. Given the nature and rate of ground-water flow in the area surrounding WIPP, collecting and analyzing one sample semiannually will be protective of human health and the environment because any hazardous constituent leaving the underground disposal facility will not have the potential to migrate beyond the ground-water monitoring network in a one-year time frame. Ground-water flow characteristics are presented in detail in Appendices D6 and E1 of the RCRA Part B Permit Application (DOE, 1997b).

Ground-water surface elevations will be monitored in each of the seven DMP wells on a monthly basis. The ground-water surface elevation in each DMP well will also be measured prior to each sampling event. Ground-water surface elevation measurements in the other existing WQSP well sites will also be monitored on a monthly basis to supplement the area water-level database and to help define regional changes in ground-water flow directions and gradients. The characteristics of the RCRA DMP (frequency, location) will be evaluated if significant changes are observed in the ground-water flow direction or gradient. If any change occurs which could affect the ability of the DMP to fulfill the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264 Subpart F), the Permittees shall promptly notify NMED in writing and apply for a permit modification, if appropriate.

L-4b Analytical Parameters

The analytes of interest measured to establish background ground-water quality prior to emplacement of waste include all indicator parameters and all other parameters listed in 20.4.1.500 NMAC (incorporating 40 CFR §264) Appendix IX. Field measurements of pH, SC, temperature, chloride, Eh, total iron, and alkalinity are also measured during background sampling .

The DMP will be initiated upon waste emplacement, at which time the semiannual samples will be analyzed for the parameters listed in Table L-3. This list includes the parameters of interest identified by the Permittees in the Waste Analysis Plan, Table C-3, of the RCRA Part B Permit Application (DOE, 1997b). Parameters to be analyzed by the contract laboratory such as specific conductance, total dissolved solids, total suspended solids, density, pH, total organic carbon, and total organic halogens were included as indicator parameters because of their universal commonality to ground water. Parameters such as chloride, alkalinity, calcium, magnesium, and potassium were included as matrix-specific general indicator parameters. Calcium, magnesium, potassium, chloride, and iron may be deleted during detection monitoring, with prior approval of NMED. Organic and inorganic compounds on the right hand side of Table L-3 were chosen because they will occur in the waste to be disposed at the WIPP facility. Additional parameters may be identified through the tentatively identified compound (**TIC**) process specified in the Waste Analysis Plan, Permit Attachment B. If compounds are identified, these will be added to the DMP list, unless the Permittees provide justification for their omission, and this omission is approved by NMED.

L-4c Ground-water Surface Elevation Measurement, Sample Collection and Laboratory Analysis

Ground-water surface elevations will be measured in each well prior to ground-water sample collection. Ground water will be extracted using serial and final sampling methods. Serial samples will be collected until ground-water field indicator parameters stabilize, after which the final sample for complete analysis will be collected. Final samples will then be analyzed for the DMP analytical suite.

L-4c(1) Ground-water Surface Elevation Monitoring Methodology

The WIPP ground-water level monitoring program (**WLMP**) is a subprogram of the DMP. The quality assurance activities of the WLMP are in strict accordance with WP 13-1, and the quality assurance implementing procedure specific to ground-water surface elevation monitoring is WIPP Procedure WP 02-EM1014[2]. Current versions of both WP 13-1 and WP 02-EM1014 are maintained in the WIPP Operating Record.

Ground-water surface elevation monitoring is in progress now and will continue through the post-closure care period specified in Permit Module VI. This section of the plan addresses the activities of the WLMP during the preoperational and operational phases of WIPP.

Collection of ground-water surface elevation data is required by 20.4.1.500 NMAC (incorporating 40 CFR §264.97(f)). These data also provide:

- Data collection as required by the Environmental Monitoring Plan.
- A means to fulfill commitments made in the Final Environmental Impact Statement (**FEIS**).
- A means to comply with future ground-water inventory and monitoring regulations.
- Input for making land use decisions, (i.e., designing long-term active and passive institutional controls for the site).
- Assistance in understanding any changes to readings from the water-pressure transducers installed in each of the shafts to monitor water conditions behind the liners.
- An understanding of whether or not the horizontal and vertical gradients of flow are changing over time.

The objective of the WLMP is to extend the documented record of ground-water surface elevation fluctuations in the Culebra and Magenta members of the Rustler in the vicinity of the WIPP facility and to meet the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.97(f)). Ground-water surface elevation data will be collected from each well of the RCRA DMP. Ground-water surface elevation data will also be collected from other Culebra wells, as well as monitoring wells completed in other water-bearing zones overlying and underlying the WIPP repository horizon (see Figure L-18) when access to those zones is possible. This includes, but is not limited to, the Bell Canyon, the Forty-niner, the contact zone between the Rustler and Salado, and the Dewey Lake.

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[2] WP 02-EM1014 "Groundwater Level Measurements" is a technical procedure that specifies the steps followed by Environmental Monitoring (**EM**) personnel for making manual ground-water level measurements in ground-water wells in the vicinity of the WIPP facility. The procedure provides general instructions including prerequisites, safety precautions, performance frequency, quality assurance, and records. Specific instructions are included for using the water level measurement electrical conductance probe and data management.

Ground-water surface elevation measurements will be taken monthly in at least one accessible completed interval at each available well pad. At well pads with two or more wells completed in the same interval, quarterly measurements will be taken in the redundant wells (well locations are shown in Figure L-18). Ground-water surface elevation measurements will be taken monthly at each of the seven DMP wells, as well as prior to each sampling event. If a cumulative ground-water surface elevation change of more than 2 feet is detected in any DMP well over the course of one year which is not attributable to site tests or natural stabilization of the site hydrologic system, the Permittees will notify NMED in writing and discuss the origin of the changes in the report specified in Permit Module V. Abnormal, unexplained changes in ground-water surface elevation may indicate changes in site recharge/discharge which could affect the assumptions regarding DMP well placement and constitute new information as specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.41(a)(2)).

Ground-water surface elevation monitoring will continue through the post-closure care period specified in Permit Module VI. The Permittees may temporarily increase the frequency of monitoring to effectively document naturally occurring or artificial perturbations that may be imposed on the hydrologic systems at any point in time. This will be conducted in selected key wells by increasing the frequency of the manual ground-water surface elevation measurements or by monitoring water pressures with the aid of electronic pressure transducers and remote data-logging systems. The Permittees will include such additional data in the reports specified in Section L-5.

Interpretation of ground-water surface elevation measurements and corresponding fluctuations over time is complicated at WIPP by spatial variation in fluid density both vertically in well bores and areally from well to well. To monitor the hydraulic gradients of the hydrologic flow systems at WIPP accurately, actual ground-water surface elevation measurements will be monitored at the frequencies specified in Table L-2, and the densities of the fluids in the well bores will be measure annually. When both of these parameters are known, equivalent freshwater heads will be calculated. The concept of freshwater head is discussed in Lusczynski (1961).

A discussion explaining the calculation of freshwater heads from mid-formation depth at WIPP can be found in Haug, et al. (1987). Freshwater heads are useful in identifying hydraulic gradients in aquifers of variable density such as those existing at the WIPP site. Freshwater head at a given point is defined as the height of a column of freshwater that will balance the existing pressure at that point (Lusczynski, 1961).

Measured ground-water surface elevation data can be converted to equivalent freshwater head from knowledge of the density of the borehole fluid, using the following formula.

$$p = \rho g h$$

where

p = freshwater head (pressure)
ρ = average specific gravity of the borehole fluid (unitless)
g = freshwater density (mass/volume)
h = fluid column height above the datum (length)

If the freshwater density is assumed to be 1.000 gram per cubic centimeter (g/cm3), then the equivalent freshwater head is equal to the fluid column height times the average borehole fluid density (expressed as specific gravity).

L-4c(1)(i) Field Methods and Data Collection Requirements

To obtain an accurate ground-water surface elevation measurement, a calibrated water-level measuring device will be lowered into a test well and the depth to water recorded from a known reference point. When using an electrical conductance probe, the depth to water will be determined by reading the appropriate measurement markings on the embossed measuring tape when the alarm is activated at the surface. WIPP Procedure WP 02-EM1014 specifies the methods to be used in obtaining groundwater-level measurements. A current revision of this procedure will be maintained in the WIPP Operating Record.

L-4c(1)(ii) Ground-water Surface Elevation Records and Document Control

All incoming data will be processed in a timely manner to assure data integrity. The data management process for ground-water surface elevation measurements will begin with completion of the field data sheets. Date, time, tape measurement, equipment identification number, calibration due date, initial of the field personnel, and equipment/comments will be recorded on the field data sheets. If, for some unexpected reason, a measurement is not possible (i.e., a test is under way that blocks entry to the well bore), then a notation as to why the measurement was not taken will be recorded in the comment column. Personnel will also use the comment column to report any security observations (i.e., well lock missing).

Data recorded on the field data sheets and submitted by field personnel will be subject to guidelines outlined in WIPP Procedures WP 02-EM3001[3] and WP 02-EM1014[4]. Current copies

[3] WP 02-EM3001 "Administrative Processes for Environmental Monitoring Programs" is a management control procedure to provide the administrative guidance to be used by Environmental Monitoring (EM) personnel to maintain quality control (QC) associated with EM sampling activities and to assure that data acquired under the WIPP Environmental Monitoring Program are valid. The precautions and limitations portion of this procedure assure that only qualified personnel acquire samples under the EM program, that cross contamination of sampling equipment is prevented, and that sample hold times are not exceeded. The Performance portion of the procedure provides step-by-step instructions for Quality Assurance/Quality Control (QA/QC) implementation, the use of data sheets and sample tracking logbooks, sample tacking from collection to submittal, and actions to take if sample results indicate the potential for exceeding a regulatory limit.

of these procedures are maintained within the WIPP Operating Record. These procedures specify the processes for administering and managing such data. The data will be entered onto a computerized work sheet. The work sheet will calculate ground-water surface elevation in both feet and meters relative to the top of the casing and also relative to mean sea level. The work sheet will also adjust ground-water surface elevations to equivalent freshwater heads.

A check print will be made of the work sheet printout. The check print will be used to verify that data taken in the field was properly reported on the database printout. A minimum of 10 percent of the spreadsheet calculations will be randomly verified on the check print to ensure that calculations are being performed correctly. If errors are found, the work sheet will be corrected. The data contained on the computerized work sheet will be translated into a database file. A printout will be made of the database file. The data each month will then be compiled into report format and transmitted to the appropriate agencies as requested by the Permittees. Ground-water surface elevation data and equivalent freshwater heads for all Culebra wells will be transmitted to NMED one month after data are collected.

A computerized database file will be maintained for all ground-water surface elevation data. Monthly and quarterly data will be appended into a yearly file. Upon verification that the yearly database is free of errors, it will be appended into the project database file. A printed copy of the current project database (through December of the preceding year) will be kept in the Environment, Safety and Health Department (**ES&H**) EM fire-resistant storage area.

L-4c(2) Ground-water Sampling

L-4c(2)(i) Ground-water Pumping and Sampling Systems

The water-bearing units at WIPP are highly variable in their ability to yield water to monitoring wells. The Culebra, the most transmissive hydrologic unit in the WIPP area, exhibits transmissivities that range many orders of magnitude across the site area and is the primary focus of the DMP.

The ground-water pumping and sampling systems used to collect a ground-water sample from the seven new DMP wells will provide continuous and adequate production of water so that a representative ground-water sample can be obtained. The wells used for ground-water quality sampling vary in yield, depth, and pumping lift. These factors affect the duration of pumping as well as the equipment required at each well.

The type of pumping and sampling system to be used in a well depends primarily on the aquifer characteristics of the Culebra and well construction. The DMP wells will be individually equipped with dedicated submersible pumping assemblies. Each well has a specific type of

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[4] WP 02-EM1014 “Groundwater Level Measurement”, is a technical procedure which lists the equipment required and the operational checks necessary to perform groundwater level measurements. This procedure as well as WP 02-EM3001 also provides information on performing validation and verification of laboratory data.

submersible pump, matched to the ability of the well to yield water during pumping. The down hole submersible pumps will be controlled by a variable electronic flow controller to match the production capacity of the formation at each well.

The electronic flow controller allows personnel collecting samples to control the rate of discharge during well purging to minimize the potential for loss of volatiles from the sample. As recommended in the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" (EPA, 1986) the wells will be purged a minimum of three well bore volumes at a rate that will minimize the agitation of recharge water. This will be accomplished by monitoring formation pressure and matching the rate of discharge from the well as nearly as possible to the rate of recharge to the well. WIPP Procedure WP 02-EM1002[5] specifies the methods used for controlling flow rates and monitoring formation pressure. A current version of this document will be maintained in the WIPP Operating Record. Well purging requirements will be used in conjunction with serial sampling to determine when the ground-water chemistry stabilizes and is therefore representative of undisturbed ground water.

The DMP wells will be cased and screened through the production interval with materials that do not yield contamination to the aquifer or allow the production interval to collapse under stress (high epoxy fiberglass). Details of well construction are presented in Section L-3b(1). An electric, submersible pump installation without the use of a packer will be used in this instance. The largest amount of discharge from the submersible pump will take place from a discharge pipe. In addition to this main discharge pipe a dedicated Teflon® sample line, running parallel to the discharge pipe, will also be used. Flow through the pipe will be regulated on the surface by a flow control valve and/or variable speed drive controller. Cumulative flow will be measured using a totalizing flow meter. Flow from the discharge pipe will be routed to a discharge tank for disposal.

The dedicated Teflon® sampling line will be used to collect the water sample that will undergo analysis. By using a dedicated Teflon® sample line, the water will not be contaminated by the metal discharge pipe. The sample line will branch from the main discharge pipe a few inches above the pump. Flow from the sample line will be routed into the sample collection area. Flow through the sample collection line will be regulated by a flow-control valve. The sample line will be insulated at the surface to minimize temperature fluctuations.

<u>Pressure Monitoring Systems</u>

The DMP wells do not require the installation of a packer because sample biases due to well construction deficiencies are not present. However, pressures will be monitored using down hole

[5] WP 02-EM1002 "Electric Submersible Pump Monitoring System Installation and Operation" is a technical procedure that provides step-by-step instructions for acquiring ground-water samples using electric submersible pumps (ESPs). The procedure addresses the equipment in general, lists precautions and limitations which assure that only qualified individuals operate the equipment, prerequisite actions which assure the correct installation and operation. The procedure details how to install the various subsystems such as the surface discharge and pressure monitoring system and the pressure monitoring bubbler and how to start up and shut down the ESP.

automatic air line bubblers in the formation to maintain the water level above the pump intake. Pressure transducers may be used in line with bubblers to provide continual electronic monitoring through data acquisition systems. WIPP Procedure WP 02-EM1002 provides instructions for monitoring formation pressure using automatic airline bubblers in conjunction with pressure transducers and data acquisition systems. A current version of this document will be maintained in the WIPP Operating Record.

The mobile field laboratory provides a work place for conducting field sampling and analyses. The laboratory will be positioned near the wellhead, will be climate controlled, and will contain the necessary equipment, reagents, glassware, and deionized water for conducting the various field analyses.

Sampling Overview

Two types of water samples will be collected: serial samples and final samples. Serial samples will be taken at regular intervals and analyzed in the mobile field laboratory for various physical and chemical parameters (called field indicator parameters). The serial sample data will be used to determine whether the sample is representative of undisturbed ground water as a direct function of the stabilization of field indicator parameters and the volume of the water being pumped from the well. Interpretation of the serial sampling data will enable the Team Leader (see Section L-7) to determine when conditions representative of undisturbed ground water are attained in the pumped ground water.

Final samples will be collected when the serially sampled field indicator parameters have stabilized and are therefore representative of undisturbed ground water.

L-4c(2)(ii) Serial Samples

Serial sampling is the collection of sequential samples for the purpose of determining when the ground-water chemistry stabilizes and is therefore representative of undisturbed ground water. The Permittees will consider a serial sample representative of undisturbed ground water when the majority of field indicator parameter measurements have stabilized within ±5 percent of the average of analytical results for the field indicator parameter from the background ground-water quality for each DMP well. Nonstabilization of one or two field indicator parameters attributable to matrix interferences, instrument drift, or other unforeseen reasons will not preclude the collection of final samples, provided the volume of purged water exceeds three well bore volumes. The Permittees will report, in the operating record, any final samples collected when field indicator parameters were not stabilized, and will provide an explanation of why the sample was collected when field indicator parameters were not stabilized.

Serial samples will be collected and analyzed to detect and monitor the chemical variation of the ground water as a function of the volume of water pumped. Once serial sampling begins, the frequency at which serial samples are collected and analyzed will be left to the discretion of the Team Leader (see Section L-7), but will be performed a minimum of three times during a sampling round.

The Permittees will use appropriate field methods to identify stabilization of the following field indicator parameters: chloride, divalent cations (hardness), alkalinity, total iron, pH, Eh, temperature, specific conductance, and specific gravity.

Protocols for collection of serial samples are specified in WIPP Procedure WP 02-EM1006[6]. Analysis of serial samples are specified in WIPP Procedure WP 02-EM1005[7]. Current versions of these procedures will be maintained in the WIPP Operating Record.

The three field indicator parameters of temperature, Eh, and pH will be determined by either an "in-line" technique, using a self-contained flow cell, or an "off-line" technique, in which the samples will be collected from a Teflon® sample line at atmospheric pressure. The iron, divalent cation, chloride, alkalinity, specific conductance, and specific gravity samples will be collected from the Teflon® sample line at atmospheric pressure. Because of the lack of sophisticated weights and measures equipment available for field density assessments, field density evaluations will be expressed in terms of specific gravity, which is a unitless measure. Density is expressed as unit weight per unit volume.

New polyethylene containers will be used to collect the serial samples from the Teflon® sample line. Serial sampling water collected for solute and specific conductance determinations will be filtered through a 0.45 micrometers (µm) membrane filter using a stainless-steel, in-line filter holder. Filtered water will be used to rinse the sample bottle prior to serial sample collection. Unfiltered ground water will be used when determining temperature, pH, Eh, and specific gravity. Sample bottles will be properly identified and labeled.

The filtered sample collected for solute analyses will be immediately analyzed for iron and alkalinity because these two solution parameters are extremely sensitive to changes in the ambient water-sample pressure and temperature. A sample and duplicate of filtered water will be collected and analyzed for solute parameters (alkalinity, chloride, divalent cations, and iron). Temperature, pH, and Eh, when not measured in a flow cell, will be measured at the approximate time of serial sample collection. These samples will be collected from the unfiltered sample line.

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[6] WP 02-EM1006 "Final Sample and Serial Sample Collection" is a technical procedure that provides step-by-step instructions for acquiring ground-water samples from the WQSP wells and from privately-owned wells in the vicinity of WIPP. The procedure addresses the equipment in general, lists precautions and limitations which assure that only qualified individuals operate the equipment, and prerequisite actions which assure the data quality. The procedure addresses collection of samples from private wells, collection of serial ground-water samples, the collection of final samples for submittal to the laboratory, and data review by the monitoring task leader.

[7] WP 02-EM1005 "Groundwater Serial Sample Analysis" is a technical procedure that provides step-by-step instructions for on site analysis of ground water to determine ground-water stability prior tot he collection of final samples for analysis. The procedure addresses the equipment in general, lists precautions and limitations which assure that only qualified individuals operate the equipment, prerequisite actions which assure data quality. The procedure addresses the field measurement of Eh, pH, temperature, specific gravity, specific conductance, alkalinity, chloride, divalent cation, and total iron as indicators of ground-water stability.

Samples to be analyzed for chloride and divalent cations (after preservation with nitric acid and stored at 4°C) may be stored for one week prior to analysis with confidence that the analytical results will not be altered.

Upon completion of the collection of the last serial sample suite, the serial sample bottles accrued throughout the duration of the pumping of the well will be discarded. No serial sample bottles will be reused for sampling purposes of any sort. However, serial samples may be stored for a period of time depending upon the need. WIPP Procedure WP 02-EM1006 defines the protocols for the collection of final and serial samples. WIPP Procedure WP 02-EM1005 defines the protocols for serial sample analysis. Current versions of these procedures will be maintained in the WIPP Operating Record.

During the first two years of DMP well serial sampling, the first sample will be analyzed as soon as possible after the pump is turned on and daily thereafter for a period of four days or until the field indicator parameters (chloride, divalent cations, alkalinity, and iron) stabilize. Eh, pH, and SC will be continually monitored by using a flow cell with ion-specific electrodes and a real-time readout. When detection monitoring begins, the serial sampling process may be modified and the decision to collect final samples would then be based on the number of well bore volumes purged and results of the analysis of chloride, temperature, specific gravity, pH, Eh, and SC. Removal of serial sampling from the DMP will be accomplished through a permit modification and a modification to this plan.

L-4c(2)(iii) Final Samples

The final sample will be collected once the measured field indicator parameters have stabilized (refer to Section L-4(c)(2)(ii)). A serial sample will also be collected and analyzed for each day of final sampling to ensure that samples collected for laboratory analysis are still representative of stable conditions. Sample preservation, handling, and transportation methods will maintain the integrity and representativeness of the final samples.

Prior to collecting the final samples, the collection team shall consider the analyses to be performed so that proper shipping or storage containers can be assembled. Table L-4 presents the sample containers, volumes, and holding times for laboratory samples collected as part of the DMP.

The monitoring system will use dedicated pumping systems and sample collection lines from the sampled formation to the well head. Non-dedicated sample collection lines from the well head to the sample collection area will be discarded after each use.

Sample integrity will be ensured through appropriate decontamination procedures. Laboratory glassware will be washed after each use with a solution of nonphosphorus detergent and deionized (**DI**) water and rinsed in DI water. Sample containers will be new, certified clean containers that will be discarded after one use. Ground-water surface elevation measurement devices will be rinsed with fresh water after each use. Non-dedicated sample collection manifold assemblies will be rinsed with two gallons of fresh water, then rinsed with five gallons of 5 percent nitric acid solution and rinsed with five gallons of DI water after each use. The exposed ends will be capped off during storage. Prior to the next use of the sampling manifold, it will be rinsed a second time with DI water and a blank rinsate sample will be collected to verify decontamination.

Water samples will be collected at atmospheric pressure using either the filtered or unfiltered Teflon® sampling lines branching from the main sample line. Detailed protocols, in the form of procedures, assure that final samples will be collected in a consistent and repeatable fashion. WIPP Procedure WP 02-EM1006 defines the requirements for collection of final samples for analyses. A current version of this procedure will be maintained in the WIPP Operating Record.

Final samples will be collected in the appropriate type of container for the specific analysis to be performed. The samples will be collected in new and unused glass and plastic containers (refer to Table L-4). For each parameter analyzed, a sufficient volume of sample will be collected to satisfy the volume requirements of the analytical laboratory (as specified by laboratory Standard Operating Procedures [**SOPs**]). This includes an additional volume of sample water necessary for maintaining quality control standards. All final samples will be treated, handled, and preserved as required for the specific type of analysis to be performed. Details about sample containers, preservation, and volumes required for individual types of analyses are found in the applicable procedures generated, approved, and maintained by the contract analytical laboratory.

Before the final sample is taken, all plastic and glass containers will be rinsed with the pumped ground water, either filtered or unfiltered, dependent upon analysis protocol. When the rinsing procedure is completed the final sample will be collected.

Final samples will be sent to contract laboratories and analyzed for general chemistry, radionuclides, metals, and selected VOCs that are specific to the waste anticipated to arrive at WIPP. Table L-3 presents the specific analytes for the DMP.

WIPP has not accepted TRU mixed waste for disposal prior to issuance of a hazardous waste disposal permit, and previous WQSP sample analyses have shown that requested hazardous constituents have not been introduced to the ground water in the vicinity of WIPP by other activities. Appendix D18, Attachment A, of the RCRA Part B Permit Application (DOE, 1997b) presented analytical data obtained from WQSP wells 1-6 which indicated that, for the Appendix IX parameters analyzed for, none of the anticipated waste constituents presented on Table L-3 were present in sampled ground water at WIPP.

Duplicates of the final sample will be provided to WIPP oversight agencies as requested by the Permittees or NMED.

Resulting wastes are disposed of in accordance with the WIPP Procedure WP 02-RC.01[8]. A current version of this procedure will be maintained in the WIPP Operating Record.

L-4c(2)(iv) Sample Preservation, Tracking, Packaging, and Transportation

Many of the chemical constituents measured by the DMP are not chemically stable and require preservation and special handling techniques. Samples requiring acidification will be treated with either high purity hydrochloric acid, nitric acid, or sulfuric acid (ULTREX or equivalent), depending upon the standard method of treatment required for the particular parameter suite or as requested by contract laboratory SOPs (see Table L-4).

The contract laboratory receiving the samples will use procedures that prescribe the type and amount of preservative, the container material type, and the required sample volumes that shall be collected. This information will be recorded on the Final Sample Checklist for use by field personnel when final samples are being collected. The Permittees will follow the EPA "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document," Table 4-1 (EPA, 1986), if laboratory SOPs do not specify sample container, volume, or preservation requirements.

The sample tracking system at WIPP will use uniquely numbered chain of custody (**CofC**) Forms and request for analysis (**RFA**) Forms. The primary consideration for storage or transportation is that samples shall be analyzed within the prescribed holding times for the parameters of interest. WIPP Procedure WP 02-EM3001 provides instructions to ensure proper sample tracking protocol. A current revision of this procedure will be maintained within the WIPP Operating Record.

Insulated shipping containers packaged with crushed ice or reusable ice packs will be used to keep the samples cool during transport to the contract laboratory. Holding times for specific analytical parameters require samples to be shipped by express air freight. The coolers will be packaged to meet Department of Transportation and International Air Transportation Association commercial carrier regulations.

L-4c(2)(v) Sample Documentation and Custody

To ensure the integrity of samples from the time of collection through reporting date, sample collection, handling, and custody shall be documented. Sample custody and documentation procedures for EM sampling and analysis activities are detailed in WIPP Procedure WP 02-EM3001. These procedures will be strictly followed throughout the course of each sample

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[8] WP 02-RC.01 "Site-Generated, Non-Radioactive Hazardous Waste Management Plan" is a step-by-step procedure that defines site-generate non-radioactive hazardous waste (SGNRHW) and lists responsibilities of waste management organizations including the generator, waste handlers, sampling personnel, safety personnel, and compliance personnel. In addition, the procedure defines training requirements, container marking requirements, spill response, and list prohibitions. A Section of the procedure is focused on waste management practices including the management in satellite accumulation areas, the hazardous waste staging area for materials awaiting analysis, the establishment of accumulation times, and hazardous waste disposal.

collection and analysis event. A current revision of this procedure will be maintained in the WIPP Operating Record.

Standardized forms used to document samples will include sample identification numbers, sample labels, custody tape, the sample tracking log books, and the request for analysis/chain of custody (RFA and CofC) form. The forms are briefly defined in the following subsections.

All sample documentation will be completed for each sample and reviewed by the Team Leader or his/her designee for completeness and accuracy.

Sample Numbers and Labels

A unique sample identification number will be assigned to each sample sent to the laboratory for analysis. The Team Leader (see Section L-7) will assign the numbers prior to sample collection. The sample identification numbers will be used to track the sample from the time of collection through data reporting. Every sample container sent to the laboratory for analysis will be identified with a label affixed to it. Sample label information will be completed in permanent, indelible ink and will contain the following information: sample identification number with sample matrix type; sample location; analysis requested; time and date of collection; preservative(s), if any; and the sampler's name or initials.

Custody Seals

Custody seals will be used to detect unauthorized sample tampering from collection through analysis. The custody seals will be adhesive-backed strips that are destroyed when removed or when the container is opened. The seal will be dated, initialed, and affixed to the sample container in such a manner that it is necessary to break the seal to open the container. Seals will be affixed to sample containers in the field immediately after collection. Upon receipt at the laboratory, the laboratory custodian will inspect the seal for integrity; a broken seal will invalidate the sample.

Sample Tracking Logbook

A sample tracking logbook (**STLB**) form will be completed for each sample collected. The STLB will include the following information: C of C number; RFA No.; date sample(s) were sent to the lab; laboratory name; acknowledgment of receipt or comments; well name and round number. Sample codes will indicate the well location; the geologic formation where the water was collected from, the sampling round number; and the sample number. The code is broken down as follows:

WQ6[1]C[2]R2[3]N1[4]

[1] Well identification (e.g., WQSP-6 in this case)
[2] Geologic formation (e.g., the Culebra in this case)
[3] Sample round no. (Round 2)
[4] Sample no. (N1)

To distinguish duplicate samples from other samples, a "D" is added as the last digit to signify a duplicate. STLB information will be completed in the field by the sampling team and checked by the Team Leader. When samples are shipped, the STLB will remain in the custody of the EM Section for sample tracking purposes.

Request for Analysis and Chain of Custody

An RFA and CofC form will be completed during or immediately following sample collection and will accompany the sample through analysis and disposal. An example of the RFA and CofC form is presented in Figures L-17a and L-17b. The RFA and CofC form will be signed and dated each time the sample custody is transferred. A sample will be considered to be in a person's custody if: the sample is in his/her physical possession; the sample is in his/her unobstructed view; and/or the sample is placed, by the last person in possession of it, in a secured area with restricted access. During shipment, the carrier's air bill number serves as custody verification. Upon receipt of the samples at the laboratory, the laboratory sample custodian acknowledges possession of the samples by signing and dating the RFA and CofC. The completed original (top page) of the RFA and CofC will be returned to the Team Leader with the laboratory analytical report and becomes part of the permanent record of the sampling event. The RFA and CofC form also contains specific instructions to the laboratory for sample analysis, potential hazards, and disposal instructions.

L-4c(3) Laboratory Analysis

Analysis of samples will be performed by a commercial laboratory. Methods will be specified in procurement documents and will be selected to be consistent with EPA recommended procedures in SW 846 (EPA, 1996). Additional detail on analytical techniques and methods will be given in laboratory SOPs. Table L-3 presents the analytical parameters for the WIPP DMP.

The Permittees will establish the criteria for laboratory selection, including the stipulation that the laboratory follow the procedures specified in SW 846 and that the laboratory follow EPA protocols. The selected laboratory shall demonstrate, through laboratory SOPs, that it will follow appropriate EPA SW 846 requirements and the requirements specified by the EPA protocols. The laboratory shall also provide documentation to the Permittees describing the sensitivity of laboratory instrumentation. This documentation will be retained in the facility operating record and will be available for review upon request by NMED. Instrumentation sensitivity needs to be considered because of regulatory requirements governing constituent concentrations in ground water and the complexity of brines associated with the WIPP repository.

Once the initial qualification criteria, as specified above, have been met, the Permittees will select a laboratory based upon competitive bid. The selected laboratory will perform analytical work for the Permittees for a predetermined period of time, as specified in the contract between the Permittees and the selected laboratory. As this period of performance comes to an end, a new laboratory selection/competitive bid process will be initiated by the Permittees. The same or a different laboratory may be selected for the new contract period. The SOPs for the laboratory currently under contract will be maintained in a file in the operating record by the Permittees.

The Permittees will provide NMED with an initial set of applicable laboratory SOPs for information purposes, and provide NMED with any updated SOPs on an annual basis.

Data validation will be performed on behalf of the Permittees by the Management and Operating Contractor (**MOC**) Environmental Monitoring (**EM**). Data validation results are documented on an Approval/Variation Request (**AR/VR**) form (Procedure WP 15-PC3041). If no discrepancies are found in the data, the AR/VR form will be signed and the approved box will be checked. If however, discrepancies are found, the AR/VR form will be signed and the disapproved or approved-on-condition box will be checked and the form will be returned to the team leader accompanied by an attached report discussing the data validation results, any anomalies, and resolutions. Copies of the data validation report will be distributed to the EM Manager, QA Manager, the Team Leader, and the Contract Administrator. Copies of the data validation report will be kept on file in the EM records section for review upon request by NMED.

L-4d Calibration

L-4d(1) Sampling Equipment Calibration Requirements

The equipment used to collect data for the WQSP and this DMP will be calibrated in accordance with maintenance administrative procedures specified below. The EM Section will be responsible for calibrating needed equipment on schedule, in accordance with written procedures. The EM Section will also be responsible for maintaining current calibration records for each piece of equipment.

L-4d(2) Ground-water Surface Elevation Monitoring Equipment Calibration Requirements

The equipment used in taking ground-water surface elevation measurements will be maintained in accordance with WIPP Procedure WP 10-AD3029[9] A current revision of this procedure will be maintained in the WIPP Operating Record. The EM Section will be responsible for calibrating the needed equipment on schedule in accordance with written procedures. The EM Section will also be responsible for maintaining current calibration records for each piece of equipment.

L-4e Statistical Analysis of Laboratory Data

As required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.97 and 264.98), data collected to establish background ground-water quality and as part of the DMP will be evaluated using appropriate statistical techniques. The following specifies the statistical analysis to be performed

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[9] WP 10-AD3029 "Calibration and Control of Monitoring and Data Collection Equipment" provides the step-by-step protocols for the establishment and maintenance of a master database of monitoring and data collection (**M&DC**) equipment, the recall process for equipment needing calibration, the performance of calibrations, the management of calibration results to determine the adequacy of recall frequencies, functional testing of M&DC equipment, and reporting including out-of-tolerance reporting and expired calibration reporting. In addition, the procedure provides step-by-step process for the storage of calibrated M&DC equipment and the use of rental equipment.

by the DMP. Statistical analysis of DMP data will conform to EPA guidance "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities" (EPA, 1989) and "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance" (EPA, 1992).

L-4e(1) Temporal and Spatial Analysis

Environmental parameters vary with space and time. The effect of one or both of these two factors on the expected value of a point measurement will be statistically evaluated through spatial analysis and time series analysis. These methods often require extensive sampling efforts that may exceed the practical limits of the DMP sampling procedures.

Spatial analysis may have limited use DMP during the operational period, although the effect of spatial auto-correlation on the interpretation of the data will be considered for each parameter. Spatial variability will be accounted for by the use of predetermined key sampling locations. Data analysis will be performed on a location-specific basis, or data from different locations will be combined only when the data are statistically homogeneous. Statistical homogeneity will be determined by evaluating mean values and variances from the residuals from the individual well data.

Time series analysis plays a more important role in data analysis for the DMP. Parameters will be reported as time series, either in tabular form or as time plots. For key time series parameters, these plots will be in the form of control charts on which control levels will be identified based on preoperational database, fixed standards, control location databases, or other standards for comparison. Where significant seasonal changes in the expected value of the parameter are identified in the preoperational database or in the control locations, corrections in the control levels which reflect the seasonal change will be made and documented.

L-4e(2) Distributions and Descriptive Statistics

For data sets which include more than ten data points that are homogeneous in space and time (including seasonal homogeneity) and have less than ten percent missing data, a test for conformance to the normal distribution will be performed. The test for normality of the data will be performed in accordance with the methodologies presented in "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance" (EPA, 1992).

If normality is not met, the data will be log-transformed (or transformed using a suitable mathematical transformation, e.g., square root) and retested for normality. If the transformed data fit a normal distribution, the original data will be accepted as having lognormal or an otherwise mathematically-transformed normal distribution. If normality is still not found, two courses may be taken. One will be to continue to test the fit to standard families of distributions, such as the gamma, beta, and Weibull, with proper modifications to subsequent analyses based on these results. The other course will be to use nonparametric methods of data analysis.

For data sets smaller than ten, but homogeneous and complete, the lognormal distribution will be assumed. Data sets with more than ten percent missing data will be analyzed using nonparametric methods. Nonhomogeneous data sets will be subdivided into homogeneous sets and each of these analyzed individually.

Descriptive statistics will be calculated for each homogeneous data set. At a minimum, these include a central value and a range of variation. The central value is the arithmetic mean of the untransformed data if the data are not censored at either end. If the data are censored, either a trimmed mean or the median will be used as the central value (which may be within the censored range). If the data set is greater than ten and is uncensored, the standard deviation will be calculated and used as a basis for the reported range in variation. If these criteria are not met, the range between the 0.25 and 0.75 cartelist will be used.

L-4e(3) Data Anomalies

Data anomalies include data points reported as being below the limit of detection (**LD**) or otherwise censored over a specific range of values, missing data points occurring randomly in the data set, and outliers that cannot be ascribed to a known source of variation.

Whenever possible, sample values which are reported below detection limits will be incorporated into the database as sample values measured at one-half the detection limit for statistical analysis. When values are not available, alternative methods of analysis, as specified in previous sections, will be used. In particular, the use of nonparametric statistics will be required.

Missing data points comprising less than 10 percent of the data set do not significantly affect data analyses. Results based on data in which more than 10 percent is missing will be identified as such at the time of reporting. Consideration of the potential effect of missing data shall be made when the majority of the data are missing from a discrete time span.

Formal testing for outliers will only be done in accordance with EPA guidance. The methodologies specified in Section 8.2 of the "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities" (EPA, 1989) will be used to check for outliers.

If an outside source of variation is not identified to account for outliers in a data set, it will be included in the data set and all subsequent analyses. If the inclusion of such outliers is found to affect the final results of the analyses significantly, both results (with and without outliers) will be reported.

L-4e(4) Comparisons and Reporting

Prior to waste receipt, measurements will have been made of each background ground-water quality parameter and constituent specified in Table L-3 at every DMP ground-water monitoring well during each of the four background sampling events. If any background ground-water quality parameter or constituent has not been measured prior to waste receipt, measurements will be made for those parameters or constituents in hydraulically upgradient DMP ground-water monitoring wells for a sequence of four sampling events. Following completion of the four sampling events, the arithmetic mean and variance shall then be calculated by the field supervisor or designee for each well. These measurements will then serve as a background value against which statistical values for subsequent sampling events during detection monitoring will be compared. Statistical analysis and comparison will be accomplished using one of the five statistical tests specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.98(h)), which may include Cochran's Approximation to the Behrens-Fisher students' t-test at the 0.01 level of significance (described in Appendix IV to 20.4.1.500 NMAC (incorporating 40 CFR §264). If the comparisons show a significant increase at any monitoring site (as defined in 20.4.1.500 NMAC (incorporating 40 CFR §264.98(f)), the well shall be resampled and an analysis performed as soon as possible, in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.98(g)(2)). The results of the statistical comparison will be reported annually in the Annual Site Environmental Report (**ASER**), and will be reported to NMED as required under 20.4.1.500 NMAC (incorporating 40 CFR §264.98(g)).

L-5 Reporting

L-5a Laboratory Data Reports

Laboratory data will be provided in electronic and hard copy reports to the Permittees. Laboratory data reports will be forwarded to the Team Leader (see Section L-7) and NMED and will contain the following information for each analytical report:

- A brief narrative summarizing laboratory analyses performed, date of issue, deviations from the analytical method, technical problems affecting data quality, laboratory quality checks, corrective actions (if any), and the project manager's signature approving issuance of the data report.
- Header information for each analytical data summary sheet including: sample number and corresponding laboratory identification number; sample matrix; date of collection, receipt, preparation and analysis; and analyst's name.
- Analytical parameter, analytical result, reporting units, reporting limit, analytical method used.
- Results of QC sample analyses for all concurrently analyzed QC samples.

All analytical results will be provided to NMED.

L-5b Statistical Analysis and Reporting of Results

Analytical results from semi-annual ground-water sampling activities will be compared and interpreted by the Team Leader through generation of statistical analyses as specified in Section L-4e. The Team Leader will perform statistical analyses; the results will be included in the ASER in summary form, and will also be provided to NMED as specified in Permit Module V.

L-5c Annual Site Environmental Report

Data collected from this DMP will be reported to NMED as specified in Permit Module V, and to the EM Manager and NMED in the ASER. The ASER will include all applicable information that may affect the comparison of background ground-water quality and ground-water surface elevation data through time. This information will include but is not limited to:

- Well configuration changes that may have occurred from the time of the last measurement (i.e., plug installation and removal, packer removal and reinstallation, or both; and the type and quantity of fluids that may have been introduced into the test wells).
- Any pumping activities that may have taken place since publication of the last annual report (i.e., ground-water quality sampling, hydraulic testing, and shaft installation or grouting activities).
- Radionuclide-specific data collected during the previous year.

The DMP data used in generating the ASER will be maintained as part of the WIPP operating record and will be provided to NMED for review as specified in the permit.

L-6 Records Management

Records generated during ground-water sampling and ground-water surface elevation monitoring events will be maintained in the form project files in the EM section. Project records will include, but are not limited to:

- Sampling and Analysis Plans (**SAP**)
- SOPs
- STLBs
- RFA and CofC forms
- Contract Analytical Laboratory Data Reports
- Variance Logs and Nonconformance Reports
- Corrective Action Reports.

These and all raw analytical records generated in conjunction with ground-water sampling and ground-water surface elevation monitoring will be stored in fire resistant cabinets in the EM section according to the Records Inventory and Disposition Schedule (**RIDS**) and will be made available for inspection upon request. The following records will be transmitted to the Permittees' Project Records Services (**PRS**) for long-term storage in accordance with the RIDS:

- Instrument maintenance and calibration records
- QC sample data
- Control charts and calculation

- Sample tracking and control documentation
- Raw analytical results.

L-7 Project Organization and Responsibilities

L-7a Environmental Monitoring Manager

The EM Manager will be responsible for the overall design and implementation of the DMP. The EM Manager will develop and approve specific procedures all DMP activities, and will review and approve programmatic reports. The EM Manager will provide oversight of appropriate levels of cooperation and consultation between the EM Section and the State of New Mexico regarding environmental monitoring and will revise the QA section of the DMP, if necessary, and submit revisions as permit modifications as specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.42).

The EM Manager and staff will be responsible for achieving and maintaining quality in the DMP. All DMP data will be reviewed and approved by the EM Manager, or designee, prior to release.

The EM Manager will establish minimum qualification criteria and training requirements for all DMP personnel. The EM Manager will assure that position descriptions for assigned DMP personnel are adequately prepared. The EM Manager and/or Team Leader will assure that training is performed on an individual basis to maintain an acceptable level of proficiency by all new or temporary DMP staff and by all permanent GWSP staff. The EM Manager will assure that documents detailing all staff training are current and properly filed. Copies of training records will be on file for the Permittees in the MOC Technical Training Section.

The EM Manager will appoint a DMP Team Leader and Field Team, and assign the following responsibilities specified below.

L-7b Team Leader

The Team Leader will coordinate and oversee field sampling activities, ensuring that sampling and associated procedures will be followed and that QA/QC and safety guidelines will be met. The Team Leader will direct the DMP per written approved procedures, and initiate the review of programmatic plans and procedures. The Team Leader will review and evaluate sample data, prepare and review programmatic reports, and assure that appropriate samples will be collected and analyzed. The Team Leader will assure that adequate technical support is provided to the Quality Assurance (**QA**) Department, when required during audits of vendor facilities. Any nonconformances or project changes will be immediately communicated to the Team Leader.

L-7c Field Team

The field team members will consist of one or more scientists, engineers, or technicians, who will be responsible for sample collection, handling, shipping, and preparation and maintenance of appropriate data sheets, and completion of sample tracking documentation under the direction of the Team Leader, in accordance with this DMP and associated field procedures. The field team will inspect, maintain, and ensure proper calibration of equipment prior to use at each site, while ensuring that site health and safety requirements will be met at all times. The field team will communicate any nonconformances, malfunctions, or project changes to the Team Leader immediately.

L-7d Safety Manager

The Safety Manager will be responsible for ensuring that the necessary requirements for the health and safety of personnel associated with sampling and analysis activities are met. The cognizant manager will be responsible for ensuring that field team members operate in a safe manner and personnel have appropriate training. The Safety Manager will ensure that periodic health and safety assessments are conducted and that the cognizant manager will initiate corrective actions where deficiencies are identified.

L-7e Analytical Laboratory Management

Sample collection containers supplied by the laboratory will be certified as clean by either the laboratory or their supplier. The Permittees will supply containers for radiological samples. The analytical laboratory will be responsible for performing analyses in accordance with this DMP Plan and regulatory requirements. The laboratory will maintain documentation of sample handling and custody, analytical results, and internal QC data. Additionally, the laboratory will analyze QC samples in accordance with this plan and its own internal QC program for indicators of analytical accuracy and precision. Data generated outside laboratory acceptance limits will trigger an investigation and, if appropriate, corrective action, as directed by the EM Manager. The laboratory will report the results of the environmental sample and QC sample analyses and any necessary corrective actions that were performed. In the event that more than one analytical laboratory is used (e.g., for different analyses), each one will have the responsibilities specified above.

L-7f Quality Assurance (QA) Manager

The QA Manager will provide independent oversight of the DMP, via the assigned cognizant QA engineer, to verify that quality objectives are defined and achieved. The QA Manager will ensure objective, independent assessments of the DMP quality performance and the quality performance of the contract analytical laboratory. The QA Manager has been delegated authority on behalf of the Permittees by the MOC General Manager and will have access to work areas, identify quality problems, initiate or recommend corrective actions, verify implementation of corrective actions, and ensure that work will be controlled or stopped until adequate disposition of an unsatisfactory condition has been implemented.

L-8 Quality Assurance Requirements

Specific Quality Assurance (**QA**) requirements for WIPP are defined in WIPP document WP 13-1. A current revision of this document will be maintained in the WIPP Operating Record. Requirements specific to the DMP are presented in this section.

L-8a QA Program—Overview

The QA program was developed to assure that integrity and quality will be maintained for all samples collected and that equipment and records will be maintained in accordance with EPA guidance. The QA Program identifies data quality objectives (**DQO**), processes for assuring sample quality, and processes for generating and maintaining quality records.

L-8b DQOs

DQOs are qualitative and quantitative statements that specify the quality of data required to support project decisions. DQOs will be established to ensure that the data collected will be of a sufficient and known quality for their intended uses. The overall DQO for this project will be to collect accurate and defensible data of known quality that will be sufficient to assess the concentrations of constituents in the ground water underlying the WIPP area. The data generated thus far by the DMP has been used to establish background ground-water quality. For the purpose of this DMP, DQOs for measurement data will be specified in terms of accuracy, precision, completeness, representativeness, and comparability. Measurements of data quality in terms of accuracy and precision will be derived from the analysis of QC samples generated in the field and laboratory. Appropriate QC procedures will be used so that known and acceptable levels of accuracy and precision will be maintained for each data set. This section defines the acceptance criteria for each QC analysis performed. The following subsections define each DQO.

L-8b(1) Accuracy

Accuracy is the closeness of agreement between a measurement and an accepted reference value. When applied to a set of observed values, accuracy is a combination of a random component and a common systematic error (bias) component. Measurements for accuracy will include analysis of calibration standards, laboratory control samples, matrix spike samples, and surrogate spike samples. The bias component of accuracy is expressed as percent recovery (%R). Percent recovery is expressed as follows:

$$\%R = \frac{(measured\ sample\ concentration)}{true\ concentration} \times 100$$

L-8b(1)(i) Accuracy Objectives for Field Measurements

Field measurements will include pH, SC, temperature, Eh, and static ground-water surface elevation. Field measurement accuracy will be determined using calibration check standards.

Thermometers used for field measurements will be calibrated to the National Institute for Standards and Technology (**NIST**) traceable standard on an annual basis to assure accuracy. Accuracy of ground-water surface elevation measurements will be checked before each measurement period by verifying calibration of the device within the specified schedule. WIPP document WP 13-1 outlines the basic requirements for field equipment use and calibration. WIPP Procedure WP 10-AD3029 contains instructions that outline protocols for maintaining current calibration of ground-water surface elevation measurement instrumentation. A current revision of this document or procedure will be maintained in the WIPP Operating Record.

L-8b(1)(ii) Accuracy Objectives for Laboratory Measurements

Analytical system accuracy will be quantified using the following laboratory accuracy QC checks: calibration standards, laboratory control samples (**LCS**), laboratory blanks, matrix and surrogate spike samples. Single LCSs and matrix spike and surrogate spike sample analyses will be expressed as %R. Laboratory analytical accuracy is parameter dependent and will be prescribed in the laboratory SOP.

L-8b(2) Precision

Precision is the agreement among a set of replicate measurements without assumption or knowledge of the true value. Precision data will be derived from duplicate field and laboratory measurements. Precision will be expressed as relative percent difference (**RPD**), which is calculated as follows:

$$RPD = \frac{\left|\left(measured\ value\ sample\ 1 - measured\ value\ sample\ 2\right)\right|}{average\ of\ \ measured\ samples\ 1+2} \times 100$$

L-8b(2)(i) Precision Objectives for Field Measurements

Precision of field measurements of water-quality parameters will meet or exceed required reporting levels. SC, pH, temperature, and optionally Eh will be measured during well purging and after sampling. SC measurements will be precise to ±10% pH to 0.10 standard unit, and temperature to 0.10 degrees Celsius (°C), Eh to 10 millivolts (mV).

L-8b(2)(ii) Precision Objectives for Laboratory Measurements

Precision of laboratory analyses will be assessed by performing the same analyses twice on LCSs with each analytical batch assessed at a minimum frequency of 1 in 20 ground-water samples for nonradiological parameters and 1 in 10 for radiological parameters. The laboratory will determine analytical precision control limits by performing replicate analyses of control samples. Precision measurements will be expressed as RPD. Laboratory analytical precision is also parameter dependent and will be prescribed in laboratory SOPs.

L-8b(3) Contamination

In addition to measurements of precision and bias, QC checks for contamination will be performed. QC samples including trip blanks, field blanks, and method blanks will be analyzed to assess and document contamination attributable to sample collection equipment, sample handling and shipping, and laboratory reagents and glassware. Trip blanks will be used to assess volatile organic compound (**VOC**) sample contamination during shipment and handling and will be collected and analyzed at a frequency of 1 sample per sample shipment. Field blanks will be used to assess field sample collection methods and will be collected and analyzed at a minimum frequency of one sample per 20 samples (five percent of the samples collected). Method blanks will be used to assess contamination resulting from the analytical process and will be analyzed at a minimum frequency of one sample per 20 samples, or five percent of the samples collected. Evaluation of sample blanks will be performed following U.S. EPA "National Functional Guidelines for Organic Data Review" (EPA, 1991) and "Functional Guidelines for Evaluating Inorganics Analyses" (EPA, 1988). Only method blanks will be analyzed via wet chemistry methods. The criteria for evaluating method blanks will be established as follows: If method blank results exceed reporting limits, then that value will become the detection limit for the sample batch. Detection of analytes of interest in blank samples may be used to disqualify some samples, requiring resampling and additional analyses on a case-by-case basis.

L-8b(4) Completeness

Completeness is a measure of the amount of usable valid data resulting from a data collection activity, given the sample design and analysis. Completeness may be affected by unexpected conditions that may occur during the data collection process.

Occurrences that reduce the amount of data collected include sample container breakage in the laboratory and data generated while the laboratory was operating outside prescribed QC limits. All attempts will be made to minimize data loss and to recover lost data whenever possible. The completeness objective for noncritical measurements (i.e., field measurements) will be 90 percent and 100 percent for critical measurements (i.e., compliance data). If the completeness objective is not met, the WIPP EM Manager will determine on behalf of the Permittees the need for resampling on a case-by-case basis. Numerical expression of the completeness (**%C**) of data is as follows:

$$\%C = \frac{number\ of\ accepted\ samples}{total\ number\ of\ samples\ collected} \times 100$$

L-8b(5) Representativeness

Representativeness is the degree to which sample analyses accurately and precisely represent the media they are intended to represent. Data representativeness for this DMP will be accomplished through implementing approved sampling procedures and the use of validated analytical methods. Sampling procedures will be designed to minimize factors affecting the integrity of the samples. Ground-water samples will only be collected after well purging criteria have been met. The analytical methods selected will be those that will most accurately and precisely represent the true concentration of analytes of interest.

L-8b(6) Comparability

Comparability is the extent to which one data set can be compared to another. Comparability will be achieved through reporting data in consistent units and collection and analysis of samples using consistent methodology. Aqueous samples will consistently be reported in units of measures dictated by the analytical method. Units of measure include:

- Milligrams per liter (mg/L) for alkalinity, inorganic compounds and metals
- Micrograms per liter (µg/L) for VOCs.

Ground-water surface elevation measurements will be expressed as equivalent freshwater elevation in feet above mean sea level.

L-8c Design Control

The ground-water monitoring system was designed and will be maintained to meet specifications established in 20.4.1.500 NMAC (incorporating 40 CFR §§264 Subpart F and 264.601 through 264.603).

L-8d Instructions, Procedures, and Drawings

Provisions and responsibilities for the preparation and use of instructions and procedures at WIPP are outlined in WIPP document WP 13-1. Any activities performed for ground-water monitoring that may affect ground water will be performed in accordance with documented and approved procedures which comply with the Permit and the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264 Subpart F).

Technical procedures, as specified elsewhere in this DMP, have been developed for each quality-affecting function performed for ground-water monitoring. The technical procedures unique to the DMP will be controlled by the ES&H at WIPP. The procedures are sufficiently detailed and include, when applicable, quantitative or qualitative acceptance criteria.

Procedures were prepared in accordance with requirements in WIPP document WP 13-1. A current revision of this document will be maintained in the WIPP Operating Record.

L-8e Document Control

Document controls will ensure that the latest approved versions of procedures will be used in performing ground-water monitoring functions and that obsolete materials will be removed from work areas.

L-8f Control of Work Processes

Process control requirements, defined in WIPP document WP 13-1 are met, and will continue to be met, for this DMP. A current revision of this document will be maintained in the WIPP Operating Record.

L-8g Inspection and Surveillance

Inspection and surveillance activities will be conducted as outlined in WIPP document WP 13-1. The QA Department will be responsible for performing the applicable inspections and surveillance on the scope of work. EM section personnel will be responsible for performance checks as defined in applicable procedures and determined for the Permittees by MOC metrology laboratory personnel. Performance checks for the DMP will determine the acceptability of purchased items and assess degradation that occurs during use. A current revision of this document will be maintained in the WIPP Operating Record.

L-8h Control of Monitoring and Data Collection Equipment

WIPP document WP 13-1 outlines the basic requirements for control and calibrating monitoring and data collection (**M&DC**). M&DC equipment shall be properly controlled, calibrated, and maintained according to WIPP Procedure WP 10-AD3029 to ensure continued accuracy of ground-water monitoring data. Results of calibrations, maintenance, and repair will be documented. Calibration records will identify the reference standard and the relationship to national standards or nationally accepted measurement systems. Records will be maintained to track uses of M&DC equipment. If M&DC equipment is found to be out of tolerance, the equipment will be tagged and it will not be used until corrections are made. A current revision of this document or procedure will be maintained in the WIPP Operating Record.

L-8i Control of Nonconforming Conditions

WIPP document WP 13-1 specifies the system used at WIPP for ensuring that appropriate measures are established to control nonconforming conditions. Nonconforming conditions connected to the DMP will be identified in and controlled by documented procedures. Equipment that does not conform to specified requirements will be controlled to prevent use. The disposition of defective items will be documented on records traceable to the affected items. Prior to final disposition, faulty items will be tagged and segregated. Repaired equipment will be subject to the original acceptance inspections and tests prior to use. A current revision of this document will be maintained in the WIPP Operating Record.

L-8j Corrective Action

Requirements for the development and implementation of a system to determine, document, and initiate appropriate corrective actions after encountering conditions adverse to quality at WIPP are outlined in WIPP document WP 13-1. Conditions adverse to acceptable quality will be documented and reported in accordance with corrective action procedures and corrected as soon as practical. Immediate action will be taken to control work performed under conditions adverse to acceptable quality and its results to prevent quality degradation. A current revision of this document will be maintained in the WIPP Operating Record.

L-8k Quality Assurance Records

WIPP document WP 13-1 outlines the policy that will be used at WIPP regarding identification, preparation, collection, storage, maintenance, disposition, and permanent storage of QA records. A current revision of this document will be maintained in the WIPP Operating Record.

Records to be generated in the DMP will be specified by procedure. QA and RCRA operating records will be identified. This will be the basis for the labeling of records as "QA" or "RCRA operating" on the EM RIDS.

QA records will document the results of the DMP implementing procedures and will be sufficient to demonstrate that all quality-related aspects are valid. The records will be identifiable, legible, and retrievable.

L-9 References

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TABLES

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TABLE L-1
HYDROLOGICAL PARAMETERS FOR ROCK UNITS ABOVE THE SALADO AT WIPP

Unit		Hydraulic Conductivity	Storage Coefficient	Transmissivity	Permeability	Thickness	Hydraulic Gradient
Santa Rosa		2×10^{-8} to 2×10^{-6} m/s (1) (2)	Specific capacity 0.029 to 0.041 ℓ/s/m	6×10^{-7} to 6×10^{-5} m^2/s (3)	10^{-10} m^2	0 to 91 m	0.001 (5)
Dewey Lake		10^{-8} m/s	Specific storage 1×10^{-5} (1/m) (2)	2.8×10^{-6} to 2.8×10^{-4} m^2/s (4)	5.01×10^{-17} m^2	152 m	0.001 (5)
	Forty-niner	1×10^{-13} to 1×10^{-11} m/s (anhydrite) 1×10^{-9} m/s (mudstone) (2)	Specific storage 1×10^{-5} (1/m) (2)	8×10^{-8} to 8×10^{-9} m^2/s	0 m^2	13 to 23 m	NA (6)
	Magenta	$1 \times 10^{-8.5}$ to $1 \times 10^{-6.5}$ m/s (2)	Specific storage 1×10^{-5} (1/m) (2)	4×10^{-4} to 1×10^{-9} m^2/s	6.31×10^{-14} m^2	7 to 8.5 m	3 to 6
Rustler	Tamarisk	1×10^{-13} to 1×10^{-11} m/s (anhydrite) 1×10^{-9} m/s (mudstone) (2)	Specific storage 1×10^{-5} (1/m) (2)	$<2.7 \times 10^{-11}$ m^2/s	0 m^2	26 to 56 m	NA (6)
	Culebra	$1 \times 10^{-7.5}$ to $1 \times 10^{-5.5}$ m/s (2)	Specific storage 1×10^{-5} (1/m) (2)	1×10^{-3} to 1×10^{-9} m^2/s	2.1×10^{-14} m^2	4 to 11.6 m	0.003 to 0.007 (5)
	Unnamed lower member	6×10^{-15} to 1×10^{-13} m/s 1.5×10^{-11} to 1.2×10^{-11} m/s (basal interval)	Specific storage 1×10^{-5} (1/m) (2)	2.9×10^{-10} to 2.2×10^{-13} m^2/s 2.9×10^{-10} to 2.4×10^{-10} m^2/s (basal interval)	0 m^2	29 to 38 m	NA (6)

Matrix characteristics relevant to fluid flow include values used in this table such as permeability, hydraulic conductivity, gradient, etc.)

Table Notes:

(1) The Santa Rosa Formation is not present in the western portion of the WIPP site. It was combined with the Dewey Lake Red Beds in three-dimensional regional groundwater flow modeling (Corbet and Knupp, 1996), and the range of values entered here are those used in that study for the Dewey Lake/Triassic hydrostratigraphic unit.

(2) Values or ranges of values given for these entries are the values used in three-dimensional regional groundwater flow modeling (Corbet and Knupp, 1996). Values are estimated based on literature values for similar rock types, adjusted to be consistent with site-specific data where available. Ranges of values include spatial variation over the WIPP site and differences in values used in different simulations to test model sensitivity to the parameter.

(3) The range of values given here for transmissivity of the Santa Rosa is estimated for the center of the site. Transmissivity is the product of the thickness of the productive interval times its hydraulic conductivity.

Thickness of the Santa Rosa is estimated to be 30 meters at the center of the WIPP site, and the range of derived transmissivities are based on the range of hydraulic conductivity values used by Corbet and Knupp (1996) for the combined Dewey Lake/Triassic unit.

(4) The range of values given here by transmissivity of the Dewey Lake is estimated for the center of the site. Transmissivity is the product of the thickness of the productive interval times its hydraulic conductivity. Thickness of the Dewey Lake is estimated to be 140 meters at the center of the WIPP site, and the range of derived transmissivities are based on the range of hydraulic conductivity values used by Corbet and Knupp (1996) for the combined Dewey Lake/Triassic unit.

(5) Hydraulic gradient is a dimensionless term describing change in the elevation of hydraulic head divided by change in horizontal distance. Values given in these entries are determined from potentiometric surfaces. The range of values given for the Culebra reflects the highest and lowest gradients observed within the WIPP site boundary. Values for the Dewey Lake and Santa Rosa are assumed to be the same as the gradient determined from the water table. Note that the Santa Rosa Formation is absent or above the water table in most of the controlled area, and that the concept of a horizontal hydraulic gradient is not meaningful for these regions.

(6) Flow in units of very low hydraulic conductivity is slow, and primarily vertical. The concept of a horizontal hydraulic gradient is not applicable.

Sources: Beauheim, 1986; Domenico and Schwartz, 1990; Domski, Upton, and Beauheim, 1996; Earlough, 1977.

TABLE L-2
WIPP GROUND-WATER DETECTION MONITORING PROGRAM SAMPLE COLLECTION AND GROUND-WATER SURFACE ELEVATION MEASUREMENT FREQUENCY

Installation	Frequency
Ground-water Quality Sampling	
DMP monitoring wells	Semiannually
All other WIPP surveillance wells	On special request only
Ground-water Surface Elevation Monitoring	
DMP monitoring wells	Monthly and prior to sampling events
All other WIPP surveillance well sites	Monthly
Redundant wells at all other WIPP surveillance well sites	Quarterly

TABLE L-3
ANALYTICAL PARAMETER LIST FOR THE WIPP DETECTION MONITORING PROGRAM

Background Ground-water Quality	**Operational Detection Monitoring Ground-water Quality**
<u>Indicator Parameters</u> pH, SC, TOC, TOH, TDS, TSS, density <u>Parameters Listed in</u> 20.4.1.500 NMAC (incorporating 40 CFR §264) Appendix IX, Calcium, Magnesium, Potassium <u>Field Analyses</u> pH, SC, temperature, chloride, Eh, alkalinity, total Fe, specific gravity	<u>Indicator Parameters</u> pH, SC, TOC, TOH, TDS, TSS, density <u>Organic Parameters</u> Chloroform 1,2-dichloroethane Carbon tetrachloride Chlorobenzene 1,1-dichloroethylene 1,1-dichloroethane Methylene chloride 1,1,2,2-tetrachloroethane Toluene 1,1,1-trichloroethane Cresols; 1,4-dichlorobenzene 1,2-dichlorobenzene; cis-1,2-dichloroethylene trans-1,2-dichloroethylene 2,4-dinitrophenol; 2,4-dinitrotoluene Hexachloroethane; Hexachlorobenzene Isobutanol; Methyl ethyl ketone Pentachlorophenol Pyridine; Tetrachloroethylene 1,1,2 Trichloroethane; Trichloroethylene Trichlorofluoromethane; Xylenes Nitrobenzene; Vinyl Chloride <u>Metals</u> Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver Antimony; Calcium Beryllium; Magnesium Nickel; Potassium Thallium Vanadium <u>Field Analyses</u> pH, SC, temperature, chloride, Eh, alkalinity, total Fe, specific gravity

Note: Because of the lack of sophisticated weights and measures equipment available for field density assessment, field density evaluations are expressed in terms of specific gravity, which is a unitless measure.

TABLE L-4
ANALYTICAL PARAMETER AND SAMPLE REQUIREMENTS

(10) PARAMETERS	(12) NO. OF BOTTLES	(13) VOLUME	(14) TYPE	(15) ACID WASH	(16) SAMPLE FILTER	(17) PRESERVATIVE	(18) HOLDING TIME
Indicator[1] Parameters:							
• pH	-	25 ml[2]	Glass	Field determined	No?	Field determined	None
• SC	-	100 ml[2]	Glass	Field determined	No	Field determined	None
• TOC	4	15 ml[2]	Glass	yes	No	HCl	28 days[2]
• TOX	3	250 ml	Glass	yes	No	H_2SO_4, pH<2	7 days[2]
General Chemistry	1	1 Liter	Plastic	Yes	No	HNO_3,4pH<2	not specified in DMP
Phenolics	1	1 Liter	Amber Glass	Yes	No	H_2SO_4, pH<2	not specified in DMP
Metals/Cations	2	1 Liter	Plastic	Yes	No	HNO_3, pH<2	6 months[2,3]
VOC	4	40 ml	Glass	No	No	HCL, ph<2	14 days[2]
VOC (Purgable)	2	40 ml	Glass	No	No	HCL, ph<2	14 days[2]
VOC (Non-Purgable)	2	40 ml	Glass	No	No	HCL, ph<2	14 days[2]
BN/As	1	½ Gallon	Amber Glass	Yes	No	None	
TCLP	1	1 Liter	Plastic	Yes	No	HNO_3, pH<2	7 days[2]
Cyanide (Total	1	1 Liter	Plastic	Yes	No	NaOH, pH>12	14 days[2]
Sulfide	1	250 ml	Amber Glass	Yes	No	NaOH + Zn Acetate	28 days[2]
Radionuclides	1	1 Gallon	Plastic Cube	Yes	Yes	HNO_3, pH<2	6 months[2]

1 = RCRA Detection Monitoring Analytes
2 = As specified in Table 4-1 of the RCRA TEGD
3 = Reduced holding time of 1 week for WIPP-specific Divalent cation 2 samples noted in the GMD

Note: Unless otherwise indicated, data are from DOE Procedure WP 02-EM1006 methods and are provided as information only.

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FIGURES

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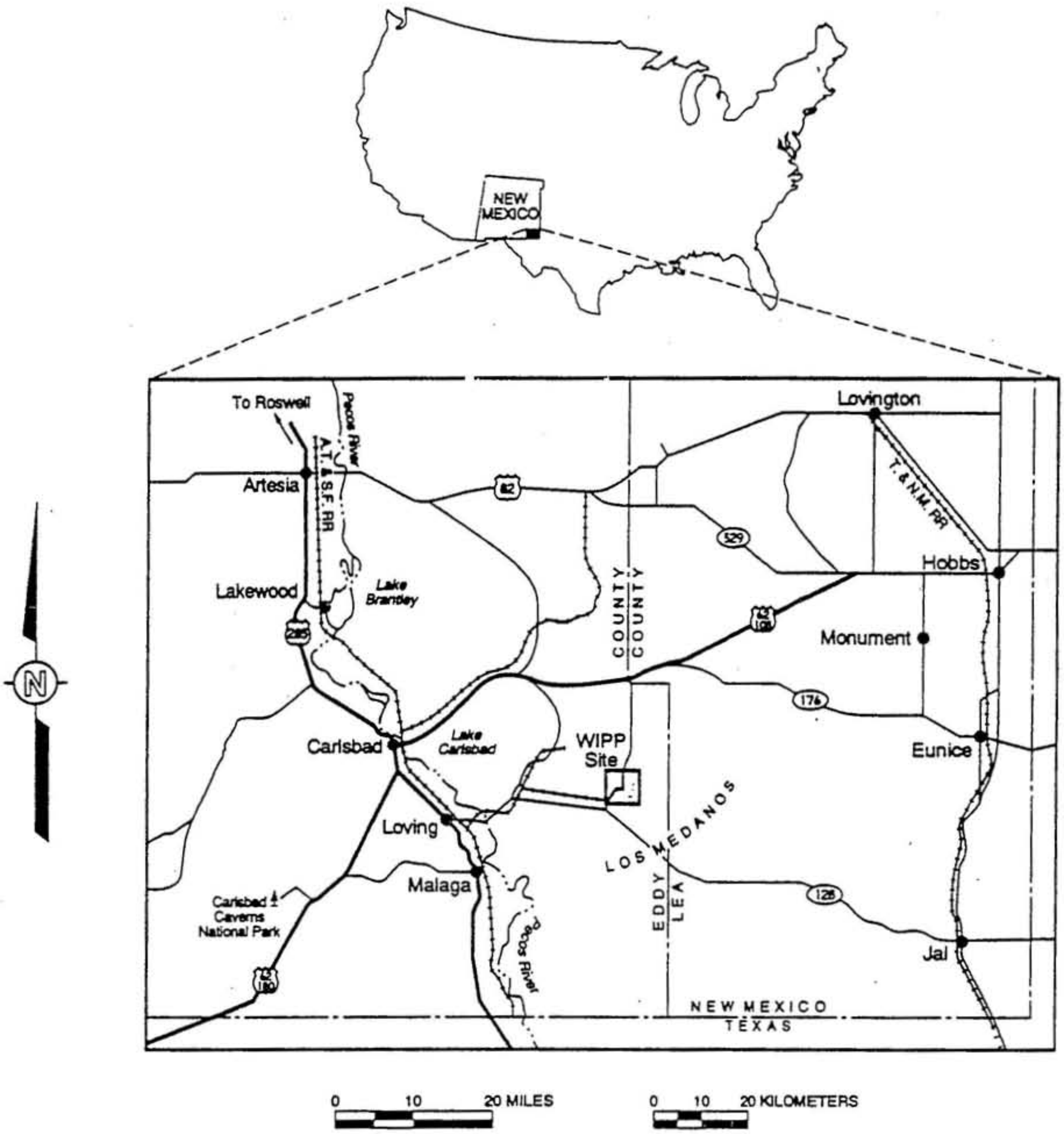


Figure L-1
General Location of the WIPP Facility

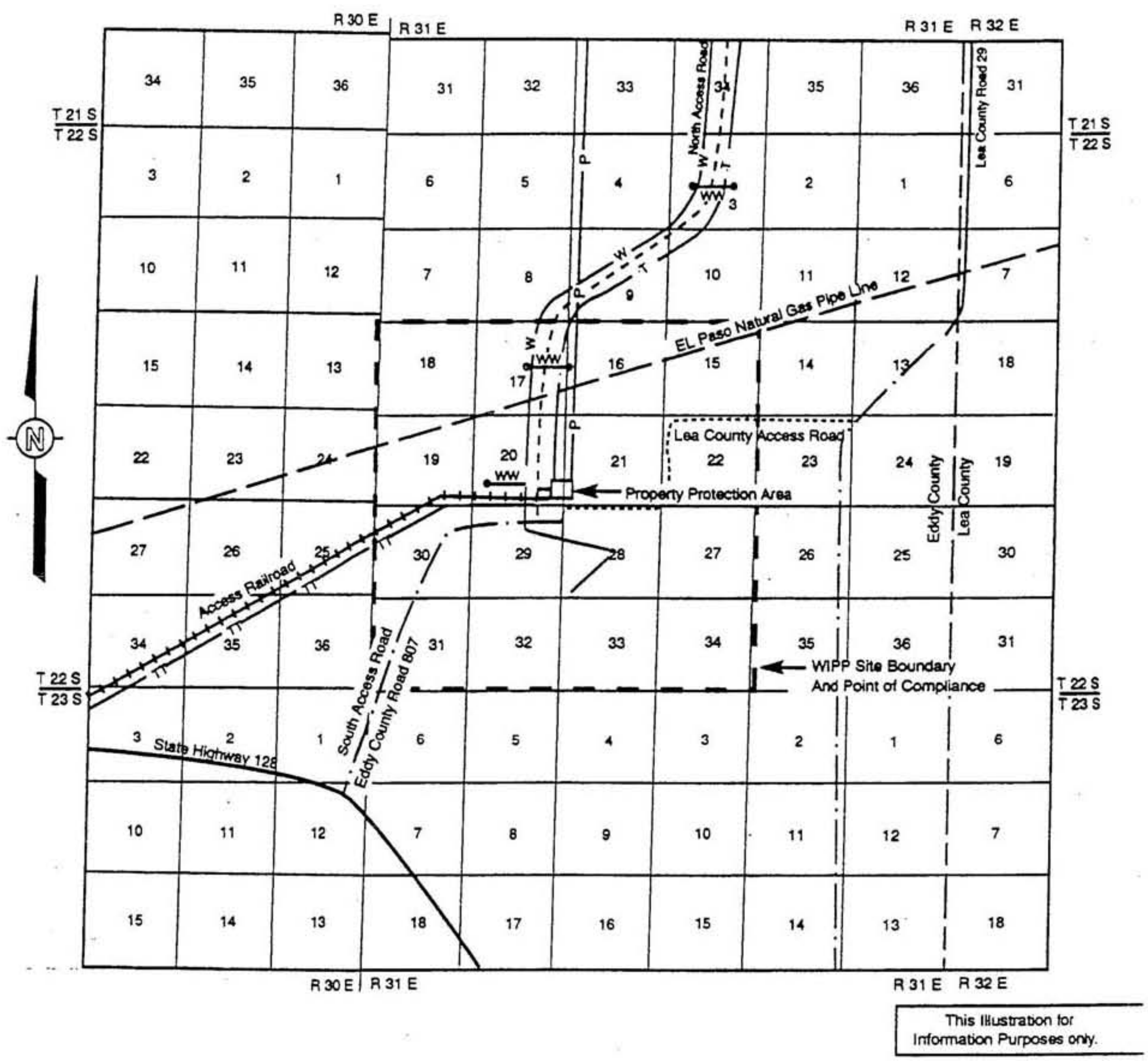


Figure L-2
WIPP Facility Boundaries Showing 16-Square-Mile Land Withdrawal Boundary

System	Series	Group	Formation	Member
Recent	Recent		Surficial Deposits	
Quater-nary	Pliesto-cene		Mescalero Caliche	
			Gatuña	
Tertiary	Mid-Pliocene		Ogallala	
Triassic		Dockum	Santa Rosa	
Permian	Ochoan		Dewey Lake	
			Rustler	Forty-niner
				Magenta
				Tamarisk
				Culebra
				Unnamed lower
			Salado	Upper
				McNutt Potash
				Lower
			Castile	
	Guadalupian	Delaware Mountain	Bell Canyon	
			Cherry Canyon	
			Brushy Canyon	

Figure L-3
Site Geologic Column

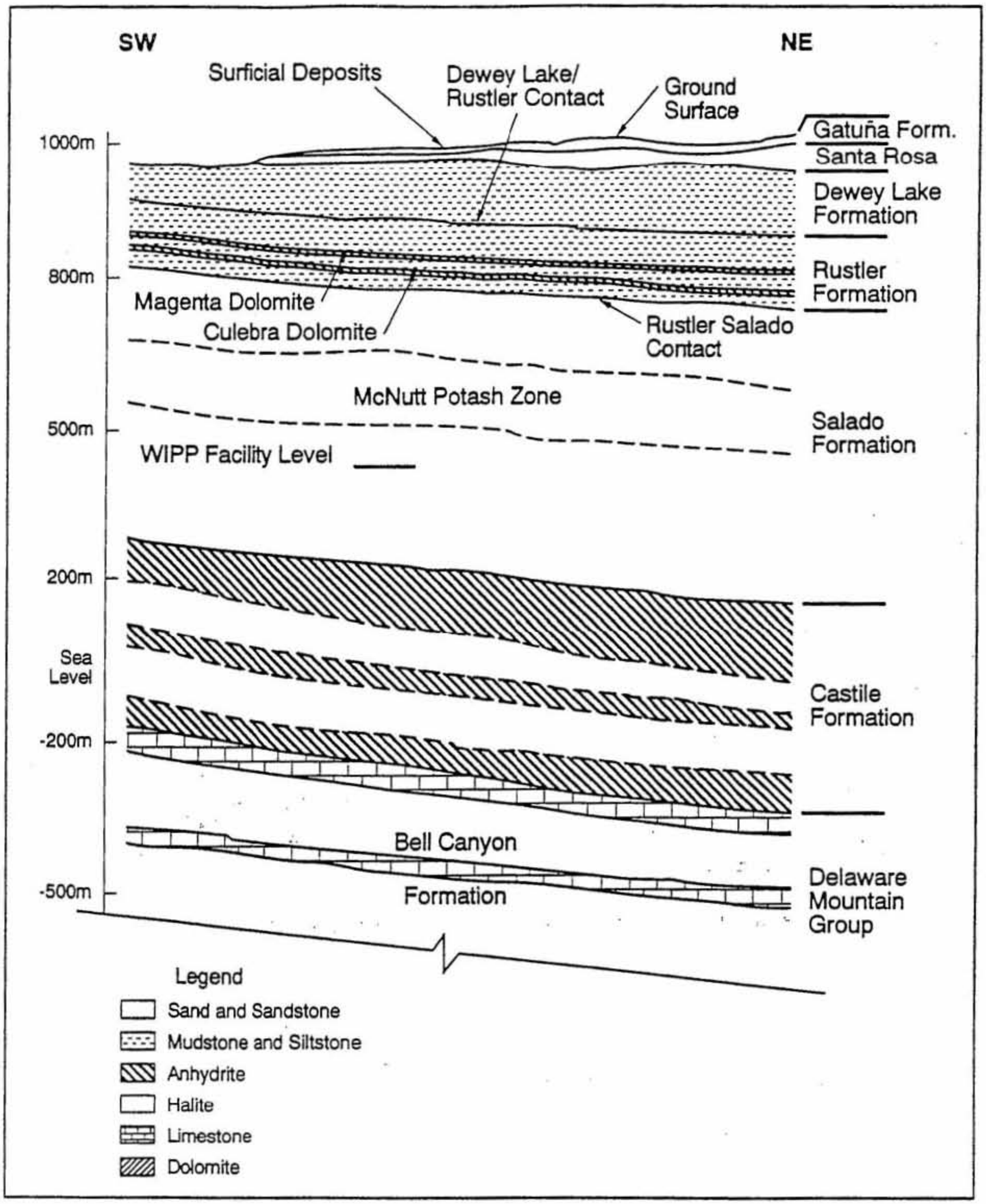


Figure L-4
Generalized Stratigraphic Cross Section above Bell Canyon Formation at WIPP Site

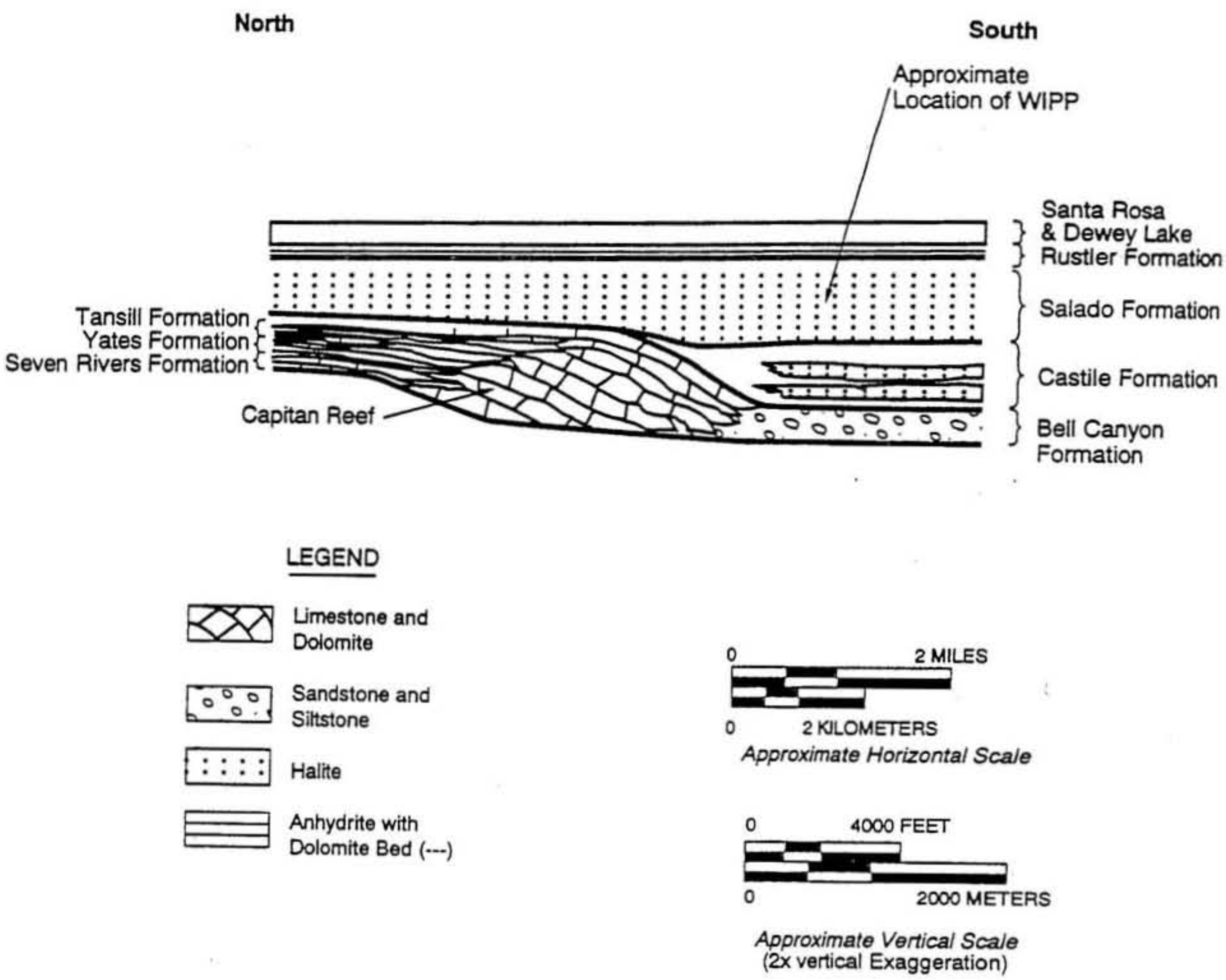


Figure L-5
Schematic North-South Cross Section Through the North Delaware Basin

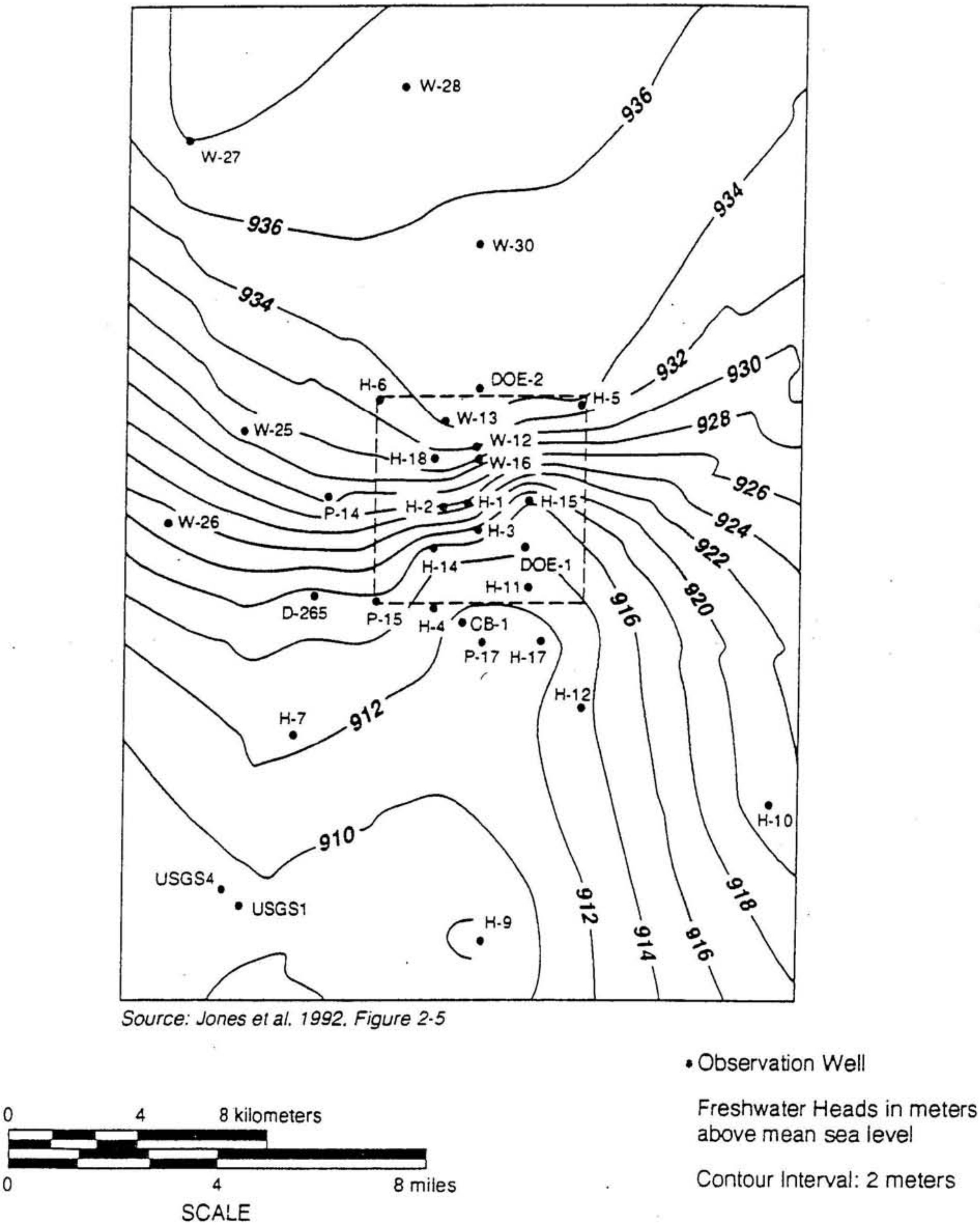


Figure L-6
Culebra Freshwater-Head Contour Surface

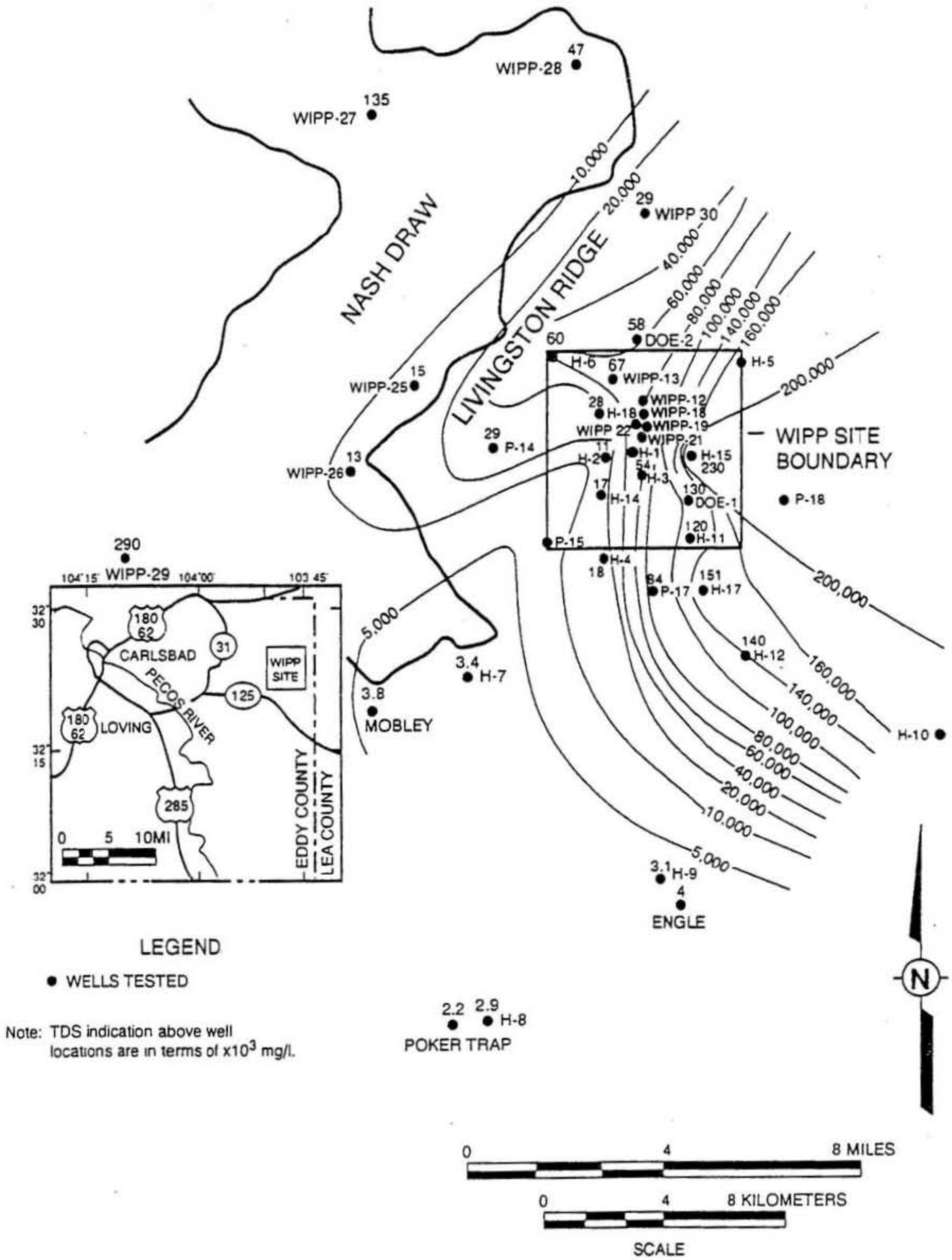


Figure L-7
Total Dissolved Solids Distribution in the Culebra

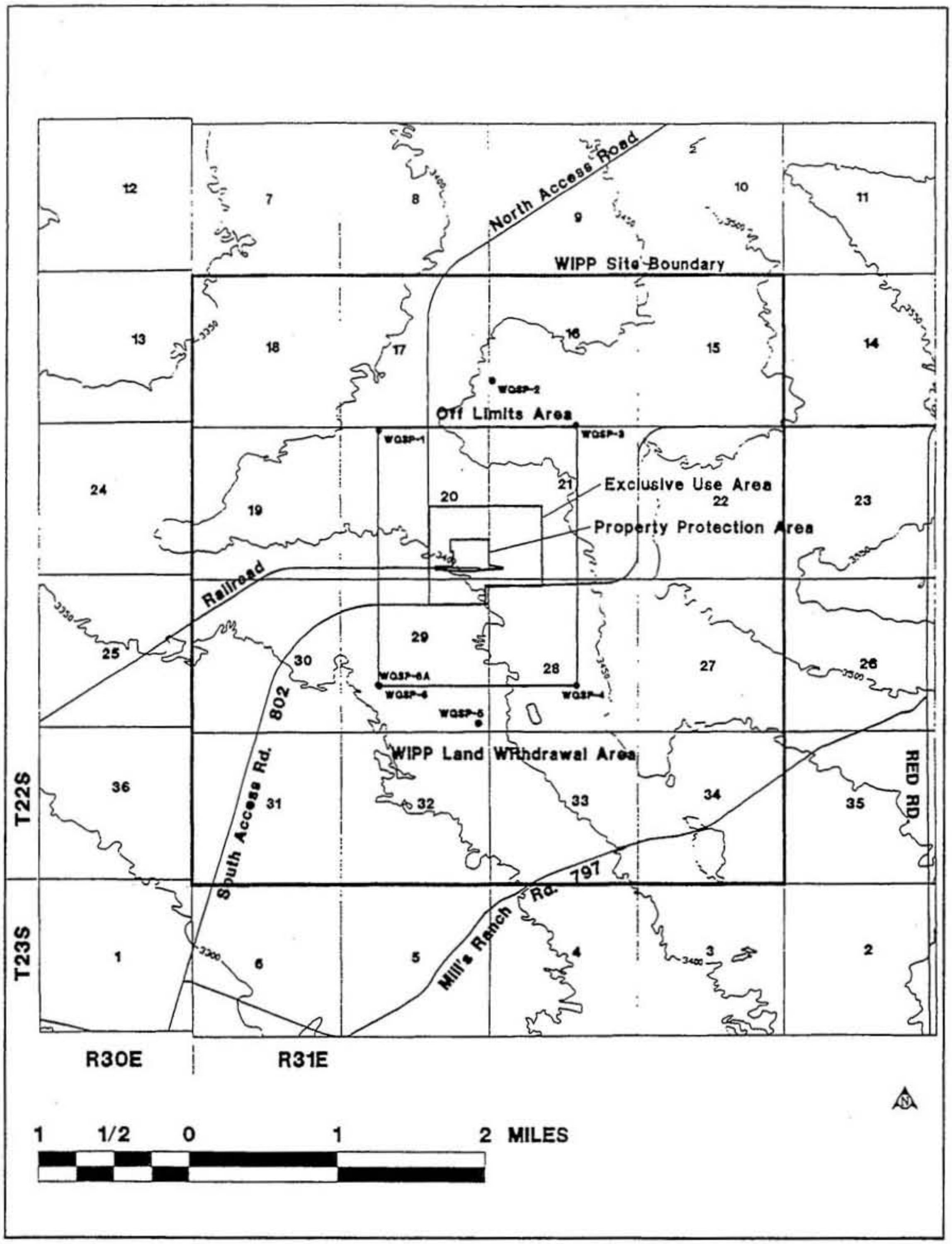


Figure L-8
WQSP Monitor Well Locations

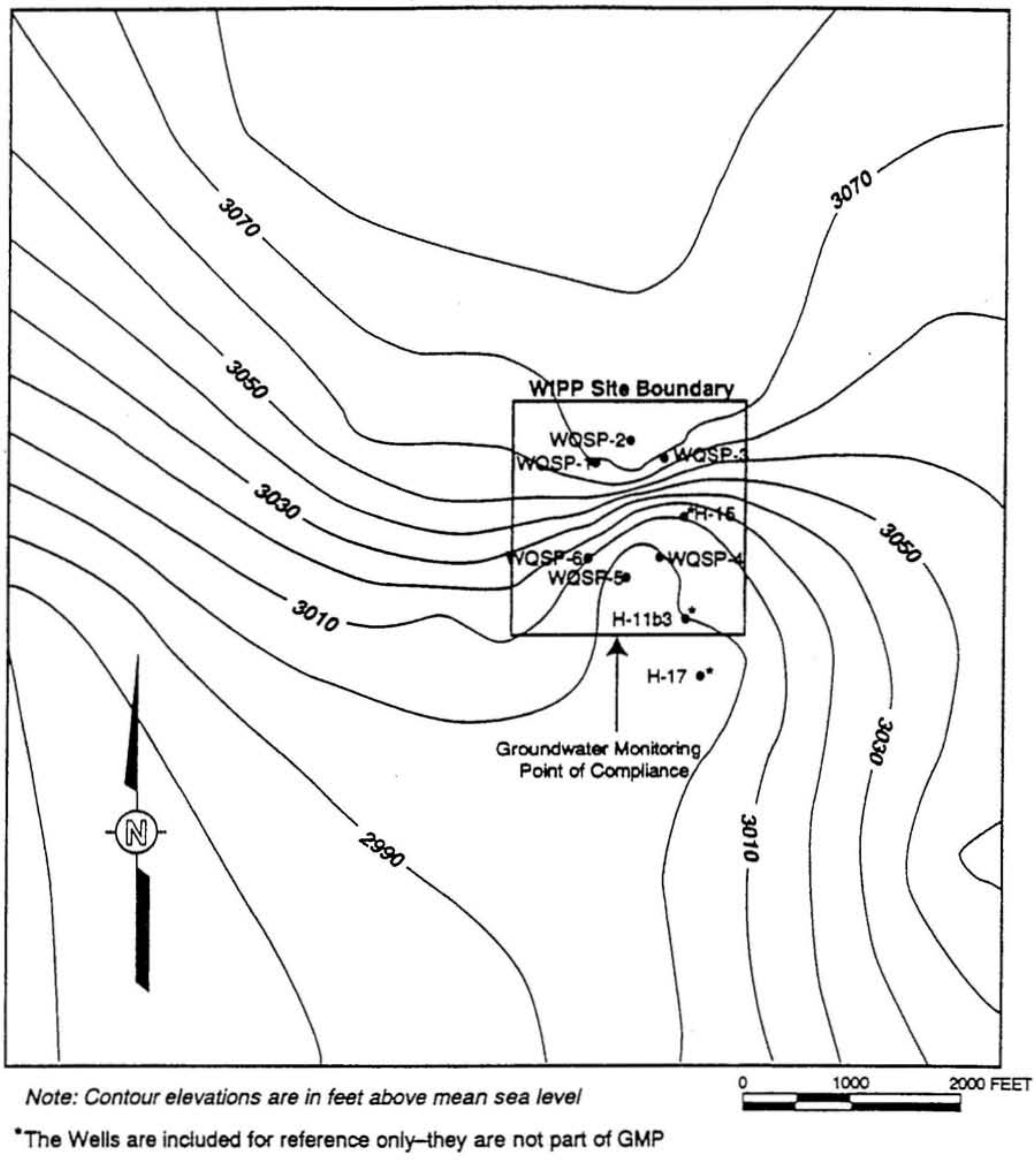


Figure L-9
WIPP DMP Monitor Well Locations and Potentiometric Surface of the Culebra Near the WIPP Site as of 12/96 (adjusted to equivalent freshwater head)

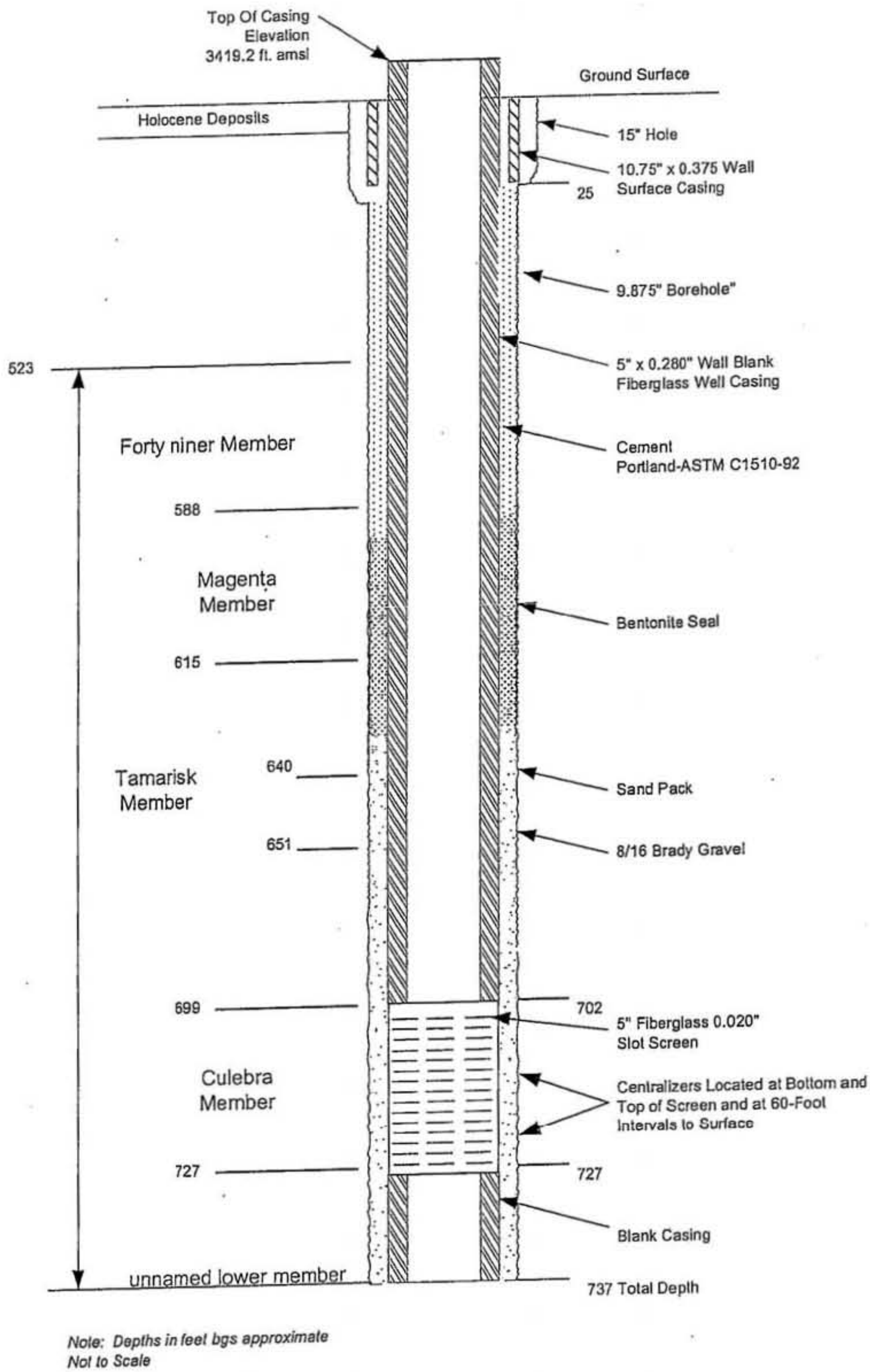


Figure L-10
As-Built Configuration of Well WQSP-1

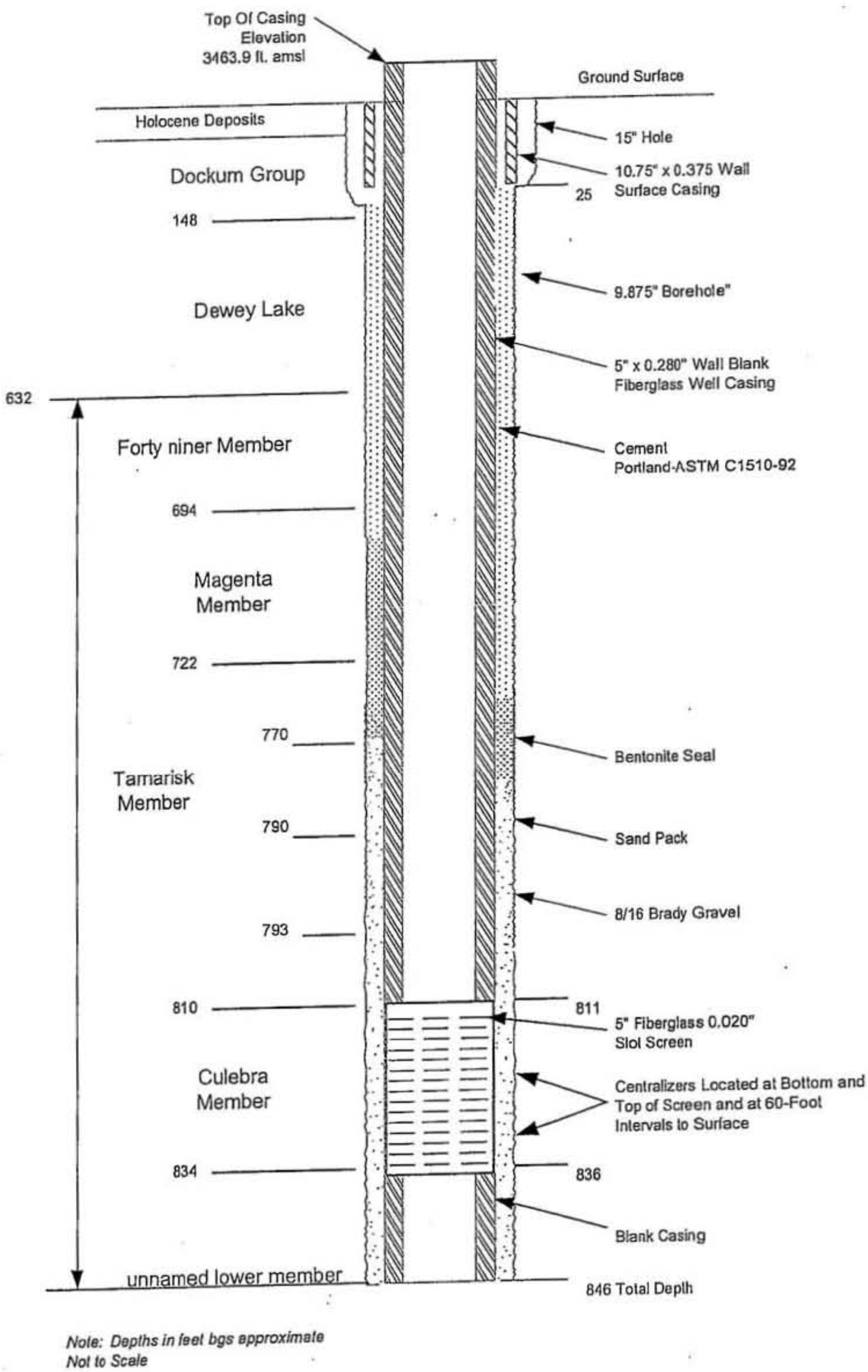


Figure L-11
As-Built Configuration of Well WQSP-2

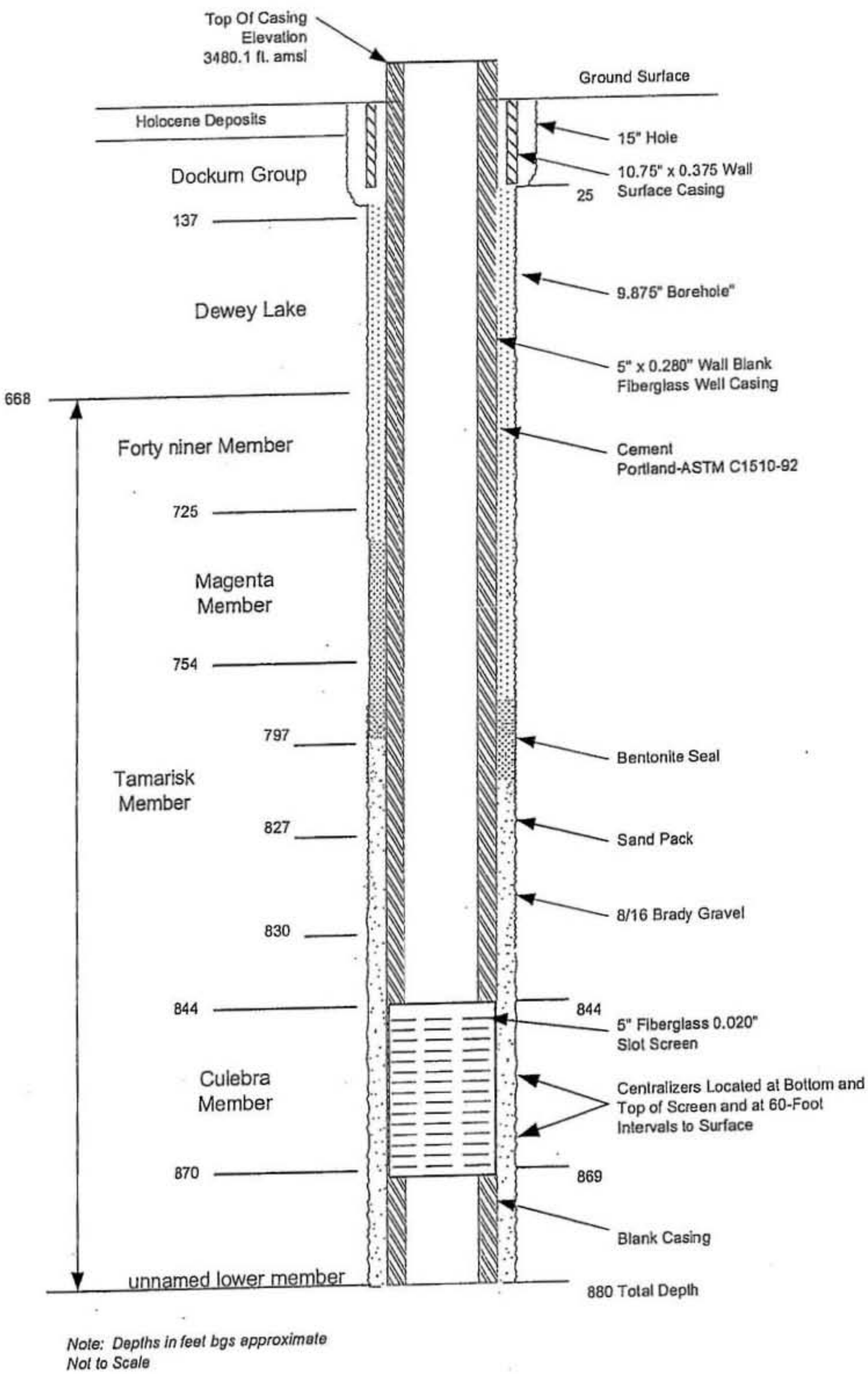


Figure L-12
As-Built Configuration of Well WQSP-3

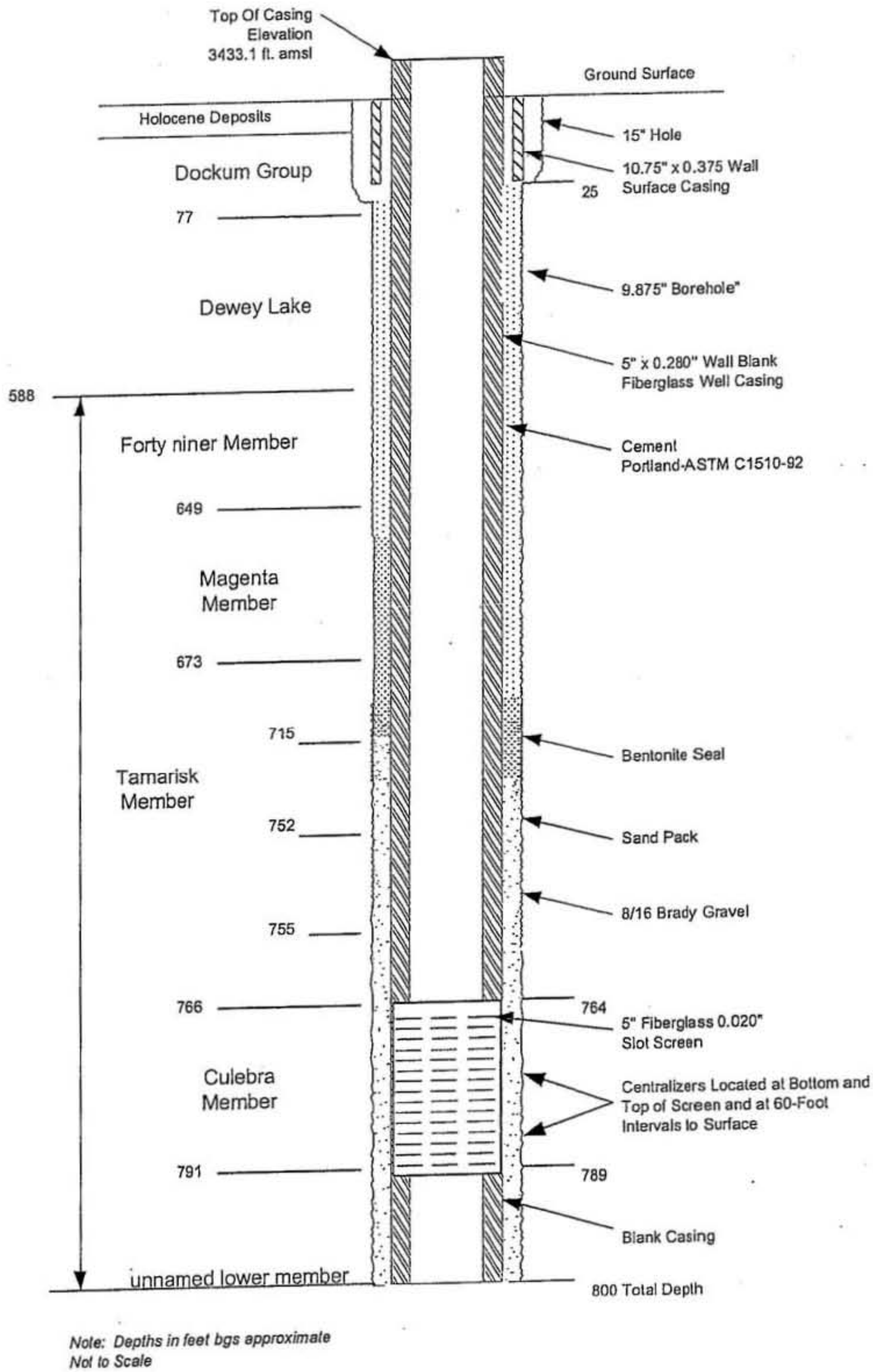
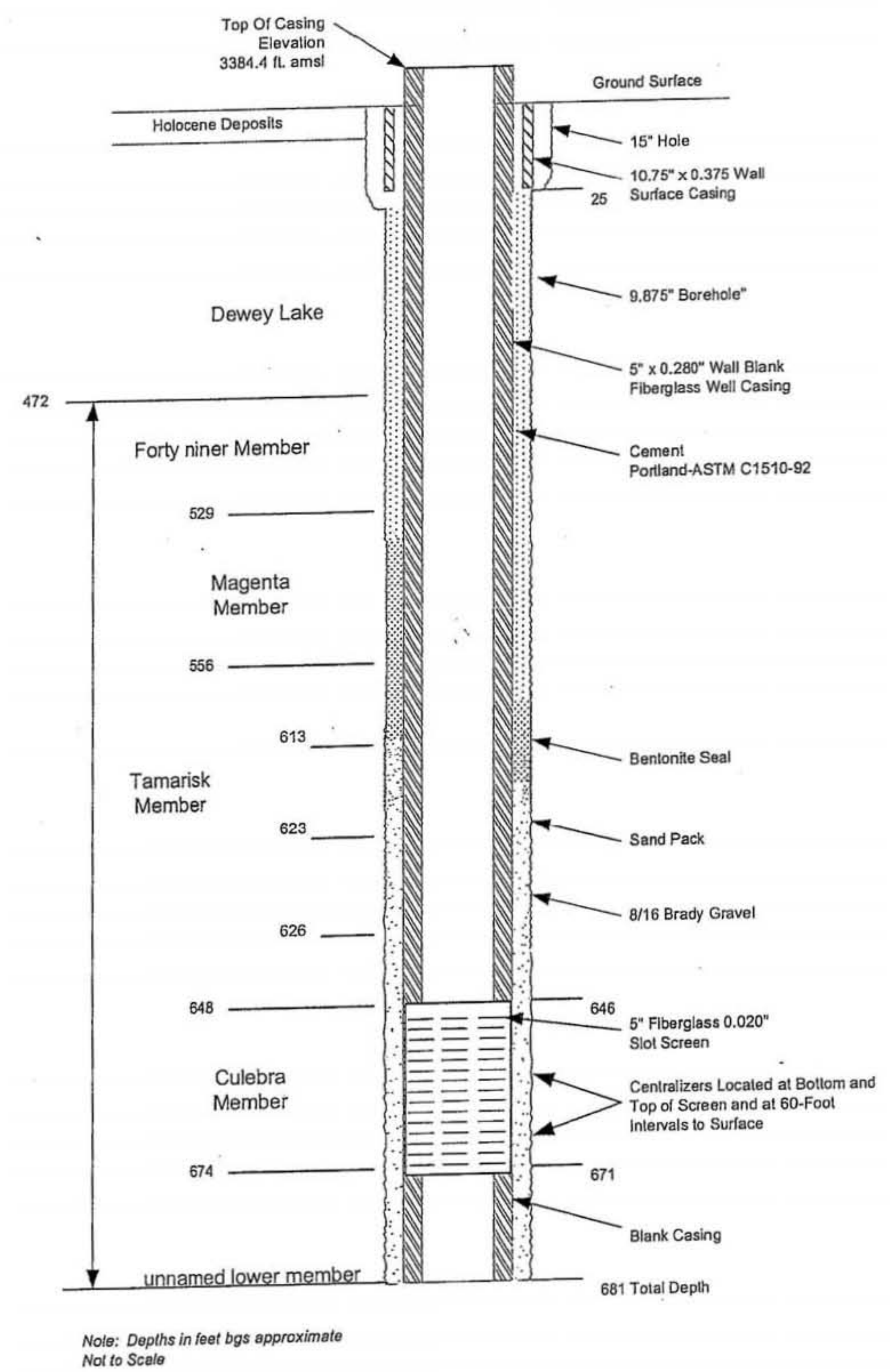


Figure L-13
As-Built Configuration of Well WQSP-4

1



2 Figure L-14
3 As-Built Configuration of Well WQSP-5

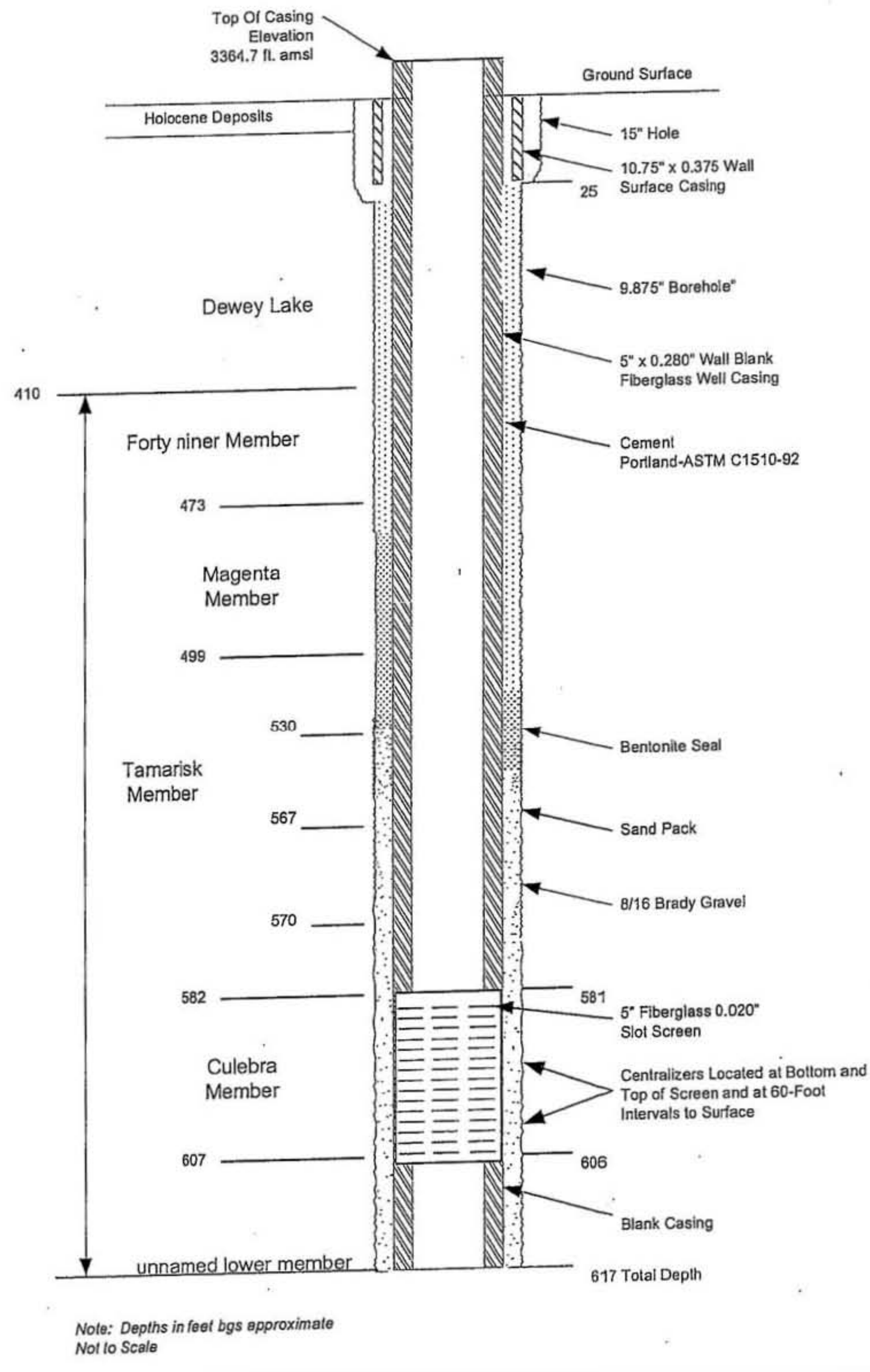


Figure L-15
As-Built Configuration of Well WQSP-6

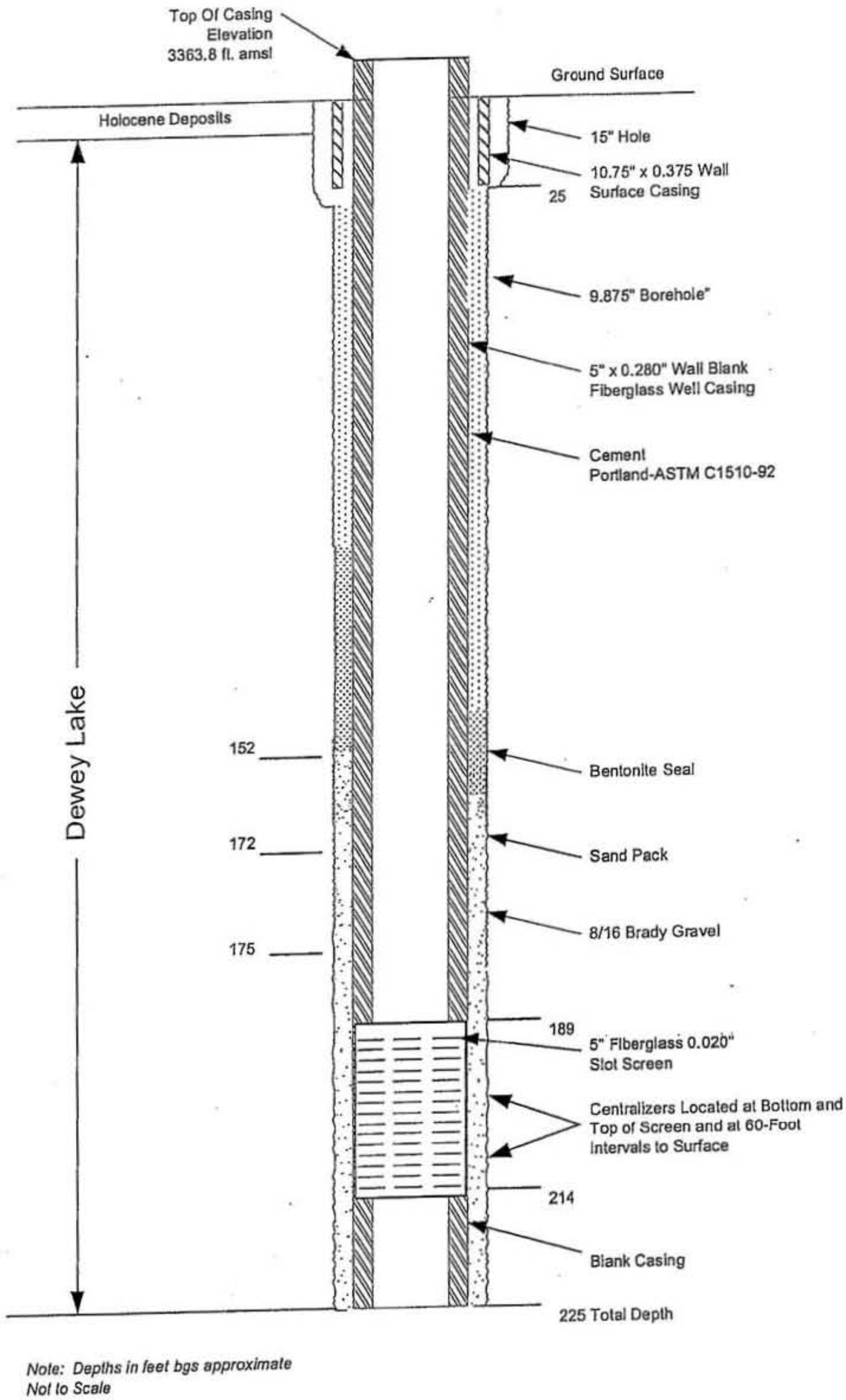


Figure L-16
As-Built Configuration of Well WQSP-6A

Chain of Custody Record

{MOC Name and Address} ____________

____

____

____

C of C Control No. ____________

RFA Control No. ____________

SAMPLING PROGRAM ____________ LAB DESTINATION ____________

SAMPLE TEAM MEMBERS ____________ CARRIER/WAYBILL NO. ____________

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No.

Special Instructions ____________

Possible Sample Hazards: ____________

Signatures: (Name, Company, Date and Time: ____________

1. Relinquished By: ____________
   Received By: ____________
2. Relinquished By: ____________
   Received By: ____________
3. Relinquished By: ____________
   Received By: ____________
4. Relinquished By: ____________
   Received By: ____________

WHITE - Original, to accompany samples YELLOW- Field Copy PINK- OTHER

Figure L-17a
Example Chain-of-Custody Record

REQUEST FOR ANALYSIS

{MOC Name and Address} ____________

____

____

____

R/A Control ____________

C/C Control No. ____________

Date Sample Shipped ____________

Lab Destination ____________

Laboratory Contact ____________

Send Lab Report To____________

____

____

VOC Monitoring Program____________

Date Report Required ____________

Project Contact ____________

Purchase Order No.____________

Project Contact Phone No. ____________

Serial No.	Sample No.	C-of-C No.	Sample Type	Sample Pressure	Preservative	Contract-Specific Testing	Special Instructions

TURNAROUND TIME REQUIRED: (Rush must be approved by appropriate Manager) NORMAL______ RUSH____(Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or contain high levels of hazardous substances.)

NONHAZARD______ FLAMMABLE______ SKIN IRRITANT______ HIGHLY TOXIC______ BIOLOGICAL______ OTHER

____

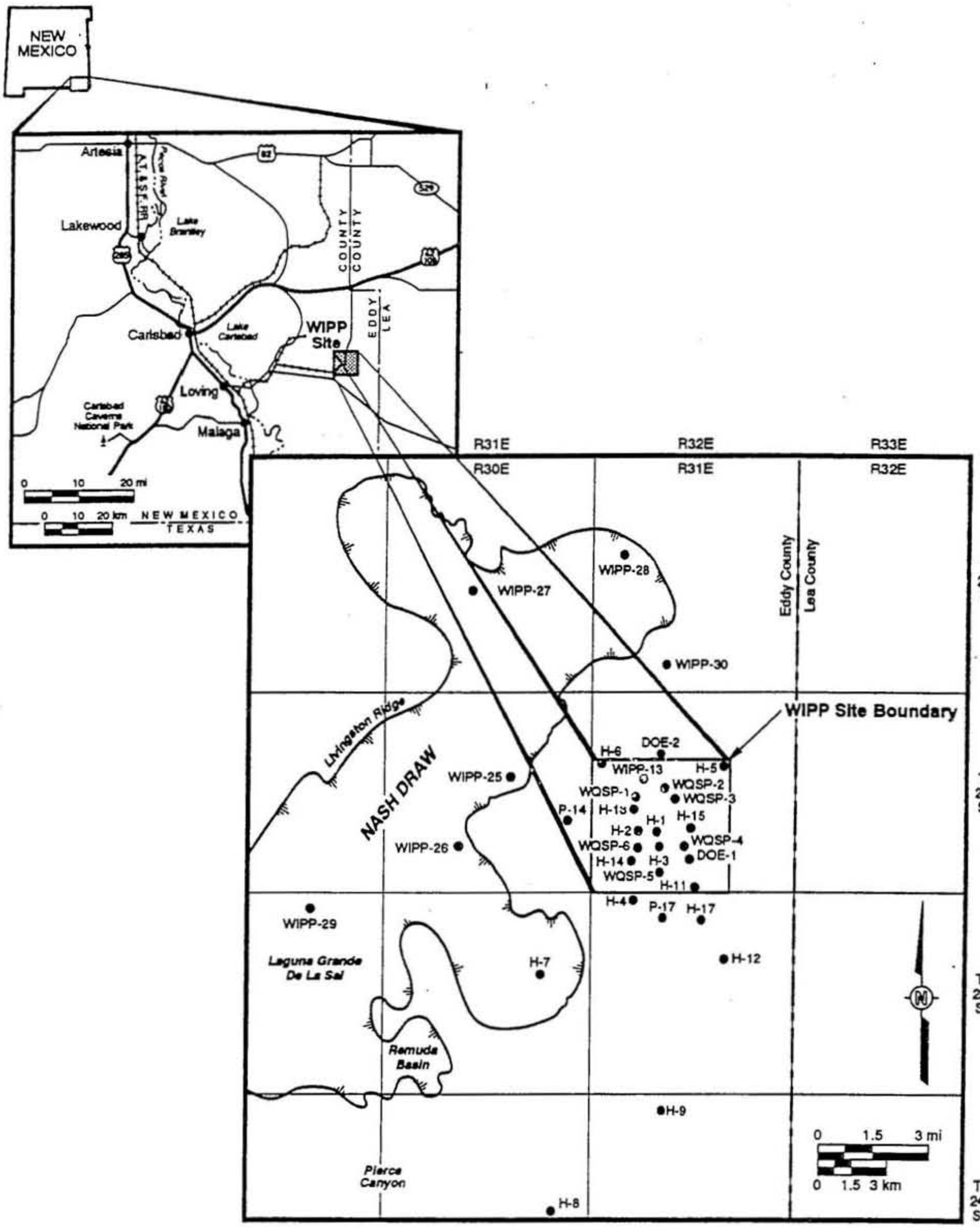
SAMPLE DISPOSAL (Please indicate disposition of sample following analysis.) RETURN TO CLIENT______ DISPOSAL BY LAB______ (Please Specify)

____

FOR LAB USE ONLY

RECEIVED BY ____________ DATE/TIME ____________

Figure L-17b
Example Request for Analysis



1

2 Figure L-18
3 Ground-water Surface Elevation Monitoring Locations

ADDENDUM L1

SITE CHARACTERIZATION

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ADDENDUM L1
SITE CHARACTERIZATION

TABLE OF CONTENTS

List of Tables

List of Figures

ADDENDUM L1

SITE CHARACTERIZATION

Introduction

This addendum describes the Waste Isolation Pilot Plant (WIPP) site in terms of its geology, hydrology, climatology, air quality, ecology, and cultural and natural resources. The purpose of this addendum is to provide information on the disposal system's natural characteristics that are relevant to the assessment of the WIPP site as a repository for transuranic (TRU) and TRU mixed waste and to establish the favorable characteristics of the site and background environmental quality. The U.S. Department of Energy (DOE) has developed the WIPP facility as a deep geologic repository for disposal of TRU waste. In order for the DOE to formulate a reasonable expectation of site conditions far into the future, the site has been characterized in detail to provide data for a variety of geologic and hydrologic parameters. The DOE uses these parameters in computational models to predict the likelihood and possible consequences of various scenarios impacting to the WIPP site over a 10,000-year period

The DOE located the WIPP site 26 miles (mi) (41.8 kilometers (km)) east of Carlsbad, New Mexico, in Eddy County (Figure L1-1). The region surrounding the WIPP site has been under study for many years, and exploration of both potash and hydrocarbon deposits has provided extensive knowledge of the geology of the region. Two exploratory boreholes were drilled by the federal government during 1974 at a location northeast of the present site; that location was abandoned in 1975 as a possible repository site after a well, U.S. Energy Research and Development Administration (ERDA)-6, was drilled, and unacceptable geologic structure and pressurized brine were encountered. The results of these investigations were reported by Powers et al. (1978). During late 1975 and early 1976, the ERDA identified the present site, and an initial exploratory borehole (ERDA-9) was drilled. By the time an initial phase of site characterization was completed in August 1978, 47 boreholes had been drilled or were in progress for hydrologic and various geologic purposes. Since 1978, the DOE has drilled additional boreholes to support hydrologic programs, geologic programs, and facility design. Geophysical logs, cores, basic data reports, geochemical sampling and testing, and hydrological testing and analyses are reported by the DOE and its scientific advisor, Sandia National Laboratories (SNL), in numerous documents and are maintained in reference libraries that are available to the public, such as the Sandia WIPP Central File (in Albuquerque, New Mexico). The DOE recently submitted the second Compliance Recertification Application (DOE 2009) to the U.S. Environmental Protection Agency (EPA). CRA-2009 provides a comprehensive update of recent site characterization and monitoring activities for the WIPP Project. Where necessary, specific references from these documents are cited to reinforce the statements being made. Additional sources of information on the various topics in this section are listed in a bibliography at the end of the chapter.

Biological studies of the site began in 1975 to gather information for the Environmental Impact Statement. Meteorological studies began in 1976, and economic studies were initiated during

1977. Baseline environmental data were initially reported in 1987 and are now updated annually by the DOE.

The DOE selected the WIPP disposal horizon to be located within a salt deposit known as the Salado Formation (Salado) at a depth of 2,150 feet (ft) (650 meters (m)) below the ground surface. The present site was selected based on the following site selection criteria: the Salado is regionally extensive; includes continuous beds of salt without complicated structure; is deep enough for waste isolation, reducing the potential for dissolution of the rock salt by surface water or shallow groundwater; and is near enough to the surface to make access reasonable. Particular site-selection criteria narrowed the choices when the present site was located during 1975-76.

L1-1 Geology

Geological data were collected from the WIPP site and surrounding area for use in evaluating the suitability of the site as a radioactive waste repository. These data were collected principally by the DOE and its predecessor agencies, the United States Geological Survey (USGS), the New Mexico Bureau of Mines and Mineral Resources (NMBMMR), and private organizations engaged in natural resource exploration and extraction. The DOE has analyzed the data provided in the following discussion and has determined the WIPP site is suitable for the long-term isolation of radioactive waste. Numerous questions have been raised and subsequently discussed, investigated, and resolved in order for the DOE to reach the conclusion that the site is suitable. The DOE discusses these questions in the following with emphasis on the resolution of the issues.

Geological field studies designed to collect data pertinent to the conceptual models of WIPP site geology and hydrology are ongoing. The Culebra Dolomite Member (Culebra) and Magenta Dolomite Member (Magenta) are the two carbonates in the Rustler Formation (Rustler), the youngest evaporite-bearing formation in the Delaware Basin. Geologic data related to the Culebra remains of particular interest, as these members are the most significant transmissive units at the WIPP site.

Holt (1997) provides detailed information on enhancement of the conceptual model for transport of contaminants and radionuclides in the Culebra. Holt (1997) discusses interpretation and conceptual insights obtained from field and laboratory tracer tests and core studies that support the double-porosity conceptual model of the Culebra, in which Culebra porosity is divided into advective and diffusive components.

Geological data and hydrological testing of new wells provide the basis for estimating the transmissivity field for modeling fluid flow and transport in the Culebra (Beauheim 2002). Geological data correlate strongly with Culebra transmissivity (Holt and Yarbrough 2002), and they are available from many more locations, such as industry (oil, gas potash) drillholes, than are transmissivity data, which generally require hydrological well tests. With this correlation, Culebra properties can be inferred over a wide area, leading to an improved computational model of the spatial distribution of Culebra transmissivity. A comprehensive hydrological testing program for the Culebra and Magenta, including drilling and testing of new wells, has been performed to improve understanding of the Culebra and Magenta and to assess the causes(s) of rising water levels across the WIPP site (DOE 2009, Appendix Hydro).

L1-1a Data Sources

The geology of southeastern New Mexico has been of great interest for more than a century. The Guadalupe Mountains have become world renown for geologists because of the spectacular exposures of Permian-age reef rocks and related facies. Because of intense interest in both hydrocarbon and potash resources in the region, there exists a large volume of data as potential background for the WIPP site, though some data are proprietary. Finally, there is the geological information developed directly and indirectly by studies sponsored by DOE; it ranges from raw data to interpretive reports.

Elements of the geology of southeastern New Mexico have been discussed or described in professional journals or technical documents from many different sources. These types of articles are an important source of information, and where there is no contrary evidence, the information in these articles is included through reference where subject material is relevant. Implicit rules of professional conduct of research and reporting are assumed to have been applied, and journal/editorial review has been applied as well. Certain elements of the geology presented in such sources have been deemed critical to the WIPP Project and have been the subject of specific DOE-sponsored studies.

Geological data have been developed by the DOE through a variety of DOE-sponsored studies using drilling, mapping, or other direct observation; geophysical techniques; and laboratory work. Boreholes are, however, a major source of geological data for the WIPP site and surrounding area. From boreholes come raw data that provide the basis for point data and interpreted data sets. These data serve as the base for computing other useful elements such as structure maps for selected stratigraphic horizons or isopachs (thickness) of selected stratigraphic intervals.

L1-1b Geologic History

This section summarizes the more important points of the geologic history within about a 200 mi (321.9 km) radius of the WIPP site, with emphasis on more recent or nearby events. Major elements of the geological history from the end of the Precambrian in the vicinity of the WIPP site were compiled in graphic form (Figure L1-2). The geologic time scale that the DOE uses for the WIPP site is based on a compilation by Palmer (1983) for *The Decade of North American Geology* (DNAG). There is no consensus on either reference boundaries or most representative ages. The DNAG scale is accepted by the DOE as a standard that is useful and sufficient for WIPP Project purposes, as no known critical parameters require more accurate or precise dates.

The geologic history in this region can conveniently be subdivided into three general phases:

- A Precambrian period, represented by metamorphic and igneous rocks, ranging in age from about 1.5 to 1.1 billion years old
- A period principally of erosion from about 1.1 to 0.6 billion years ago, as there is no rock record from this time
- An interval from 0.6 billion years to the present; represented by a more complex deposition of mainly sedimentary rocks with shorter periods of erosion and dissolution.

This latter phase is the main subject of the DOE's detailed discussion in this text.

Precambrian crystalline rocks have been penetrated in only a few deep boreholes in the vicinity of the WIPP site, and therefore relatively little petrological information is available. Foster (1974) extrapolated the elevation of the Precambrian surface under the area of the WIPP site as being between 14,500 ft (4.42 km) and 15,000 ft (4.57 km) below sea level; the site surface at the WIPP facility is about 3,400 ft (1,036 m) above sea level. Keesey (1977, Vol. II, Exhibit No. 2) projected a depth to the top of Precambrian rocks of 18,200 ft (5.55 km) based on the geology of a nearby borehole in Section 15, T22S, R31E.

Precambrian rocks of a variety of types crop out in the following locations: the Sacramento Mountains northwest of the WIPP site; around the Sierra Diablo and Baylor Mountains near Van Horn, Texas; west of the Guadalupe Mountains at Pump Station Hills; and in the Franklin Mountains near El Paso, Texas. East of the WIPP site, a relatively large number of boreholes on the Central Basin Platform have penetrated the top of the Precambrian (Foster, 1974). As summarized by Foster (1974), Precambrian rocks in the area considered similar to those in the vicinity of the site range in age from about 1.35 to 1.14 billion years.

For a period of about 500 million years (1.1 to 0.6 billion years ago), there is no certain rock record in the region around the WIPP site. The most likely rock record for this period may be the Van Horn sandstone, but there is no conclusive evidence that it represents part of this time period. The region is generally interpreted to have been subject to erosion for much of the period, until the Bliss sandstone began to accumulate during the Cambrian.

L1-1c Stratigraphy and Lithology in the Vicinity of the WIPP Site

This section presents the stratigraphy and lithology of the Paleozoic and younger rocks underlying the WIPP site and vicinity (Figure L1-3), emphasizing the units nearer the surface. Details begin with the Permian (Guadalupian) Bell Canyon Formation (hereafter referred to as the Bell Canyon) the upper unit of the Delaware Mountain Group―because this is the uppermost water-bearing formation below the evaporites. The principal stratigraphic data are the chronologic sequence, age, and extent of rock units, including some of the nearby relevant facies changes. Characteristics such as thickness and depth are summarized here from published sources for deeper rocks. The main lithologies for upper formations and members of some formations are described; some of the major stratigraphic divisions (e.g., Jurassic) are not described because they do not occur at or near the WIPP site.

L1-1c(1) General Stratigraphy and Lithology below the Bell Canyon Formation

As stated previously, the Precambrian basement near the site is projected to be about 18,200 ft (5.55 km) below the surface (Keesey, 1977, Vol. II, Exhibit No. 2), consistent with information presented by Foster in 1974. Ages of similar rock suites in the region range from about 1.35 to 1.14 billion years.

The basal units overlying Precambrian rocks are clastic rocks commonly attributed either to the Bliss sandstone or the Ellenberger Group (Foster, 1974), considered most likely to be Ordovician in age in this area. The Ordovician system comprises the Ellenberger, Simpson, and Montoya groups in the northern Delaware Basin. Carbonates are predominant in these groups, with sandstones and shales common in the Simpson group. Foster (1974) reported 975 ft (297 m) of Ordovician north of the site area and extrapolated a thicker section of about 1,300 ft (396 m) at the present site. Keesey (1977, Vol. II, Exhibit No. 2) projected a thickness of 1,200 ft (366 m) within the site boundaries.

Silurian-Devonian rocks in the Delaware Basin are not stratigraphically well defined, and there are various notions for extending nomenclature into the basin. Common drilling practice is not to differentiate, although the Upper Devonian Woodford shale at the top of the sequence is frequently distinguished from the underlying dolomite and limestone (Foster, 1974). Foster (1974) showed a reference thickness of 1,260 ft and 160 ft (384 m and 49 m) for the carbonates and the Woodford shale, respectively; he estimated thickness contours for the present WIPP site of about 1,150 ft (351 m) and 170 ft (52 m), respectively. Keesey (1977, Vol. II, Exhibit No. 2) projected 1,250 ft (381 m) of carbonate and showed 82 ft (25 m) of the Woodford shale.

The Mississippian system in the northern Delaware Basin is commonly attributed to "Mississippian limestone" and the overlying Barnett shale (Foster, 1974), but the nomenclature is not well settled. At the reference well used by Foster (1974), the limestone is 540 ft (165 m) thick and the shale is 80 ft (24 m) thick; isopachs at the WIPP site are 480 ft (146 m) and less than 200 ft (61 m). Keesey (1977, Vol. II, Exhibit No. 2) indicates 511 ft (156 m) and 164 ft (50 m), respectively, within the site boundaries.

The nomenclature of the Pennsylvanian system applied within the Delaware Basin is both varied and commonly inconsistent with accepted stratigraphic rules. Chronostratigraphic, or time-stratigraphic, names are applied to these lithologic units: the Morrow, the Atoka, and the Strawn, from base to top (Foster, 1974. Foster (1974) extrapolated thicknesses of about 2,200 ft (671 m) for the Pennsylvanian at the WIPP site. Keesey (1977, Vol. II, Exhibit No. 2) reports 2,088 ft (636 m) for these units. The Pennsylvanian rocks in this area are mixed clastics and carbonates, with carbonates more abundant in the upper half of the sequence.

The Permian system in the northern Delaware Basin is the thickest system in the northern Delaware Basin, and it is divided into four series from the base to top: the Wolfcampian, the

Leonardian, the Guadalupian, and the Ochoan. According to Keesey (1977, Vol. II, Exhibit No. 2), the three lower series total 8,684 ft (2,647 m) near the site. Foster (1974) indicates a total thickness for the lower three series of 7,665 ft (2,336 m) from a reference well north of the WIPP site. Foster's 1974 isopach maps of these series indicate about 8,500 ft (2,591 m) for the WIPP site area. The Ochoan series at the top of the Permian is considered in more detail later, because the formations host and surround the WIPP repository horizon. Its thickness at DOE-2, about 2 mi (3.2 km) north of the site center, is 3,938 ft (1,200 m) according to Mercer et al. (1987).

The Wolfcampian series is also referred to as the Wolfcamp Formation (hereafter referred to as the Wolfcamp) in the Delaware Basin. In the site area, the lower part of the Wolfcamp is dominantly shale, with carbonate and some sandstone according to Foster (1974); carbonate increases to the north. Clastics increase to the east toward the margin of the Central Basin Platform. Keesey (1977, Vol. II, Exhibit No. 2) reports the Wolfcamp to be 1,493 ft (455 m) thick at a well near the WIPP site. The Leonardian Series is represented by the Bone Spring Formation (hereafter referred to as the Bone Spring) (erroneously called the Bone Spring Limestone in many publications). According to Foster (1974) the lower part of the formation is commonly interbedded carbonate, sandstone, and some shale, while the upper part is dominantly carbonate. Near the site, the Bone Spring is 3,247 ft (990 m) thick according to Keesey (1977, Vol. II, Exhibit No. 2).

The Guadalupian series is represented in the general area of the site by a number of formations exhibiting complex facies relationships (Figure L1-4). The Guadalupian series is known in considerable detail west of the site from outcrops in the Guadalupe Mountains, where numerous outcrops and subsurface studies have been undertaken. According to Garber et al. (1989), similar facies relationships are expected from the site to the north (Figure L1-4).

Within the Delaware Basin, the Guadalupian series comprises three formations: the Brushy Canyon, the Cherry Canyon, and the Bell Canyon, from base to top. These formations are dominated by submarine channel sandstones with interbedded limestone and some shale. A limestone (Lamar) generally tops the series, immediately underneath the Castile Formation (hereafter referred to as the Castile). Around the margin of the Delaware Basin, reefs developed during the same time the Cherry Canyon and the Bell Canyon were being deposited. These massive reef limestones, the Goat Seep and Capitan limestones are equivalent in time to these basin sandstone formations but were developed much higher topographically around the basin margin. A complex set of limestone to sandstone and evaporite beds was deposited further away from the basin behind the reef limestones. The Capitan reef limestones are well known because the Carlsbad Caverns are partially developed in these rocks.

L1-1c(2) <u>The Bell Canyon Formation</u>

The Bell Canyon is known from outcrops on the west side of the Delaware Basin and from subsurface intercepts for oil and gas drilling. Several informal lithologic units are commonly named during such drilling. Mercer et al. (1987) stated that DOE-2 penetrated the Lamar limestone, the Ramsey sand, the Ford shale, the Olds sand, and the Hays sand. This informal nomenclature is used for the Bell Canyon in other WIPP Project reports.

The Clayton Williams Badger Federal borehole near the WIPP site (Section 15, T22S, R31E) intercepted 961 ft (293 m) of the Bell Canyon, including the Lamar limestone, according to Keesey (1977, Vol. II, Exhibit No. 2). Reservoir sandstones of the Bell Canyon were deposited in channels that are straight to slightly sinuous. Density currents flowed from shelf regions, cutting channels and depositing the sands that are identified in Harms and Williamson (1988).

Within the basin, the Bell Canyon (Lamar limestone)/Castile contact is distinctive on geophysical logs because of the contrast in low natural gamma of the basal Castile anhydrite compared to the underlying limestone. Density or acoustic logs are also distinctive because of the massive and uniform lithology of the anhydrite compared to the underlying beds. In cores, the transition is sharp, as described by Mercer et al. (1987) for DOE-2.

L1-1c(3) <u>The Castile Formation</u>

The Castile is the lowermost lithostratigraphic unit of the Late Permian Ochoan series (Figure L1-5). It was originally named by Richardson for outcrops in Culberson County, Texas. The Castile crops out along a lengthy area on the western side of the Delaware Basin. The two distinctive lithologic sequences, now known as the Castile and the Salado, were separated into the upper and lower Castile by Cartwright in 1930. Lang, in 1939, clarified the nomenclature by restricting the Castile to the lower unit and naming the upper unit the Salado. By defining an anhydrite resting on the marginal Capitan limestone as part of the Salado, Lang, in 1939, effectively restricted the Castile to the Delaware Basin inside the ancient reef rocks.

Through detailed studies of the Castile, Anderson et al. (1972) introduced an informal system of names that are widely used and included in many WIPP Project reports. They named the units, beginning at the base, as anhydrite I (A1), halite I (H1), anhydrite II (A2), etc. The informal nomenclature varies throughout the basin upwards from A3 because of the complexity of the depositional system. The Castile consists almost entirely of thick beds of two lithologies: 1) interlaminated carbonate and anhydrite, and 2) high-purity halite. The interlaminated carbonate and anhydrite are well known as possible examples of annual layering or varves.

In the eastern part of the Delaware Basin, the Castile is commonly 980 to 2,022 ft thick (299 to 616 m) (Powers et al, 1996, see also Borns and Shaffer, 1985, Figs. 9, 11, and 16 for a range based on fewer boreholes). At DOE-2, the Castile is 989 ft (301 m) thick. The Castile is thinner in the western part of the Delaware Basin, and it lacks halite units. Anderson et al. (1978) and Anderson (1978, Figs. 1, 3, 4, and 5) correlated geophysical logs, interpreting thin zones equivalent to halite units as dissolution residues. Anderson further interpreted the lack of halite in the basin as having been removed by dissolution.

For borehole DOE-2, a primary objective was to ascertain whether a series of depressions in the Salado, 2 mi (3.3 km) north of the site center, was from dissolution in the Castile as proposed by Davies in his doctoral thesis in 1984. Studies have suggested that these depressions were not due to dissolution but to halokinesis in the Castile (for example, see Borns (1987) and Chaturvedi (1987)). Robinson and Powers (1987) determined that one deformed zone in the western part of the Delaware Basin was partly due to synsedimentary, gravity-driven clastic deposition and suggested that the extent of dissolution may be overestimated. No Castile dissolution is known to be present in the immediate vicinity of the WIPP site. The process of dissolution and the resulting features are further discussed later in this addendum.

In Culberson County, Texas, the Castile hosts major native sulfur deposits. The outcrops of the Castile on the Gypsum Plain south of White's City, New Mexico, have been explored for native sulfur without success, and there is no reported indicator of native sulfur anywhere in the vicinity of the WIPP site.

In a portion of the area around the WIPP site, the Castile has been significantly deformed, and there are pressurized brines associated with the deformed areas; borehole ERDA-6 encountered both. WIPP-12, 1 mi (1.6 km) north of the WIPP site, revealed lesser Castile structure, but it also encountered a zone of pressurized brine within the Castile.

The Castile continues to be an object of research interest unrelated to the WIPP program as an example of evaporites supposedly deposited in "deep water." Anderson (1993) discusses alternatives and contradictory evidence. Similar discussions may eventually affect concepts of the Castile deposition and dissolution; however, this issue is largely of academic interest and bears no impact on the suitability of the Los Medaños region for the WIPP site.

L1-1c(4) The Salado Formation

The Salado is dominated by halite, in contrast to the underlying Castile, and extends well beyond the Delaware Basin. Lowenstein (1988) has termed the Salado a "saline giant." The Fletcher Anhydrite Member, which is deposited on the Capitan reef rocks, is defined by Lang (1939; 1942) as the base of the Salado. Some investigators believe the Fletcher Anhydrite Member may interfinger with anhydrites normally considered part of the Castile. The Castile/Salado contact is not uniform across the basin, and whether it is conformable is still under consideration. Around the WIPP site, the Castile/Salado contact is commonly placed at the top of a thick anhydrite informally designated as A3; the overlying halite is called the infra-Cowden salt and is included within the Salado. Bodine (1978) suggests that the clay mineralogy of the infra-Cowden in ERDA-9 cores changes at about 15 ft (4.6 m) above the lowermost Salado and that the lowermost clays are more like the Castile clays. The top of the thick anhydrite remains the local contact for differentiating the Salado from the Castile, and there is no known significance to the WIPP repository from these differences.

The Salado in the northern Delaware Basin is broadly divided into three informal members. (Figure L1-6 details the Salado stratigraphy.) The middle member is known locally as the McNutt potash zone, and it includes 11 defined potash zones, 10 of which are of economic significance in the Carlsbad Potash District. The lower and upper members remain unnamed. The WIPP repository level is located below the McNutt Potash Zone in the lower member.

Within the Delaware Basin, a system is used for numbering the more significant sulfate beds in the Salado, from Marker Bed 100 (near the top of the formation) to Marker Bed 144 (near the base). The system is generally used within the Carlsbad Potash District as well as the WIPP site. The facility horizon is located between Marker Bed 139 and Marker Bed 138.

In the central and eastern part of the Delaware Basin, the Salado is at its thickest, ranging up to about 2,000 ft (about 600 m) thick and consisting mainly of interbeds of sulfate minerals and halite, with halite dominating. The thinnest portions of the Salado consist of a brecciated residue of insoluble material a few tens of feet thick that are exposed at the surface in parts of the western Delaware Basin. The common sulfate minerals are anhydrite ($CaSO_4$), gypsum ($CaSO_42H_2O$) near the surface, and polyhalite ($K_2SO_4MgSO_42CaSO_42H_2O$). The sulfate minerals form beds and are also found along boundaries between halite crystals.

Early investigators of the Salado recognized a repetitious vertical succession, or cycle, of beds in the Salado: clay-anhydrite-polyhalite-halite and minor polyhalite-halite. Later investigators described the cyclical units as clay-magnesite-anhydrite, polyhalite or glauberite-halite-argillaceous halite capped by mudstone. Lowenstein (1988) defined a depositional cycle (Type I) consisting of: 1) basal mixed siliciclastic and carbonate (magnesite) mudstone, 2) laminated to massive anhydrite or polyhalite, 3) halite, and 4) halite with mud. Lowenstein in 1988 also recognized repetitious sequences of halite and halite with mud as incomplete Type I cycles and termed them Type II cycles. Lowenstein (1988) interpreted the Type I cycles as having formed in a shallowing upward, desiccating basin beginning with a perennial lake or lagoon of marine origin and evaporating to saline lagoon and saltpan environments. Type II cycles are differentiated because they do not exhibit features of prolonged subaqueous deposition and also have more siliciclastic influx than do Type I cycles.

From detailed mapping of the Salado in the air intake shaft (AIS) at the WIPP site, Holt and Powers (1990a) interpreted depositional cycles of the Salado in terms of modern features such as those at Devil's Golf Course at Death Valley National Monument, California. The evaporative basin was desiccated, and varying amounts of insoluble residues had collected on the surface through surficial dissolution, eolian sedimentation, and some clastic sedimentation from temporary flooding caused from surrounding areas. The surface developed local relief that could be mapped in some cycles, while the action of continuing desiccation and exposure increasingly concentrated insoluble residues. Flooding, most commonly from marine sources, reset the sedimentary cycle by depositing a sulfate bed.

The details available from the shaft demonstrated the important role of syndepositional water level to water table changes that created solution pits and pipes within the halitic beds while they were at the surface. Holt and Powers (1990a, Appendix F) concluded that passive halite cements filled the pits and pipes, as well as less dramatic voids, as the water table rose. Early diagenetic to synsedimentary cements filled the porosity early and rather completely with commonly clear and coarsely crystalline halite, reducing the porosity to a very small volume according to Casas and Lowenstein (1989).

Although Holt and Powers (1990a) found no evidence for postdepositional halite dissolution in the AIS, dissolution of the upper Salado halite has occurred west of the WIPP site. Effects of dissolution are visible in Nash Draw and at other localities where gypsum karst has formed, where units above the Salado such as the Rustler, the Dewey Lake Redbeds (Dewey Lake), and the post-Permian rocks have subsided. Dissolution studies are summarized in CCA Appendix DEF, Section DEF.3. The dissolution margin of upper Salado halite, based on changes in thickness of the interval from the Culebra dolomite to the Vaca Triste Sandstone Member of the Salado, has been interpreted in detail by Powers (2002a, 2002b, 2003a), Holt and Powers (2002), and Powers et al. (2003). Powers (2002a, 2002b, 2003a) examined data from additional drillholes and noted that the upper Salado dissolution margin appears relatively narrow in many areas, and it directly underlies much of Livingston Ridge. The hydraulic properties of the Culebra correlate in part with dissolution of halite from the upper Salado (Holt and Yarbrough 2002; Powers et al. 2003).

Within the Nash Draw, Robinson and Lang (1938) recognized a zone equivalent to the upper Salado but lacking halite. Test wells in the southern Nash Draw produced brine from this interval, and it has become known as the brine aquifer. Robinson and Lang in 1938 considered this zone a residuum from dissolution of Salado halite. Jones et al. (1960) remarked that the residuum should be considered part of the Salado, though geophysical log signatures may resemble the lower Rustler.

At the center of the site, Holt and Powers in their 1984 report recognized clasts of fossil fragments and mapped channeling in siltstones and mudstones above halite; they considered these beds to be a normal part of the transition from shallow evaporative lagoons and desiccated salt pans of the Salado to the saline lagoon of the lower Rustler. Although the Salado salt may have been dissolved prior to deposition of the Rustler clastics, the process is detached from the concept of subsurface removal of salt from the Salado in more recent time to develop a residuum and associated "brine aquifer."

Based on the Salado isopachs, thickness begins to change significantly near Livingston Ridge, the eastern margin of the Nash Draw. That should be the approximate eastward limit to the residuum and "brine aquifer," although the normal sedimentary sequence may yield limited fluids east of this margin.

The DOE believes the Salado is of primary importance to the containment of waste. As the principal natural barrier, many of the properties of the Salado have been characterized, and numerical codes were developed to simulate the natural processes within the Salado that affect the disposal system performance.

L1-1c(5) Rustler Formation

The Rustler is the youngest evaporite-bearing formation in the Delaware Basin. It was originally named by Richardson for outcrops in the Rustler Hills of Culberson County, Texas. Adams (1944) first used the names "Culebra member" and "Magenta member" to describe the two carbonates in the formation, indicating that W. B. Lang favored the names, although Lang did not use these names in his most recent publication. Vine in his 1963 work described extensively the Rustler in the Nash Draw and proposed the four formal names and one informal term for the stratigraphic subdivisions still used for the Rustler (from the base): the Los Medaños member, the Culebra member, the Tamarisk member, the Magenta member, and the Forty-niner member (Forty-niner) (Figure L1-7).

An additional system of informal subdivisions was contributed by Holt and Powers (1988, Fig. 3.2), based on more detailed lithologic units of the noncarbonate members (Figure L1-7). These subdivisions have partially been related to hydrostratigraphic units for the Rustler.

Two studies of the Rustler since Vine's 1963 work contribute important information about the stratigraphy, sedimentology, and regional relationships while examining more local details as well. Eager (1983) reported on relationships of the Rustler observed in the southern Delaware Basin as part of sulfur exploration in the area. Holt and Powers (1988, Chapter 5.0) reported the details of sedimentologic and stratigraphic studies of WIPP shafts and cores as well as of geophysical logs from about 600 boreholes in southeastern New Mexico.

The Rustler is regionally extensive (a similar unit in the Texas panhandle is also called the Rustler). Within the area around the WIPP site, evaporite units of the Rustler are interbedded with significant siliciclastic beds and carbonates. Both the Magenta and the Culebra extend regionally beyond areas of direct interest to the WIPP Project. In the general area of the WIPP site, both the Tamarisk and the Forty-niner have similar lithologies: lower and upper sulfate beds and a middle unit that varies principally from mudstone to halite from west to east (Figure L1-7).

In a general sense, halite in the Los Medaños broadly persists to the west of the WIPP site, and halite is found east of the center of the WIPP site in the Tamarisk and the Forty-niner (Figure L1-8). (Additional detail on the lithologies of these members follows.)

Two different explanations have been proposed over the history of the project to account for the observed distribution of halite in the non-dolomite members of the Rustler. The earliest researchers (e.g., Bachman [1985] and Snyder [1985]) assumed that halite had originally been present in all the non-sulfate intervals of the Forty-niner, Tamarisk, and Los Medaños Members, and that its present-day absence reflected post-depositional dissolution.

An alternative interpretation was presented by Holt and Powers (1988) following detailed mapping of the Rustler exposed in the WIPP shafts in 1984. Fossils, sedimentological features, and bedding relationships were identified in units that had previously been interpreted from boreholes as dissolution residues. Cores from existing boreholes, outcrops, geophysical logs, and petrographic data were also reexamined to establish facies variability across the area.

As a result of these studies, the Rustler was interpreted to have formed in variable depositional environments, including lagoon and saline playas, with two major episodes of marine flooding which produced the carbonate units. Sedimentary structures were interpreted to indicate synsedimentary dissolution of halite from halitic mudstones around a saline playa and fluvial transport of more distal clastic sediments. The halite in the Rustler, by this interpretation, has a present-day distribution similar to that at the time the unit was deposited. Some localized dissolution of halite may have occurred along the depositional margins, but not over large areas.

Hence, the absence of halite in Rustler members at the WIPP site more generally reflects non-deposition than dissolution.

This hypothesis was tested and refined by subsequent investigations (e.g., Powers and Holt 1990, 1999, 2000; Holt and Powers 1990a) and is now considered the accepted explanation for the present-day distribution of halite in the Rustler. Powers and Holt (1999) thoroughly described the sedimentary structures and stratigraphy of the Los Medaños as part of the procedure for naming the unit. This shows the basis for interpreting the depositional history of the member and for rejecting significant post-burial dissolution of halite in that unit. Powers and Holt (2000) further describe the lateral facies relationships in other Rustler units, especially the Tamarisk, developed on sedimentologic grounds, and rejected the concept of broad, lateral dissolution of halite from the Rustler across the WIPP site area.

The Culebra transmissivity shows about six orders of magnitude variation across the area around the site, and the changes have commonly been attributed to post-depositional dissolution of the Rustler halite. Powers and Holt (1990, 1999, and 2000) largely rule out this explanation. Variations in transmissivity of the Culebra were correlated qualitatively to the thickness of overburden above the Culebra (see discussion in Section 2.1.5.2), the amount of dissolution of the upper Salado, and the distribution of gypsum fillings in fractures in the Culebra (Beauheim and Holt 1990). Subsequently, Holt and Yarbrough (2002) and Powers et al. (2003) related the variation in Culebra transmissivity more quantitatively to overburden thickness and dissolution of upper Salado halite. The Permittees believe that variations in Culebra transmissivity are primarily caused by the relative abundance of open fractures in the unit, which may be related to each of these factors.

In the region around the WIPP site, the Rustler reaches a maximum thickness of more than 500 ft (152 m) (Figure L1-9), while it is about 300 to 350 ft (91 to 107 m) thick within most of the WIPP site. Much of the difference in the Rustler thickness can be attributed to variations in the amount of halite contained in the formation from place to place. The Tamarisk accounts for a larger part of thickness changes than do either the Los Medaños or the Forty-niner. Much project-specific information about the Rustler is contained in Holt and Powers (1988). The WIPP shafts were a crucial element in their study, exposing features not previously reported. Cores were available from several WIPP boreholes, and their lithologies were matched to geophysical log signatures to extend the interpretation throughout a larger area in southeastern New Mexico.

L1-1c(5)(a) The Los Medaños Member

The Los Medaños[1] rests on the Salado with apparent conformity at the WIPP site. It consists of significant proportions of bedded and burrowed siliciclastic sedimentary rocks with cross bedding and fossil remains. These beds record the transition from strongly evaporative

[1] The Los Medaños was named by Powers and Holt in 1999. Older documents refer to this unit as the "unnamed lower member" of the Rustler.

environments of the Salado to saline lagoonal environments. The upper part of the Los Medaños includes halitic and sulfitic beds within clastics. Holt and Powers (1988) interpret these as facies changes within a saline playa environment. The implied model from earlier descriptions is that the nonhalitic areas of the upper Los Medaños are dissolution residues from post-depositional dissolution.

As shown in Holt and Powers (1988), the Los Medaños ranges in thickness from about 96 to 126 ft (29 to 38 m) within the site boundaries. The maximum thickness recorded during that study was 208 ft (63 m) southeast of the WIPP site. Halite extends west of most of the site area in this unit (see Figure L1-8 for an illustration of the halite margins). Cross sections based on geophysical log interpretations in Holt and Powers (1988) show the relationship between the thickness of the unit and the presence of halite.

L1-1c(5)(b) The Culebra Dolomite Member

The Culebra rests with apparent conformity on the Los Medaños, though the underlying unit ranges from claystone to its lateral halitic equivalent in the site area. West of the WIPP site, in the Nash Draw, the Culebra is disrupted in response to dissolution of underlying halite. Holt and Powers (1988) attribute this principally to dissolution of the Salado halite, noting the presence of sedimentologic features in the lower Rustler (Powers and Holt, 1999).

The Culebra was described by Robinson and Lang in 1938 as a dolomite 35 ft (11 m) in thickness; Adams (1944) noted that oölites are present in some outcrops as well. The Culebra is generally brown, finely crystalline, locally argillaceous and arenaceous dolomite, with rare to abundant vugs with variable gypsum and anhydrite filling. Holt and Powers (1988) describe the Culebra features in detail, noting that most of the Culebra is microlaminated to thinly laminated, while some zones display no depositional fabric. Holt and Powers (1984) described an upper interval of the Culebra consisting of waxy, golden-brown carbonate, dark organic claystone, and some coarser siltstone of probable algal origin. Because of the unique organic composition of this thin layer, Holt and Powers (1984) did not include it in the Culebra for thickness computations, and this will be factored into discussions of Culebra thickness. Based on core descriptions from the WIPP Project, Holt and Powers (1988) concluded that there is very little variation of depositional sedimentary features throughout the Culebra.

Vugs are an important part of Culebra porosity (additional discussion on Culebra hydrologic characteristics is given in Section L1-2a[5]). They are commonly zoned parallel to bedding. In outcrop, vugs are commonly empty. In the subsurface, vugs may be filled with anhydrite or gypsum, or they may have some clay lining. Lowenstein (1988) noted similar features. Holt and Powers (1988) attribute vugs partly to syndepositional growth as nodules and partly, later, as replacive textures. Lowenstein (1988) also described textures related to later replacement and alteration of sulfates. Vugs or pore fillings vary across the WIPP site and contribute to the porosity structure of the Culebra. Natural fractures filled with gypsum are common east of the WIPP site center and in a smaller area west of the site center (Figure L1-10).

Holt (1997) reexamined geological and hydrological data for the Culebra and developed a conceptual model for transport processes. In this document, Holt (1997) recognized several porosity types for the Culebra, and separated four Culebra units (CU) informally designated CU-1 through CU-4 from top to bottom. CU-1 differs from underlying units because it has been disrupted very little by syndepositional processes. Microvugs and interbeds provide most of the porosity, and the permeability of CU-1 is relatively limited. CU-2 and CU-3 likely contribute most of the flow in the Culebra, and the significant difference is that CU-2 includes more persistent silty dolomite interbeds. CU-2 and CU-3 include "small-scale bedding-plane fractures, networks of randomly oriented small-scale fractures and microfractures, discontinuous silty dolomite interbeds, large vugs hydraulically connected with microfractures and small-scale fractures, microvugs hydraulically connected with microfractures and intercrystalline porosity, blebs of silty dolomite interconnected with microfractures and intercrystalline porosity, and intercrystalline porosity" (Holt 1997). Bedding-plane fractures dominate CU-4 at the base of the Culebra, and the unit shows some brittle deformation. CU-4 has not been isolated for hydraulic testing.

Holt (1997) also related porosity and solute transport, conceptualizing the medium "as consisting of advective porosity, where solutes are carried by the groundwater flow, and fracture-bounded zones of diffusive porosity, where solutes move through slow advection or diffusion." Holt (1997) noted that length or time scales will govern how each porosity type will contribute to solute transport.

After dolomite, Sewards et al. (1991) report that clay is the most abundant mineral of the Culebra. Clay minerals include corrensite, illite, serpentine, and chlorite. Clay occurs in bulk rock and in fracture surfaces.

In the WIPP site area, the Culebra varies in thickness. Different data sources provide varying estimates (Table L1-1). Holt and Powers (1988) considered the organic-rich layer at the Culebra/Tamarisk contact separately from the Culebra in interpreting geophysical logs.

Comparing data sets, Holt and Powers (1988) typically interpret the Culebra as being about 3 ft (about 1 m) thinner than have other sources. In general, this reflects the difference between including or excluding the unit at the Culebra/Tamarisk contact. Each data set shows areal differences in thickness of the Culebra when it is examined township by township.

LaVenue et al. (1988) calculated a mean thickness of 25 ft (7.7 m) for the Culebra based on 78 boreholes. This mean thickness has been used uniformly for the Culebra in PA calculations. Many of the boreholes represented multiple drilling locations (points) at individual hydrology drill pads H-2 through H-11. The multiple points at each drillhead normally would be considered a single location for statistical purposes. If each data point is considered to be distinct, the implication is that thickness varies significantly over the distances between these closely spaced boreholes, and it may not be consistent for calculations to use averaging thickness as a parameter. Mercer (1983, Table 1) reported a data set similar to LaVenue et al. (1988), but without statistics.

The borehole database makes it possible to defend choices of the Culebra thicknesses for the area being modeled. If repository performance is insensitive to Culebra thickness, defining the specific thickness of the Culebra is not important.

L1-1c(5)(c) The Tamarisk Member

Vine (1963) named the Tamarisk for outcrops near Tamarisk Flat in the Nash Draw. Outcrops of the Tamarisk are distorted, and subsurface information was used to establish member characteristics. Vine reported two sulfate units separated by a siltstone, about 5 ft (1.5 m) thick, interpreted by Jones et al. (1960) as a dissolution residue.

The Tamarisk is generally conformable with the underlying Culebra. The transition is marked by an organic-rich unit interpreted as being present over most of southeastern New Mexico. The Tamarisk around the site area consists of lower and upper sulfate units separated by a unit that varies from mudstone (generally to the west) to mainly halite (to the east). Near the center of the WIPP site, the lower anhydrite was partially eroded during deposition of the middle mudstone unit, as observed by in the WIPP Waste Shaft and the WIPP Exhaust Shaft. The lower anhydrite was completely eroded at WIPP-19. Before shaft exposures were available, the lack of the lower Tamarisk anhydrite at WIPP-19 was interpreted as the result of solution, and the mudstone was considered a cave filling.

Jones et al. (1960) interpreted halite to be present east of the center of the WIPP site based on geophysical logs and drill cuttings. Based mainly on cores and cuttings records from the WIPP site potash drilling program, Snyder prepared a map in 1985 showing the halitic areas of each of the noncarbonate Rustler members. A very similar map based on geophysical log characteristics was prepared independently by Powers in 1984 (see Figure L1-8).

Holt and Powers (1988) describe the mudstones and halitic facies in the middle of the Tamarisk, and they interpreted the unit as formed in a salt pan to mud-flat system. They cited sedimentary features and the lateral relationships as evidence of syndepositional dissolution of halite in the marginal mud-flat areas.

The Tamarisk thickness varies greatly in southeastern New Mexico, principally as a function of the thickness of halite in the middle unit. Within T22S, R31E, Holt and Powers (1988) show a range from 84 to 184 ft (26 to 56 m) for the entire Tamarisk and a range from 6 to 110 ft (2 to 34 m) for the interval of mudstone-halite between lower and upper anhydrites. Expanded geophysical logs with corresponding lithology illustrate some of the lateral relationships for this interval (Figure L1-11). See also Powers and Holt (2000).

L1-1c(5)(d) The Magenta Member

Adams (1944) attributes the name "Magenta member" to W. B. Lang, based on a feature north of Laguna Grande de la Sal named Magenta Point. According to Holt and Powers (1988), the Magenta is a gypsiferous dolomite with abundant primary sedimentary structures and well-developed algal features. It does not vary greatly in sedimentary features across the site area.

Holt and Powers (1988) reported that the Magenta varies from 23 to 28 ft (7.0 to 8.5 m); they did not contour the thickness because of limited changes.

L1-1c(5)(e) The Forty-niner Member

Vine (1963) named the Forty-niner for outcrops at Forty-niner Ridge in the eastern Nash Draw, but the outcrops of the Forty-niner are poorly exposed. In the subsurface around the WIPP site, the Forty-niner consists of basal and upper sulfates separated by a mudstone. It is conformable with the underlying Magenta. As with other members of the Rustler, geophysical log characteristics can be correlated with core and shaft descriptions to extend geological inferences across a large area (Holt and Powers, 1988).

The Forty-niner ranges from 43 to 77 ft (13 to 23 m) thick within T22S, R31E. East and southeast of the WIPP site, the Forty-niner exceeds 80 ft (24 m), and some of the geophysical logs from this area indicate halite is present in the beds between the sulfates. See also Powers and Holt (2000).

Within the Waste Shaft, the Forty-niner mudstone displays sedimentary features and bedding relationships indicating sedimentary transport. These beds have not been described in detail prior to mapping in the Waste Shaft at the WIPP site. The features found in the shaft led Holt and Powers (1988) to reexamine the available evidence for and interpretations of dissolution of halite in the Rustler units.

L1-1c(6) The Dewey Lake

The nomenclature for rocks included in the Dewey Lake was introduced during the 1960s to clarify relationships between these rocks assigned to the Upper Permian and the Cenozoic Gatuña Formation (Gatuña).

There are three main sources of data about the Dewey Lake in the area around the WIPP. Miller reported the petrology of the unit in 1955 and 1966. Schiel described outcrops in the Nash Draw areas and interpreted geophysical logs of the unit in southeastern New Mexico and west Texas to infer the depositional environments and stratigraphic relationships in 1988 and 1994. Holt and Powers (1990) were able to describe the Dewey Lake in detail at the AIS for the WIPP facility in 1990, confirming much of Schiel's information and adding data regarding the lower Dewey Lake.

The Dewey Lake overlies the Rustler conformably though local examples of the contact (e.g., the AIS described by Holt and Powers (1990a) show minor disruption by dissolution of some of the upper Rustler sulfate). The formation is predominantly reddish-brown fine sandstone to siltstone or silty claystone with greenish-gray reduction spots. Thin bedding, ripple cross-bedding, and larger channeling are common features in outcrops, and additional soft sediment deformation features and early fracturing are described from the lower part of the formation by Holt and Powers (1990). Schiel (1988; 1994) attributed the Dewey Lake to deposition on "a large, arid fluvial plain subject to ephemeral flood events."

There is no direct faunal or radiometric evidence of the age of the Dewey Lake in the vicinity of the WIPP site. It is assigned to the Ochoan series considered to be late Permian in age, and it is regionally correlated with units of similar lithology and stratigraphic position. Schiel in both 1988 and 1994 reviewed the limited radiometric data from lithologically similar rocks (Quartermaster Formation) and concluded that much of the unit could be early Triassic in age. Renne et al. (1996) resampled tephra from the Quartermaster in the Texas panhandle area and found that radiometric data support the idea that the Quartermaster is mainly Triassic in age rather than Permian. Others have begun to infer as well that the Dewey Lake in the vicinity of the WIPP site may be mostly Triassic (e.g., Powers and Holt 1999). These age relationships continue to be of academic interest because of the geologic significance of the Permo-Triassic boundary, but there is no significance for waste isolation at the WIPP repository.

Near the center of the WIPP site, Holt and Powers (1990) mapped 498 ft (152 m) of the Dewey Lake (Figure L1-12). The formation is thicker to the east (Schiel, 1994) of the WIPP site, in part because western areas were eroded before the overlying Triassic rocks were deposited.

The Dewey Lake is extensively fractured, and both cements and fracture fillings have been further examined to ascertain the possible contributions of surface infiltration to underlying units. Holt and Powers (1990) described the Dewey Lake as cemented by carbonate above 164.5 ft (50 m) in the AIS; some fractures in the lower part of this interval were also filled with carbonate, and the entire interval surface was commonly moist. Below this point, the cement is harder and more commonly anhydrite (Powers 2003b), the shaft is dry, and fractures are filled with gypsum. Powers (2002c; 2003b) reports core and geophysical log data supporting these vertical changes in natural mineral cements in the Dewey Lake over a larger region at a horizon that is believed to underlie known natural groundwater occurrences in the Dewey Lake. In areas where the Dewey Lake has been exposed to weathering after erosion of the overlying Santa Rosa, this cement boundary tends to generally parallel the eroded upper surface of the Dewey Lake, suggesting that weathering has affected the location of the boundary. Where the Dewey Lake has been protected by overlying rocks of the Santa Rosa, the cement change appears to be stratigraphically controlled but the data points are too few to be certain. Holt and Powers (1990) suggested the cement change might be related to infiltration of meteoric water. They also determined that some of the gypsum-filled fractures are syndepositional. The Dewey Lake fractures include horizontal to subvertical trends, some of which were mapped in detail (Holt and Powers, 1986).

Lambert (1991) analyzed the deuterium/hydrogen (D/H) ratios of gypsum from all of the various members of the Rustler and gypsum veins in the Dewey Lake and suggests that none of the gypsum formed from evaporitic fluid, such as Permian seawater. Rather, they last recrystallized in the presence of meteoric water. Several samples were collected from localities known or proposed as evaporitic karst features. Lambert (1991) infers that the gypsum D/H is not consistent with modern meteoric water, but it may be consistent with earlier meteoric fluids (Pleistocene or older) isotopically resembling Rustler meteoric water. There is no obvious correlation with depth indicating infiltration of modern surface-derived groundwaters or precipitation. Strontium isotope ratios ($^{87}Sr/^{86}Sr$) indicate no intermixing or homogenization of fluids between the various Rustler members and between the Rustler and the Dewey Lake, but there may be lateral movement of water within the Dewey Lake. The Dewey Lake carbonate vein material shows a broader range of strontium ratios than does surface caliche, and the ratios barely overlap. Lambert (1987) concluded, based on isotopic data that confined Rustler groundwaters have a minimal meteoric component, and have been isolated from the atmosphere for at least 12,000 to 16,000 years. These data also suggest that the present day Rustler hydrologic system is transient rather than at steady state.

L1-1c(7) The Santa Rosa

There have been different approaches to the nomenclature of rocks of the Triassic age in southeastern New Mexico. Bachman generally described the units in 1974 as “Triassic, undivided” or as the Dockum Group. Vine in 1963 used the term “Santa Rosa Sandstone.” “The Santa Rosa” has become common usage. Lucas and Anderson in 1993 imported other formation names that are unlikely to be useful for WIPP Project.

The Santa Rosa is disconformable over the Dewey Lake (Vine, 1963). The rocks of the Santa Rosa have more variegated hues than the underlying uniformly colored Dewey Lake. Coarse-grained rocks, including conglomerates are common, and the formation includes a variety of cross-bedding and sedimentary features (Lucas and Anderson, 1993).

Within the WIPP site boundary, the Santa Rosa is relatively thin to absent (Figure L1-13). At the AIS, Holt and Powers (1990, Fig. 5) attributed about 2 ft (0.6 m) of rock to the Santa Rosa. The Santa Rosa is a maximum of 255 ft (78 m) thick in potash holes drilled for the WIPP Project east of the site boundary. The Santa Rosa is thicker to the east.

The geologic data from design studies (Sergent et al. 1979) were incorporated with data from drilling to investigate shallow subsurface water in the Santa Rosa to provide structure and thickness maps of the Santa Rosa in the vicinity of the WIPP facility surface structures area (Powers 1997). These results are consistent with the broader regional distribution of the geologic structure of the Santa Rosa.

L1-1c(8) The Gatuña Formation

Lang in Robinson and Lang (1938) named the Gatuña for outcrops in the vicinity of the Gatuña Canyon in the Clayton Basin. Rocks now attributed to the Gatuña in Pierce Canyon were once included in the “Pierce Canyon Formation,” along with rocks now assigned to the Dewey Lake. The formation has been mapped from the Santa Rosa, New Mexico, area south to the vicinity of Pecos, Texas. It unconformably overlies different substrates.

Vine in 1963 and Bachman in 1974 provided some limited description of the Gatuña. The DOE’s most comprehensive study of the Gatuña is based on WIPP site investigations and landfill studies for Carlsbad and Eddy County. Much of the formation is colored light reddish-brown. It is broadly similar to the Dewey Lake and the Santa Rosa, though the older units have more intense hues. The formation is highly variable, ranging from coarse conglomerates to claystones with some highly gypsiferous sections. Sedimentary structures are abundant. Analysis of lithofacies indicates that the formation is dominantly fluvial in origin with areas of low-energy deposits and evaporitic minerals. It was deposited in part over areas actively subsiding in response to dissolution.

The thickness of the Gatuña is not very consistent regionally. Thicknesses range up to about 300 ft (91 m) at the Pierce Canyon, with thicker areas generally subparallel to the Pecos River. To the east, the Gatuña is thin or absent. Holt and Powers (1990a) reported about 9 ft (2.7 m) of undisturbed Gatuña in the AIS at the WIPP facility. Powers (1997) integrated data from facility design geotechnical work (Sergent et al. 1979) and drilling to investigate shallow water to develop maps of the Gatuña in the vicinity of the WIPP site surface facility. These maps are consistent with the broader regional view of the distribution of the Gatuña.

The Gatuña has been considered to be Pleistocene in age based on a volcanic glass in the upper Gatuña that has been identified as the Lava Creek B ash dated at 0.6 million years by Izett and Wilcox (1982). An additional volcanic ash from the Gatuña in Texas yields consistent K-Ar and geochemical data, indicating it is about 13 million years (Powers and Holt 1993). Thus the Gatuña ranges in age over a period of time that may be greater than the Ogallala Formation (hereafter referred to as the Ogallala) on the High Plains east of the WIPP site.

L1-1c(9) <u>The Mescalero Caliche</u>

The Mescalero Caliche is an informal stratigraphic unit apparently first differentiated by Bachman in 1974, though Bachman (1973) described the "caliche on the Mescalero Plain." He differentiated the Mescalero from the older, widespread Ogallala caliche or caprock on the basis of textures, noting that breccia and pisolitic textures are much more common in the Ogallala caliche. The Mescalero has been noted over significant areas in the Pecos drainage, including the WIPP area, and it has been formed over a variety of substrates. Bachman described the Mescalero as a two-part unit: (1) an upper dense laminar caprock and (2) a basal, earthy-to-firm, nodular calcareous deposit. Machette (1985) classified the Mescalero as having Stage V morphologies of a calcic soil (the more mature Ogallala caprock reaches Stage VI).

Bachman (1976, Figure 8) provided structure contours on the Mescalero caliche for a large area of southeastern New Mexico, including the WIPP site. From the contours and Bachman's discussion of the Mescalero as a soil, it is clear that the Mescalero is expected to be continuous over large areas. Explicit WIPP data are limited mainly to boreholes, though some borehole reports do not mention the Mescalero. The unit may be as much as 10 feet (3 meters) thick.

The Mescalero overlies the Gatuña and was interpreted by Bachman on basic stratigraphic grounds as having accumulated during the early-to-middle Pleistocene. Samples of the Mescalero from the vicinity of the WIPP site were studied using uranium-trend methods. Based on early written communication from Rosholt, Bachman (1985) reports that the basal Mescalero began to form about 510,000 years ago and the upper part began to form about 410,000 years ago; these ages are commonly cited in WIPP Project literature. The samples are interpreted by Rosholt and McKinney (1980, Table 5) in the formal report as indicating ages of 570,000 ± 110,000 years for the lower part of the Mescalero and 420,000 ± 60,000 years for the upper part.

According to Bachman (1985), where the Mescalero is flat-lying and not breached by erosion, it is an indicator of stability or integrity of the land surface over the last 500,000 years.

L1-1c(10) Surficial Sediments

Soils of the region have developed mainly from Quaternary and Permian parent material. Parent material from the Quaternary system is represented by alluvial deposits of major streams, dune sand, and other surface deposits. These are mostly loamy and sandy sediments containing some coarse fragments. Parent material from the Permian system is represented by limestone, dolomite, and gypsum bedrock. Soils of the region have developed in a semiarid, continental climate with abundant sunshine, low relative humidity, erratic and low rainfall, and a wide variation in daily and seasonal temperatures. Subsoil colors normally are light brown to reddish brown but are often mixed with lime accumulations (caliche) that result from limited, erratic rainfall and insufficient leaching. A soil association is a landscape with a distinctive pattern of soil types (series). It normally consists of one or more major soils and at least one minor soil. There are three soil associations within 5 mi (8.3 km) of the WIPP site: the Kermit-Berino, the Simona-Pajarito, and the Pyote-Maljamar-Kermit. Of these three associations, only the Kermit-Berino have been mapped across the WIPP site (by Chugg et al. [1952, Sheet No. 113]). These are sandy soils developed on eolian material. The Kermit-Berino include active dune areas. The Berino soil has a sandy A horizon; the B horizons include more argillaceous material and weak to moderate soil structures. A and B horizons are described as noncalcareous, and the underlying C horizon is commonly caliche. Bachman in 1980 interpreted the Berino soil as a paleosol that is a remnant B horizon of the underlying Mescalero.

Generally, the Berino which covers about 50 percent of the site, consists of deep, noncalcareous, yellow-red to red sandy soils that developed in wind-worked material of mixed origin. These soils are described as undulating to hummocky and gently sloping (ranging from 0 to 3 percent slopes). The soils are the most extensive of the deep, sandy soils in the Eddy County area. The Berino is subject to continuing wind and water erosion. If the vegetative cover is seriously depleted, the water-erosion potential is slight, but the wind-erosion potential is very high. These soils are particularly sensitive to wind erosion in the months of March, April, and May, when rainfall is minimal and winds are highest.

The Kermit consists of deep, light-colored, noncalcareous, excessively drained loose sands, typically yellowish-red fine sand. The surface is undulating to billowy (from 0 to 3 percent slopes) and consists mostly of stabilized sand dunes. The Kermit is slightly to moderately eroded. Permeability is very high, and if vegetative cover is removed, the water-erosion potential is slight, but the wind-erosion potential is very high. In 1980, Rosholt and McKinney applied uranium-trend methods to samples of the Berino from the WIPP site area. They interpreted the age of formation of the Berino as 330,000 ±75,000 years.

L1-1d Physiography and Geomorphology

In this section, the DOE presents a discussion of the physiography and geomorphology of the WIPP site and surrounding area.

L1-1d(1) Regional Physiography and Geomorphology

The WIPP site is in the Pecos Valley section of the southern Great Plains physiographic province (Figure L1-14), a broad highland belt sloping gently eastward from the Rocky Mountains and the Basin and Range Province to the Central Lowlands Province. The Pecos Valley section itself is dominated by the Pecos River Valley, a long north-south trough that is from 5 to 30 mi (8.3 to 50 km) wide and as much as 1,000 ft (305 m) deep in the north. The Pecos River system has evolved from the south, cutting headward through the Ogallala sediments and becoming entrenched some time after the middle Pleistocene. It receives almost all the surface and subsurface drainage of the region; most of its tributaries are intermittent because of the semiarid climate. The surface locally has a karst terrain containing superficial sinkholes, dolines, and solution-subsidence troughs from both surface erosion and subsurface dissolution. The valley has an uneven rock- and alluvium-covered floor with widespread solution-subsidence features, the result of dissolution in the underlying Upper Permian rocks. The terrain varies from plains and lowlands to rugged canyonlands, including such erosional features as scarps, cuestas, terraces, and mesas. The surface slopes gently eastward, reflecting the underlying rock strata. Elevations range from more than 6,000 ft (1,829 m) in the northwest to about 2,000 ft (610 m) in the south.

The Pecos Valley section is bordered on the east by the Llano Estacado, a virtually uneroded plain formed by river action. The Llano Estacado is part of the High Plains section of the Great Plains physiographic province and is a poorly drained, eastward-sloping surface covered by gravels, wind-blown sand, and caliche that has developed since early to middle Pleistocene time. Few and minor topographic features are present in the High Plains section, formed when more than 500 ft (152 m) of Tertiary silts, gravels, and sands were laid down in alluvial fans by streams draining the Rocky Mountains. In many areas, the nearly flat surface is cemented by a hard caliche layer.

To the west of the Pecos Valley section are the Sacramento Mountains and the Guadalupe Mountains, part of the Sacramento section of the Basin and Range Province. The Capitan Escarpment along the southeastern side of the Guadalupe Mountains marks the boundary between the Basin and Range and the Great Plains Provinces. The Sacramento section has large basinal areas and a series of intervening mountain ranges.

L1-1d(2) Site Physiography and Geomorphology

The land surface in the area of the WIPP site is a semiarid, wind-blown plain sloping gently to the west and southwest and is hummocky with sand ridges and dunes. A hard caliche layer (Mescalero caliche) is typically present beneath the sand blanket and on the surface of the underlying Pleistocene Gatuña. Figure L1-15 is a topographic map of the area. Elevations at the site range from 3,570 ft (1,088 m) in the east to 3,250 ft (990 m) in the west. The average east-to-west slope is 50 ft per mi (9.4 m per km).

The Livingston Ridge is the most prominent physiographic feature near the site. It is a west-facing escarpment that has about 75 ft (23 m) of topographic relief and marks the eastern edge of the Nash Draw, the drainage course nearest to the site. The Nash Draw is a shallow 5-mile-wide (8-km-wide) basin, 200 to 300 ft (61 to 91 m) deep and open to the southwest. It was caused, at least in part, by subsurface dissolution and the accompanying subsidence of overlying sediments. The Livingston Ridge is the approximate boundary between terrain that has undergone erosion and/or solution collapse and terrain that has been affected very little.

About 18 mi (24 km) east of the site is the southeast-trending San Simon Swale, a depression due, at least in part, to subsurface dissolution (Figure L1-1). Between San Simon Swale and the site is a broad, low mesa named "the Divide." Lying about 6 mi (9.7 km) east of the site and about 100 ft (30 m) above the surrounding terrain, the Divide is a boundary between southwestern drainage toward the Nash Draw and southeastern drainage toward the San Simon Swale. The Divide is capped by the Ogallala and the overlying caliche, upon which have formed small, elongated depressions similar to those in the adjacent High Plains section to the east.

Surface drainage is intermittent; the nearest perennial stream is the Pecos River, 12 mi (19 km) southwest of the WIPP site boundary. The site's location near a natural divide protects it from flooding and serious erosion caused by heavy runoff. Should the climate become more humid, any perennial streams should follow the present basins, and the Nash Draw and the San Simon Swale would be the most eroded, leaving the area of the Divide relatively intact.

Dissolution-caused subsidence in the Nash Draw and elsewhere in the Delaware Basin has caused a search for geomorphic indications of subsidence near the site. One feature that has attracted some attention is a very shallow sink about 2 mi (3 km) north of the center of the site. It is very subdued, about 1,000 ft (305 m) in diameter, and about 30 ft (9 m) deep. Resistivity studies indicate a very shallow surficial fill within this sink and no disturbance of underlying beds, implying a surface, rather than subsurface, origin. Resistivity surveys in the site area showed an anomaly in Section 17 within the WIPP site boundary. It resembles the pattern over a known sink, a so-called breccia pipe, but drilling showed a normal subsurface structure without breccia, and the geophysical anomaly is assumed to be caused by low-resistivity rock in the Dewey Lake.

L1-1e Tectonic Setting and Site Structural Features

The processes and features included in this section are those more traditionally considered part of tectonics, broad-scale processes that develop the features of the earth. Salt dissolution is a different process that can develop some features resembling those of tectonics.

Broad-scale structural elements of the area around the WIPP site developed over geological time, and most formed during the late Paleozoic. There is little historical or recent geological evidence of significant tectonic activity in the vicinity. More recently, the entire region has tilted, and activity related to Basin and Range tectonics formed major structures southwest of the area. Seismic activity is specifically addressed in Section L1-4.

Broad subsidence began in the area as early as the Ordovician, developing a sag called the Tabosa Basin. By late Pennsylvanian to early Permian time, the Central Basin Platform developed (Figure L1-16), separating the Tabosa Basin into two parts: the Delaware Basin to the west and the Midland Basin to the east. The Permian Basin refers to the collective set of depositional basins in the area during the Permian period. Southwest of the Delaware Basin, the Diablo Platform began developing either late in the Pennsylvanian or early Permian. The Marathon Uplift and Ouachita tectonic belt limited the southern extent of the Delaware Basin. Most of these broader scale features surrounding the Delaware Basin formed during the late Paleozoic and have remained relatively constant in their relationships since.

L1-1e(1) Basin Tilting

According to Brokaw et al. (1972) pre-Ochoan sedimentary rocks in the Delaware Basin show evidence of gentle downwarping during deposition, while Ochoan and younger rocks do not. A relatively simple eastward tilt generally from about 75 to 100 ft per mi (14 to 19 m per km) has been superimposed on the sedimentary sequence. King (1948) generally attributes the uplift of the Guadalupe and Delaware mountains along the west side of the Delaware Basin to later Cenozoic, though he also notes that some faults along the west margin of the Guadalupe Mountains have displaced Quaternary gravels.

King (1948) also infers that the uplift is related to the Pliocene-age deposits of the Llano Estacado. Subsequent studies of the Ogallala of the Llano Estacado show that it ranges in age from Miocene (about 12 million years before present) to Pliocene. This is the most likely time range for uplift of the Guadalupe Mountains and broad tilting to the east of the Delaware Basin sequence.

L1-1e(2) Faulting

Fault zones are well known along the Central Basin Platform, east of the WIPP site, from extensive drilling for oil and gas as reported by Hills (1984). Holt and Powers performed a more recent analysis in 1988 of geophysical logs to examine regional geology for the Rustler that showed these faults displaced, at least, the Rustler rocks of late Permian age. The overlying Dewey Lake shows marked thinning along the same trend as the fault line or zone according to Schiel (1988), but the structure contours of the top of the Dewey Lake are not clearly offset. Schiel (1988) concluded that the fault was probably reactivated during Dewey Lake deposition, but movement ceased at least by the time the Santa Rosa was deposited. No surface displacement or fault has been reported along this trend, indicating movement has not been significant enough to rupture the overlying materials since Permian time.

Within the Delaware Basin, there are few examples of faults that may offset part of the evaporite section. At the northern end of the WIPP site, Snyder in Borns et al. (1983) drew structure contours on the top of the basal A1 of the Castile for boreholes WIPP-11, WIPP-12, and WIPP-13. Northeast-southwest-trending faults were interpreted to displace this unit both north and south of WIPP-11 (Borns et al., 1983). Snyder inferred that the Bell Canyon/Castile contact is also faulted and displaced along the same trend. Barrows in Borns et al. (1983) interpreted seismic reflection data to indicate, with varying confidence, faults within Castile rocks but not in underlying units.

The faults interpreted by Snyder (Borns et al., 1983) around WIPP-11 depend on the correct identification of the basal Castile anhydrite (A1) in that borehole. The evaporite structure is complex, and some of the upper units of the Castile and the lower Salado differ from surrounding boreholes. The diagnostic Castile/Bell Canyon contact was not reached by this borehole, and the faults inferred for the Castile/Bell Canyon contact also depend on correct identification of A1 and projection of A1 thickness by Snyder (Borns et al., 1983). Inferred connections with the underlying Bell Canyon or deeper units could signify circulation of fluids to the evaporite section within the site boundaries. This is unlikely, given the Castile geology within boreholes WIPP-13 and DOE-2 near the trend of the inferred fault. The structure contour maps by Snyder were based on data obtained from WIPP-11, however, when WIPP-13 and DOE-2 were drilled much later, the projected trends by Snyder were not valid. WIPP-13 and DOE-2 did not show evidence of complex structure in the upper limits of the Castile and lower Salado. Drilling for hydrocarbon exploration has been extensive around the northern and western boundaries of the site since the mid-1980s.

Muehlberger et al. (1978) have mapped quaternary fault scarps along the Salt Basin graben west of both the Guadalupe and the Delaware Mountains. These are the nearest known Quaternary faults of tectonic origin to the WIPP site. Kelley in 1971 inferred the Carlsbad and Barrera faults along the eastern escarpment of the Guadalupe Mountains based mainly on vegetative linaments. Hayes and Bachman reexamined the field evidence for these faults in 1979 and concluded that they were nonexistent.

On a national basis, Howard et al. (1971) assessed the location and potential for activity of young faults. For the region around the WIPP site, Howard et al. (1971) located faults along the western escarpment of the Delaware and the Guadalupe mountains trend. These faults were judged to be late Quaternary (approximately the last 500,000 years) or older.

In summary, there are no known Quaternary or Holocene faults of tectonic origin offsetting rocks at the surface nearer to the site than the western escarpment of the Guadalupe Mountains. A significant part of the tilt of basin rocks is attributed to a mid-Miocene to Pliocene uplift along the Guadalupe/Sacramento mountains trend that is inferred on the basis of High Plains sediments of the Ogallala. Seismic activity is low and is commonly associated with secondary oil recovery along the Central Basin Platform.

L1-1e(3) Igneous Activity

Within the Delaware Basin, only one feature of igneous origin is known to have formed since the Precambrian. An igneous dike or series of echelon dikes occurs along a linear trace about 75 mi (120 km) long from the Yeso Hills south of White's City, New Mexico, to the northeast. At its closest, the dike trend passes about 8 mi (13 km) northwest of the WIPP site center. Evidence for the extent of the dike ranges from outcroppings at Yeso Hills to subsurface intercepts in boreholes and mines to airborne magnetic responses.

An early radiometric determination by Urry (1936) for the dike yielded an age of 30 ± 1.5 million years. Work by Calzia and Hiss (1978) on dike samples are consistent with early work, indicating an age of 34.8 ±0.8 million years. Work by Brookins et al. (1980) on dike samples in contact with polyhalite indicated an age of about 21.4 million years.

Volcanic ashes found in the Gatuña were airborne from distant sources such as Yellowstone and do not represent volcanic activity at the WIPP site.

L1-1e(4) Loading and Unloading

Loading and unloading during the geological history since deposition is considered an influence on the hydrology of the Permian units because of its possible effect on the development of fractures (Powers and Holt, 1995).

The sedimentary loading, depth of total burial, and erosion events combine in a complex history reconstructed here from regional geological trends and local data. The history is presented in Figure L1-17 with several alternatives, depending on the inferences that are drawn, ranging from minimal to upper-bound estimates. The estimates are made with a reference point and depth to the Culebra at the AIS (Holt and Powers, 1990a).

Given the maximum local thickness of the Dewey Lake, the maximum load at the end of the Permian was no more than approximately 787 feet (240 meters). Given the present depth to the Culebra from the top of the Dewey Lake in the AIS, approximately 115 feet (35 meters) of Dewey Lake might have been eroded during the Early Triassic before additional sediments were deposited. The Triassic thickness at the AIS is approximately 26 feet (8 meters). Northeast of the WIPP site (T21S, R33E), Triassic rocks (Dockum Group) have a maximum local thickness of approximately 1,233 feet (373 meters). This thickness is a reasonable estimate of the maximum thickness also attained at the WIPP site prior to the Jurassic Period. At the end of the Triassic, the total thickness at the WIPP site may have then attained approximately 1,863 feet (586 meters) in two similar loading stages of a few million years each, over a period of approximately 50 million years.

The Jurassic outcrops nearest to the WIPP site are in the Malone Mountains of west Texas. There is no evidence that Jurassic rocks were deposited at or in the vicinity of the WIPP site. As a consequence, the Jurassic is considered a time of erosion or nondeposition at the site, though erosion is most likely.

This much erosion during the Jurassic obviously cannot be broadly inferred for the area or there would not be thick Triassic rocks still preserved. Triassic rocks of this thickness are preserved nearby, indicating either pre-Jurassic tilting or that erosion did not occur until later (but still after tilting to preserve the Triassic rocks near the WIPP site). It is also possible that the immediate site area had little Triassic deposition or erosion, but very limited Triassic deposition (that is, 26 feet (8 meters)) at the WIPP site seems unlikely.

Lang (1947) reported fossils from Lower Cretaceous rocks in the Black River Valley southwest of the WIPP site. Bachman (1980) also reported similar patches of probable Cretaceous rocks near Carlsbad and south of White's City. From these reports, it is likely that some Cretaceous rocks were deposited at the WIPP site. Approximately 70 miles (110 kilometers) south-southwest of the WIPP site, significant Cretaceous outcrops of both Early and Late Cretaceous age have a total maximum thickness of approximately 1,000 feet (300 meters). Southeast of the WIPP site, the nearest Cretaceous outcrops are thinner and represent only the Lower Cretaceous. Based on outcrops, a maximum thickness of 1,000 feet (300 meters) of Cretaceous rocks could be estimated for the WIPP site. Compared to the estimate of Triassic rock thickness, it is less likely that Cretaceous rocks were this thick at the site. The uppermost lines of Figure L1-17 summarize the assumptions of maximum thickness of these units.

A more likely alternative is that virtually no Cretaceous rocks were deposited, followed by erosion of remaining Triassic rocks during the Late Cretaceous to the Late Cenozoic. Such erosion may also have taken place over an even longer period, beginning with the Jurassic Period. Ewing (1993) favors Early Cretaceous uplift and erosion for the Trans-Pecos Texas area, but he does not analyze later uplift and erosional patterns.

In the general vicinity of the WIPP site, there are outcrops of Cenozoic rock from the Late Miocene (Gatuña and Ogallala Formations). There is little reason to infer any significant Early Cenozoic sediment accumulation at the WIPP site. Erosion is the main process inferred to have occurred during this period and an average erosion rate of approximately 11 meters per million years is sufficient during the Cenozoic to erode the maximum inferred Triassic and Cretaceous thickness prior to Gatuña and Ogallala deposition. Significant thicknesses of Cretaceous rocks may not have been deposited, however, and average erosion rates could have been lower.

Maximum-known Gatuña thickness in the area around the WIPP site is approximately 330 feet (100 meters); at the WIPP site the Gatuña is very thin to absent. Ogallala deposits are known from the Divide east of the WIPP site, as well as from the High Plains further east and north. On the High Plains northeast of the WIPP site, the Upper Ogallala surface slopes to the southeast at a rate of approximately 20 feet per mile (4 meters per kilometer). A straight projection of the 4,100-foot (1,250-meter) contour line from this High Plains surface intersects the site area, which is at an elevation slightly above 3,400 feet (1,036 meters). This difference in elevation of 700 feet (213 meters) represents one estimate, probably near an upper bound, of possible unloading subsequent to deposition of the Ogallala Formation.

Alternatively, the loading and unloading of the Ogallala could have been closer to 330 feet (100 meters). In any case, it would have occurred as a short-lived pulse over a few million years at most.

While the above inferences about greater unit thicknesses and probable occurrence are permissible, a realistic assessment suggests a more modest loading and unloading history. It is likely that the Dewey Lake accumulated to near local maximum thickness of approximately 787 feet (240 meters) before being slightly eroded prior to the deposition of Triassic rocks. It also is most probable that the Triassic rocks accumulated at the site to near local maximum thickness. In two similar cycles of rapid loading, the Culebra was buried to a depth of approximately 2,132 feet (650 meters) by the end of the Triassic.

It also seems unlikely that a significant thickness of Cretaceous rock accumulated at the WIPP site. Erosion probably began during the Jurassic, slowed or stopped during the Early Cretaceous as the area was nearer or at base level, and then accelerated during the Cenozoic, especially in response to uplift as Basin and Range tectonics encroached on the area and the basin was tilted more. Erosional beveling of Dewey Lake and Santa Rosa suggest considerable erosion since tilting in the mid-Cenozoic. Erosion rates for this shorter period could have been relatively high, resulting in the greatest stress relief on the Culebra and surrounding units. Some filling occurred during the Late Cenozoic as the uplifted areas to the west formed an apron of Ogallala sediment across much of the area, but it is not clear how much Gatuña or Ogallala sediment was deposited in the site area. From general reconstruction of Gatuña history in the area (Powers and Holt 1993), the DOE infers that Gatuña or Ogallala deposits likely were not much thicker at the WIPP site than they are now. The loading and unloading spike (Figure L1-17) representing Ogallala thickness probably did not occur. Cutting and headward erosion by the Pecos River has created local relief and unloading by erosion. At the WIPP site, this history is little complicated by dissolution, though locally (for example, Nash Draw) the effects of erosion and dissolution are more significant. The underlying evaporites have responded to foundering of anhydrite in less dense halite beds. These have caused local uplift of the Culebra (as at ERDA 6) but little change in the overburden at the WIPP site. Areas east of the WIPP site are likely to have histories similar to that of the site. West of the site, the final unloading is more complicated by dissolution and additional erosion leading to exposure of the Culebra along stretches of the Pecos River Valley.

L1-1f Nontectonic Processes and Features

Halite in evaporite sequences is relatively plastic, which can lead to the process of deformation; it is also highly soluble, which can lead to the process of dissolution. Both processes (deformation and dissolution) can develop structural features similar to those developed by tectonic processes. The features developed by dissolution and deformation can be distinguished from similar-looking tectonic features where the underlying units do not reflect the same feature as do the evaporites. Beds underlying areas of dissolved salt are not affected, but overlying units to the surface may be affected. As an example, evaporite deformation can commonly be shown not to affect the underlying Bell Canyon. The deformation also tends to die out in overlying units, and the Rustler or the Dewey Lake may show little, if any, of the effects of the deformed evaporites.

L1-1f(1) Evaporite Deformation

The most recent review of evaporite deformation in the northern Delaware Basin and original work to evaluate deformation is summarized here.

L1-1f(1)(a) Basic WIPP History of Deformation Investigations

Gravity-Driven Structure in the Castile Formation

This document describes the structural features in the Castile that are commonly attributed to gravity-driven deformation. In order to properly present this subject, the data will first be presented in a general historical overview. The known extent of deformation in the Castile, how these structures are likely to develop in the future, how well they can be predicted, and the potential impact law act of these structures on the WIPP site will also be discussed. Apart from the general geological impact, the performance of the WIPP repository as it might be affected by such structures is not specifically assessed here.

Background Information

Parts of the Castile have been known for a number of years to be deformed. Cross sections of the basin geology through its margins have shown some evidence of deformation. Jones et al. (1973) provided a map of the isopachs of part of the Castile that clearly show much thicker portions in some of the areas along the northwestern to northern Delaware Basin, just inside the margin of the Capitan reef. Very little information was collated concerning deformation within the Delaware Basin prior to studies of the basin as a possible site for radioactive waste disposal.

Jones et al. (1973) is probably the most lucid early presentation of this information, although a dissertation by Snider (1966) and a paper by Anderson et al. (1972) also reflect thicker sections in some Castile units adjacent to the reef.

In 1975, SNL drilled a borehole, ERDA-6, at a site (Figure L1-18) that had been partially investigated by Oak Ridge National Laboratories (ORNL) during 1974. Two boreholes (AEC-7 and AEC-8) had been drilled in 1974 by ORNL. Formation boundaries and marker beds in ERDA-6 were structurally high compared to AEC-7 and AEC-8, and the degree of deformation increased downward. At about the 2,711-ft (826-m) depth, ERDA-6 began to produce pressurized brine and gas. The hole was eventually tested extensively to determine the nature and origin of the brine. Beds within the Castile were displaced structurally upward, apparently by hundreds of feet (Jones, 1981; Anderson and Powers, 1978), and some of the lower units may have actually pierced upper units (Anderson and Powers, 1978). Because of the desire for structurally uncomplicated units to simplify mining for a repository, the site under investigation at ERDA-6 was abandoned in 1975. In 1975-76 the current site was initially selected, and investigations were begun (Powers et al., 1978). As part of the selection criteria, a zone about 6 mi (10 km) wide inside the Capitan reef was avoided because it included known deformed Castile and Salado (Griswold, 1977). This is the first instance in which the site investigations were directly influenced by discovery of deformation in the Castile and the lower Salado.

The present site for the WIPP facility was selected and initially investigated in 1976 to determine if the desired characteristics for the preliminary site selection were present (Griswold, 1977; Powers et al.,1978). As the general criteria appeared to be met during this phase, the site and surrounding areas were characterized much more extensively and intensively beginning in 1977. Extensive new seismic reflection data were collected in 1977 and 1978 that began to reveal the deformed Castile north of the center of the site (Figure L1-19). Because the principal effect was that the good quality Castile seismic reflectors from the area south of the site center were “disturbed,” the area to the north was dubbed the “disturbed zone” (DZ). It also became known as “the area of anomalous seismic reflectors,” or the “zone of anomalous seismic reelection data.” The boundary of the DZ was variously described as being from about 0.5 to 1 mi (0.8 to 1.6 km) north of the center of the site, depending on the criteria to define the DZ. Powers et al. (1978) generally defined the DZ as beginning about 1 mi (1.6 km) north of the site center, where the seismic reflector character was poor to uninterpretable or “anomalous” (Borns et al., 1983). About 0.5 mi (0.8 km) north of the site center, it appeared that beds within the Castile began to steepen in gradient, dipping to the south from a higher area to the north. The Environmental Evaluation Group (EEG) summarized various map limits to the DZ, including the area where the Castile dip begins to steepen (Neill et al., 1983). Borns et al. (1983) included two separate areas south of the site as part of the DZ-based seismic character.

The first new drillhole within the area encompassed by the DZ was WIPP-11, and it was located about 3 mi (5 km) north of the center of the WIPP site (Figure L1-18). Long and Associates (1977) examined proprietary petroleum company data in 1976, and they identified anomalous areas around the WIPP site, including the structural anomaly at the WIPP-11 location. Seismic reflection data acquired in 1977 indicated possible salt flowage within the Castile and a structure that could be similar to that at ERDA-6 (SNL and USGS, 1979). WIPP-11 was drilled early in 1978, demonstrating the extensive deformation within the Castile and extending upward into the Salado. WIPP-11 did not encounter any brine or gas flows.

Seismic reflection data acquired in 1977 not only showed a zone of steepened dip of the Castile north of the site center, it also showed a possible fault offsetting parts of the Salado and the Rustler. A series of five boreholes were planned to provide detailed information on the structure of the Rustler/Salado contact. Four boreholes (WIPP-18, -19, -21, and -22) were required to demonstrate that there was no detectable offset on that contact in the area interpreted from 1977 seismic reflection data (Figure L1-18). Later epochs (1978 and 1979) of seismic data in the same area, along with the drilling, continued to show generally poor resolution or uninterpretable data in the area of the DZ. These studies generally showed that the acoustic velocity of the upper section changes laterally, complicating further the interpretation of the deeper Castile structure. Through the WIPP-18 to 22 drilling program, the upper Salado and the Rustler were determined to be fundamentally undisturbed over the southern margin of the disturbed zone where the Castile appears to dip to the south (SNL and USGS, 1979).

The upper part of the Castile about 1 mi (1.6 km) north of the WIPP site center was interpreted to range from about 250 ft to as much as 400 ft (100 to 120 m) (SNL and D'Appolonia Consulting Engineers, 1982a) above the elevation of the top of the Castile at about the center of the WIPP site. WIPP-12 was located approximately 1 mi (1.6 km) north of the site center to test the amount the Castile was elevated (Figures L1-18 and L1-19). It was drilled late in 1978 to the top of the Castile and detected approximately 160 ft (50 m) of structural elevation compared to ERDA-9 and the center of the site (SNL and D'Appolonia Consulting Engineers, 1982a). The amount of disturbance of the Salado was not considered to be an impediment to underground development, although the underground storage facility was later reoriented away from this northern area to an area south of the site center. From drilling WIPP-12 and the WIPP-18 to 22 series, the southern margin of the DZ was considered to be much more gentle in structure, while the seismic character and WIPP-11 indicated much more severe deformation of the Castile further to the north.

Two additional phases of seismic reflection data were acquired in 1978 and 1979. These data mainly concerned the immediate site area (about 4 square mi [10 square km]) and the southern edge of the DZ. They indicated much the same problems and margins associated with the DZ from the 1977 data. The latest seismic data (1979) were principally acquired to facilitate construction and Site and Preliminary Design Validation (SPDV) activities. As the project moved into SPDV activities, the DZ was little investigated directly during the period from about late 1979 until mid-1981.

A microgravity survey of the site area was conducted to determine if the structure within the DZ could be partially resolved (Barrows et al., 1983; Barrows and Fett, 1985). The large differences in density of halite and anhydrite could cause detectable differences in the gravity field locally if the units were displaced and/or thickened relative to the surrounding areas. The microgravity survey covered an area of "normal" stratigraphy from south of the WIPP site center to the area of WIPP-11 (Figure L1-20). As interpreted (Barrows et al., 1983), the microgravity does not resolve the larger scale deformation within the Castile. Based on the interpretation of probable shallow disturbance of the gravity field, WIPP-14 and WIPP-34 were drilled about 2 mi (3 km) north and about 0.5 mi (0.8 km) east of the site center (Figure L1-18). These boreholes encountered normal stratigraphy within the Rustler and upper Salado (SNL and D'Appolonia Consulting Engineers, 1982b; SNL and USGS, 1981), with some slight structural depression made apparent mainly by the deformation northeast of this area around ERDA-6 (Holt and Powers, 1988). Barrows et al. (1983) attributed the gravity anomaly around WIPP-14 to decreased density within parts of the Rustler, mainly from the difference in density due to anhydrite versus gypsum in WIPP-14. The overall difference in mass was attributed to karst processes by Barrows et al. (1983) rather than to deformation of any of the units associated with the DZ.

During the mapping of the first shaft drilled at the WIPP site (the Salt Handling Shaft), Marker Bed 139 was observed to have a few inches of relief on the basal contact and 2 to 3 ft (0.6 to 0.9 m) of relief on the upper surface. Jarolimek et al. (1983) interpreted the internal structure on these high points of Marker Bed 139 as showing a radial structure due apparently to gypsum growth textures and subsequent crushing, indicating a fundamentally depositional origin to the relief rather than any structural disturbance related to the DZ. Borns and Shaffer (1985) conducted an investigation of additional cores and holes drilled through Marker Bed 139, as there was concern on the part of the EEG that the apparent structure was related to the DZ. Borns and Shaffer (1985) also concluded that the relief was not due to structural deformation, but instead, was due mainly to erosional processes that carved part of the relief found on the top of the Marker Bed. From either point of view, the difference in relief on the upper and basal contacts of Marker Bed 139, in such a thin unit, were convincing evidence that a form of tectonic deformation was not involved.

In late 1981, WIPP-12 was deepened to test for the possible presence of brine and/or pressurized gas within the structure in the Castile (D'Appolonia Consulting Engineers, 1982). The probability of producing brine/gas from WIPP-12 was considered reasonably low at the time, because most known pressurized brine/gas was associated with much more deformed units in the Castile at WIPP-12. Fractured anhydrite in the upper Castile did begin to yield pressurized brine and gas when intercepted late in 1981, and WIPP-12 and ERDA-6 were further tested. Later geophysical work (Earth Technology Corporation, 1987) suggests that the brine may underlie part of the WIPP facility, beyond the area usually included in the DZ. Though the DOE and the EEG agreed that the structure did not constitute a threat to health and safety, the proposed underground facilities were reoriented south of the site center, avoiding longer haulage and the slight structure encountered at the facility horizon. As a consequence of the deepening and testing of WIPP-12, the link between structure and pressurized brine and gas was strengthened.

The last direct investigation of the DZ was a by-product of another investigation. DOE-2 was drilled approximately 2 mi (3.2 km) north of the center of the WIPP site to investigate the origin of a modest depression on Marker Bed 124 (Griswold, 1977; Powers et al., 1978) that was detected in a core hole drilled by a potash company. DOE-2 was principally a test of the hypothesis that the depression was caused by ductile flow of halite in response to deep dissolution of halite by water from the Bell Canyon (Mercer et al., 1987). Halite layers in the lower Salado were thicker than usual, indicating that part of the sequence had not been dissolved, and the Castile was very deformed. The Castile stratigraphy was not normal; the second halite was apparently squeezed out of the area during deformation. The stratigraphy in DOE-2 is apparently the result of processes which caused the DZ and is not the result of any dissolution (Borns, 1987; Mercer et al., 1987).

The preceding paragraphs describe most of the direct investigations of the disturbed zone and place them in their historical context. In the following text, more of the specific features of the DZ will be described, interpreted, and discussed to indicate the significance of the structures and processes of formation for the WIPP repository.

Specific Features of the Disturbed Zone

The first specific feature of the DZ is its boundary. As discussed above, the different concepts of the boundary depend on ideas of where the Castile began to change and steepen its dip (about one-half mi [0.8 km] north of the site center) or where the seismic data became unreliable to uninterpretable. Borns et al. (1983) present one diagram (Figure L1-19) of the seismic time structure for the top of the Castile that illustrates the variously defined boundaries. The principal part of the disturbed zone is defined by a lobate area (Figure L1-19) shown as an “area of complex structure” where the seismic data are considered “ambiguous.” The structurally deformed area clearly includes an area about halfway between boreholes WIPP-12 and ERDA-9, as well as a larger area to the northeast. The two-way travel time contoured on the map is a function of depth; as the seismic reflector is nearer the surface, the travel time to the reflector and back to the surface decreases. Thus, the areas enclosed with contours of smaller values should be interpreted as structurally higher. (The top of the Castile in WIPP-12 was 160 ft [50 m] higher than it is in ERDA-9.) The map was not directly converted to depth because the seismic reflection and borehole geophysical logging programs clearly demonstrate that there are also lateral velocity variations within the upper part of the rock section, especially within the Rustler and the Dewey Lake. These velocity variations cannot be extracted from the travel times adequately to permit converting the travel time to depth. Nonetheless, the map demonstrates the best general information about the extent of the DZ. The central and southern parts of the WIPP site area display relatively uniform seismic travel time structure, and nothing within the geological data contradicts that information to date.

The broad forms of the structures within the DZ are generally anticlinal and synclinal (Borns, 1987), although they are not necessarily regular shapes. The best known shape for part of the DZ is between WIPP-12 and ERDA-9, where seismic information and several drillholes constrain part of the interpretation of the stratigraphy. There the structure tends to be a gently dipping limb of an anticlinal structure. Most of the remaining shapes attributed to the Castile within the DZ or related areas are based on one drill hole or a few drill holes that somewhat constrain the interpretation of the structure. WIPP-11, WIPP-13, DOE-1, and ERDA-6 are all examples. A generalized cross section of the structure at ERDA-6 (Anderson and Powers, 1978) shows a piercement structure and a regular shape; the piercement is based on stratigraphic inferences, but the shape is fundamentally uncontrolled by closely spaced data. WIPP-11 and WIPP-12 are both believed to penetrate anticlinal forms, though the structure is only partially known from drilling and seismic reflection data. DOE-2 is believed to lie in a synclinal structure, and contacts on various units show a nested series of depressions in the upper Salado (Borns, 1987). There are too few drill holes into the Castile to reconstruct the detailed shapes of Castile structures. The seismic data are not well enough constrained to calculate depths to reflectors, and most reflectors are too "disturbed" to interpret in this area. The specific shapes of individual structures are unlikely to be defined in the near future.

Anderson and Powers (1978) contoured several structures within the Delaware Basin, including structures at Poker Lake at least grossly similar to ERDA-6. Borns and Shaffer (1985) reexamined the information from Poker Lake and concluded that the actual shape is poorly constrained. Outside of the area on the north side of the current WIPP site, the information available is too sparse to define the individual shapes of structural features on borehole data.

It is important to note that, to date, none of the structures are demonstrably associated with comparable structure on the underlying Delaware Mountain Group. Snyder (in Borns et al., 1983) does show an upthrown block (horst) through WIPP-11 on the top of the Bell Canyon that is based on his projection of the thickness of the lower Castile; WIPP-11 did not penetrate the complete Castile section. Other areas, such as the Poker Lake structures, may display some relief on the top of the Delaware Mountain Group, but Borns and Shaffer (1985) do not attribute the relief to faulting. They believe the relief existed before and during deposition of the overlying Castile units. The underlying units to the Castile are, for the most part, uninvolved in the structures displayed by the Castile.

Structure contour and isopach maps of the Salado and the Rustler over areas of the complicated Castile structure also show that the overlying units are successively less involved in the structure (e.g., Borns and Shaffer, 1985; Borns et al., 1983; Holt and Powers, 1988). Lower units that are thicker and deformed are overlain by units that are thinner and less structurally involved in the deformation. Under normal geological circumstances, e.g., dealing with a rock sequence of carbonates or siliciclastics, the deformation would be considered to be completed by the time of deposition of the lowermost undeformed rock unit. Here, within a much more plastic set of rocks, the same geological reasoning is of less value, as the rocks may compensate laterally for late deformation effects and produce the same results.

Borns (1983; 1987; Borns et al., 1983) has extensively examined the macroscopic to microscopic features from cores taken within the structurally deformed areas. These studies follow earlier, broader studies of macroscopic features from the "state line outcrop" (Kirkland and Anderson, 1970) and ERDA-6 (Anderson and Powers, 1978). Kirkland and Anderson (1970) reported that small-scale folding within the Castile outcrops is oriented consistently along the general north-south strike of beds in the Delaware Basin. From this they concluded that the deformation was related to tilt of the basin, generally believed to be Cenozoic in age (e.g., Anderson, 1978; King, 1948; Borns et al., 1983), although authors differ in opinions on when this took place by tens of millions of years. Anderson and Powers (1978) used this apparent relationship to estimate that folding at ERDA-6 took place after the tilt of the basin. Jones (1981) estimated that deformation took place before the Ogallala was deposited because that unit is undeformed at the location of ERDA-6. Bachman (1980) and Madsen and Raup (1988) are among investigators who interpret angular relationships between various formations of the Ochoan Series, beginning with the Castile/Salado contact. These relationships require tilting of the existing beds to the east, as the angular unconformities are always placed on the western side of the basin. Tilting of the basin may well have occurred through much of the time when the Ochoan Series was being deposited, as Holt and Powers (1988) present evidence that the depocenter for the Rustler was displaced eastward from the Castile and the Salado patterns and overlies part of the Capitan reef on the northeastern side of the Delaware Basin. The Delaware Basin appears to have tilted at various times from the late Permian to at least the Cenozoic, and the conditions for deformation may well have existed since the late Permian. Direct evidence of the time of affirmation has been difficult to obtain, and tilting of the basin, as a condition for the deformation, appears to have occurred at times beginning in the late Permian. Jones (1981) argues that the structure at ERDA-6 must be in part younger than Triassic because Triassic rocks are also deformed over the deformed evaporates, and that the structure must be older than late Cenozoic because the Ogallala over part of the structure is undeformed and erosionally truncates the upper part of the Triassic rocks. This may be the most conclusive age relationship demonstrated for any of these related structures. Conventional relationships with beds overlying deformed evaporites, such as that cited by Jones (1981) for the Ogallala, are suspect if the deformation ends or dies out vertically within the evaporites because of the potential for compensating deformation in evaporates (e.g., Borns, 1983).

Borns (1983, 1987) reexamined the "state line outcrop" as well as the cores from various boreholes and concluded that the styles of deformation present in these cores indicate a very complicated history, including episodes of deformation that are probably synsedimentary. The folding may, for example, display disharmonic or opposing styles that would not normally be attributed to a single episode of strain in a pervasive stress field. If the deformation all occurred in response to a single event such as the tilting of the Delaware Basin, the folds and other strain indicators should all have a common orientation. Isoclinal folding may occur very early, while asymmetric folding is often penetrative, indicating later time of origin. Fractures in more brittle units such as the Castile anhydrites are often very high-angle to vertical and are considered one of the late deformation features in cores. These fractures in the larger anticlinal structures of the DZ are apparently the proximate source of pressurized brines and gases. Borns (Borns and Shaffer, 1985; Borns, 1987) recognized that tilting of the basin, among other possible sources of stress, may have occurred at several different times and is not limited to a single Cenozoic event.

Hypotheses of Formation of Deformation in Castile

Several hypotheses have been advanced for the formation of the Castile structures in the DZ and other parts of the Delaware Basin (Borns et al., 1983). The five principal processes hypothesized as causes of the DZ are gravity foundering, dissolution, gravity sliding, gypsum dehydration, and depositional processes (Borns et al., 1983). Each of these hypotheses will be briefly summarized, though gravity foundering due to density differences between halite and anhydrite is considered the leading hypothesis (Borns, 1987).

Gravity foundering is based on the fact that anhydrite (about 181 pounds per cubic ft (lb/ft^3), or 2.9 grams per cubic centimeter [gm/cc]) is much more dense than halite (about 134 lb/ft^3 (2.15 gm/cc)). When anhydrite beds overlie halite, there is considerable potential for the anhydrite to sink and for the halite to rise. This potential exists throughout much of the Delaware Basin in the Castile. Mathematical and centrifuge models of similar systems confirm the potential for such deformation and even suggest that the rate of deformation is about 0.02 inch (in)/year (yr) (0.05 centimeters (cm)/yr) (Borns et al., 1983). At such a rate, the DZ could be inferred to have developed over about 700,000 years (Borns et al., 1983). The principal difficulty with this hypothesis is that there are large areas of the Delaware Basin that remain undeformed, though the stratigraphy is similar to that within the DZ. The potential for gravity foundering exists over most of the basin, yet only a small part actually manifests such deformation. A special condition, such as a localized higher water content or an anomalous distribution of water, is hypothesized to explain why deformation is localized despite the pervasive density inversion (Borns et al., 1983). The presence of pressurized brine and gas associated with some of these structures is at least consistent with this explanation.

Halite could potentially be removed from the evaporite section by dissolution and change the form of the evaporites. The density structure could be changed by removing salt near the surface, causing collapse and fill with sediment that is more dense than the removed salt (Anderson and Powers, 1978). Borns et al. (1983) reviewed some of the evidence that evaporites were deformed near surficial sinks and concluded that there was certainly some association but that the pattern of deformation did not match the shallow dissolution. If salt is dissolved from the lower Salado or the Castile, then overlying beds should deform in response to the removal of mass. DOE-2 was drilled to test that hypothesis. Recrystallized halite has been offered as evidence of the passage of fluids, but there appears to be no unique relationship between recrystallized halite and deformation. In addition, certain halite sections appear much overthickened, which is clearly not directly due to halite removal. These features indicate generally that the halite can be squeezed and will “move” laterally. The fact that the Rustler shows no discernable overall structural lowering over the DZ (Holt and Powers, 1988) suggests that neither the dissolution of the lower Salado nor the Castile is the origin of the deformation. The one area in which the Rustler is structurally affected is around ERDA-6, and there it is warped upward as noted by Jones (1981). Borns et al. (1983) do not believe that the Bell Canyon has been a source for brines in the Castile because of the chemistry (Lambert, 1978; 1983a) and the small volume.

Gravity sliding in the Delaware Basin could be driven by two physical situations: the general eastward dip and the dip off the Capitan reef and forereef into the basin. In contrast to the gravity foundering mechanism, where movement is dominantly vertical, gravity would result in sliding blocks moving mainly laterally as well as downslope in this mechanism. Some of the deformation is adjacent to the reef (Jones et al., 1973), lending some substance to the hypothesis that the reef-forereef slope and facies changes could cause such sliding. Some deformation is in somewhat isolated portions of the basin (e.g. Poker Lake) (Anderson and Powers, 1978; Borns and Shaffer, 1985), and these structures were originally interpreted to align along the strike of the basin (Anderson and Powers, 1978). Borns and Shaffer (1985) conclude that the data do not uniquely support that interpretation, and these structures may or may not support the concept of gravity sliding within the basin. Borns et al. (1983) also concluded that the timing of the various structures is an important factor in evaluating this hypothesis. As discussed above, neither the age of the various structures nor the timing of the basin tilt are well constrained. If tilting of the basin is an important event in forming these structures, the various macro to microstructures should probably be consistently related. As in gravity foundering, much of the basin area has not reacted to what appears to be widespread similar stresses. Special circumstances, such as an anomalous distribution of water, may be necessary to overcome a threshold for deformation to occur.

In general, as temperature and pressure increase, gypsum dehydrates to form anhydrite and release free water. Borns et al. (1983) discuss the effects this process has in experiments that weaken the anhydrite. Borns et al. (1983) suggest, however, that a major difficulty with this hypothesis is that there should remain relics of the original gypsum within the sedimentary column; these are not observed. Borns et al. (1983) suggest that mostly anhydrite was deposited in the Castile, and as a consequence, the dehydration hypothesis has little observable support. More recently pseudomorphs after gypsum have been recorded in every major anhydrite of the Castile (Harwood and Kendall, 1988; Hovorka, 1988; Powers, unpublished data; SNL and D'Appolonia Consulting Engineers, 1982c). Gypsum certainly has been present in the Castile, though anhydrite cannot be dismissed as possibly an important primary mineral. Delicate forms of original gypsum crystals are sometimes preserved and pseudomorphed by anhydrite or halite. Each requires volume-for-volume replacement, probably through dissolution and crystallizing the replacement mineral. There are no observed fluid escape paths, and the gypsum may have been replaced very early in the sedimentary history. The additional major drawback to this hypothesis is that the process should be pervasive, while the deformation is localized. Special pleading for an additional factor is necessary in this process as in some other hypotheses.

Depositional or syndepositional processes have been invoked for some of the deformation in the Castile. Borns et al. (1983) list four main mechanisms that have been suggested: penecontemporaneous folding, resedimentation, slump blocks off of reef margins, and sedimentation on inclined surfaces. Penecontemporaneous folding requires consolidation of the units over relatively short times. Borns et al. (1983) also cite the lack of observed features that indicate the rocks were reexposed. Evaporite units in the Mediterranean contain resedimented material: turbidities, slumping, and mud flows with other clastic sediment. Borns et al. (1983) report that "the units of the WIPP area show little chaotic or clastic structures." They also apply the same argument of Kirkland and Anderson (1970) that the deformed units would have to be consolidated by the time of resedimentation.

In a more recent study of cores from the western part of the Delaware Basin, Robinson and Powers (1987) report a lobate unit of the resedimented Castile anhydrite clasts overlying both the lower anhydrite and halite of the Castile and underlying the second anhydrite. The apparently unconformable contact with both anhydrite 1 and halite 1 lies across the extension of the Huapache monocline, which appears to have been still active during the time part of the Castile was deposited. Polyclasts within some beds of this unit demonstrate that the original anhydrite was partially consolidated and that a unit of clasts was also at least partially consolidated to provide the polyclasts. These units were consolidated early between the time halite 1 was deposited and anhydrite began to be deposited.

In the rest of the basin there is no apparent interval between the end of the halite and beginning of the anhydrite deposition. The relationship clearly indicates that the western margin was an area of sulfate clast formation, deposition, and lithification over a very short interval of geologic time. Hovorka (1988) indicates that similar clastic deposits occur in cores from nearer the eastern margin of the Delaware Basin. Snider (1966) proposed much earlier that sedimentation caused anomalous thickness of Castile units near the basin margin, and Billo (1986) presented a similar conclusion. Neither reported any textural evidence to support their conclusions.

Clearly, Castile rock has been resedimented, but in the area where textural data are available, only modest deformation appears to be present (Robinson and Powers, 1987). At this time, there is little to suggest that such sedimentation resulted in the deformation in the DZ. There is also no direct evidence from the WIPP area that suggests slump blocks off of the reef margin moved into the area, causing deformation. The high inferred slopes of some of these structures argues strongly against sedimentation on inclined surfaces (Borns et al., 1983).

The concept that deformation was syndepositional or penecontemporaneous with deposition appears to mainly be driven by the fact that deformation decreases upward through successive units. Normal geologic reasoning would support penecontemporaneous deformation but does not take into account the rather plastic behavior of halite, allowing flow from over high areas to move halite into low areas. Overlying units, such as the Rustler, are made of much less plastic material and do not respond as the Salado does. The deformation appears to be compensated in overlying units through deposition.

Overall, both gravity-driven mechanisms require some special additional conditions restricting deformation to small areas though most of the basin appears to be equally susceptible. Dissolution permits a more localized effect, but there does not appear to be an overall loss of mass in these areas, and the chemistry of the fluids and hydrology of the units do not readily support the concept. Most of the syndepositional processes have no evidence to support them in the area of the DZ. The most favored hypothesis at the moment is gravity foundering, with a yet undetected anomalous distribution of fluid lowering the viscosity of halite locally to permit deformation.

Timing of Deformation

Most of the arguments about timing of deformation have already been discussed. Standard geologic arguments about relative timing, based on involvement of the overlying units, is unlikely to hold for the evaporite units. Jones (1981) notes that uplifted and arched Triassic rocks near the ERDA-6 borehole are truncated by the flat-lying, undeformed Pliocene Ogallala. This was interpreted as an indication that salt movement was complete before deposition of the Ogallala (Jones, 1981). However, he does not explain either how the Triassic structure relates to the deeper DZ or how it is distinguished from near surface dissolution effects (Borns et al., 1983). The Castile rocks may have been deformed during any time period from Permian to the present. More to the point, for some hypotheses, the general conditions thought necessary to deform the Castile and the Salado are still present, and mechanisms such as gravity foundering are potentially active (Borns et al., 1983).

An additional piece of data is relevant. Brines from ERDA-6 and WIPP-12 were analyzed, and the brines were calculated to last have moved after about 800,000 years ago (Lambert and Carter, 1984; Barr et al., 1979). One set of reasonable assumptions about brine chemistry and interactions with the rock leads to calculated residence times of about 25,000 to 50,000 years for these brines. This may relate to the last time deformation was active on this structure, although it is not uniquely an indicator of deformation. The interaction between rock and water may have been strictly hydrologically driven and may not require deformation at that time.

The second point of interest is that some modeling calculations indicate, as stated above, that the kinds of structures observed in the DZ may require periods on the order of 700,000 years to form. There is no indication when the structures formed by this calculation, but it is relevant to timing and assessing how these structures might affect the WIPP repository.

Importance to the WIPP Repository

The structures interpreted from core retrieved from WIPP-12 and ERDA-6 serve as possible analogs to effects of deformation on the WIPP repository. The DOE and the EEG have analyzed the effects of brine and structure at WIPP-12 and the southern portion of the site and have concluded that the geologic conditions represent no threat to health and safety. In addition, both boreholes encountered brine only within the anhydrite units, and that is the experience of all other encounters of these larger brine inflows (Popielak et al., 1983). Anhydrite supports the fractures that provide porosity for the brine, and the anhydrite/halite units form an effective seal, as the pressurized brines and gas did not escape upward. The principal concern for isolation would be that the deformation, and its associated phenomena such as pressurized brine and gas could cause breaching of the repository and provide or make a pathway for the escape of the waste constituents. The period of time expected for development of the structure (700,000 years) is well beyond periods of regulatory concern. In addition, the evidence of the pressurized brine and gas occurrences is that they are confined to these Castile anhydrite layers and do not breach the lower Salado to reach the stratigraphic level of the repository. There is nothing at present to indicate that these features will form in the time period of concern or that they can directly cause a breach of the repository.

L1-1f(2) Evaporite Dissolution

Because evaporites are much more soluble than most other rocks, project investigators have considered it important to understand the dissolution processes and rates that take place within any site considered for long-term isolation. These dissolution processes and rates constitute the limiting factor in any evaluation of the site. Over the course of the WIPP Project, extensive resources have been committed to identify and study a variety of features in southeastern New Mexico interpreted to have been caused by dissolution. The subsurface distribution of halite for various units has been mapped. Several different kinds of surface features have been attributed to dissolution of salt or karst formation. The processes proposed or identified include point-source (brecciation), "deep" dissolution, "shallow" dissolution, and karst. The categories are not well defined. Nonetheless, as discussed in the following sections, dissolution is not considered a threat to isolation of waste at the WIPP facility.

L1-1f(2)(a) Brief History of Project Studies

Well before the WIPP Project, several geologists recognized that dissolution is an important process in southeastern New Mexico and that it contributed to the subsurface distribution of halite and to the surficial features. A number of these are listed in the Bibliography to this addendum, including Lee (1925), Maley and Huffington (1953), and Olive (1957). Robinson and Lang identified an area in 1938 under the Nash Draw where brine occurred at about the stratigraphic position of the upper Salado/basal Rustler and considered that salt had been dissolved to produce a dissolution residue. Vine mapped the Nash Draw and surrounding areas, reporting in 1963 on various dissolution features. Vine (1963) reported surficial domal structures later called "breccia pipes" and identified as deep seated dissolution and collapse features.

As the USGS and ORNL began to survey southeastern New Mexico as an area in which to locate a repository site in salt, Brokaw et al. in 1972 prepared a summary of the geology that included solution and subsidence as significant processes in creating the features of southeastern New Mexico. Brokaw et al. (1972) recognized a solution residue at the top of salt in the Salado, and the unit commonly became known as the "brine aquifer" because it yielded brine in the Nash Draw area. Brokaw et al. (1972) interpreted the east-west decrease in thickness of the Rustler to be a consequence of removal of halite and other soluble minerals from the formation by dissolution.

During the early 1970s, the basic ideas about shallow dissolution of salt (generally from higher stratigraphic units and within a few hundred feet of the surface) were set out in a series of reports by Bachman, Jones, and collaborators. Piper independently evaluated the geological survey data for ORNL. Claiborne and Gera (1974) concluded that salt was being dissolved too slowly from the near-surface units to affect a repository for several million years, at least.

By 1978, shallower drilling around the WIPP site to evaluate potash resources was interpreted by Jones (1978), who felt the Rustler included "dissolution debris, convergence of beds, and structural evidence for subsidence." Halite in the Rustler has been reevaluated by the DOE, but there are only minor differences in distribution among the various investigators, and these investigators have different explanations about how this distribution occurred (see previous section on the Rustler stratigraphy): through dissolution of the Rustler's halite after the Rustler was deposited or through syndepositional dissolution of halite from saline mud flat environments during the Rustler deposition.

Under contract to SNL, Anderson, in work reported in 1978, reevaluated halite distribution in deeper units, especially the Castile and the Salado. He identified local anomalies proposed as features developed after dissolution of halite by water circulating upward from the underlying Bell Canyon. In response to Anderson's developing concepts, ERDA-10 was drilled south of the WIPP area during the latter part of 1977. ERDA-10 is interpreted to have intercepted a stratigraphic sequence without evidence of solution residues in the upper Castile. Anderson mapped geophysical log signatures of the Castile and interpreted lateral thinning and change from halite to nonhalite lithology as evidence of lateral dissolution of deeper units (part of "deep dissolution"). Anderson (1978) considered that deep dissolution might threaten the WIPP site.

A set of annular or ring fractures is evident in the surface around the San Simon Sink, about 18 mi (30 km) east of the WIPP site. Nicholson and Clebsch (1961) suggested that San Simon Sink developed as a result of deep-seated collapse. WIPP-15 was drilled at about the center of the sink to a depth of 811 ft (245 m) to obtain samples for paleoclimatic data and stratigraphic data to interpret collapse. Anderson and Bachman both interpret San Simon Sink as dissolution and collapse features, and the annular fractures are not considered evidence of tectonic activity.

Following the work by Anderson, Bachman mapped surficial features in the Pecos Valley, especially at the Nash Draw, and differentiated between those surface features in the basin that were formed by karst and deep collapse features over the Capitan reef. WIPP-32, WIPP-33, and two boreholes over the Capitan reef were eventually drilled. Their data, which demonstrated the concepts proposed by Bachman, are documented in Snyder and Gard (1982).

A final program concerning dissolution and karst was initiated following a microgravity survey of a portion of the site during 1980. Based on localized low-gravity anomalies, Barrows et al., in 1983 interpreted several areas within the site as locations of karst. WIPP-14 was drilled during 1981 at a low-gravity anomaly. It revealed normal stratigraphy through the zones previously alleged to be affected by karst. As a follow-up in 1985, Bachman also reexamined surface features around the WIPP site and concluded there was no evidence for active karst within the WIPP site. The nearest karst feature is northwest of the site boundaries at WIPP-33 and is considered inactive.

L1-1f(2)(b) Extent of Dissolution

Within the Rustler, dissolution of halite is believed to have occurred only near the depositional margins.

Upper intervals of the Salado thin dramatically west and south of the WIPP site (Figures L1-21 and L1-22) compared to deeper Salado intervals (Figure L1-23). There are no cores for further consideration of possible depositional variations. As a consequence, this margin is interpreted as the edge of dissolution of the upper Salado.

General margins of halite for the Castile are well west of the WIPP site and are generally accepted. Although Robinson and Powers (1987) question the volume of salt that may have been dissolved from the Castile, the general boundaries are not disputed.

L1-1f(2)(c) Timing of Dissolution

The dissolution of Ochoan-Epoch evaporites through the near-surface processes of weathering and groundwater recharge has been studied extensively (Anderson, 1981; Lambert, 1983a; Lambert, 1983b; Bachman, 1984; see also Holt and Powers, 1988). The work of Lambert (1983a) was specifically mandated by the DOE's agreement with the State of New Mexico in order to evaluate, in detail, the conceptual models of evaporite dissolution proposed by Anderson (1981). There was no clear consensus of the volume of rock salt removed. Hence, estimates of the instantaneous rate of dissolution vary significantly. Dissolution may have taken place as early as the Ochoan, during or shortly after deposition. For the Delaware Basin as a whole, Anderson (1981) proposed that up to 40 percent of the rock salt in the Castile and the Salado was dissolved during the past 600 thousand years ago (ka). Lambert (1983b) suggested that in many places the variations in salt-bed thicknesses inferred from borehole geophysical logs that were the basis for Anderson's (1981) calculation were depositional in origin, compensated by thickening of adjacent nonhalite beds, and were not associated with the characteristic dissolution residues. Borns and Shaffer also suggested in 1985 a depositional origin for many apparent structural features attributed to dissolution.

Snyder (1985), as do earlier workers (e.g., Vine, 1963; Lambert, 1983b; Bachman, 1984), attributes the variations in thickness in the Rustler, which crops out in the Nash Draw, to post-depositional evaporite dissolution. Holt and Powers (1988) have challenged this view and attribute the east-to-west thinning of salt beds in the Rustler to depositional facies variability rather than post-depositional dissolution. Bachman (1974; 1976; 1980) envisioned several episodes of dissolution since the Triassic, each dominated by greater degrees of evaporite exhumation and a wetter climate, interspersed with episodes of evaporite burial and/or a drier climate. Evidence for dissolution after deposition of the Salado and before deposition of the Rustler along the western part of the Basin was cited by Adams (1944). Others have argued that the evaporites in the Delaware Basin were above sea level and therefore subject to dissolution during the Triassic, Jurassic, Tertiary, and Quaternary periods. Because of discontinuous deposition, not all of these times are separable in the geological record of southeastern New Mexico. Bachman (1984) contends that dissolution was episodic during the past 225 million years as a function of regional base level, climate, and overburden.

Some investigators have reasoned that wetter climate accelerated the dissolution. Various estimates of middle Pleistocene climatic conditions have indicated that climate was more moist during the time of the Gatuña than during the Holocene. An example of evidence of mass loss from dissolution since Mescalero time (approximately 500 ka) is found in displacements of the Mescalero caliche as large as 180 ft (55 m) in collapse features in the Nash Draw. However, given the variations in Pleistocene climate, it is unrealistic to apply a calculated average rate of dissolution, determined over 500 ka, to shorter periods, much less extrapolate such a rate into the geological future.

There have been several attempts to estimate the rates of dissolution in the basin. Bachman provided initial estimates of dissolution rates in 1974 based on a reconstruction of the Nash Draw relationships. Although these rates do not pose a threat to the WIPP repository, Bachman later reconsidered the Nash Draw relationships and concluded that pre-Cenozoic dissolution had also contributed to salt removal. Thus the initial estimated rates were too high. Anderson concluded in 1978 that the integrity of the WIPP repository to isolate radioactive mixed waste would not be jeopardized by dissolution within about 1 million years. Anderson and Kirkland (1980) expanded on the concept of brine-density flow proposed by Anderson in 1978 as a means of dissolving evaporites at a point by circulating water from the underlying Bell Canyon. Wood et al. (1982) examined the mechanism and concluded that, while it was physically feasible, it would not be effective enough in removing salt to threaten the ability of the WIPP repository to isolate TRU mixed waste.

There is local evidence of Cenozoic dissolution taking place at the same time that part of the Gatuña was being deposited in the Pierce Canyon area. Nonetheless, there is no indicator that the rates of dissolution in the Delaware Basin are sufficient to affect the ability of the WIPP repository to isolate TRU mixed waste.

L1-1f(2)(d) Features Related to Dissolution

Bachman (1980) separated breccia pipes, formed over the Capitan reef by dissolution and collapse of a cylindrical mass of rock, from evaporite karst features that appear similar to breccia pipes. There are surficial features, including sinks and caves, in large areas of the basin. The Nash Draw is the result of combined dissolution and erosion. Within the site boundaries, there are no known surficial features due to dissolution or karst.

The subsurface structure of the Culebra is shown in Figure L1-24. South of the WIPP site, an antiformal structure informally called the "Remuda Basin anticline" has been created by dissolution of salt from the underlying Salado to the southwest of the anticline. Beds generally dip to the east, and salt removed to the west created the other limb of the structure. Units below the evaporites apparently do not show the same structure.

L1-2 Surface-Water and Groundwater Hydrology

The DOE believes the hydrological characteristics of the disposal system require evaluation to determine if contaminant transport via fluid flow is a pathway of concern. At the WIPP site, one of the DOE's selection criteria was to choose a location that would minimize fluid-related impacts. This was accomplished when the DOE selected: 1) a disposal medium that contains very small quantities of groundwater, 2) a location where the effects of groundwater circulation on the disposal system are limited and reasonably predictable, 3) an area where groundwater use is very limited, 4) an area where there are no surface waters, 5) an area where future groundwater use is unlikely, and 6) a repository host rock that will not likely be affected by anticipated long-term climate changes possible within 10,000 years.

The following discussion summarizes the characteristics of the groundwater and surface water at and around the WIPP site. This summary is based on data-collection programs that were initiated at the inception of the WIPP program and which continue to some extent today. These programs have several purposes as follows:

- To provide sufficient information to develop predictive models of the groundwater movement within the vicinity of the WIPP site
- To collect data to evaluate the predictive models and to adapt them to the specific conditions of the WIPP site
- To develop an understanding of the surface water characteristics and the interaction between surface waters and groundwater
- To develop predictive models of the interaction between surface water and groundwater during reasonably expected climate changes.

In order to provide a comprehensive understanding of the impact of groundwater and surface water on the disposal system, the following relevant factors have been evaluated:

- Groundwater
  - General flow direction
  - Flow type
  - Horizontal and vertical flow velocities
  - Hydraulic interconnectivity between rock units
  - General groundwater use
  - Chemistry (including, but not limited to, salinity, mineralization, age, Eh, and pH)
- Surface Water
  - Regional precipitation and evapotranspiration rates
  - Location and size of surface-water bodies
  - Water volume, flow rate, and direction
  - Drainage network
  - Hydraulic connection with groundwater
  - Soil hydraulic properties (infiltration)
  - General water chemistry and use

For the purposes of groundwater modeling, the hydrological system is divided into three segments. These are 1) the Salado, which for the most part concerns the undisturbed performance of the disposal system; 2) the non-Salado rock units, which essentially are impacted by the disturbed (human intrusion) performance of the disposal system; and 3) the surface waters, which are impacted by the natural variability of the climate.

The WIPP site lies within the Pecos River drainage area (Figure L1-25). The climate is semiarid, with a mean annual precipitation of about 12 in. (0.3 m), a mean annual runoff of from 0.1 to 0.2 in. (2.5 to 5 millimeters [mm]), and a mean annual pan evaporation of more than 100 in. (2.5 m). Brackish water with total dissolved solids (TDS) concentrations of more than 3,000 parts per million (ppm) is common in the shallow wells near the WIPP site. Surface waters typically have high TDS concentrations, particularly of chloride, sulfate, sodium, magnesium, and calcium.

At the WIPP site, the DOE obtains hydrologic data from conventional and special-purpose test configurations in multiple surface and underground boreholes. (Figure L1-26 is a map of surface borehole locations.) Geophysical logging of the surface boreholes has provided hydrologic information on the rock strata intercepted. Pressure measurements, fluid samples, and ranges of rock permeability have been obtained for selected formations through the use of standard and modified drill-stem and packer tests. Slug injection or withdrawal and tracer tests have provided additional data to aid in the estimation of transmissivity and storage of several water-bearing units. Also, the hydraulic head of groundwaters within many water-bearing zones in the region has been mapped from measured depths to water and fluid pressure measurements in the surface boreholes.

Historically, the DOE has obtained hydrological data principally from a conventional well monitoring network comprising 71 wells located on 45 separate well pads (DOE 2003). Most of the 71 wells are completed only to a single hydrologic unit; however, six are multiple-completions to allow monitoring of two or more units in the same well. Hydrologic information (such as hydraulic head) is obtained at 80 completion intervals within the 71 wells. The focus of the hydrological monitoring is the Rustler (comprising 72 of the 80 monitored intervals) because this formation contains two of the most transmissive saturated units, the Culebra and Magenta, which are important to the modeling of releases during various human intrusion scenarios. Limited hydrological monitoring of the Bell Canyon, Dewey Lake, and Santa Rosa also occurs.

L1-2a Groundwater Hydrology

Rock units that are important to WIPP hydrology are the Bell Canyon of the Delaware Mountain Group, the Castile, the Salado, the Rustler, the Dewey Lake, and the Santa Rosa (or Dockum Group) (Figures L1-27 and L1-28). Of these rock units, the Castile and the Salado are defined as aquitards (nonwater-transmitting layers of rock that bound an aquifer).

The Bell Canyon is of interest to the DOE because it is the first regionally continuous water-bearing unit beneath the WIPP site. The Castile provides a hydrologic barrier underlying the Salado, though it may contain isolated occurrences of pressurized brine.

The Culebra is the first laterally continuous unit located above the WIPP underground facility to display hydraulic conductivity sufficient to warrant concern over lateral contaminant transport. Barring a direct breach to the surface, the Culebra provides the most direct pathway between the WIPP underground facility and the accessible environment. The hydrology and fluid geochemistry of the Culebra are very complex and, as a result, have received a great deal of study in WIPP site characterization. (See for example LaVenue et al. (1988), Haug et al. (1987), and Siegel et al. (1991) in the Bibliography.)

At the site, the Dewey Lake is 60 ft (18 m) below the surface and about 490 ft (149 m) thick. These units appear to be mostly unsaturated hydrologically in the vicinity of the WIPP shafts and over the waste emplacement panels. However, since 1995, routine inspections of the WIPP exhaust shaft have revealed water entering the shaft at a depth of approximately 80 ft (24 m) at a location where no water had been observed during construction. The quantity and quality of water in the Dewey Lake is also monitored in a deeper fractured zone in the Dewey Lake at well WQSP-6a.

The Santa Rosa is shallow and unsaturated at the site (with the exception of a perched water table directly below the WIPP surface structures), and apparently receives recharge only through infiltration.

At the WIPP site, the DOE recognizes the Culebra and the Magenta of the Rustler as the most significant water-bearing units. The DOE's sampling and analysis of groundwater has focused on these two rock units, and the hydrologic background presented here is more detailed than for other rock units. The hydrologic properties of the interface between the Rustler and the Salado will also be discussed. Table L1-2 provides an overview of the hydrologic characteristics of the rock units of interest at the WIPP site and the Rustler/Salado contact zone.

L1-2a(1) Conceptual Models of Groundwater Flow

The DOE addresses issues related to groundwater flow within the context of a conceptual model of how the natural hydrologic system works on a large scale. The conceptual model of regional flow around the WIPP site that is presented here is based on widely accepted concepts of regional groundwater flow in groundwater basins (see, for example, Hubbert 1940, Tóth 1963, and Freeze and Witherspoon 1967).

An idealized groundwater basin is a three-dimensional closed hydrologic unit bounded on the bottom by an impermeable rock unit (units with much smaller permeability than the units above), on the top by the ground surface, and on the sides by groundwater divides. The water table is the upper boundary of the region of saturated liquid flow. All rocks in the basin are expected to have finite permeability; in other words, hydraulic continuity exists throughout the basin. This means that the potential for liquid flow from any unit to any other units exists, although the existence of any particular flow path is dependent on a number of conditions related to gradients and permeabilities. All recharge to the basin is by infiltration of precipitation to the water table and all discharge from the basin is by flow across the water table to the land surface.

Differences in elevation of the water table across an idealized basin provide the driving force for groundwater flow. The pattern of groundwater flow depends on the lateral extent of the basin, the shape of the water table, and the heterogeneity of the permeability of the rocks in the basin. Water flows along gradients of hydraulic head from regions of high head to regions of low head. The highest and lowest heads in the basin occur at the water table at its highest and lowest points, respectively. Therefore, groundwater flows from the elevated regions of the water table, downward across confining layers (layers with relatively small permeability), then laterally along more conductive layers, and finally upward to exit the basin in regions where the water table (and by association, the land surface) is at low elevations. Recharge is necessary to maintain relief on the water table, without which flow does not occur.

Groundwater divides are boundaries across which it is assumed that no groundwater flow occurs. In general, these are located in areas where groundwater flow is dominantly downward (recharge areas) or where groundwater flow is upward (discharge areas). Topography and surface-water drainage patterns provide clues to the location of groundwater divides. Ridges between creeks and valleys may serve as recharge-type divides, and rivers, lakes, or topographic depressions may serve as discharge-type divides.

In the groundwater basin model, rocks can be classified into hydrostratigraphic units. A hydrostratigraphic unit is a continuous region of rock across which hydraulic properties are similar or vary within described or stated limits. The definition of hydrostratigraphic units is a practical exercise to separate rock regions with similar hydrologic characteristics from rock regions with dissimilar hydrologic characteristics. Although hydrostratigraphic units often are defined to be similar to stratigraphic units, this need not be the case. Hydrostratigraphic unit boundaries can reflect changes in hydraulic properties related to differences in composition, fracturing, dissolution, or a variety of other factors that may not be reflected in the definition of stratigraphic formations.

Confining layers in a groundwater basin model can be characterized as allowing vertical flow only. The amount of vertical flow occurring in a confining layer generally decreases in relation to the depth of the layer. Flow in conductive units is more complicated. In general, flow will be lateral through conductive units. The magnitude (in other words, volume flux) of lateral flow is related to the thickness, conductivity, and gradient present in the unit. Gradients generally decrease in deeper units. The direction of flow is generally related to the distance the unit is from the land surface. Near the land surface, flow directions are influenced primarily by the local slope of the land surface. In deeper conductive units, flow directions are generally oriented parallel to the direction between the highest and lowest points in a groundwater basin. Thus, flow rates, volumes, and directions in conductive units in a groundwater basin are generally not expected to be the same.

In the WIPP region, the Salado provides an extremely low-permeability layer that forms the base for a regional groundwater-flow basin in the overlying rocks of the Rustler, Dewey Lake, and Santa Rosa. The Castile and Salado together form their own groundwater system, and they separate flow in units above them from that in units below. Because of the plastic nature of halite and the resulting low permeability, fluid pressures in the evaporites are more related to lithostatic stress than to the shape of the water table in the overlying units, and regionally neither vertical nor horizontal flow will occur as a result of natural pressure gradients in time scales relevant to the disposal system. (On a repository scale, however, the excavations themselves create pressure gradients that may induce flow near the excavated region.) Consistent with the recognition of the Salado as the base of the groundwater basin of primary interest, the following discussion is divided into three sections: hydrology of units below the Salado, hydrology of the Salado, and hydrology of the units above the Salado.

L1-2a(2) Units Below the Salado

Units of interest to the WIPP project below the Salado are the Bell Canyon and the Castile. These units have quite different hydrologic characteristics. Because of its potential to contain brine reservoirs below the repository, the hydrology of the Castile is regarded as having the most potential of all units below the Salado to impact the performance of the disposal system.

L1-2a(2)(a) Hydrology of the Bell Canyon Formation

The Bell Canyon is considered for the purposes of regional groundwater flow to form a single hydrostratigraphic unit about 1,000 feet (300 meters) thick. Tests at five boreholes (AEC-7, AEC-8, ERDA-10, DOE-2, and Cabin Baby) indicate a range of hydraulic conductivities for the Bell Canyon from 5×10^{-2} feet per day to 1×10^{-6} feet per day (1.7×10^{-7} to 3.5×10^{-12} meters per second). The pressure measured in the Bell Canyon at the DOE-2 and Cabin Baby boreholes ranges from 12.6 to 13.3 megapascals (Mercer 1983; DOE 1983a; Beauheim 1986).

After recovery from well work in 1999, the Bell Canyon water levels at CB-1 have remained steady for more than three years at 919 m (3,015 ft) above mean sea level (SNL 2003a). In contrast, since the beginning of 1994, the Bell Canyon water levels at AEC-8 have steadily risen by more than 32 m (106 ft) at a rate of approximately 0.5 m/month (1.6 ft/month) and stood at over 933.4 m (3,062 ft) above mean sea level (SNL 2003a) at the end of 2002. This water-level rise is hypothesized to be the result of deterioration of the well and not a response to actual Bell Canyon hydrologic conditions at this location.

Fluid flow in the Bell Canyon is markedly influenced by the presence of the extremely low-permeability Castile and Salado above it, which effectively isolate it from interaction with overlying units except where the Castile is absent because of erosion or nondeposition, such as in the Guadalupe Mountains, or where the Capitan Reef is the overlying unit (Figures L1-27 and L1-28). Because of the isolating nature of the Castile and Salado, fluid flow directions in the Bell Canyon are sensitive only to gradients established over very long distances. At the WIPP site, the brines in the Bell Canyon flow northeasterly under an estimated hydraulic gradient of 25 to 40 feet per mile (4.7 to 7.6 meters per kilometer) and discharge into the Capitan aquifer. Velocities are on the order of tenths of feet per year, and groundwater yields from wells in the Bell Canyon are 0.6 to 1.5 gallons (2.3 to 5.8 liters) per minute. The fact that flow directions in the Bell Canyon under the WIPP site are inferred to be almost opposite to the flow directions in units above the Salado is not of concern because the presence of the Castile and Salado makes the flow in the Bell Canyon sensitive to gradients established over long distances, whereas flow in the units above the Salado is sensitive to gradients established by more local variations in water table elevation.

L1-2a(2)(b) Castile Hydrology

The Castile is dominated by low-permeability anhydrite and halite zones. However, fracturing in the upper anhydrite has generated isolated regions with much greater permeability than the surrounding intact anhydrite. These regions are located in the area of structural deformation. The higher-permeability regions of the Castile contain brine at pressures greater than hydrostatic and have been referred to as brine reservoirs. The fluid pressure measured by Popielak et al. in 1983 in the WIPP-12 borehole (12.7 [MPa]) is greater than the nominal hydrostatic pressure for a column of equivalent brine at that depth (11.1 MPa). Therefore, under open-hole conditions, brine could flow upward to the surface through a borehole.

Results of hydraulic tests performed in the ERDA-6 and WIPP-12 boreholes suggest that the extent of the highly permeable portions of the Castile is limited. The vast majority of brine is thought to be stored in low-permeability microfractures; about 5 percent of the overall brine volume is stored in large open fractures. The volumes of the ERDA-6 and WIPP-12 brine reservoirs were estimated by Popielak et al. in 1983 to be 3.5×10^6 cubic feet (100,000 cubic meters) and 9.5×10^6 cubic feet (270,000 cubic meters), respectively.

The origin of brine in the Castile has been investigated geochemically. Popielak et al. (1983) concluded that the ratios of major and minor element concentrations in the brines indicate that these fluids originated from ancient seawater and that no evidence exist for fluid contribution from present meteoric waters. The Castile brine chemistries from the ERDA-6 and WIPP-12 reservoirs are distinctly different from each other and from local groundwaters. These geochemical data indicate that brine in reservoirs has not mixed to any significant extent with other waters and has not circulated. The brines are saturated, or nearly so, with respect to halite and, consequently, have little potential to dissolve halite.

L1-2a(2)(c) Hydrology of the Salado

The Salado consists mainly of halite and anhydrite. A considerable amount of information about the hydraulic properties of these rocks has been collected through field and laboratory experiments.

Hydraulic testing in the Salado in the WIPP underground facility provided quantitative estimates of the hydraulic properties controlling brine flow through the Salado. The tests are interpreted by Beauheim et al. in 1991 and 1993 using models based on potentiometric flow. The tests influence rock as far as 10 meters distant from the test zone and are not thought to significantly alter the pre-test conditions of the rock. The stratigraphic intervals tested include both pure and impure halite. Because tests close to the repository are within the disturbed rock zone (DRZ) that surrounds the excavated regions, it is reasonable to use the results of the tests farthest from the repository as most representative of undisturbed conditions.

Fifty-nine intervals were isolated and monitored and/or tested in 27 boreholes. Thirty-five of the intervals isolated halite beds, and 24 isolated anhydrite beds. Permeability estimates were obtained from 14 of the halite intervals and 16 of the anhydrite intervals. Interpreted permeabilities using a Darcy-flow model vary from 2×10^{-23} to 3×10^{-16} m^2 for impure halite intervals, with the lower values representing halite with few impurities and the higher values representing intervals within the DRZ of the excavations. Interpreted formation pore pressures vary from atmospheric to 9.8 megapascals (MPa) for impure halite, with the lower pressures believed to show effects of the DRZ. Tests in pure halite show no observable response, indicating either extremely low permeability ($<10^{-23}$ square meters), or no flow whatsoever, even though appreciable pressures are applied to the test interval.

Interpreted permeabilities using a Darcy-flow model vary from 2×10^{-20} to 9×10^{-18} square meters for anhydrite intervals. Interpreted formation pore pressures vary from atmospheric to 14.8 MPa for anhydrite intervals (Beauheim and Roberts, 2002). Lower values are caused by depressurization near the excavation. The difference in maximum pressure between anhydrite and halite intervals is explained later in this section.

As discussed in Beauheim and Roberts (2002), permeabilities of some tested intervals have been found to be dependent on the pressures at which the tests were conducted, which is interpreted as the result of fracture apertures changing in response to changes in effective stress. Flow dimensions inferred from most test responses are subradial, meaning that flow to/from the test boreholes is not radially symmetric but is derived from a subset of the rock volume. The subradial flow dimensions are believed to reflect channeling of flow through fracture networks, or portions of fractures, that occupy a diminishing proportion of the radially available space, or through percolation networks that are not “saturated” (that is, fully interconnected). This is probably related to the directional nature of the permeability created or enhanced by excavation effects. Other test responses indicate flow dimensions between radial and spherical, which may reflect propagation of pressure transients above or below the plane of the test interval or into regions of increased permeability (e.g., closer to an excavation). The variable stress and pore-pressure fields around the WIPP excavations probably contribute to the observed non-radial flow dimensions.

The properties of anhydrite interbeds have also been investigated in the laboratory. Tests were performed on three groups of core samples from MB 139 as part of the Salado Two-Phase Flow Laboratory Program. The laboratory experiments provided porosity, intrinsic permeability, and capillary pressure data. Preliminary analysis of capillary pressure test results indicate a threshold pressure of less than 1 MPa.

Fluid pressure above hydrostatic is a hydrologic characteristic of the Salado (and the Castile) that plays a potentially important role in the repository behavior. It is difficult to accurately measure natural pressures in these formations because the boreholes or repository excavations required to access the rocks decrease the stress in the region measured. Stress released instantaneously decreases fluid pressure in the pores of the rock, so measured pressures must be considered as a lower bound of the natural pressures. Stress effects related to test location and the difficulty of making long-duration tests in lower-permeability rocks result in higher pore pressures observed to date in anhydrites. The highest observed pore pressure in halite-rich units, near Room Q, is on the order of 9 MPa, whereas the highest pore pressures observed in anhydrite are 12 MPa (Beauheim and Roberts, 2002). It is expected that the far-field pore pressures in halite-rich and anhydrite beds in the Salado at the repository level are similar because the anhydrites are too thin and of too low permeabilities to have liquid pressures much different than those of the surrounding salt. For comparison, the hydrostatic pressure for a column of brine at the depth of the repository is about 7 MPa, and the lithostatic pressure calculated from density measurements in ERDA-9 is about 15 MPa.

Fluid pressure in sedimentary basins that are much higher or much lower than hydrostatic are referred to as abnormal pressures by the petroleum industry, where they have received considerable attention. In the case of the Delaware Basin evaporites, the high pressures are almost certainly maintained because of the large compressibility and plastic nature of the halite and, to a lesser extent, the anhydrite. The lithostatic pressure at a particular horizon must be supported by a combination of the stress felt by both the rock matrix and the pore fluid. In highly deformable rocks, the portion of the stress that must be borne by the fluid exceeds hydrostatic pressure but cannot exceed lithostatic pressure.

Brine content within the Salado is estimated at 1 to 2 percent by weight, although the thin clay seams have been inferred by Deal et al. (1993) to contain up to 25 percent brine by weight. Brine in the Salado is likely Late Permian. This brine may move toward areas of low pressure, such as a borehole or mined section of the Salado.

Observation of the response of pore fluids in the Salado to changes in pressure boundary conditions at walls in the repository, in boreholes without packers, in packer-sealed boreholes, or in laboratory experiments is complicated by low permeability and low porosity. Qualitative data on brine flow to underground workings and exploratory boreholes have been collected routinely between 1985 and 1993 under the Brine Sampling and Evaluation Program (BSEP) and have been documented in a series of reports (Deal and Case 1987; Deal et al. 1987, 1989, 1991a, 1991b, 1993, and 1995). Additional data on brine inflow are available from the Large-Scale Brine Inflow Test (Room Q). Flow has been observed to move to walls in the repository, to boreholes without packers, and to packer-sealed boreholes. In certain cases, evidence for flow is no longer observed where it once was; in others, flow has begun where it once was not observed. In many cases, observations and experiments must last for months or years to obtain useful results. In part because of design requirements such as duration (the experimental period is short relative to the time required for the geological materials to fully respond), few quantitative data have been obtained for brine flow into the excavated region at atmospheric pressure. For performance assessment modeling, brine flow is a calculated term dependent on local pressure gradients and hydraulic properties of the Salado units. Data on pore pressure and permeability of halite and anhydrite layers are available from the Room Q test and other borehole tests (as summarized in Beauheim and Roberts, 2002), and these data form the basis for the quantification of the material properties used in the performance assessment.

L1-2a(3) Units Above the Salado

In evaluating groundwater flow above the Salado, the DOE considers the Rustler, Dewey Lake, Santa Rosa, and overlying units to form a groundwater basin with boundaries coinciding with selected groundwater divides as discussed in Section L1-2a(i). The boundary follows Nash

Draw and the Pecos River valley to the west and south and the San Simon Swale to the east (Figure L1-29). The boundary continues up drainages and dissects topographic highs along its northern part. It is assumed that these boundaries represent groundwater divides whose positions remain fixed over the past several thousand years and 10,000 years into the future. For reasons described in Section L1-2a(1), the lower boundary of the groundwater basin is the upper surface of the Salado.

Nash Draw and the Pecos River are areas where discharge to the surface occurs. Hunter in 1985 described discharge at Surprise Spring and into saline lakes in Nash Draw. She reported groundwater discharge into the Pecos River between Avalon Dam north of Carlsbad and a point south of Malaga Bend as approximately 32.5 cubic feet per second (0.92 cubic meter per second), mostly in the region near Malaga Bend.

Within this groundwater basin, hydrostratigraphic units with relatively high permeability are called conductive units, and those with relatively low permeability are called confining layers. The confining layers consist of halite and anhydrite and are perhaps five orders of magnitude less permeable than conductive units.

In a groundwater basin, the position of the water table moves up and down in response to changes in recharge. The amount of recharge is generally a very small fraction of the amount of rainfall; this condition is expected for the WIPP site. The water table would stabilize at a particular position if the pattern of recharge remained constant for a long time. The equilibrated position depends, in part, on the distribution of hydraulic conductivity in all hydrostratigraphic units in the groundwater basin. However, the position of the water table depends mainly on the topography and geometry of the groundwater basin and the hydraulic conductivity of the uppermost strata. The position of the water table adjusts to changes in recharge. Consequently, the water table can be at a position that is very much different from its equilibrium position at any given time. Generally, the water table drops very slowly in response to decreasing recharge but might rise rapidly in times of increasing recharge.

The asymmetry of response occurs because the rate at which the water table drops is limited by the rate at which water flows through the entire basin. In contrast, the rate at which the water table rises depends mainly on the recharge rate and the porosity of the uppermost strata. From groundwater basin modeling, the head distribution in the groundwater basin appears to equilibrate rapidly with the position of the water table.

The groundwater basin conceptual model described above has been implemented as a numerical model used to simulate the interactive nature of flow through conductive layers and confining units for a variety of possible rock properties and climate futures. Thus, this model has allowed insight into the magnitude of flow through various units.

One conclusion from the regional groundwater basin modeling is pertinent here. In general, vertical leakage through confining layers is directed downward over all of the area within the WIPP Site Boundary. This downward leakage uniformly over the WIPP site is the result of a well-developed discharge area, Nash Draw and the Pecos River, along the western and southern boundaries of the groundwater basin. This area acts as a drain for the laterally conductive units in the groundwater basin, causing most vertical leakage in the groundwater basin to occur in a downward direction. This conclusion is important in numerical modeling simplifications related to the relative importance of lateral flow in the Magenta versus the Culebra.

Public concern was expressed in 2004 as part of the WIPP recertification effort that groundwater flow to the spring supplying brine to Laguna Grande de la Sal could be related to the presence of karst features. Lorenz (2006a and 2006b) reviewed historical data and arguments on karst at the WIPP site. Lorenz (2006b) concludes that most of the geological evidence offered for the presence of karst in the subsurface at the WIPP site "has been used uncritically and out of context, and does not form a mutually supporting, scientifically defensible framework. . . . The remaining evidence is more readily interpreted as primary sedimentary features." Powers et al. (2006) provide new details on the gypsum karst present in the Rustler of Nash Draw. Powers (2006a) studies some of the natural brine lakes in Nash Draw, finding some of them to be fed by a shallow gypsum karst system with enough storage to sustain year-round flow, while others were fed by the potash-processing effluent discharged by Mosaic Potash Carlsbad into Laguna Uno. Powers (2006b) also maps closed catchment basins in the SW arm of Nash Draw that drain internally to karst features.

L1-2a(3)(a) Hydrology of the Rustler Formation

The Rustler is of particular importance for WIPP facility because it contains the most transmissive units above the repository. Fluid flow in the Rustler is characterized by very slow rates of vertical leakage through confining layers and faster lateral flow in conductive units. To illustrate this point, regional modeling with the groundwater basin model indicates that lateral specific discharges in the Culebra, for example, are perhaps two to three orders of magnitude greater than the vertical specific discharges across the top of the Culebra.

Because of its importance, the Rustler continues to be the focus of studies to understand better the complex relationship between hydrologic properties and geology, particularly in view of water-level rises observed in the Culebra and Magenta (e.g., SNL 2003a). An example of the complex nature of Rustler hydrology is the variation in Culebra transmissivity (T). Culebra T varies over three orders of magnitude on the WIPP site itself and over six orders of magnitude on the scale of the regional groundwater basin model with lower T east of the site and higher T west of the site in Nash Draw (e.g., Beauheim and Ruskauff 1998). As discussed below, site investigations and studies (e.g., Holt and Powers 1988; Beauheim and Holt 1990; Powers and Holt 1995; Holt 1997; Holt and Yarbrough 2002; Powers et al. 2003) suggest that the variability in Culebra T can be explained largely by the thickness of Culebra overburden, the location and extent of upper Salado dissolution, and the occurrence of halite in the mudstone units bounding the Culebra.

L1-2a(3)(a)(i) Los Medaños

The Los Medaños makes up a single hydrostratigraphic unit in WIPP models of the Rustler, although its composition varies somewhat. Overall, it acts as a confining layer. The basal interval of the Los Medaños, approximately 64 feet (20 m) thick, is composed of siltstone, mudstone, and claystone and contains the water-producing zones of the lowermost Rustler. Transmissivities of 2.7×10^{-4} square feet per day (2.9×10^{-10} square meters per second) and 2.2×10^{-4} square feet per day (2.4×10^{-10} square meters per second) were reported by Beauheim (1987a, 50) from tests at well H-16 that included this interval. The porosity of the Los Medaños was measured in 1995 as part of testing at the H-19 hydropad. Two claystone samples had effective porosities of 26.8 and 27.3 percent. One anhydrite sample had an effective porosity of 0.2 percent. These transmissivity values correspond to hydraulic conductivities of 4.2×10^{-6} feet per day (1.5×10^{-11} meters per second) and 3.4×10^{-6} feet per day (1.2×10^{-11} meters per second). Hydraulic conductivity in the lower portion of the Los Medaños is believed by the DOE to increase to the west in and near Nash Draw, where dissolution at the underlying Rustler-Salado contact has caused subsidence and fracturing of the sandstone and siltstone.

The remainder of the Los Medaños contains mudstones, anhydrite, and variable amounts of halite. The hydraulic conductivity of these lithologies is extremely low; tests of mudstones and claystones in the waste-handling shaft gave hydraulic conductivity values varying from 2×10^{-9} feet per day (6×10^{-15} meters per second) to 3×10^{-8} feet per day (1×10^{-13} meters per second) according to Saulnier and Avis (1988).

The Los Medaños contains two mudstone layers: one in the middle of the Los Medaños and one immediately below the Culebra. An anhydrite layer separates the two mudstones. The lower and upper Los Medaños mudstones have been given the designations M1/H1 and M2/H2, respectively, by Holt and Powers (1988). This naming convention is used to indicate the presence of halite in the mudstone at some locations at and near the WIPP site. Powers (2002a) has mapped the margins delineating the occurrence of halite in both mudstone layers. Whereas early researchers (e.g., Snyder 1985) interpreted the absence of halite west of these margins as evidence of dissolution, Holt and Powers (1988) interpreted it as reflecting changes in the depositional environment, not dissolution. However, Holt and Powers (1988) concluded that dissolution of Rustler halite may have occurred along the present-day margins. The presence of halite in the Los Medaños mudstones is likely to affect the conductivity of the mudstones, but its greater importance is the implications it has for the conductivity of the Culebra. Culebra transmissivity in locations where halite is present in M2/H2 and M3/H3 (a mudstone in the lower Tamarisk Member of the Rustler) is assumed to be an order of magnitude lower than where halite does not occur (Holt and Yarbrough 2002).

Fluid pressures in the Los Medaños have been continuously measured at well H-16 since 1987. During this period, the fluid pressure has remained relatively constant at between 190 and 195 psi or a head of approximately 450 ft (137 m). Given the location of the pressure transducer, the current elevation of the Los Medaños water level at H-16 is approximately 949 m amsl. No other wells in the WIPP monitoring network are completed to the Los Medaños. Thus, H-16 provides the only current head information for this member.

L1-2a(3)(a)(ii) The Culebra

The Culebra is of interest because it is the most transmissive unit at the WIPP site, and hydrologic research has been concentrated on the unit for over a decade. Although it is relatively thin, it is an entire hydrostratigraphic unit in the WIPP hydrological conceptual model, and it is the most important conductive unit in this model.

The two primary types of field tests that are being used to characterize the flow and transport characteristics of the Culebra are hydraulic tests and tracer tests.

The hydraulic testing consists of pumping, injection, and slug testing of wells across the study area (e.g., Beauheim 1987a). The most detailed hydraulic test data exist for the WIPP hydropads (e.g., H-19). The hydropads generally comprise a network of three or more wells located within a few tens of meters of each other. Long-term pumping tests have been conducted at hydropads H-3, H-11, and H-19 and at well WIPP-13 (Beauheim 1987b, 1987c; Beauheim et al. 1995, Meigs et al, 2000). These pumping tests provided transient pressure data at the hydropad and over a much larger area. Tests often included use of automated data-acquisition systems, providing high-resolution (in both space and time) data sets. In addition to long-term pumping tests, slug tests and short-term pumping tests have been conducted at individual wells to provide pressure data that can be used to interpret the transmissivity at that well (Beauheim 1987a). (Additional short-term pumping tests have been conducted in the WQSP wells [Beauheim and Ruskauff, 1998]). Detailed cross-hole hydraulic testing has recently been conducted at the H-19 hydropad (Beauheim, 2000).

The hydraulic tests are designed to yield pressure data for the interpretation of such characteristics as transmissivity, permeability, and storativity. The pressure data from long-term pumping tests and the interpreted transmissivity values for individual wells are used for the generation of transmissivity fields in flow modeling. Some of the hydraulic test data and interpretations are also important for the interpretation of transport characteristics. For instance, the permeability values interpreted from the hydraulic tests at a given hydropad are needed for interpretations of tracer test data at that hydropad.

To evaluate transport properties of the Culebra, a series of tracer tests were conducted at six locations (the H-2, H-3, H-4, H-6, H-11, and H-19 hydropads) near the WIPP site. The first five of these tests consisted of both two-well dipole tests and multi-well convergent flow tests and are described in detail in Jones et al. (1992). A 1995 to 1996 tracer test program consists of single-well injection-withdrawal tests and multi-well convergent flow tests (Meigs and Beauheim, 2001). Unique features of this testing program include the injection of tracers into seven wells and the injection of tracer into an upper and a lower zone of Culebra at the H-19 hydropad, repeated injections under different convergent-flow pumping rates, and the use of tracers with different free-water diffusion coefficients at both the H-19 and H-11 hydropads. The 1995 to 1996 tracer tests were specifically designed to evaluate the importance of heterogeneity and diffusion on transport processes.

The Culebra is a fractured dolomite with nonuniform properties both horizontally and vertically. There are multiple scales of porosity (and permeability) within the Culebra, including fractures ranging from microscale to potentially large, vuggy zones, and inter-particle and intercrystalline porosity (Holt, 1997). Flow occurs within fractures, vuggy zones and probably to some extent in intergranular porosity. (In other words, flow occurs in response to hydraulic gradients in all places that are permeable). When the permeability contrast is large between different scales of connected porosity, transport processes can be distinguished as those occurring within advective porosity φ_a (typically referred to as fracture porosity) and those occurring within diffusional porosity φ_d (typically referred to as matrix porosity). Matrix porosity traditionally refers to inter- and intragranular porosity.

Diffusional (matrix) porosity in the Culebra may include other features such as microfractures and/or vugs. In some regions, the effective advective porosity of the Culebra is limited because a portion of the porosity has been partially or even almost totally filled by gypsum.

For the Culebra in the vicinity of the WIPP site, defining advective porosity is not a simple matter. Three regions with different types of advective porosity may be present: (1) regions with no open fractures, where matrix flow dominates and φ_a would refer to the connected matrix porosity; (2) regions with some open fractures, where advective flow occurs through matrix and fractures having permeabilities of similar magnitudes, where φ_a refers to some combination of the connected matrix porosity and the connected fracture porosity; and (3) regions with some large-aperture, open fractures with most advective flow in the fractures, where φ_a refers to the connected fracture porosity. It is thought that the dominant mode of advective transport may vary from location to location within the Culebra at the WIPP site.

The major physical transport processes that affect actinide transport through the Culebra include advection (through fractures and possibly other permeable porosity), matrix diffusion (between fractures and matrices [the matrix may include vugs and small fractures] or, more generally, diffusion between adjacent regions with large permeability contrasts), and dispersive spreading due to heterogeneity. For locations with advective transport occurring primarily within large-aperture fractures, the Culebra can most likely be considered to behave as a double-porosity medium (i.e., φ_a and φ_d are present).

Fluid flow in the Culebra is dominantly lateral and southward except in discharge areas along the west or south boundaries of the basin. Where transmissive fractures exist, flow is dominated by fractures but may also occur in vuggy zones and to some extent in intergranular porous regions. Regions where flow is dominantly through vuggy zones or intergranular porosity have been inferred from pumping tests and tracer tests. Flow in the Culebra may be concentrated along zones that are thinner than the total thickness of the Culebra. In general, the upper portion of the Culebra is massive dolomite with a few fractures and vugs, and appears to have low permeability. The lower portion of the Culebra appears to have many more vuggy and fractured zones and to have a significantly higher permeability.

There is strong evidence that the permeability of the Culebra varies spatially and varies sufficiently that it cannot be characterized with a uniform value or range over the region of interest to the WIPP Project. The transmissivity of the Culebra varies spatially over six orders of magnitude from east to west in the vicinity of the WIPP site (Figure L1-30). Over the site, Culebra transmissivity varies over three to four orders of magnitude. Figure L1-30 shows variation in transmissivity in the Culebra in the WIPP region. Transmissivities are from 1×10^{-3} square feet per day (1×10^{-9} square meters per second) at well P-18 east of the WIPP site to 1×10^{3} square feet per day (1×10^{-3} square meters per second) at well H-7 in Nash Draw.

Transmissivity variations in the Culebra are believed to be controlled by the relative abundance of open fractures rather than by primary (that is, depositional) features of the unit. Lateral variations in depositional environments were small within the mapped region, and primary features of the Culebra show little map-scale spatial variability, according to Holt and Powers 1988. Direct measurements of the density of open fractures are not available from core samples because of incomplete recovery and fracturing during drilling, but observation of the relatively unfractured exposures in the WIPP shafts suggests that the density of open fractures in the Culebra decreases to the east.

Recent investigations have made a significant contribution to the understanding of the large variability observed for Culebra transmissivity (e.g., Holt and Powers 1988; Beauheim and Holt 1990; Powers and Holt 1995; Holt 1997; Holt and Yarbrough 2002; Powers et al. 2003). The spatial distribution of Culebra transmissivity is believed to be due strictly to deterministic post-depositional processes and geologic controls (Holt and Yarbrough 2002). The important geologic controls include Culebra overburden thickness, dissolution of the upper Salado, and the occurrence of halite in the mudstone Rustler units (M2/H2 and M3/H3) above and below the Culebra (Holt and Yarbrough 2002). Culebra transmissivity is inversely related to thickness of overburden because stress relief associated with erosion of overburden leads to fracturing and opening of preexisting fractures. Culebra transmissivity is high where dissolution of the upper Salado has occurred and the Culebra has subsided and fractured. Culebra transmissivity is observed to be low where halite is present in overlying and/or underlying mudstones. Presumably, high Culebra transmissivity leads to dissolution of nearby halite (if any). Hence, the presence of halite in mudstones above and/or below the Culebra can be taken as an indicator for low Culebra transmissivity.

Geochemical and radioisotope characteristics of the Culebra have been studied. There is considerable variation in groundwater geochemistry in the Culebra. The variation has been described in terms of different hydrogeochemical facies that can be mapped in the Culebra. A halite-rich hydrogeochemical facies exists in the region of the WIPP site and to the east, approximately corresponding to the regions in which halite exists in units above and below the Culebra, and in which a large portion of the Culebra fractures are gypsum filled. An anhydrite-rich hydrogeochemical facies exists west and south of the WIPP site, where there is relatively less halite in adjacent strata and where there are fewer gypsum-filled fractures. Radiogenic isotopic signatures suggest that the age of the groundwater in the Culebra is on the order of 10,000 years or more (see, for example, Lambert 1987, Lambert and Carter 1987, and Lambert and Harvey 1987).

The Culebra groundwater geochemistry studies continue. Culebra water quality is evaluated semiannually at six wells, three north (WQSP-1, WQSP-2, and WQSP-3) and three south (WQSP-4, WQSP-5, and WQSP-6) (WIPP MOC 1995) of the surface structures area. Five rounds of semiannual sampling of water quality completed before the first receipt of waste at the WIPP facility were used to establish the initial Culebra water-quality baseline for major ion species including Na^{+}, Ca^{2+}, Mg^{2+}, K^{+}, Cl^{-}, SO_4^{2-}, and HCO_3^{2-} (Crawley and Nagy 1998). In 2000, this baseline was expanded to include five additional rounds of sampling that were completed before first receipt of RCRA-regulated waste (IT Corporation 2000). Culebra water quality is extremely variable among the six sampling wells, For example, the Cl^{-} concentrations range from approximately 6,000 mg/L at WQSP-6 to 130,000 mg/L at WQSP-3

The radiogenic ages of the Culebra groundwater and the geochemical differences provide information potentially relevant to the groundwater flow directions and groundwater interaction with other units and are important constraints on conceptual models of groundwater flow. Previous conceptual models of the Culebra (see for example, Chapman 1986, Chapman 1988, LaVenue et al. 1990, and Siegel et al. 1991) have not been able to consistently relate the hydrogeochemical facies, radiogenic ages, and flow constraints (that is, transmissivity, boundary conditions, etc.) in the Culebra.

The groundwater basin modeling that has been conducted, although it did not model solute transport processes, provides flow fields that reasonably explain observed hydrogeochemical facies and radiogenic ages. The groundwater basin model combines and tests three fundamental processes: (1) it calculates vertical leakage, which may carry solutes into the Culebra; (2) it calculates lateral fluxes in the Culebra (directions as well as rates); and (3) it calculates a range of possible effects of climate change. The presence of the halite facies is explained by vertical leakage of solutes into the Culebra from the overlying halite-containing Tamarisk by advective or diffusive processes. Because lateral flow rates here are low, even slow rates of solute transport into the Culebra can result in high solute concentration. Vertical leakage occurs slowly over the entire model region, and thus the age of groundwater in the Culebra is old, consistent with radiogenic information. Lateral fluxes within the anhydrite zone are larger because of higher transmissivity, and where the halite and anhydrite facies regions converge, the halite facies signature is lost by dilution with relatively large quantities of anhydrite facies groundwater.

Groundwater levels in the Culebra in the WIPP region have been measured continuously in numerous wells. Water-level rises have been observed in the WIPP region and are attributed to causes discussed below. The extent of water-level rise observed at a particular well depends on several factors, but the proximity of the observation point to the cause of the water-level rise appears to be a primary factor. Beginning in 1989, a general long-term rise has been observed in both Culebra and Magenta water levels over a broad area of the WIPP site including Nash Draw (SNL 2003a). This long-term rise was recognized, but was thought (outside of Nash Draw) to represent recovery from the accumulation of hydraulic tests that had occurred since the late 1970s and the effects of grouting around the WIPP shafts to limit leakage. Water levels in Nash Draw were thought to respond to changes in the volumes of potash mill effluent discharged into the draw (Silva 1996); however, correlation of these water levels with potash mine discharge cannot be proven because sufficient data on the timing and volumes of discharge are not available.

Hydrological investigations conducted from 2003 through 2007 provided a wealth of new information, some of it confirming long-held assumptions and others offering new insight into the hydrological system around the WIPP site. A Culebra monitoring-network optimization study was completed by McKenna (2004) to identify locations where new Culebra monitoring wells would be of greatest value and to identify wells that could be removed from the network with little loss of information. Eighteen new wells were completed, guided by the optimization study, geologic considerations, and/or unique opportunities. Seventeen wells were plugged and abandoned, and two others were transferred to the U.S. Bureau of Land Management.

The WIPP groundwater monitoring program has augmented monthly water-level measurements with continuous (nominally hourly) fluid-pressure measurements using downhole programmable TROLL® pressure gauges in all Culebra wells except for the Water Quality Sampling Program wells. The most significant new finding arising from the continuous measurements has been the observation of Culebra water-level responses to rainfall in Nash Draw. The Culebra has long been suspected of being unconfined in at least portions of Nash Draw because of dissolution of the upper Salado, subsidence and collapse of the overlying Rustler, and karst in Rustler gypsum units (Beauheim and Holt 1990). However, continuous monitoring with TROLL® gauges has provided the first direct evidence of Culebra water levels responding to rainfall. Furthermore, the rainfall-induced head changes originating in Nash Draw are now observed to propagate under Livingston Ridge and across the WIPP site over periods of days to months (Hillesheim, Hillesheim, and Toll 2007), explaining some of the changes in Culebra water levels. Other water-level changes that appear to occur quite suddenly can now be conclusively related to drilling of nearby oil and gas wells.

Extensive hydraulic testing has been performed in the new wells. This testing has involved both single-well tests, which provide information on local transmissivity and heterogeneity, and long-term (19 to 32 days) pumping tests that have created observable responses in wells up to 9.5 km (5.9 mi) away. The transmissivity values inferred from the single-well tests (Roberts 2006 and 2007) support the correlation between geologic conditions and Culebra transmissivity developed by Holt and Yarbrough (2002) and elucidated by Holt, Beauheim, and Powers (2005). The types of heterogeneities indicated by the diagnostic plots of the pumping-test data are consistent with the known spatial distribution of transmissivity in the Culebra. Mapping diffusivity values obtained from analysis of observation-well responses to pumping tests shows areas north, west, and south of the WIPP site connected by fractures, and also a wide area that includes a NE-to-SW swath across the middle part of the WIPP site where hydraulically significant fractures are absent (Beauheim 2007). This mapping, combined with the responses observed to the long-term SNL-14 pumping test, has confirmed the presence of a high-transmissivity (high-T) area extending from the SE quadrant of the WIPP site to at least 10 km (6 mi) to the south.

Combining the Culebra monitoring data with catchment basin mapping in southwestern Nash Draw and groundwater geochemistry data provides insight into Culebra recharge. While some of the water entering gypsum karst in Nash Draw discharges into brine ponds such as Laguna Cinco, some portion of it must come into hydraulic communication with the Culebra, at least locally, because Culebra wells in Nash Draw show water-level responses to major rainfall events. However, these responses do not mean that the precipitation reached the Culebra. Rather, they indicate that the Culebra cannot be completely confined, but must be in hydraulic communication with a water table in a higher unit that does receive direct recharge from precipitation. Some of this water must eventually reach the Culebra, where it is recognized as the low ionic strength, $CaSO_4$-dominated hydrochemical facies B, but it must first have spent a considerable period in the Rustler gypsum beds to have as high a total dissolved solids (TDS) as it does. As a further indication of the recharge's indirect nature, the water from SNL-16 (which is located within a small catchment basin in Nash Draw) does not fall in the domain of facies B, but is instead in the higher ionic strength facies C, even though SNL-16 shows a clear pressure response to major rainfall events. This shows conclusively that rainfall is not rapidly flushing the Culebra in this area (Domski and Beauheim 2008).

Lowry and Beauheim (2004 and 2005) conclude from two modeling studies that leakage from units above the Culebra through poorly plugged and abandoned boreholes is a plausible explanation for the long-term rise in water levels observed at and near the WIPP site. The Intrepid East tailings pile may well be the primary source of leaking water north of the WIPP site, while natural recharge where the Culebra is unconfined southwest of the site could provide the leaking water ascribed to a southern borehole by Lowry and Beauheim (2005). The studies showed that a physically reasonable amount of leakage through unconfirmed but realistic pathways is consistent with the observed rising water levels

Although Culebra heads have been rising, the head distribution in the Culebra (Figure L1-31) is consistent with groundwater basin modeling results indicating that the generalized directional flow of groundwater is north to south. However, caution should be used when making assumptions based on groundwater-level data alone. Studies in the Culebra have shown that fluid density variations in the Culebra can affect flow direction. One should also be aware that the fractured nature of the Culebra, coupled with variable fluid densities, can also cause localized flow patterns to differ from general flow patterns.

Inferences about vertical flow directions in the Culebra have been made from well data collected by the DOE. Beauheim (1987a) reported flow directions towards the Culebra from both the Los Medaños and the Magenta over the WIPP site, indicating that the Culebra acts as a drain for the units around it. This indication is consistent with results of groundwater basin modeling.

The conceptual model, referred to as the groundwater basin model, offers a three-dimensional approach to treatment of supra-Salado rock units, and assumes that vertical leakage (albeit very slow) occurs between rock units of the Rustler (where hydraulic gradients exist). Flow in the Culebra is considered transient, but is not expected to change significantly over the next 10,000 years. This differs from previous interpretations, wherein no flow was assumed between the Rustler units.

L1-2(a)(3)(a)(iii) The Tamarisk

The Tamarisk acts as a confining layer in the groundwater basin model. Attempts were made in two wells, H-14 and H-16, to test a 7.9-foot (2.4-meter) sequence of the Tamarisk that consists of claystone, mudstone, and siltstone overlain and underlain by anhydrite. Permeability was too low to measure in either well within the time allowed for testing; consequently, Beauheim (1987a, 108–110) estimated the transmissivity of the claystone sequence to be one or more orders of magnitude less than that of the tested interval in the Los Medaños (that is, less than approximately 2.5×10^{-5} square feet per day [2.7×10^{-11} square meters per second]). The porosity of the Tamarisk was measured in 1995 as part of testing at the H-19 hydropad. Two claystone samples had an effective porosity of 21.3 to 21.7 percent. Five anhydrite samples had effective porosities of 0.2 to 1.0 percent.

Fluid pressures in the Tamarisk have been measured continuously at well H-16 since 1987. From 1998 through 2002, the pressures increased approximately 20 psi, from 80 to 100 psi (185 to 230 ft of water), probably in a continuing recovery response to shaft grouting conducted in 1993 to reduce leakage. Given the location of the pressure transducer, the elevation of Tamarisk water level has increased from 2,950 to 2,995 ft amsl (899 to 913 m amsl) during this period. Currently, no other wells in the WIPP monitoring network are completed to the Tamarisk. Thus, H-16 provides the only information on Tamarisk head levels.

Similar to the Los Medaños, the Tamarisk includes a mudstone layer (M3/H3) that contains halite in some locations at and around the WIPP site. This layer is considered to be important because of the effect it has on the spatial distribution of transmissivity of the Culebra.

L1-2(a)(3)(a)(iv) The Magenta

The Magenta is a conductive hydrostratigraphic unit about 19 feet (6 meters) thick at the WIPP site. The Magenta is saturated except near outcrops along Nash Draw, and hydraulic data are available from 22 wells, including seven wells recompleted to the Magenta between 1995 and 2002 (SNL, 2003a). According to Mercer (1983), transmissivity ranges over five orders of magnitude from 1×10^{-3} to 4×10^{2} square feet per day (1×10^{-9} to 4×10^{-4} square meters per second). A slug test performed in H-9c, a recompleted Magenta well, yielded a transmissivity of 0.56 ft^2/day (6×10^{-7} m^2/s), which is consistent with Mercer's findings (SNL 2003a). The porosity of the Magenta was measured in 1995 as part of testing at the H-19 hydropad (TerraTek, 1996). Four samples had effective porosities ranging from 2.7 to 25.2 percent.

The hydraulic transmissivities of the Magenta, based on sparse data, show a decrease from west to east, with slight indentations of the contours north and south of the WIPP site that correspond to the topographic expression of Nash Draw. In most locations, the hydraulic conductivity of the Magenta is one to two orders of magnitude less than that of the Culebra. The Magenta does not have hydraulically significant fractures in the vicinity of the WIPP site.

Based on Magenta water levels measured in the 1980s (Lappin et al, 1989) when a wide network of Magenta monitoring wells were used, the hydraulic gradient in the Magenta varies from 16 to

20 feet per mile (3 to 4 meters per kilometer) on the eastern side, steepening to about 32 feet per mile (6 meters per kilometer) along the western side near Nash Draw (see Figure L1-32).

Regional modeling using the groundwater basin model indicates that leakage occurs into the Magenta from the overlying Forty-niner and out of the Magenta downwards into the Tamarisk. Regional modeling also indicates that flow directions in the Magenta are dominantly westward, similar to the slope of the land surface in the immediate area of the WIPP site. This flow direction is different than the dominant flow direction in the next underlying conductive unit, the Culebra. This difference is consistent with the groundwater basin conceptual model, in that flow in shallower units is expected to be more sensitive to local topography.

Inferences about vertical flow directions in the Magenta have been made from well data collected by the DOE. Beauheim (1987a) reported flow directions downwards out of the Magenta over the WIPP site, consistent with results of groundwater basin modeling. However, Beauheim concluded that flow directions between the Forty-niner and Magenta would be upward in the three boreholes from which reliable pressure data are available for the Forty-niner (H-3, H-14, and H-16), which is not consistent with the results of groundwater modeling. This inconsistency may be the result of local heterogeneity in rock properties that affect flow on a scale that cannot be duplicated in regional modeling.

As is the case for the Culebra, groundwater elevations in the Magenta have changed over the period of observation. The pattern of changes is similar to that observed for the Culebra.

L1-2a(3)(a)(v) The Forty-niner

The Forty-niner is a confining hydrostratigraphic layer about 66 feet (20 meters) thick throughout the WIPP area and consists of low-permeability anhydrite and siltstone. Tests by Beauheim (1987a) in H-14 and H-16 yielded transmissivities of about 3×10^{-2} to 7×10^{-2} square feet per day (3×10^{-8} to 8×10^{-6} square meters per second) and 5×10^{-3} to 6×10^{-3} square feet per day (3×10^{-9} to 6×10^{-9} square meters per second), respectively for the medial siltstone unit of the Forty-niner. Tests of the siltstone in H-3d provided transmissivity estimates of 3.8×10^{-9} to 4.8×10^{-9} m^2/s (3.5×10^{-3} to 4.5×10^{-3} ft^2/day) (Beauheim et al. 1991b, Table 5-1). The porosity of the Forty-niner was measured as part of testing at the H-19 hydropad (TerraTek 1996). Three claystone samples had effective porosities ranging from 9.1 to 24.0 percent. Four anhydrite samples had effective porosities ranging from 0.0 to 0.4 percent.

Fluid pressures in the Forty-niner have been measured continuously at well H-16, approximately 13.9 m (45.6 ft) from the well of the Air Intake Shaft (AIS), since 1987. The pressures cycle in a sinusoidal fashion on an annual basis. These cycles correlate with cycles observed in rock bolt loads in the WIPP shafts (DOE 2002b), and presumably reflect seasonal temperature changes causing the rock around the shafts to expand and contract. From 1998 through 2002, the pressures have cycled between 40 and 70 psi (90 and 160 ft of fresh water). Given the location of the pressure transducer, the elevation of Forty-niner water level has varied between 2,950 to 3,020 ft (899 to 920 m) amsl during this period. Through April 2002, Forty-niner water levels were also measured monthly at H-3d as part of the WIPP groundwater monitoring program.

Measurements were discontinued after April 2002 because of an obstruction in the well. The April 2002 Forty-niner water level elevation determined at H-3d was 3,092 ft (942 m) amsl. Differences in Forty-niner water levels at H-16 and H-3d are probably due, in part, to differences in the densities of the fluids in the wells. No other wells in the WIPP monitoring network are completed to the Forty-niner.

L1-2a(3)(b) Hydrology of the Dewey Lake and the Santa Rosa

The Dewey Lake and the Santa Rosa, and surficial soils, overlie the Rustler and are the uppermost hydrostratigraphic units considered by the DOE. The Dewey Lake and overlying rocks are more permeable than the anhydrites at the top of the Rustler. Consequently, basin modeling indicates that most (probably more than 70%) of the water that recharges the groundwater basin (that is, percolates into the Dewey Lake from surface water) flows only in the rocks above the Rustler. As modeled, the rest leaks vertically through the upper anhydrites of the Rustler and into the Magenta or continues downward to the Culebra. More flow occurs into the Rustler units at times of greater recharge. Even though it carries most of the recharge because of its low permeability in most areas, lateral flow in the Dewey Lake is slow.

A saturated, perched-water zone has been identified in the lower Santa Rosa directly below the operational area of the WIPP site (DOE 1999; INTERA 1997a; INTERA 1997b; DES 1997). The zone occurred at a location that previously had been dry or only partially saturated.

L1-2a(3)(b)(i) The Dewey Lake

The Dewey Lake contains a productive zone of saturation, probably under water-table conditions, in the southwestern to south-central portion of the WIPP site and south of the site. Several wells operated by the J.C. Mills Ranch south of the WIPP site produce sufficient quantities of water from the Dewey Lake to supply livestock. Short-term production rates of 25 to 30 gallons per minute (5.7 to 6.8 cubic meters per hour) were observed in boreholes P-9 (Jones 1978, Vol. 1., 167 and 168), WQSP-6, and WQSP-6a. Based on a single hydraulic test conducted at WQSP-6a, Beauheim and Ruskauff (1998) estimated the transmissivity of a 24 ft (7 m) fractured section of the Dewey Lake at 360 ft^2/day (3.9×10^{-4} m^2/s).The productive zone is typically found in the middle of the Dewey Lake, 180 to 265 feet (55 to 81 meters) below ground surface and appears to derive much of its transmissivity from open fractures. Where present, the saturated zone may be perched or simply underlain by less transmissive rock. Fractures below the productive zone tend to be completely filled with gypsum. Open fractures and/or moist (but not fully saturated) conditions have been observed at similar depths north of the zone of saturation, at the H-1, H-2, and H-3 boreholes (Mercer 1983).

Under the groundwater monitoring program, water levels are measured in two Dewey Lake wells, WQSP-6a and H-3d, located south of the WIPP site center. Water levels in these two wells are currently 3,198 and 3,075 ft (975 and 937 m) amsl, respectively. Water levels at WQSP-6a remain relatively constant. Over the past several years, water levels at H-3d have risen about 1 ft/yr. Similar to the six Culebra WQSP wells (WQSP-1 through WQSP-6), Dewey Lake water quality is determined semiannually at WQSP-6a. Baseline concentrations for major ion species have also been determined from ten rounds of sampling. Major ion concentrations have been stable within the baseline for all rounds of sampling conducted through May 2009.

Powers (1997) suggests that what distinguishes the low-transmissivity lower Dewey Lake from the high-transmissivity upper Dewey Lake is a change in natural cements from carbonate (above) to sulfate (below). Resistivity logs correlate with this cement change and show a drop in porosity across the cement-change boundary. Similarly, porosity measurements made on eight core samples from the Dewey Lake from well H-19b4 showed a range from 14.9 to 24.8 percent for the four samples from above the cement change, and a range from 3.5 to 11.6 percent for the four samples from below the cement change (TerraTek 1996). In the vicinity of the WIPP site, Powers (1997) proposed the surface of the cement change is at a depth of approximately 50 to 55 m (165 to 180 ft), is irregular, and trends downward stratigraphically to the south and west of the site center.

During site characterization and initial construction of the WIPP shafts, the Dewey Lake did not produce water within the WIPP shafts or in boreholes in the immediate vicinity of the panels. However, since 1995, water has been observed leaking into the exhaust shaft at a depth of approximately 80 ft at the location of the Dewey Lake Santa Rosa contact (INTERA 1997a; INTERA 1997b). The water is interpreted to be from an anthropogenic source, including infiltration from WIPP facility rainfall-runoff retention ponds and the WIPP facility salt storage area and evaporation pond located at the surface. At the site center, thin cemented zones in the upper Dewey Lake retard, at least temporarily, downward infiltration of modern waters.

Saturation of the uppermost Dewey Lake was observed for the first time in 2001 as well C-2737 was being drilled (Powers 2002c). Well C-2811 was then installed nearby to monitor this zone (Powers and Stensrud 2003). Because of the proximity of these two wells to the WIPP facility surface structures area, and the absence of water at this horizon when earlier wells were drilled, the saturation is assumed to be an extension of the anthropogenic waters described in the following section.

It is too early to determine if infiltration control measures installed since 2005 are affecting the recharge in this zone (DBS 2008). For modeling purposes, the hydraulic conductivity of the Dewey Lake, assuming saturation, is estimated to be 3×10^{-3} ft/day (10^{-8} m/s), corresponding to the hydraulic conductivity of fine-grained sandstone and siltstone (Davies 1989). The porosity of the Dewey Lake was measured as part of testing at the H-19 hydropad. Four samples taken above the gypsum-sealed region had measured effective porosities of 14.9 to 24.8 percent. Four samples taken from within the gypsum-sealed region had porosities from 3.5 to 11.6 percent.

The groundwater basin conceptual model relies on gradients established from the position of the water table for the driving force for flow. The DOE has estimated the position of the water table in the southern half of the WIPP site from an analysis of drillers' logs from three potash exploration boreholes and five hydraulic test holes. These logs record the elevation of the first moist cuttings recovered during drilling. Assuming that the first recovery of moist cuttings indicates a minimum elevation of the water table, an estimate of the water table elevation can be made, and the estimated water table surface can be contoured. This method indicates that the elevation of the water table over the WIPP facility waste panels may be about 980 meters above sea level, as shown in Figure L1-33.

L1-2a(3)(b)(ii) The Santa Rosa

The Santa Rosa ranges from 0 to about 300 feet (0 to 91 meters) thick and is present over the eastern half of the WIPP site. It is absent over the western portion of the site. It crops out northeast of Nash Draw. The Santa Rosa near the WIPP site may have a saturated thickness of limited extent. It has a porosity of about 13 percent and a specific capacity of 0.14 to 0.20 gallons per minute per foot (0.029 to 0.041 liters per second per meter) of drawdown, where it yields water in the WIPP region.

In May 1995, a scheduled video inspection of the WIPP exhaust shaft revealed water emanating from cracks in the concrete liner at a depth of approximately 80 ft below the shaft collar. Because little or no groundwater had been encountered at this depth interval previously (Bechtel 1979; DOE 1983a; Holt and Powers 1984, 1986), the DOE implemented a program in early 1996 to investigate the source and extent of the water. The program included installation of wells and piezometers, hydraulic testing (pumping tests), water-quality sampling and analysis, and water-level and precipitation monitoring (DOE 1999; INTERA 1997a; DES 1997; INTERA 1997b).

In the initial phases of the investigation, three wells (C-2505, C-2506, and C-2507) and 12 piezometers (PZ-1 through PZ-12) were installed within the surface structures area of the WIPP site (Figure L1-34). The three wells were located near the exhaust shaft and completed to the Santa RosaDewey Lake contact (approximately 50 ft below ground surface). Similarly, the piezometers were also completed to the Santa RosaDewey Lake contact (approximately 55 to 75 ft below ground surface). All wells and piezometers, with the exception of PZ-8, encountered a saturated zone just above the Santa Rosa/Dewey Lake contact, but water did not appear to have percolated significantly into the Dewey Lake.

Subsequent to the well and piezometer installations, water-level, water-quality, and rainfall data were collected. In addition, hydraulic tests were performed to estimate hydrologic properties and water production rates. These data suggest that the water present in the Santa Rosa below the WIPP facility surface structures area represents an unconfined, water-bearing horizon perched on top of the Dewey Lake (DES 1997). Pressure data collected from instruments located in the exhaust shaft show no apparent hydrologic communication between the Santa Rosa and other formations located stratigraphically below the Santa Rosa.

A water-level-surface map of the Santa Rosa in the vicinity of the WIPP facility surface structures area indicates that a potentiometric high is located near the salt water evaporation pond and PZ-7 (Figure L1-35). The water level at PZ-7 is approximately 1 m (3.3 ft) higher than the water levels in any other wells or piezometers. Water is presumed to move radially from this potentiometric high. The areal extent of the water is larger than the 80-acre investigative area shown in Figure L1-35 as evidenced by drilling records of C-2737 (Powers 2002c) located outside of and south of the WIPP facility surface structures area that indicate a Santa Rosa

Dewey Lake perched-water horizon at a depth of approximately 18 m (60 ft). The study of this water is ongoing.

Water-quality data for the perched Santa Rosa waters are highly variable and appear to be dominated by two anthropogenic sources: (1) runoff of rainfall into and infiltration from the retention ponds located to the south of the WIPP facility surface facilities, and (2) infiltration of saline waters from the salt storage area, the salt storage evaporation pond, and perhaps remnants of the drilling and tailings pit used during the construction of the WIPP salt shaft. The total dissolved solids (TDS) in the perched water range from less than 3,000 mg/L at PZ-10 to more than 160,000 mg/L at PZ-3 (DES 1997). Concentration contours are known to shift with time. For example, the high-TDS zone centered at PZ-3 moved observably to the northeast toward PZ-9 between February 1997 and October 2000 (DOE 2002a).

Hydraulic tests (INTERA 1997a; DES 1997) conducted in the three wells and 12 piezometers indicate that the Santa Rosa behaves as a low-permeability, unconfined aquifer perched on the Dewey Lake. Hydraulic conductivity ranges from 7.4×10^{-3} to 16 ft/day (2.6×10^{-8} to 5.5×10^{-5} m/s). The wells are capable of producing at rates of about 0.3 to 1.0 gpm. The estimated storativity value for the Santa Rosa is 1×10^{-2}.

L1-2a(4) Hydrology of Other Groundwater Zones of Regional Importance

The groundwater regimes in the Capitan Limestone, which is generally regarded as the northern boundary of the Delaware Basin, and Nash Draw have been evaluated by the DOE as part of the WIPP project because of their importance in some processes, notably dissolution features, that the DOE has determined to be of low probability at the WIPP site.

L1-2a(4)(a) The Capitan Limestone

The Capitan, which outcrops in the southern end of the Guadalupe Mountains, is a massive limestone unit that grades basinward into recemented, partly dolomitized reef breccia and shelfward into bedded carbonates and evaporites. A deeply incised submarine canyon near the Eddy-Lea county line has been identified. This canyon is filled with sediments of lower permeability than the Capitan and, according to Hiss (1976) restricts fluid flow. The hydraulic conductivity of the Capitan ranges from 1 to 25 feet per day (3×10^{-6} to 9×10^{-5} meters per second) in southern Lea County and is 5 feet per day (1.7×10^{-5} meters per second) east of the Pecos River at Carlsbad. Hiss reported in 1976 that average transmissivities around the northern and eastern margins of the Delaware Basin are 10,000 square feet per day (0.01 square meters per second) in thick sections and 500 square feet per day (5.4×10^{-4} square meters per second) in incised submarine canyons. Water table conditions are found in the Capitan aquifer southwest of the Pecos River at Carlsbad; however, artesian conditions exist to the north and east. The hydraulic gradient to the southeast of the submarine canyon near the Eddy-Lea county line has been affected by large oil field withdrawals. The Capitan limestone is recharged by percolation through the northern shelf aquifers, by flow from the south and west from underlying basin aquifers and by direct infiltration at its outcrop in the Guadalupe Mountains. The Capitan is important in the regional hydrology because breccia pipes in the Salado have formed over it, most likely in response to the effects of dissolution by groundwater flowing in the Castile along the base of the Salado (see Davies 1984).

L1-2a(4)(b) Hydrology of the Rustler-Salado Contact Zone in Nash Draw

In Nash Draw the contact between the Rustler and the Salado is an unstructured residuum of gypsum, clay, and sandstone created by the dissolution of halite and has been known as the brine aquifer, Rustler-Salado residuum, and residuum. The residuum is absent under the WIPP site. It is clear that dissolution in Nash Draw occurred after deposition of the Rustler. As described previously, the topographic low formed by Nash Draw is a groundwater divide in the groundwater basin conceptual model of the units above the Salado. The brine aquifer is shown in Figure L1-36.

Robinson and Lang described the brine aquifer in 1938 and suggested that the structural conditions that caused the development of Nash Draw might control the occurrence of the brine; thus, the brine aquifer boundary may coincide with the topographic surface expression of Nash Draw. Their studies show brine concentrated along a strip from 2 to 8 miles (3.3 to 13 kilometers) wide and about 26 miles (43 kilometers) long. Data from the test holes that Robinson and Lang drilled indicate that the residuum (containing the brine) ranges in thickness from 10 to 60 feet (3 to 18 meters) and averages about 24 feet (7 meters).

In 1954, hydraulic properties were determined by Hale et al. (1954), primarily for the area between Malaga Bend on the Pecos River and Laguna Grande de la Sal. They calculated a transmissivity value of 8,000 square feet per day (8.6×10^{-3} square meters per second) and estimated the potentiometric gradient to be 1.4 feet per mile (0.27 meter per kilometer). In this area, the Rustler-Salado residuum apparently is part of a continuous hydrologic system, as evidenced by the coincident fluctuation of water levels in the test holes (as far away as Laguna Grande de la Sal) with pumping rates in irrigation wells along the Pecos River.

In the northern half of Nash Draw, the approximate outline of the brine aquifer as described by Robinson and Lang in 1938 has been supported by drilling associated with the WIPP hydrogeologic studies. These studies also indicate that the main differences in areal extent occur along the eastern side where the boundary is very irregular and, in places (test holes P-14 and H-07), extends farther east than previously indicated by Robinson and Lang.

Other differences from the earlier studies include the variability in thickness of residuum present in test holes WIPP-25 through WIPP-29. These holes indicate thicknesses ranging from 11 feet (3.3 meters) in WIPP-25 to 108 feet (33 meters) in WIPP-29 in Nash Draw, compared to 8 feet (2.4 meters) in test hole P-14, east of Nash Draw. The specific geohydrologic mechanism that has caused dissolution to be greater in one area than in another is not apparent, although a general increase in chloride concentration in water from the north to the south may indicate the effects of movement down the natural hydraulic gradient in Nash Draw.

The average hydraulic gradient within the residuum in Nash Draw is about 10 feet per mile (1.9 meters per kilometer); in contrast, the average gradient at the WIPP site is 39 feet per mile

(7.4 meters per kilometer). This difference reflects the changes in transmissivity, which are as much as five orders of magnitude greater in Nash Draw. The transmissivity determined from aquifer tests in test holes completed in the Rustler-Salado contact residuum of Nash Draw ranges from 2×10^{-4} square feet per day (2.1×10^{-10} square meters per second) at WIPP-27 to 8 square feet per day (8.6×10^{-6} square meters per second) at WIPP-29. This is in contrast to the WIPP site proper, where transmissivities range from 3×10^{-5} square feet per day (3.2×10^{-11} square meters per second) at test holes P-18 and H-5c to 5×10^{-2} square feet per day (5.4×10^{-8} square meters per second) at test hole P-14. Locations and estimated hydraulic heads of these wells are illustrated in Figure L1-37.

Hale et al. (1954) believed the Rustler-Salado contact residuum discharges to the alluvium near Malaga Bend on the Pecos River. Because the confining beds in this area are probably fractured because of dissolution and collapse of the evaporites, the brine (under artesian head) moves up through these fractures into the overlying alluvium and then discharges into the Pecos River.

According to Mercer (1983), water in the Rustler-Salado contact residuum in Nash Draw contains the largest concentrations of dissolved solids in the WIPP area, ranging from 41,500 milligrams per liter in borehole H-1 to 412,000 milligrams per liter in borehole H-5c. These waters are classified as brines. The dissolved mineral constituents in the brine consist mostly of sulfates and chlorides of calcium, magnesium, sodium, and potassium; the major constituents are sodium and chloride. Concentrations of the other major ions vary according to the spatial location of the sample, are probably directly related to the interaction of the brine and the host rocks, and reflect residence time within the rocks. Residence time of the brine depends upon the transmissivity of the rock. For example, the presence of large concentrations of potassium and magnesium in water is correlated with minimal permeability and a relatively undeveloped flow system.

L1-2b Surface-Water Hydrology

The WIPP site is in the Pecos River basin, which contains about 50 percent of the drainage area of the Rio Grande Water Resources Region. The Pecos River headwaters are west of Las Vegas, New Mexico, and the river flows to the south through eastern New Mexico and western Texas to the Rio Grande. The Pecos River has an overall length of about 500 mi (805 km), a maximum basin width of about 130 mi (209 km), and a total drainage area of about 44,535 mi^2 (115,301 km^2) (about 20,500 mi^2 [53,075 mi^2] contained within the basin have no external surface drainage and their surface waters do not contribute to Pecos River flows). Figure L1-38 shows the Pecos River drainage area.

The Pecos River is generally perennial, except in the reach below Anton Chico, where the low flows percolate into the stream bed. The main stem of the Pecos River and its major tributaries have low flows, and the streams are frequently dry. About 75 percent of the total annual precipitation and 60 percent of the annual flow result from intense local thunderstorms between April and September. The principal tributaries of the Pecos River in New Mexico, in downstream order, are the Gallinas River, Salt Creek, the Rio Hondo, the Rio Felix, the Eagle Creek, the Rio Peñasco, the Black River, and the Delaware River.

There are no perennial streams at the WIPP site. At its nearest point, the Pecos River is about 12 mi (19 km) southwest of the WIPP site boundary. The drainage area of the Pecos River at this location is 19,000 mi^2 (47,500 km^2). A few small creeks and draws are the only westward-flowing tributaries of the Pecos River within 20 mi (32 km) north or south of the site. A low-flow investigation has been initiated by the USGS within the Hill Tank Draw drainage area, the most prominent drainage feature near the WIPP site. The drainage area is about 4 mi^2 (10 km^2) with an average channel slope of 1 to 100, and drainage westward into the Nash Draw. Two years of observations showed only four flow events. The USGS estimates that the flow rate for these events was under 2 cubic ft (ft^3) per second (0.057 cubic meters [m^3] per second).

Potash mining operations in and near Nash Draw likely contribute to the flow in Nash Draw. For example, the potash operation located 7 to 8 mi due north of the WIPP site disposes of mine tailings and refining-process effluent on its property and has done so since 1965. Records obtained from the New Mexico Office of the State Engineer show that since 1973, an average of 2,400 acre-feet of water per year has been pumped from local aquifers Ogallala and Capitan) for use in the potash-refining process at that location (SNL 2003b). Based on knowledge of the potash refining process, approximately 90 percent of the pumped water is estimated to be discharged to the tailings pile. Geohydrology Associates (1978) estimated that approximately half of the brine discharged onto potash tailings piles in Nash Draw seeps into the ground annually, while the remainder evaporates.

The Black River (drainage area: 400 mi^2 (1,035 km^2)) joins the Pecos from the west about 16 mi (25 km) southwest of the site. The Delaware River (drainage area: 700 mi^2 (1,812 km^2) and a number of small creeks and draws also join the Pecos River along this reach. The flow in the Pecos River below Fort Sumner is regulated by storage in Sumner Lake, Brantley Reservoir, Lake Avalon, and several other smaller irrigation dams.

Five major reservoirs are located in the Pecos River basin: Santa Rosa Lake, Sumner Lake, Brantley Reservoir, Lake Avalon, and Red Bluff Reservoir, the last located just over the border in Texas (Figure L1-38). The storage capacities of these reservoirs and other Pecos River reservoirs adjacent to the Pecos River basin are shown in Table L1-3.

With regards to surface drainage onto and off of the WIPP site, there are no major lakes or ponds within 5 mi (8 km) of the site. The Laguna Gatuña, Laguna Tonto, Laguna Plata, and Laguna Toston are playas more than 10 mi (16 km) north of the site and are at elevations of 3,450 ft (1050 m) or higher. Thus, surface runoff from the site (elevation 3,310 ft (1,010 m) above sea level) would not flow toward any of them. To the north, west, and northwest, Red Lake, Lindsey Lake, the Laguna Grande de la Sal, and a few unnamed stock tanks are more than 10 mi (16 km) from the site, at elevations of from 3,000 to 3,300 ft (914 to 1,006 m).

The mean annual precipitation in the region is about 12 in. (0.3 m), and the mean annual runoff is 0.1 to 0.2 in. (2.5 to 5 mm). The maximum recorded 24-hour precipitation at Carlsbad was 5.12 in. (130 mm) in August 1916. The predicted maximum 6-hour, 100-year precipitation event for the site is 3.6 in. (91 mm) and is most likely to occur during the summer.

The maximum recorded flood on the Pecos River (See Figure L1-25) occurred near the town of Malaga, New Mexico, on August 23, 1966, with a discharge of 120,000 ft^3 (3,396 m^3) per second and a stage elevation of about 2,938 ft (895 m) above mean sea level. The general ground elevation in the vicinity of the surface facilities (approximately 3,400 ft [1,036m] above mean sea level) is about 500 ft (152 m) above the river bed and over 400 ft (122 m) above the maximum recorded historical flood elevation. (DOE, 1980) See Figure L1-25 for the location of the gauging station on the Pecos River where the maximum recorded flood was measured.

More than 90 percent of the mean annual precipitation at the site is lost by evapotranspiration. On a mean monthly basis, evapotranspiration at the site greatly exceeds the available rainfall; however, intense local thunderstorms may produce runoff and percolation.

Water quality in the Pecos River basin is affected by mineral pollution from natural sources and from irrigation return flows. At Santa Rosa, New Mexico, the average suspended-sediment discharge of the river is about 1,650 tons (1,819 metric tons (1,000 kg)) per day. Large amounts of chlorides from Salt Creek and Bitter Creek enter the river near Roswell. River inflow in the Hagerman area contributes increased amounts of calcium, magnesium, and sulfate; and waters entering the river near Lake Arthur are high in chloride. Below Brantley Reservoir, springs flowing into the river are usually submerged and difficult to sample; springs that could be sampled had TDS concentrations of from 3,350 to 4,000 ppm (3,350 to 4,000 mg/L). Concentrated brine entering at Malaga Bend adds an estimated 70 tons per day of chloride to the Pecos River.

L1-2c Groundwater Discharge and Recharge

The only documented points of naturally occurring groundwater discharge in the vicinity of the WIPP site are the saline lakes in the Nash Draw and the Pecos River, primarily near Malaga Bend. Although this is local flow associated with the Nash Draw and unrelated to groundwater flow at the WIPP site, it is presented here for completeness. Discharge into one of the lakes from Surprise Spring was measured by Hunter in 1985 at a rate of less than 0.35 ft^3/s (0.01 m^3/s) in 1942. Hunter also estimated total groundwater discharge into the lakes is 24 ft^3/s (0.67 m^3/s). According to Mercer (1983) discharge from the spring comes from fractured and more transmissive portions of the Tamarisk of the Rustler, and the lakes are hydraulically isolated from the Culebra and lower units.

Groundwater discharge into the Pecos River is greater than discharge into the saline lakes. Groundwater discharge into the Pecos River between Avalon Dam north of Carlsbad and a point south of Malaga Bend was no more than approximately 32.5 ft^3/s (0.92 m^3/s). Most of this gain in stream flow occurs near Malaga Bend (see Figure L1-1) and is the result of groundwater discharge from the residuum at the Rustler/Salado contact zone.

The only documented point of groundwater recharge is also near Malaga Bend, where an almost immediate water-level rise has been reported by Hale et al. in 1954 in a Rustler-Salado well following a heavy rainstorm. This location is hydraulically downgradient from the repository, and recharge here has little relevance to flow near the WIPP site. Examination of the potentiometric surface map for the Rustler/Salado contact zone indicates that some inflow may occur north of the WIPP site, where freshwater equivalent heads are highest. Additional inflow to the contact zone may occur as leakage from overlying units, particularly where the units are close to the surface and under water-table conditions.

No direct evidence exists for the location of either recharge to or discharge from the Culebra. The freshwater-head surface map (Figure L1-31) implies inflow from the north and outflow to the south. Recharge from the surface probably occurs 9 to 19 mi (15 to 30 km) northwest of the WIPP site in and north of Clayton Basin where the Rustler crops out. An undetermined amount of inflow may also occur as leakage from overlying units throughout the region.

The freshwater-head contour map (Figure L1-31) indicates that flow in the Culebra is toward the south. Some of this southerly flow may enter the Rustler/Salado contact zone under water table conditions near Malaga Bend and may ultimately discharge into the Pecos River. Additional flow may discharge directly into the Pecos River or into alluvium in the Balmorhea/Loving Trough to the south.

Recharge to the Magenta may also occur north of the WIPP site in Bear Grass Draw and Clayton Basin. The potentiometric surface map indicates that discharge is toward the west in the vicinity of the WIPP site, probably into the Tamarisk and the Culebra near the Nash Draw. Some discharge from the Magenta may ultimately reach the saline lakes in the Nash Draw. According to Brinster in 1991, additional discharge probably reaches the Pecos River at Malaga Bend or the alluvium in the Balmorhea/Loving Trough.

Isotopic data from groundwater samples suggest that groundwater travel time from the surface to the Dewey Lake and the Rustler is long and rates of flow are extremely slow. Based on observations by Lambert and Harvey reported in 1987, low tritium levels in all WIPP-area samples indicate minimal contributions from the atmosphere since 1950. Lambert in 1987 indicated four modeled radiocarbon ages from the Rustler and the Dewey Lake groundwater are between 12,000 and 16,000 years. The uranium isotope activity ratios observed require a conservative minimum residence time in the Culebra of several thousands of years and more probably reflect minimum ages of from 10,000 to 30,000 years.

Potentiometric data from four wells support the conclusion that little infiltration from the surface reaches the transmissive units of the Rustler. Hydraulic head data are available for a claystone in the Forty-niner from wells DOE-2, H-3, H-4, H-5, and H-6. Beauheim, in 1987a, compared these heads to heads in the surrounding Magenta wells and showed that flow between the units at all four wells may be upward. This observation offers no insight into the possibility of infiltration reaching the Forty-niner, but it rules out the possibility of infiltration reaching the Magenta or any deeper units at these locations.

L1-2d Water Quality

This section presents a discussion of the quality of groundwater and surface water in the WIPP area.

L1-2d(1) Groundwater Quality

Using data from only 22 wells, Siegel, Robinson, and Myers (1991) originally defined four hydrochemical facies (A, B, C, and D) for Culebra groundwater based primarily on ionic strength and major constituents. With the data now available from 59 wells, Domski and Beauheim (2008) defined transitional A/C and B/C facies, as well as a new facies E for high-moles per kilogram (molal) Na-Mg Cl brines.

- Zone B - Dilute (ionic strength ≤0.1 molal) $CaSO_4$-rich groundwater, from southern high-T area. Mg/Ca molar ratio 0.32 to 0.52
- Zone B/C - Ionic strength 0.18 to 0.29 molal, Mg/Ca molar ratio 0.4 to 0.6
- Zone C - Variable composition waters, Ionic strength 0.3 to 1.0 molal, Mg/Ca molar ratio 0.4 to 1.1
- Zone A/C - Ionic strength 1.1 to 1.6 molal, Mg/Ca molar ratio 0.5 to 1.2
- Zone A - Ionic strength >1.66 molal, up to 5.3 molal, Mg/Ca molar ratio 1.2 to 2.4
- Zone D - Defined based on inferred contamination related to potash refining operations. Ionic strength 3 molal, K/Na weight ratios of ~0.2
- Zone E - Wells east of the mudstone-halite margins, ionic strength 6.4 to 8.6, Mg/Ca molar ratio 4.1 to 6.6

The low-ionic-strength (≤0.1 molal) facies B waters contain more sulfate than chloride, and are found southwest and south of the WIPP site within and down the Culebra hydraulic gradient from the southernmost closed catchment basins mapped by Powers (2006b) in the southwest arm of Nash. These waters reflect relatively recent recharge through gypsum karst overlying the Culebra. However, with total dissolved solids (TDS) concentrations in excess of 3,000 mg/L, the facies B waters do not in any way represent modern-day precipitation rapidly reaching the Culebra. They must have residence times in the Rustler sulfate units of thousands of years before reaching the Culebra.

The higher-ionic-strength (0.3–1 molal) facies C brines have differing compositions, representing meteoric waters that have dissolved $CaSO_4$, overprinted with mixing and localized processes. Facies A brines (ionic strength 1.6–5.3 molal) are high in NaCl and are clustered along the M3-H3 halite margin. Facies A represents old waters (long flow paths) that have dissolved halite and/or mixed with connate brine from facies E. The facies D brines, as identified by Siegel, Robinson, and Myers (1991), are high-ionic-strength solutions found in western Nash Draw with high K/Na ratios representing waters contaminated with effluent from potash refining operations. Similar water is found at shallow depth (<36 ft (11 m)) in the upper Dewey Lake at SNL-1, just south of the Intrepid East tailings pile (see below). The newly defined facies E waters are very high ionic strength (6.4–8.6 molal) NaCl brines with high

Mg/Ca ratios. The facies E brines are found east of the WIPP site, where Rustler halite is present above and below the Culebra, and halite cements are present in the Culebra. They represent primitive brines present since deposition of the Culebra and immediately overlying strata.

L1-2d(2) Surface-Water Quality

The Pecos River is the nearest permanent water source to the WIPP site. Natural brine springs, representing outfalls of the brine aquifers in the Rustler, feed the Pecos River at Malaga Bend, 12 mi (19 km) southwest of the site. This natural saline inflow adds approximately 70 tons of chloride per day to the Pecos River. Return flow from irrigated areas above Malaga Bend further contributes to the salinity. The concentrations of potassium, mercury, nickel, silver, selenium, zinc, lead, manganese, cadmium, and barium also show significant elevations at Malaga Bend but tend to decrease downstream. The metals presumably are rapidly adsorbed onto the river sediments. Natural levels of certain heavy metals in the Pecos River below Malaga Bend exceed the water quality standards of the World Health Organization, the U.S. Environmental Protection Agency, and the State of New Mexico. For example, the water quality standards specify a maximum level for lead is 50 parts per billion (ppb); however, levels of up to 400 ppb have been measured.

As it flows into Texas south of Carlsbad, the Pecos River is a major source of dissolved salt in the west Texas portion of the Rio Grande Basin. Natural discharge of highly saline groundwater into the Pecos River in New Mexico keeps TDS levels in the water in and above the Red Bluff Reservoir very high. The TDS levels in this interval exceed 7,500 mg/L 50 percent of the time and, during low flows, can exceed 15,000 mg/L. Additional inflow from saline water-bearing aquifers below the Red Bluff Reservoir, irrigation return flows, and runoff from oil fields continues to degrade water quality between the reservoir and northern Pecos County in Texas. Annual discharge-weighted average TDS concentrations exceed 15,000 mg/L. Water use is varied in the southwest Texas portion of the Pecos River drainage basin. For the most part, water use is restricted to irrigation, mineral production and refining, and livestock watering. In many instances, surface-water supplies are supplemented by groundwaters that are being depleted and are increasing in salinity.

L1-3 Resources

The topic of resources is used to broadly define both economic (mineral and nonmineral) and cultural resources associated with the WIPP site. These resources are important since they 1) provide evidence of past uses of the area, and 2) indicate potential future use of the area with the possibility that such use could lead to disruption of the closed repository. Because of the depth of the disposal horizon, it is believed that only the mineral resources are of significance in predicting the long-term performance of the disposal system. However, the nonmineral and cultural resources are presented for completeness.

This section refers to the significance of specific natural resources that lie beneath the WIPP site. Resources are minerals or hydrocarbons that are potentially of economic value. Reserves are the portion of resources that are economic at today's market prices and with existing technology.

For hydrocarbons, proven reserves can be expected to be recovered from new wells on undrilled acreage or from existing wells where a relatively major expenditure is required to establish production. Probable reserves refer to reserves of hydrocarbons suspected of existing in certain locations based on favorable engineering and/or geologic data. Possible reserves are based on conditions where limited engineering and/or geologic data support recoverable potential.

Mineral resource discussions are focused principally on hydrocarbons and potassium salts, both of which have long histories of development in the region and both of which could be disruptive to the disposal system. The information regarding the mineral resources concentrates on the following factors:

- Number, location, depth, and present state of development including penetrations through the disposal horizon
- Type of resource
- Accessibility, quality, and demand
- Mineral ownership in the area

In addition to extractable resources, this section includes cultural and economic resources. These are focused on a description of past and present land uses unrelated to the development of minerals. The archaeological record supports the observation that changes on land use are principally associated with climate and the availability of forage for wild and domestic animals. In no case does it appear that past or present land use has had an impact on the subsurface beyond the development of shallow groundwater wells for watering livestock.

L1-3a Extractable Resources

The geologic studies of the WIPP site have included the investigation of potential natural resources to evaluate the impact of denying access to these resources and other consequences of their occurrence. This study was completed in support of the *Final Environmental Impact Statement* (FEIS) (DOE, 1980) to ensure knowledge of natural resources once the impacts of their denial was included in the decision-making process for the WIPP Project. Of the natural resources expected to occur beneath the site, five are of practical concern: first, the two potassium salts sylvite and langbeinite, which occur in strata above the repository salt horizon, and , the three hydrocarbons crude oil, natural gas, and distillate liquids associated with natural gas, which occur in strata below the repository horizon. Other mineral resources beneath the site are caliche, salt, gypsum, and lithium; enormous deposits of these minerals near the site and elsewhere in the country are more than adequate (and more economically attractive) to meet future requirements for these materials. In 1995 the NMBMMR performed a reevaluation of the mineral resources at and within 1 mi (1.6 km) around the WIPP site.

L1-3a(1) Potash Resources at the WIPP Site

Throughout the Carlsbad Potash District, commercial quantities of potassium salts are restricted to the middle portion, locally called the McNutt Potash Member of the Salado. A total of 11 horizons, or orebeds, have been recognized in the McNutt Potash Member. Horizon Number 1 is at the base, and Number 11 is at the top. The 11th ore zone is not mined.

The USGS uses three established standard grades: low, lease, and high to quantify the potash resources at the site. The USGS assumes that the "lease" and "high" grades comprise reserves because some lease-grade ore is mined in the Carlsbad Potash District. Most of the potash that is mined, however, is better typified by the high grade. Even the high-grade resources may not be reserves if their properties make processing uneconomic.

The 1995 study contains a comprehensive summary of all previous evaluations.

Griswold (in NMBMMR, 1995, Chapter VII) used 40 existing boreholes drilled on and around the WIPP site to perform a reevaluation of potash resources. Holes were drilled using brine so that the dissolution of potassium salts was inhibited. The results of the chemical analyses of the ore-bearing intervals were adjusted to calculate the percentage equivalent as individual natural mineral species. Only the K_2O (potassium oxide) percentages as either sylvite or langbeinite were used to compute ore reserves. The conclusion reached by Griswold is that only the 4th and 10th ore zones contain economic potash reserves. The quantities are summarized in Table L1-4. Active mine locations are shown on Figure L1-39.

L1-3a(2) Hydrocarbon Resources at the WIPP Site

In 1974 the NMBMMR conducted a hydrocarbon resource study in southeastern New Mexico under contract to ORNL. The study included an area of 1,512 mi^2 (3,914 km^2). At the time of that study, the proposed repository site was about 5 mi (8 km) northeast of the current site. The NMBMMR evaluation included a more detailed study of a four-township area centered on the old site; the present site is in the southwest quadrant of that area. The NMBMMR hydrocarbon resources study is presented in more detail in the FEIS (DOE, 1980). The reader is referred to the FEIS or the original study (Foster, 1974) for additional information.

The resource evaluation was based both on the known reserves of crude oil and natural gas in the region and on the probability of discovering new reservoirs in areas where past unsuccessful drilling was either too widely spread or too shallow to have allowed discovery. All potentially productive zones were considered in the evaluation; therefore, the findings may be used for determining the total hydrocarbon resources at the site. A fundamental assumption in this study was that the WIPP area has the same potential for containing hydrocarbons as the much larger region in which the study was conducted and for which exploration data are available. Whether such resources actually exist can be satisfactorily established only by drilling at spacings close enough to give a high probability of discovery. A 1995 mineral resource reevaluation by the NMBMMR contains a comprehensive summary of this and other previous evaluations.

Broadhead et al. (NMBMMR, 1995, Chapter XI) provided a reassessment of hydrocarbon resources within the WIPP site boundary and within the first mile adjacent to the boundary. Calculations were made for resources that are extensions of known, currently productive oil and gas resources that are thought to extend beneath the study area with reasonable certainty (called probable resources in the report). Qualitative estimates are also made concerning the likelihood that oil and gas may be present in undiscovered pools and fields in the area (referred to as possible resources). Possible resources were not quantified in the study. The results of the study are shown in Tables L1-5 and L1-6.

L1-3b <u>Cultural and Economic Resources</u>

L1-3b(1) <u>Demographics</u>

The WIPP facility is located 26 mi (42 km) east of Carlsbad in Eddy County in southeastern New Mexico and includes an area of 10,240 acres (ac) (4,143 hectares [ha]). The facility is located in a sparsely populated area with fewer than 30 permanent residents living within a 10-mi (16-km) radius of the facility (Figure L1-40). The area surrounding the facility is used primarily for grazing, potash mining, and hydrocarbon production. No resource development that would affect WIPP facility operations or the long-term integrity of the facility is allowed within the 10,240 ac (4,143 ha) that have been set aside for the WIPP Project.

The community nearest to the WIPP site is the town of Loving, New Mexico, 18 mi (29 km) west-southwest of the site center. The population of Loving increased from 11,243 in 1990 to 1,326 in 2000. The nearest population center is the city of Carlsbad, New Mexico, 26 mi (42 km) west of the site. The population of Carlsbad has increased from 24,896 in 1990 to 26,870 in 2000. Hobbs, New Mexico, 36 mi (58 km) to the east of the site had a population decrease from 29,115 in 1990 to 28,657 in 2000. Eunice, New Mexico, 40 mi (64 km) east of the site, had a 1990 population of 2,731 and a 2000 population of 2,562. Jal, New Mexico, 45 mi (72 km) southeast of the site, had a population of 2,153 in 1990 and 1,996 in 2000.

The WIPP site is located in Eddy County near the border to Lea County, New Mexico. The Eddy County population increased from 48,605 in 1990 to 51,658 in 2000. The Lea County population decreased from 55,765 in 1990 to 55,511 in 2000.

L1-3b(2) <u>Land Use</u>

At present, land within 10 mi (16 km) of the site is used for potash mining operations, active oil and gas wells, and grazing. Much of the land use within a 50-mile radius is used for agriculture, as shown in Figures L1-41 and L1-42. This pattern is expected to change little in the future.

The WIPP Land Withdrawal Act of 1992 (LWA) provided for the transfer of the WIPP site lands from the Department of the Interior to the DOE and effectively withdraws the lands, subject to existing rights, from entry, sale, or disposition; appropriation under mining laws; and operation of the mineral and geothermal leasing laws. The LWA directed the Secretary of Energy to produce a management plan to provide for grazing, recreational use such as hunting and trapping, wildlife habitat, mining, and the disposal of salt tailings. (DOE, 2004)

There are no producing hydrocarbon wells within the volumetric boundary defined by the LWA (T22S, R31E, S15-22, 27-34). Several wells tap gas resources beneath Section 31. These wells were initiated outside the WIPP site boundary. The well enters wells enter Section 31 below a depth of 6,000 ft (1.82 km) beneath ground level. Numerous gas pipelines pass within five miles of the WIPP site boundry, as shown on Figure L1-43.

Grazing leases have been issued for all land sections immediately surrounding the WIPP site. Grazing within the WIPP site lands operates within the authorization of the Taylor Grazing Act of 1934, the Federal Land Policy and Management Act, the Public Rangelands Improvement Act of 1978, and the Bankhead-Jones Farm Tenant Act of 1973. The responsibilities of the DOE include supervision of ancillary activities associated with grazing (e.g., wildlife access to livestock water development); tracking of water developments inside WIPP lands to ensure that they are configured according to the regulatory requirements; and ongoing coordination with respective allottees. Administration of grazing rights is in cooperation with the Bureau of Land Management (BLM) according to the Memorandum of Understanding and the coinciding Statement of Work through guidance established in the East Roswell Grazing Environmental Impact Statement. The WIPP site is composed of two grazing allotments administered by the BLM: the Livingston Ridge (No. 77027) and the Antelope Ridge (No. 77032).

L1-3b(3) History and Archaeology

The WIPP site boundary consists of a 10,240-ac (16-m^2) area located in southeastern New Mexico. From about 10,000 B. C. to the late 1800s, this region was inhabited by nomadic aboriginal hunters and gatherers who subsisted on various wild plants and animals. From about A. D. 600 onward, as trade networks were established with Puebloan peoples to the west, domesticated plant foods and materials were acquired in exchange for dried meat, hides, and other products from the Pecos Valley and Plains. In the mid-1500s, the Spanish Conquistadors encountered Jumano and Apachean peoples in the region practicing hunting and gathering and engaging in trade with Puebloans. After the Jumanos abandoned the southern Plains region, the Comanches became the major population of the area. Neighboring populations, with whom the Comanches maintained relationships ranging from mutual trade to open warfare, included the Lipan, or Southern Plains Apache; several Puebloan groups; Spaniards; and the Mescalero Apaches.

The best documented indigenous culture in the WIPP region is that of the Mescalaro Apaches, who lived west of the Pecos. The lifestyle of the Mescalaro Apaches represents a transition between the full sedentism of the Pueblos and the nomadic hunting and gathering of the Jumanos and the Sumas. In 1763 the San Saba expedition encountered and camped with a group of Mescaleros in Los Medaños. Expedition records indicate the presence of both Lipan and Mescalero Apaches in the region.

A peace accord reached between the Comanches and the Spaniards in 1768 resulted in two historically important economic developments: 1) organized buffalo hunting by Hispanic and

Puebloan "ciboleros," and 2) renewal and expansion of the earlier extensive trade networks by Comancheros. These events placed eastern New Mexico in a position to receive a wide array of both physical and ideological input from the Plains culture area to the east and north and from Spanish-dominated regions to the west and south. Comanchero trade began to mesh with the Southwest American trade influence in the early nineteenth century. However, by the late 1860s the importance of Comanchero trade was cut short by Texan influence.

The first cattle trail in the area was established along the Pecos River in 1866 by Charles Goodnight and Oliver Loving. By 1868, Texan John Chisolm dominated much of the area by controlling key springs along the river. Overgrazing, drought, and dropping beef prices led to the demise of open range cattle ranching by the late 1880s.

Following the demise of open-range livestock production, ranching developed using fenced grazing areas and production of hay crops for winter use. Herd-grazing patterns were influenced by the availability of water supplies as well as by the storage of summer grasses as hay for winter use.

The town now called Carlsbad was founded as "Eddy" in 1889 as a health spa. In addition to ranching, the twentieth century brought the development of the potash, oil, and gas industries that have increased the population eightfold in the last 50 years.

Although technological change has altered some of the aspects, ranching remains an important economic activity in the WIPP region. This relationship between people and the land is still an important issue in the area. Ranch-related sites that date to the 1940s and 1950s are common in parts of the WIPP area. These will be considered historical properties within the next several years and thus will be treated as such under current law.

The National Historic Preservation Act (NHPA) (16 USC 470 et seq.) was enacted to protect the nation's cultural resources in conjunction with the states, local governments, Indian tribes, and private organizations and individuals. The policy of the federal government includes: 1) providing leadership in preserving the prehistoric and historic resources of the nation; 2) administering federally owned, administered, or controlled prehistoric resources for the benefit of present and future generations; 3) contributing to the preservation of nonfederally owned prehistoric and historic resources; and 4) assisting state and local governments and the national trust for historic preservation in expanding and accelerating their historic preservation programs and activities. The act also established the National Register of Historic Places ("National Register"). At the state level, the State Historic Preservation Officer (SHPO) coordinates the state's participation in implementing the NHPA. The NHPA has been amended by two acts: the Archaeological and Historic Preservation Act (16 USC 469 et seq.), and the Archaeological Resource Protection Act (16 USC 470aa et seq.).

In order to protect and preserve cultural resources found within the WIPP site boundary, the DOE submitted a mitigation plan to the New Mexico SHPO describing the steps to be taken to either avoid or excavate archaeological sites. A "site" was defined as a place used and occupied by prehistoric people. In May 1980, the SHPO made a determination of "no adverse effect from

WIPP facility activities" on cultural resources. The National Advisory Council on Historic Preservation concurred that the WIPP Mitigation Plan is appropriate to protect cultural resources.

Known historical sites (more than 50 years old) in southeastern New Mexico consist primarily of early twentieth century homesteads that failed or isolated features from late nineteenth century and early twentieth century cattle or sheep ranching and military activities. To date, no Spanish or Mexican conquest or settlement sites have been identified. Historic components are rare but are occasionally noted in the WIPP area. These include features and debris related to ranching.

Since 1976, cultural resource investigations have recorded 98 archaeological sites and numerous isolated artifacts within the 16-mi^2 (41.5-km^2) area enclosed by the WIPP site boundary. In the central 4-mi^2 (10.4-km^2) area, 33 sites were determined to be eligible for inclusion on the National Register as an archaeological district. Investigations since 1980 have recorded an additional 14 individual sites outside the central 4-mi^2 (10.4-km^2) area that are considered eligible for inclusion on the National Register. The major cultural resource investigations to date are broken out in the following. Additional information can be found in the bibliography.

1977 The first survey of the area was conducted in 1977 by Nielson of the Agency for Conservation Archaeology (ACA) for SNL. This survey resulted in the location of 33 sites and 64 isolated artifacts.

1979 MacLennan and Schermer of ACA performed the next survey in 1979. It was conducted for access roads and a railroad right-of-way for Bechtel, Inc. The survey encountered 2 sites and 12 isolated artifacts.

1980 Schermer performed another survey in 1980 to relocate the sites originally recorded by Nielson. This survey redescribed 28 of the original 33 sites.

1981 Hicks directed the excavation of nine sites in the WIPP core-area in 1981.

1982 Bradley in 1985 recorded one site and four isolated artifacts in an archaeological survey for a proposed water pipeline.

1985 Lord and Reynolds examined three sites in 1985 within the WIPP core-area. These sites consisted of two plant-collecting and processing sites and one base camp used between 1000 B. C. and A. D. 1400. The artifacts recovered from the excavations have been placed in the Laboratory of Anthropology at the Museum of New Mexico in Santa Fe.

1987 Mariah Associates, Inc., identified 40 sites and 75 isolates in 1987 in an inventory of 2,460 ac in 15 quarter-section units surrounding the WIPP site. In this investigation, 19 of the sites were located within the WIPP site boundary. Sites encountered in this investigation tended to lack evident or intact features. Of the 40 new sites defined, 14 were considered eligible for inclusion in the National Register, 24 were identified as having insufficient data to determine eligibility, and 2 were determined to be ineligible for inclusion. The eligible and potentially eligible sites have been mapped and are being avoided by the DOE in its current activities at the WIPP site.

1988-1992 Several archaeological clearance reports have been prepared for seismic testing lines on public lands in Eddy County, New Mexico, during this period.

No artifacts were encountered during cultural resource surveys performed from 1992 until present. The following list provides examples of WIPP activities that required cultural resource surveys. All investigations were performed and reported in accordance with requirements established by the New Mexico Office of Cultural Affairs (OCA) and administered by the SHPO.

- SPDV site investigation into status of a previously recorded site (#LA 33175) to determine potential impacts from nearby reclamation activity. Assessment included minor surface excavation.
- WIPP well bore C-2737. Cultural resource investigation for well pad and access road.
- WIPP well bores WQSP 1-6 and 6a. Individual cultural resource investigations conducted for construction of each respective well pad and access road.
- WIPP well bores SNL 1, 2, 3, 9 and 12. Cultural resource investigations conducted for construction of each respective well pad and access road.
- WIPP well bore WTS 4. Cultural resource investigation conducted in support of siting and constructing reserve pits for well drilling and development.
- North Salt Pile Expansion. Cultural resource investigation conducted in support of the expansion of the North Salt Pile, a project designed to mitigate surface water infiltration.

The Delaware Basin has been used in the past for an isolated nuclear test. This test, Project Gnome, took place in 1961 at a location approximately 8 mi (13 km) southwest of the WIPP site. The primary objective of Project Gnome was to study the effects of an underground nuclear explosion in salt. The Gnome experiment involved the detonation of a 3.1-kiloton nuclear device at a depth of 1,200 ft (361 m) in the bedded salt of the Salado. The explosion created a cavity of approximately 1,000,000 ft^3 (27,000 m^3), and caused surface displacements over an area of about a 1,200-ft (360-m) radius. Fracturing and faulting caused measurable changes in rock permeability and porosity at distances up to approximately 330 ft (100 m) from the cavity. No earth tremors were reported at distances over 25 mi (40 km) from the explosion. Project Gnome was decommissioned in 1979.

L1-4 Seismicity

Seismic data are presented in two time frames, before and after the time when seismographic data for the region became available. The earthquake record in southern New Mexico dates back only to 1923, and seismic instruments have been in place in the state since 1961. Various records have been examined to determine the seismic history of the area within 180 mi (288 km) of the site. With the exception of a weak shock in 1926 at Hope, New Mexico, and shocks in 1936 and 1949 felt at Carlsbad, all known shocks before 1961 occurred to the west and southwest of the site more than 100 mi (160 km) away.

The strongest earthquake on record within 180 mi (288 km) of the site was the Valentine, Texas, earthquake of August 16, 1931. It has been estimated to have been of magnitude 6.4 on the Richter scale (Modified Mercalli Intensity of VIII). The Valentine earthquake was 130 mi (208 km) south-southwest of the site. Its Modified Mercalli Intensity at the site is estimated to have been V; this is believed to be the highest intensity felt at the site in this century.

In 1887, a major earthquake occurred in northeast Sonora, Mexico. Although about 335 mi (536 km) west-southwest of the site, it is indicative of the size of earthquakes possible in the eastern portion of the Basin and Range Province, west of the province containing the site. Its magnitude was estimated to have been 7.8 (VIII to IX in Modified Mercalli Intensity). It was felt over an area of 0.5 million mi^2 (1.3 million km^2) (as far as Santa Fe to the north and Mexico City to the south); fault displacements near the epicenter were as large as 26 ft (18 m).

Since 1961, instrumental coverage has become comprehensive enough to locate most of the moderately strong earthquakes (local magnitude >3.5) in the region (Figure L1-44). Instrumentally determined shocks that occurred within 180 mi (288 km) of the site between 1961 and 1979 are shown in Figure L1-45. The distribution of these earthquakes may be biased by the fact that seismic stations were more numerous and were in operation for longer periods north and west of the site.

Except for the activity southeast of the site, the distribution of epicenters since 1961 differs little from that of shocks before that time. There are two clusters, one associated with the Rio Grande Rift on the Texas-Chihuahua border and another associated with the Central Basin Platform in Texas near the southeastern corner of New Mexico. The latter activity was not reported before 1964. It is not clear from the record whether earthquakes were occurring in the Central Basin Platform before 1964, although local historical societies and newspapers tend to confirm their absence before that time.

A station operating for 10 months at Fort Stockton, Texas, indicated many small shocks from the Central Basin Platform (See Figure L1-45). Activity was observed at the time the station opened on June 21, 1964. This activity may be related to the injection of water underground for oil recovery. In the Ward-Estes North oilfield, operated by the Gulf Oil Corporation, the cumulative total of water injected up to 1970 was over 1 billion barrels. Accounting for 42 percent of the water injected in Ward and Winkler counties, Texas, the quantity is three times the total injected in all the oil fields of southeastern New Mexico during the same period. Water injection has not been used in the region of the WIPP site to stimulate gas production. The nearest oil fields in the Delaware Basin, where any recovery might be attempted, are adjacent to the WIPP site boundary in the Delaware Formations. The source of this seismicity is insignificant because the seismic design basis uses the observed seismicity regardless of its cause.

A recent earthquake felt at the WIPP site occurred in January 1992 and is referred to as the Rattlesnake Canyon Earthquake[2]. It occurred 60 mi (100 km) east-southeast of the WIPP site. The earthquake was assigned a magnitude of 5.0. This event had no effect on any of the structures at the WIPP facility as documented by post-event inspections by the WIPP staff and the New Mexico Environment Department. This event was within the parameters used to develop the seismic risk assessment of the WIPP facility for the purposes of construction and operation.

The Rattlesnake Canyon event likely was tectonic in origin based on a 7±1 mi (12±2 km) depth. This suggests some uncertainty regarding the origin of earthquakes associated with the Central Basin Platform.

Regional seismic activity has been the focus of ongoing geophysical investigations since the 2004. Regional seismic activity is monitored to establish a basis for predicting ground motions that the WIPP repository may experience in both the near and distant future. In the early 1990s, to increase coverage in the vicinity of the WIPP site, the New Mexico Institute of Mining and Technology (NMIMT) installed a network of seven seismograph stations in southeastern New Mexico. These instruments are sufficiently sensitive to detect events with magnitudes as low as 0.1 on the Richter scale. This further increased the number of seismic events recorded in the area.

Starting in January 1997, a large number of seismic events were concentrated in an area known as Dagger Draw, northwest of Carlsbad, New Mexico, and near the Dagger Draw gas field, suggesting that the events may be induced by natural gas production activity. In 2003, two more seismograph stations were located in the vicinity of Dagger Draw to allow the recording of smaller events that could not previously be detected. Although the number of recorded events increased dramatically in this area, peaking in 2004, almost all of the recorded events are of low magnitude.

The WIPP Delaware Basin Drilling Surveillance Program (DBDSP) tracks seismic events occurring in the vicinity of the WIPP Site. In 2007, the DBDSP completed the update of its seismic database, incorporating the changes and adding events that were not previously considered in the area. The number of recorded events that have occurred within the Delaware Basin between 1971 and September 2007 are listed in Table L1-7, Seismic Events in the Delaware Basin.

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[2] An earthquake occurred on April 13, 1995, near the town of Alpine, Texas. This earthquake has been assigned a local magnitude of M = 5.5. Details of the earthquake have not yet been published. The Alpine earthquake was felt at the WIPP site; however, no damage to WIPP facilities occurred as the result of this earthquake.

A total of 87 seismic events that have occurred within 150 mi (240 km) of the WIPP site with a reported magnitude greater than 3.0. Of these 87 events, only 4 occurred in the Delaware Basin. The one closest to the WIPP site occurred as a result of a roof fall in one of the local potash mines (DOE 2007a).

L1-5 Rock Geochemistry

An understanding of the mineralogy/geochemistry of the host repository rock is considered critical to predicting the long-term waste isolation capability of the repository. Chemical composition of the different minerals and any impurities are important to understand and predict waste-rock compatibility of the Salado. This section emphasizes the following topics:

- Mineral content and composition
- Fluid inclusions
- Fracture fillings.

The Salado is dominated by various evaporite salts; the dominant mineral is halite (NaCl) of varying purity and accessory minerals. The major accessory minerals are anhydrite ($CaSO_4$), clays, polyhalite ($K_2MgCa_2(SO_4)_42H_2O$), and gypsum ($CaSO_42H_2O$). In the vicinity of the repository, authigenic quartz (SiO_2) and magnesite ($MgCO_3$) are also present as accessory minerals. The marker beds in the salt are described as anhydrite with seams of clay. The clays within the Salado are enriched in magnesium and depleted in aluminum. The magnesium enrichment probably reflects the intimate contact of the clays with brines derived from evaporating sea water, which are relatively high in magnesium.

A partial list of minerals found in the Delaware Basin evaporites, together with their chemical formulas, is given in Table L1-8. The table also indicates the relative abundances of the minerals in the evaporite rocks of the Castile, the Salado, and the Rustler. Minerals found either only at depth, removed from influence of weathering, or only near the surface, as weathering products, are also identified. Although the most common Delaware Basin evaporite mineral is halite, the presence of less soluble interbeds (dominantly anhydrite, polyhalite, and claystone) and more soluble admixtures (e.g., sylvite, glauberite, and kainite) has resulted in chemical and physical properties significantly different from those of pure NaCl. In particular, the McNutt Potash Member, between Marker Beds 116 and Marker Bed 126, is locally explored and mined for K-bearing minerals of economic interest. Under differential stress, brittle interbeds (anhydrite, polyhalite, magnesite, and dolomite) may fracture while, under the same stress regime, pure NaCl would undergo plastic deformation. Fracturing of brittle interbeds, for example, has locally enhanced the permeability, allowing otherwise nonporous rock to carry groundwater (e.g., fractured dolomite beds in the Rustler). Some soluble minerals incorporated in the rock salt (e.g., polyhalite, sylvite, leonite, and langbeinite) can be radiometrically dated, their longevity marking the time of most recent water-incursion into the evaporite section. The survival of such minerals is significant, in that such dating is impossible in pure NaCl or calcium sulfate.

Liquids were collected from fluid inclusions and from seeps and boreholes within the WIPP drifts. Analysis of these samples indicated that there is compositional variability of the fluids showing the effects of various phase transformations on brine composition. The fluid inclusions belong to a different chemical population than do the fluids emanating from the walls. It was concluded that much of the brine is completely immobilized within the salt and that the free liquid emanating from the walls is present as a fluid film along intergranular boundaries mainly in clays and in fractures in anhydrites.

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TABLES

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TABLE L1-1
CULEBRA THICKNESS DATA SETS

Source	Data Set Location								
	T22S, R31E			T21-23S, R30-32E			Entire Set		
	n	ave	st dev	n	ave	st dev	n	ave	st dev
Richey (1989)	7	7.5 m	1.04 m	115	7.9 m	1.45 m	633	7.7 m	1.65 m
Holt and Powers (1988)	35	6.4 m	0.59 m	122	7.0 m	1.26 m	508	6.5 m	1.89 m
LaVenue et al. (1988)							78	7.7 m	
WIPP Potash Drillholes									
Jones (1978)				21	7.5 m	0.70 m			
Holt and Powers (1988)				21	6.3 m	0.50 m			

Key: n = Number of boreholes or data points
ave = Average or mean
st dev = Standard deviation

TABLE L1-2
HYDROLOGIC CHARACTERISTICS OF ROCK UNITS AT THE WIPP SITE

Member Name	Thickness (m)		Hydraulic Conductivity (m/s)		Porosity	
	max	min	max	min	max	min
Forty-niner	20	–	5.0×10^{-9}	5.0×10^{-10}	–	–
Magenta	8	4	5.0×10^{-5}	5.0×10^{-10}	–	–
Tamarisk	84	8	–	–	–	–
Culebra	11.6	4	1×10^{-4}	2×10^{-10}	0.30	0.03
Los Medaños	36	–	1×10^{-11}	6×10^{-15}	–	–
Rustler/Salado Contact Zone	33	2.4	1×10^{-6}	1×10^{-12}	0.33	0.15

m = meters

m/s = meters per

max = maximum

min = minimum

TABLE L1-3
CAPACITIES OF RESERVOIRS IN THE PECOS RIVER DRAINAGE

Reservoir	River	Total Storage Capacity[a] (acre-feet)	Use[b]
Los Esteros	Pecos	282,000	FC
Sumner	Pecos	122,100	IR, R
Brantley	Pecos	42,000	IR, R, FC
Avalon	Pecos	5,000	IR
Red Bluff	Pecos	310,000	IR
Two Rivers	Rio Hondo	167,900	FC

[a]Capacity below the lowest uncontrolled outlet or spillway.

[b]Key:

FC=Flood control

IR=Irrigation

R=Recreation

TABLE L1-4
CURRENT ESTIMATES OF POTASH RESOURCES AT THE WIPP SITE

Mining Unit	Product	Recoverable Ore (10^6 tons)	
		Within the WIPP site	Outside the WIPP site
4th Ore Zone	Langbeinite	40.5 @ 6.99%	126.0 @ 7.30%
10th Ore Zone	Sylvite	52.3 @ 13.99%	105.0 @ 14.96%

Source: NMBMMR, 1995, Chapter VII

TABLE L1-5
IN-PLACE OIL WITHIN STUDY AREA

Formation	Within WIPP site (10^6 bbl)	Outside WIPP site (10^6 bbl)	Total (10^6 bbl)
Delaware	10.33	20.8	31.13
Bone Spring	0.44	0.8	1.25
Strawn	0.4	0.4	0.8
Atoka	1.1	0.1	0.2
Total	12.3	22.9	35.3

Source: NMBMMR 1995, Chapter XI.

TABLE L1-6
IN-PLACE GAS WITHIN STUDY AREA

Formation	Gas Reserves	
	Within WIPP Site Boundary (mcf)	Adjacent to WIPP Site Boundary (mcf)
Delaware	18,176	32,873
Bone Springs	956	1,749
Strawn	9,600	9,875
Atoka	123,336	94,410
Morrow	32,000	28,780

Source: NMBMMR, 1995, Chapter XI

TABLE L1-7
SEISMIC EVENTS IN THE DELAWARE BASIN

County	No. of Events	Earliest Event	Latest Event	Smallest Magnitude	Largest Magnitude
Culberson	12	10/27/1992	12/20/2005	1.1	2.4
Eddy	15	11/28/1975	07/05/2007	0.5	3.7
Lea	1	06/23/1993	06/23/1993	2.1	2.1
Loving	4	02/04/1976	04/24/2003	1.1	2.0
Pecos	18	01/30/1975	12/22/1998	1.0	2.6
Reeves	18	02/19/1976	05/25/2002	1.0	3.1
Ward	47	09/03/1976	08/19/1978	0.3	2.8
Winkler	8	09/24/1971	09/15/1988	0.0	3.0

Key:

Magnitude	
Less than 2	Very seldom felt
2.0 to 3.4	Barely felt
3.5 to 4.2	Felt as a rumble
4.3 to 4.9	Shakes furniture; can break dishes
5.0 to 5.9	Dislodges heavy objects; cracks walls
6.0 to 6.9	Considerable damage to buildings
7.0 to 7.3	Major damage to buildings; breaks underground pipes
7.4 to 7.9	Great damage; destroys masonry and frame buildings
Above 8.0	Complete destruction; ground moves in waves

Source: DBDSP, DOE 2007b

TABLE L1-8
CHEMICAL FORMULAS, DISTRIBUTIONS, AND RELATIVE ABUNDANCES OF MINERALS IN DELAWARE BASIN EVAPORITES

Mineral	Formula	Occurrence/Abundance
Amesite	$(Mg_4Al_2)(Si_2Al_2)O_{10}(OH)_8$	S,R
Anhydrite	$CaSO_4$	CCC,SSS,RRR; rarely near surface
Calcite	$CaCO_3$	S,RR
Carnallite	$KMgCl_3 \bullet 6H_2O$	SS
Chlorite	$(Mg,Al,Fe)_{12}(Si,Al)_8O_{20}(OH)_{16}$	S,R
Corrensite	mixed-layer chlorite/smectite	S,R
Dolomite	$CaMg(CO_3)_2$	RR
Feldspar	$(K,Na,Ca)(Si,Al)_4O_8$	C,S,R
Glauberite	$Na_2Ca(SO_4)_2$	C,S (never near surface)
Gypsum	$CaSO_4 \bullet 2H_2O$	CCC (only near surface),S,RRR
Halite	NaCl	CCC,SSS,RRR; rarely near surface)
Illite	$K_{1-1.5}Al_4[Si_{7-6.5}Al_{1-1.5}O_{20}](OH)_4$	S,R
Kainite	$KMgClSO_4 \bullet 3H_2O$	SS
Kieserite	$MgSO_4\ H_2O$	SS
Langbeinite	$K_2Mg_2(SO_4)_3$	S
Magnesite	$MgCO_3$	C,S,R
Polyhalite	$K_2Ca_2Mg(SO_4)_4 \bullet 2H_2O$	SS,R (never near surface)
Pyrite	FeS_2	C,S,R
Quartz	SiO_2	C,S,R
Serpentine	$Mg_3Si_2O_5(OH)_4$	S,R
Smectite	$(Ca_{1/2},Na)_{0.7}(Al,Mg,Fe)_4(Si,Al)_8O_{20}\ (OH)_4 \bullet nH_2O$	S,R
Sylvite	KCl	SS

Key to Occurrence/Abundance notations:

C = Castile Formation; S = Salado Formation; R = Rustler Formation
3 letters = abundant; 2 letters = common; 1 letter= rare or accessory

FIGURES

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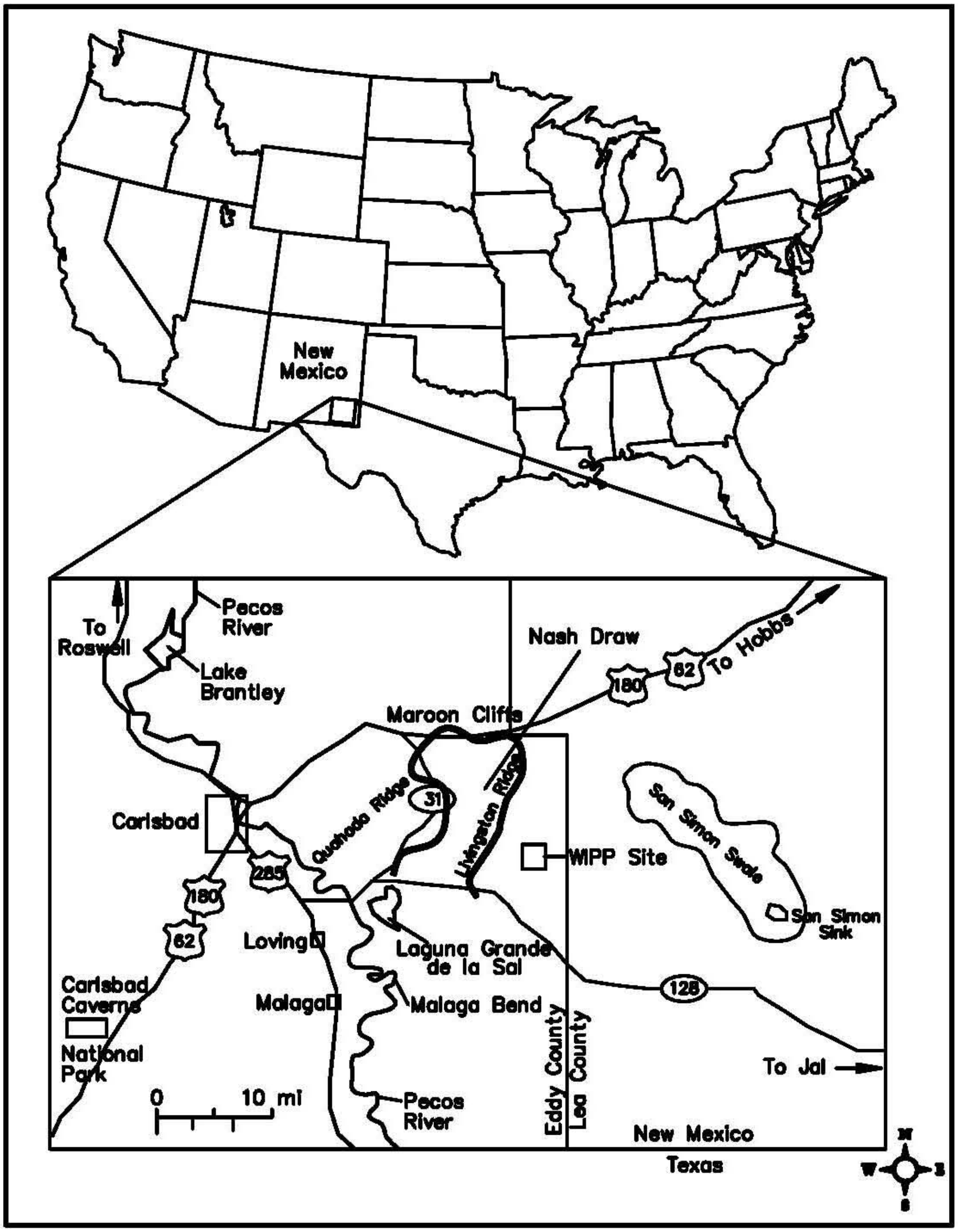


Figure L1-1
WIPP Site Location in Southeastern New Mexico

ERA	PERIOD	EPOCH	YEARS		MAJOR GEOLOGICAL EVENTS – SOUTHEAST NEW MEXICO REGION
			DURATION	BEFORE PRESENT	
CENOZOIC	Quartenary	Holocene	10,000		Eolian and erosion/solution activity. Development of present landscape.
		Pleistocene	1,590,000	1,600,000	
	Tertiary	Pliocene	3,700,000		Deposition of Gatuna fan sediments. Formation of caliche caprock.
		Miocene	18,400,000		Regional uplift and east–southeastward tilting; Basin–Range uplift of Sacramento and Guadalupe–Delaware Mountains.
		Oligocene	12,900,000		Erosion dominant. No Early to Mid–Tertiary rocks present.
		Eocene	21,200,000		
		Paleocene	8,600,000	66,400,000	Laramide "revolution" Uplift of Rocky Mountains. Mid tectonism and igneous activity to west and north.
MESOZOIC	Cretaceous		77,600,000	144,000,000	Submergence intermittent shallow seas. Thin lime–stone and clastics deposited.
	Jurassic		64,000,000	208,000,000	Emergent conditions. Erosion, formation of rolling terrain. Deposition of fluvial clastics.
	Triassic		37,000,000	245,000,000	Erosion. Broad flood plain develops.
PALEOZOIC	Permian		41,000,000	286,000,000	Deposition of evaporite sequence followed by continental red beds. Sedimentation continuous in Delaware, Midland, Val Verde basins and shelf areas.
	Pennsylvanian		34,000,000	320,000,000	Massive deposition of clastics. Shelf, margin, basin pattern of deposition develops.
	Mississippian		40,000,000	360,000,000	Regional tectonic activity accelerates, folding up Central Basin platform. Matador arch, ancestral Rockies. Regional erosion. Deep, broad basins to east and west of platform develop.
	Devonian		48,000,000	408,000,000	Renewed submergence. Shallow sea retreats from New Mexico; erosion. Mild epeirogenic movements. Tobosa basin subsiding. Pedernal landmass and Texas Penninsula emergent until Middle Mississippian.
	Silurian		30,000,000	438,000,000	
	Ordovician		67,000,000	505,000,000	Marathon–Quachita geosyncline, to south, begins subsiding. Deepening of Tobosa basin area; shelf deposition of clastics, derived partly from ancestral Central Basin platform and carbonates.
	Cambrian		65,000,000	570,000,000	Clastic sedimentation – Bliss sandstone.
	PRECAMBRIAN				Erosion to a nearly level plain. Mountain building, igneous activity, metamorphism, erosional cycles.

Source: Powers, et al., 1978; Palmer, 1983.

Figure L1-2
Major Geologic Events in Southeast New Mexico Region

SYSTEM	SERIES	GROUP	FORMATION	MEMBER
RECENT	RECENT		SURFICIAL DEPOSITS	
QUATERNARY	PLEISTOCENE		MESCALERO CALICHE	
			GATUNA	
TERTIARY	MID-PLIOCENE		OGALLALA	
TRIASSIC		DOCKUM	SANTA ROSA	
PERMIAN	OCHOAN		DEWEY LAKE	
			RUSTLER	Forty-niner
				Magenta
				Tamarisk
				Culebra
				Los Medaños
			SALADO	Upper
				McNutt Potash
				Lower
			CASTILE	
	GUADALUPIAN	DELAWARE MOUNTAIN	BELL CANYON	
			CHERRY CANYON	
			BRUSHY CANYON	

Figure L1-3
Site Geological Column

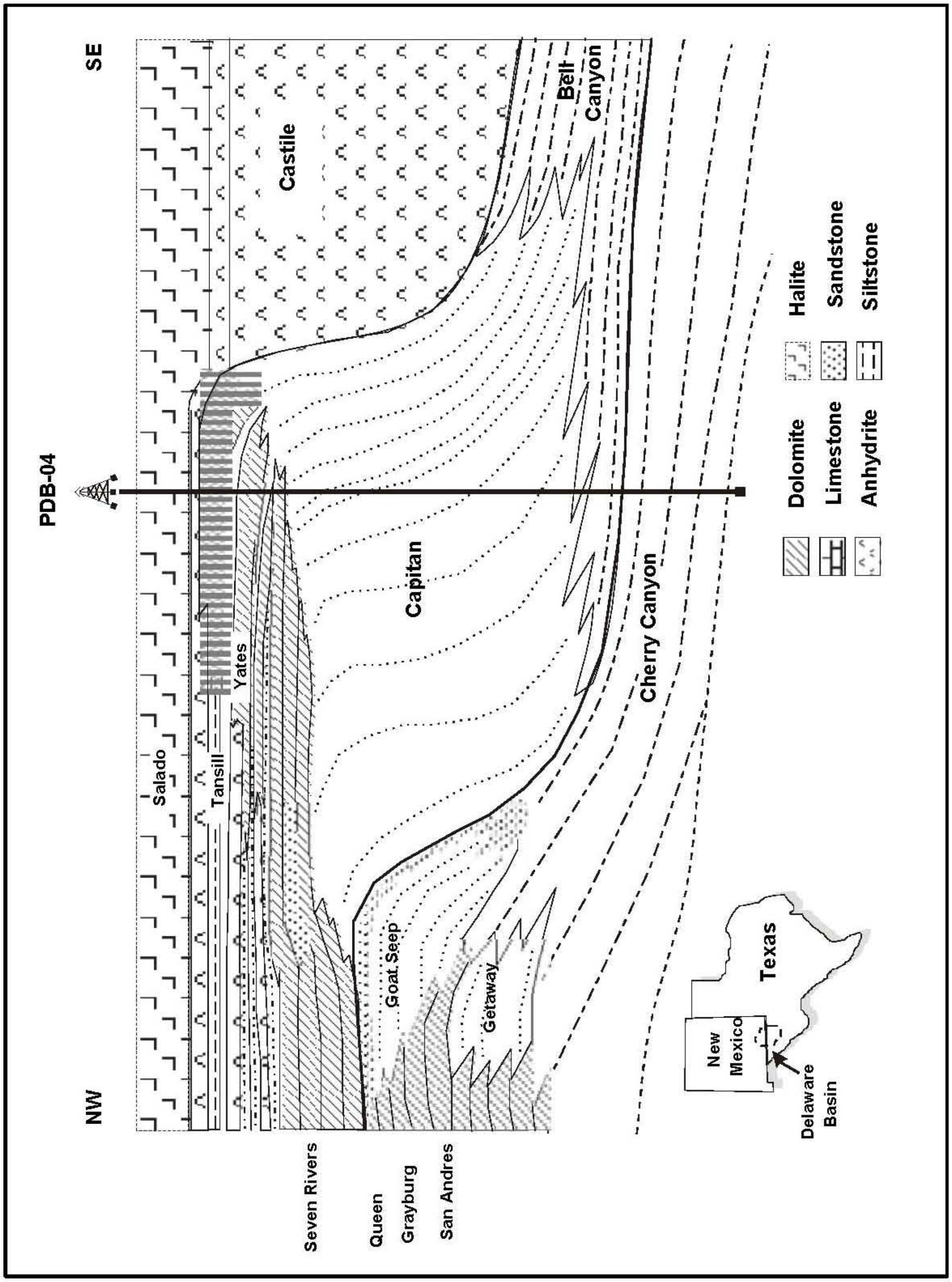


Figure L1-4
Cross Section from Delaware Basin (S.E.) Through Marginal Reef Rocks to Back-Reef Facies

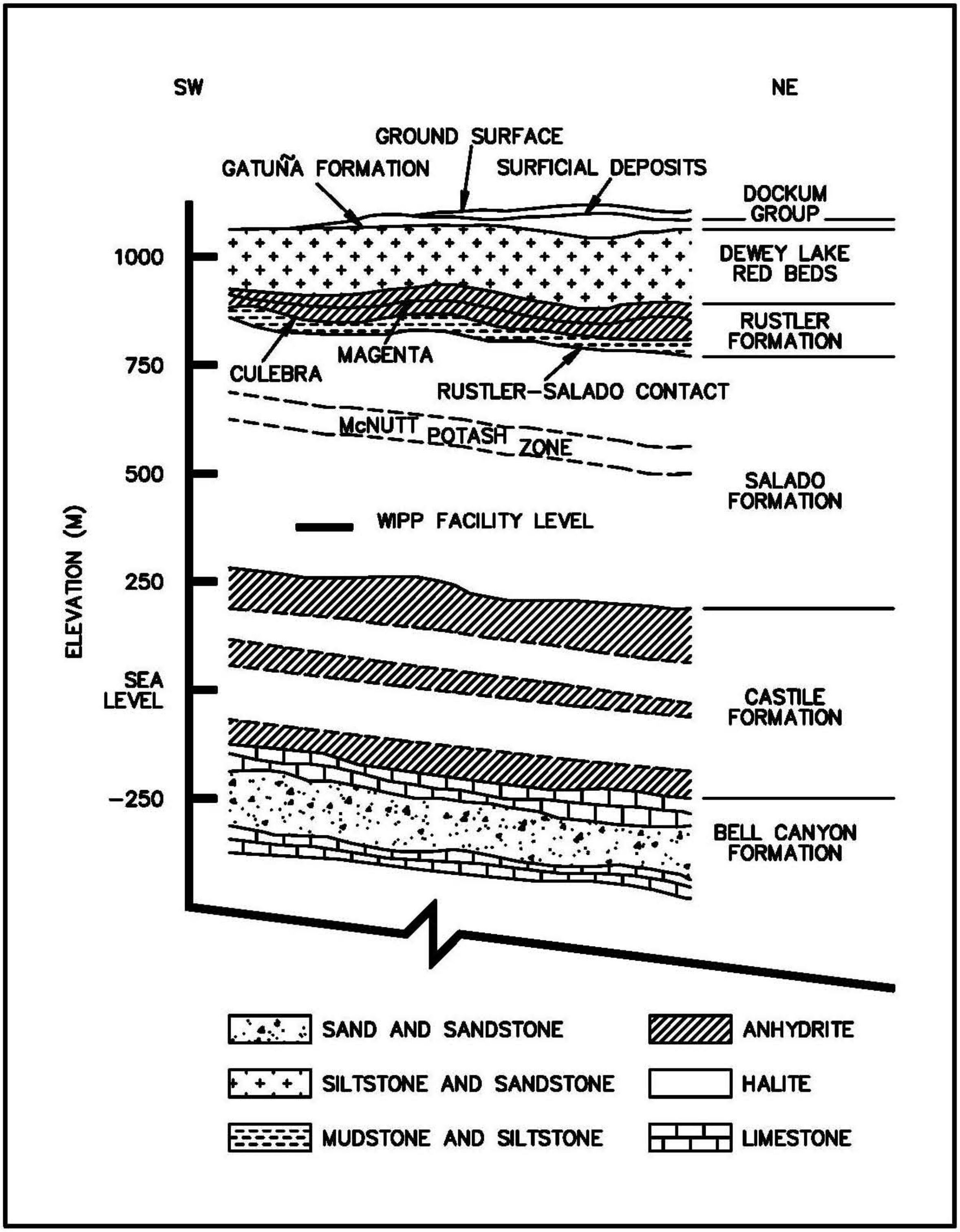


Figure L1-5
Generalized Stratigraphic Cross-Section above Bell Canyon Formation at WIPP Site

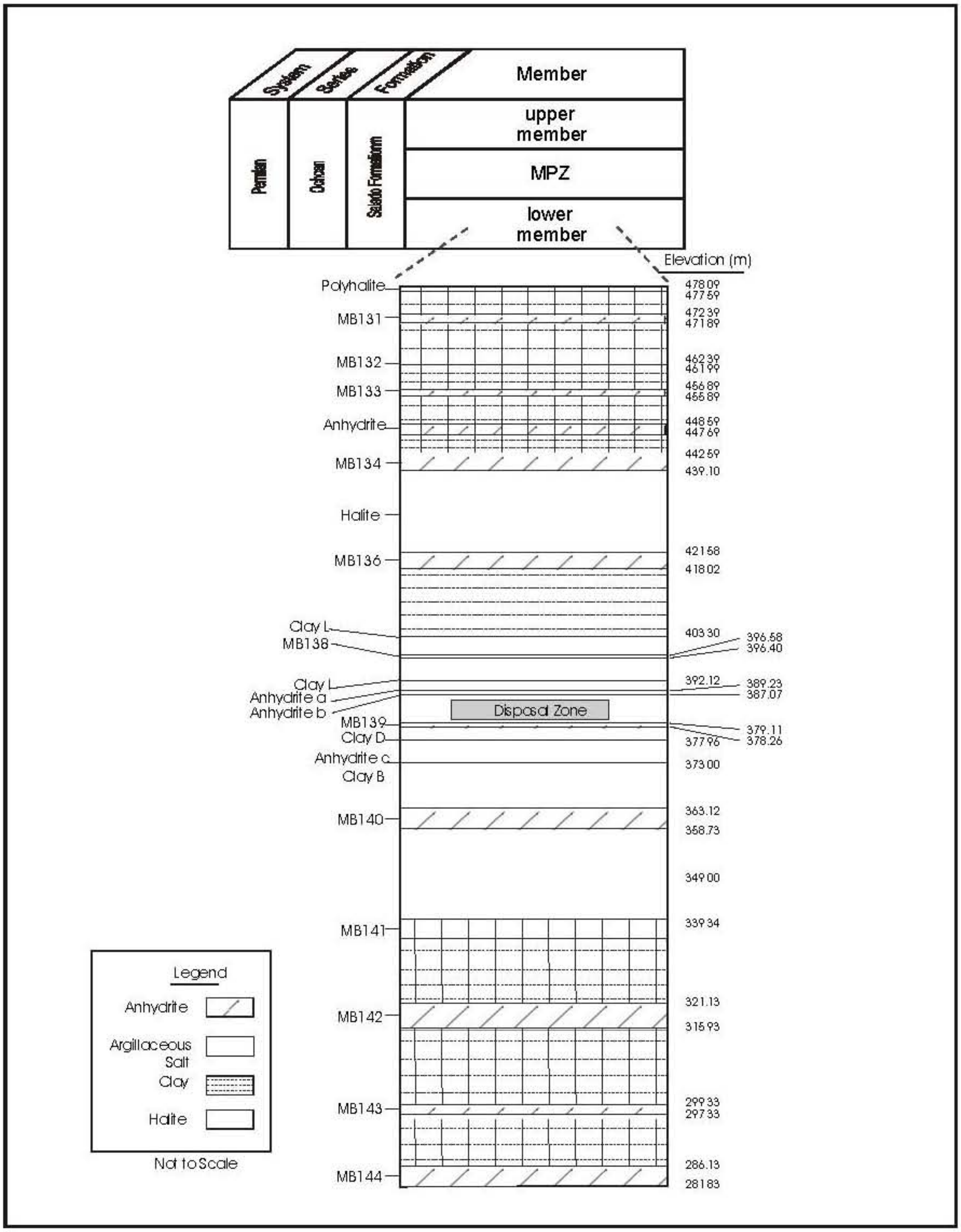


Figure L1-6
Salado Stratigraphy

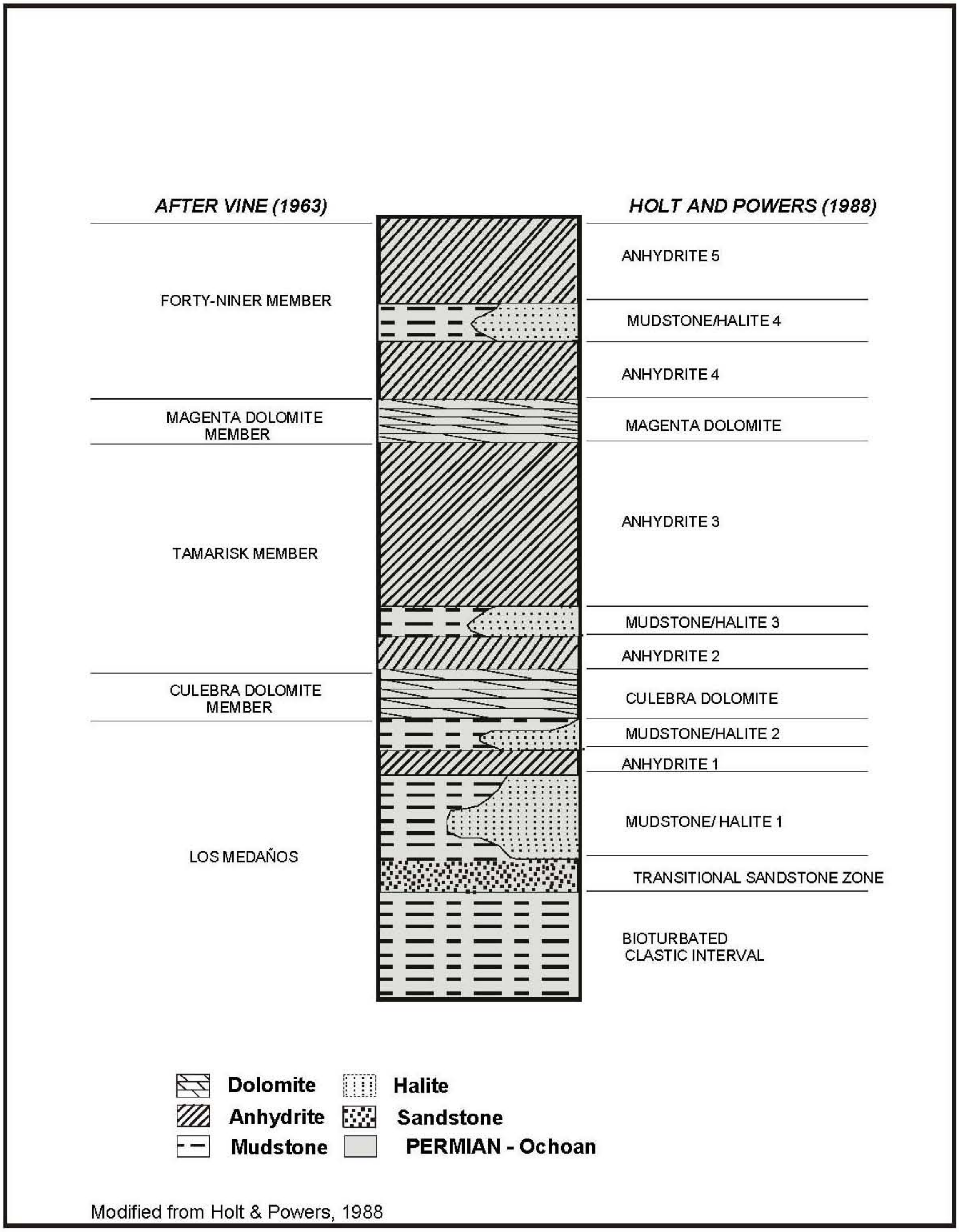
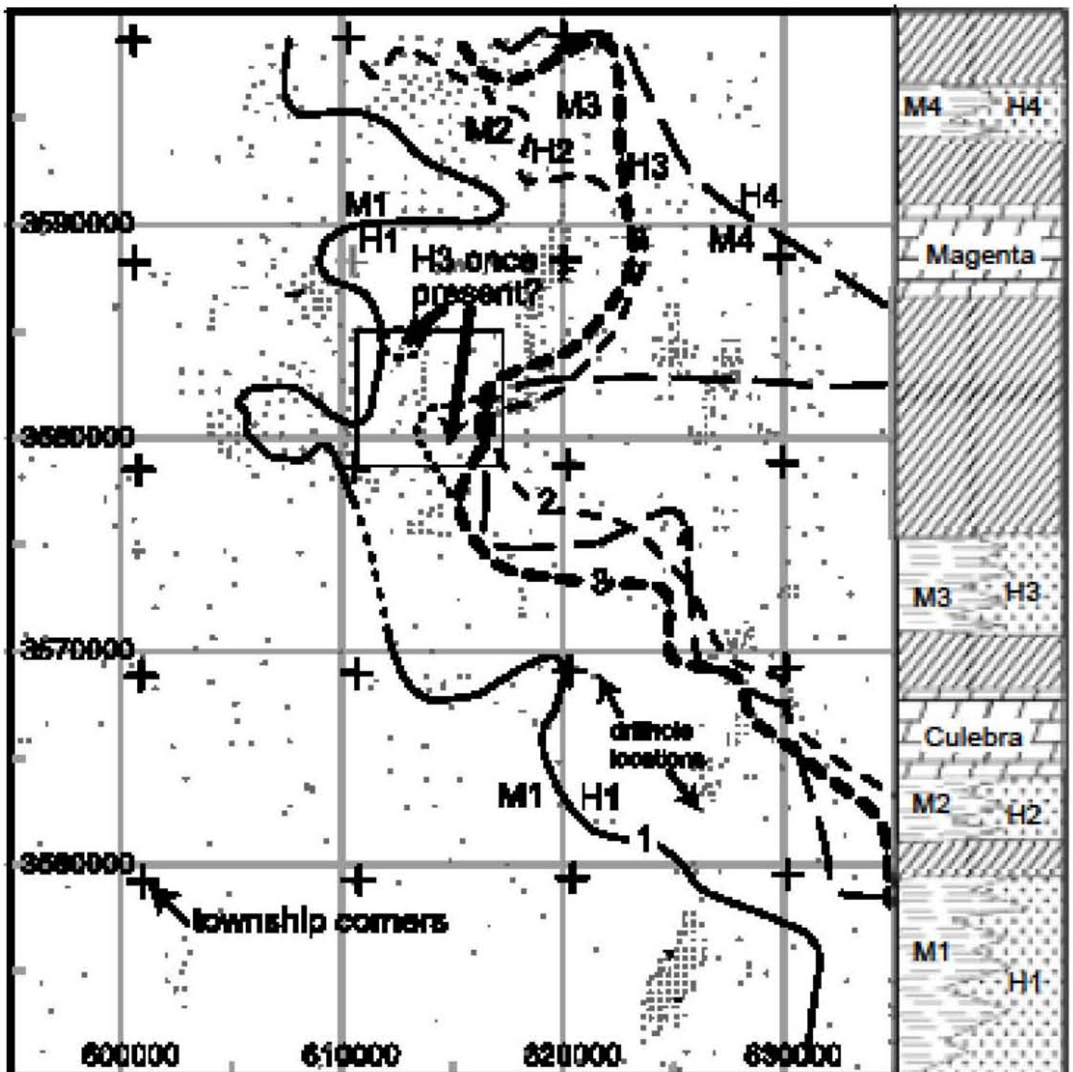


Figure L1-7
Rustler Stratigraphy



Explanation

M#, H# indicate mudstone and halitic facies on each side of estimated halite margin (numbered line on map) for stratigraphic intervals as indicated in the column to the right (key on Figure 2-14).

UTM coordinates (m) for Zone 13 (NAD27) are provided for easting and northing.

Two zones within the WIPP site boundary ("H3 once present?") indicate where halite may have been present west of the current boundary of H3 (marked by ▬▬▬▬▬).

Figure L1-8
Halite Margins in Rustler

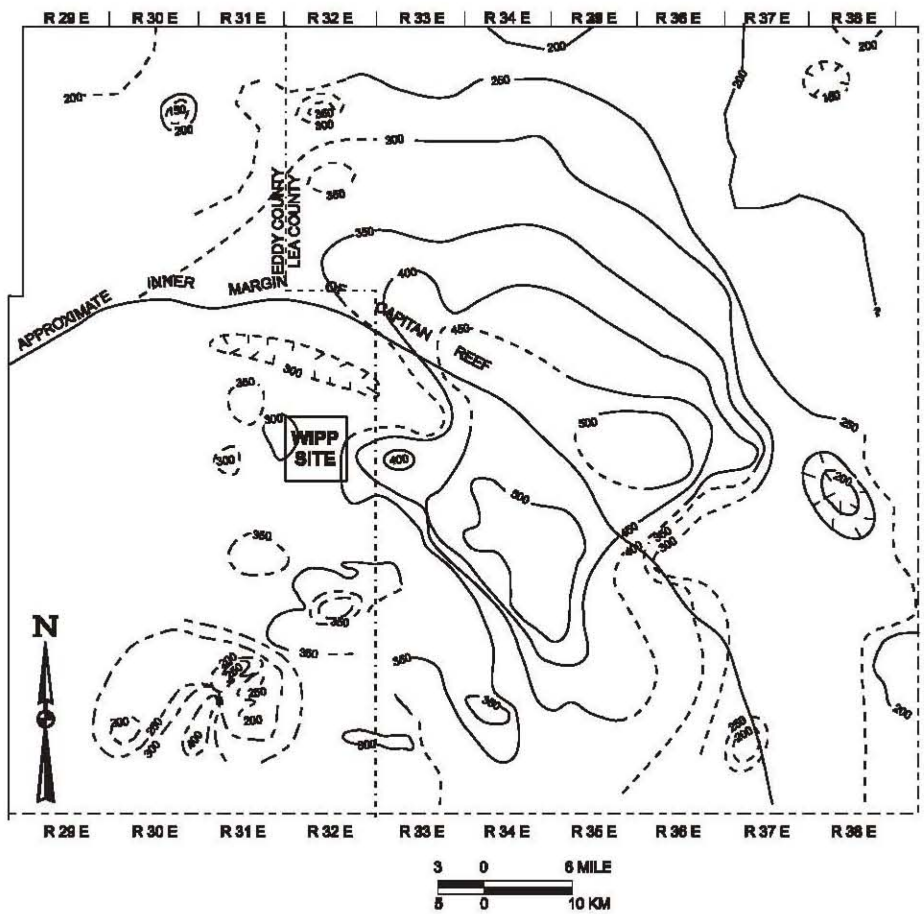


Figure L1-9
Isopach Map of the Entire Rustler

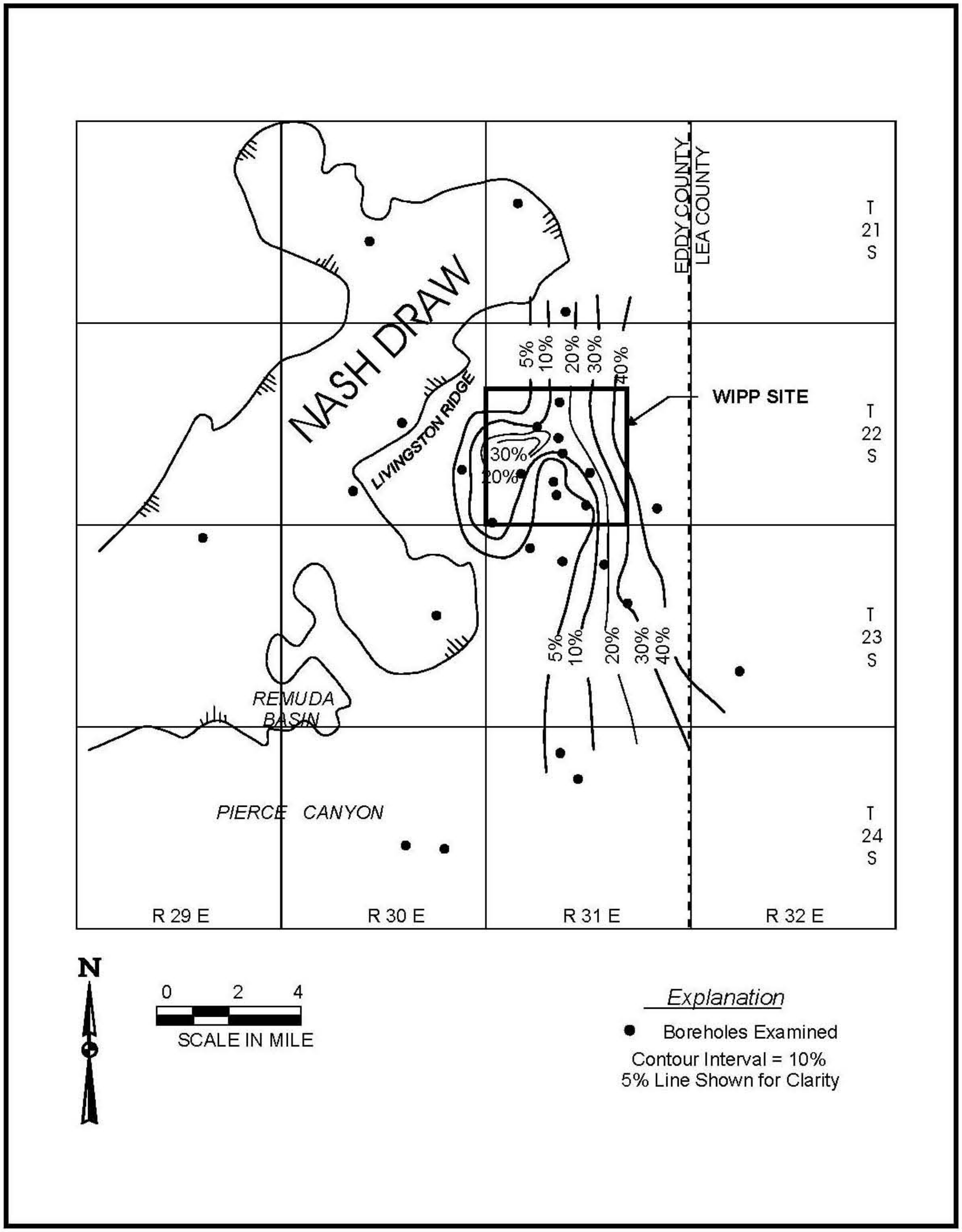


Figure L1-10
Percentage of Natural Fractures in the Culebra Filled with Gypsum

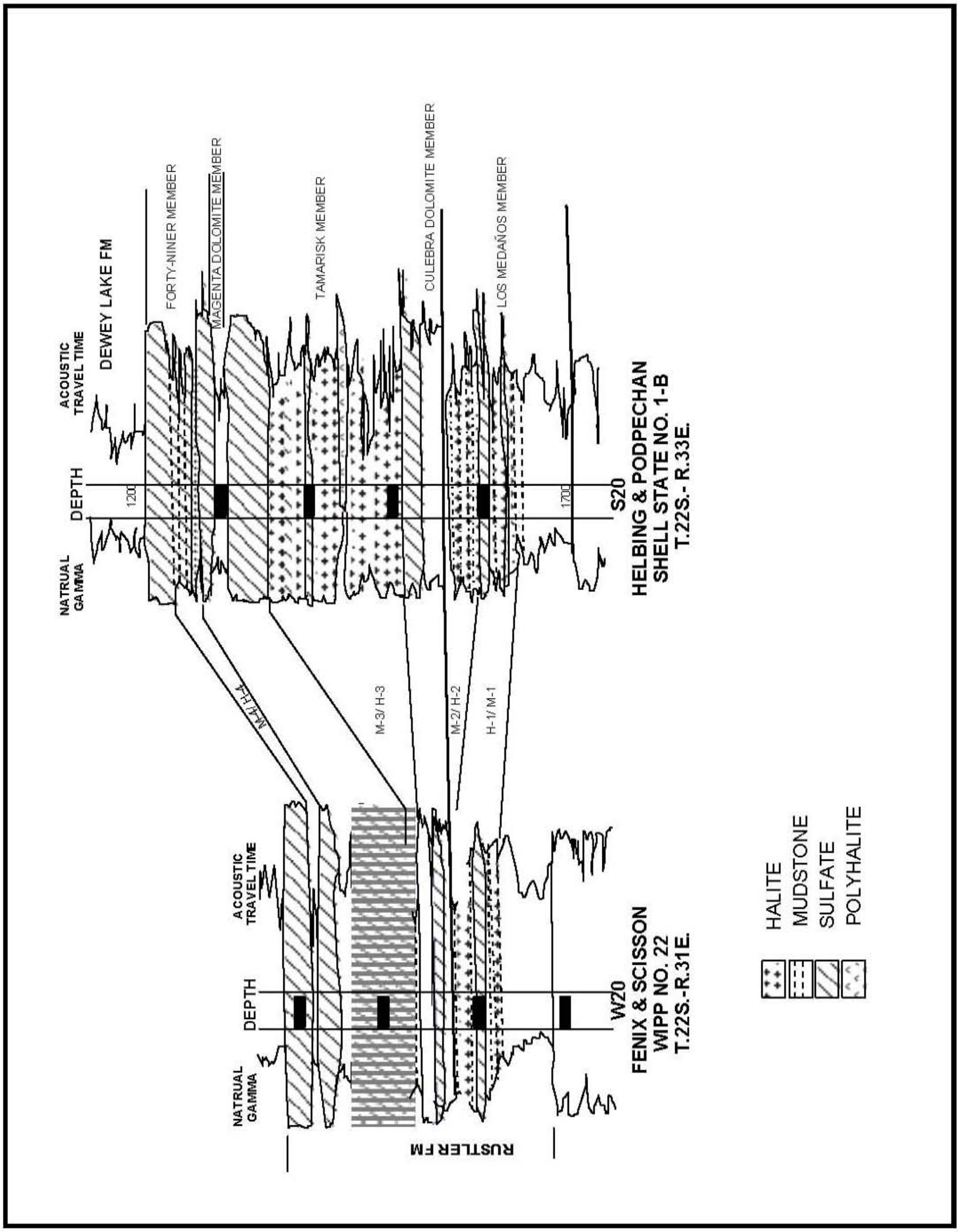
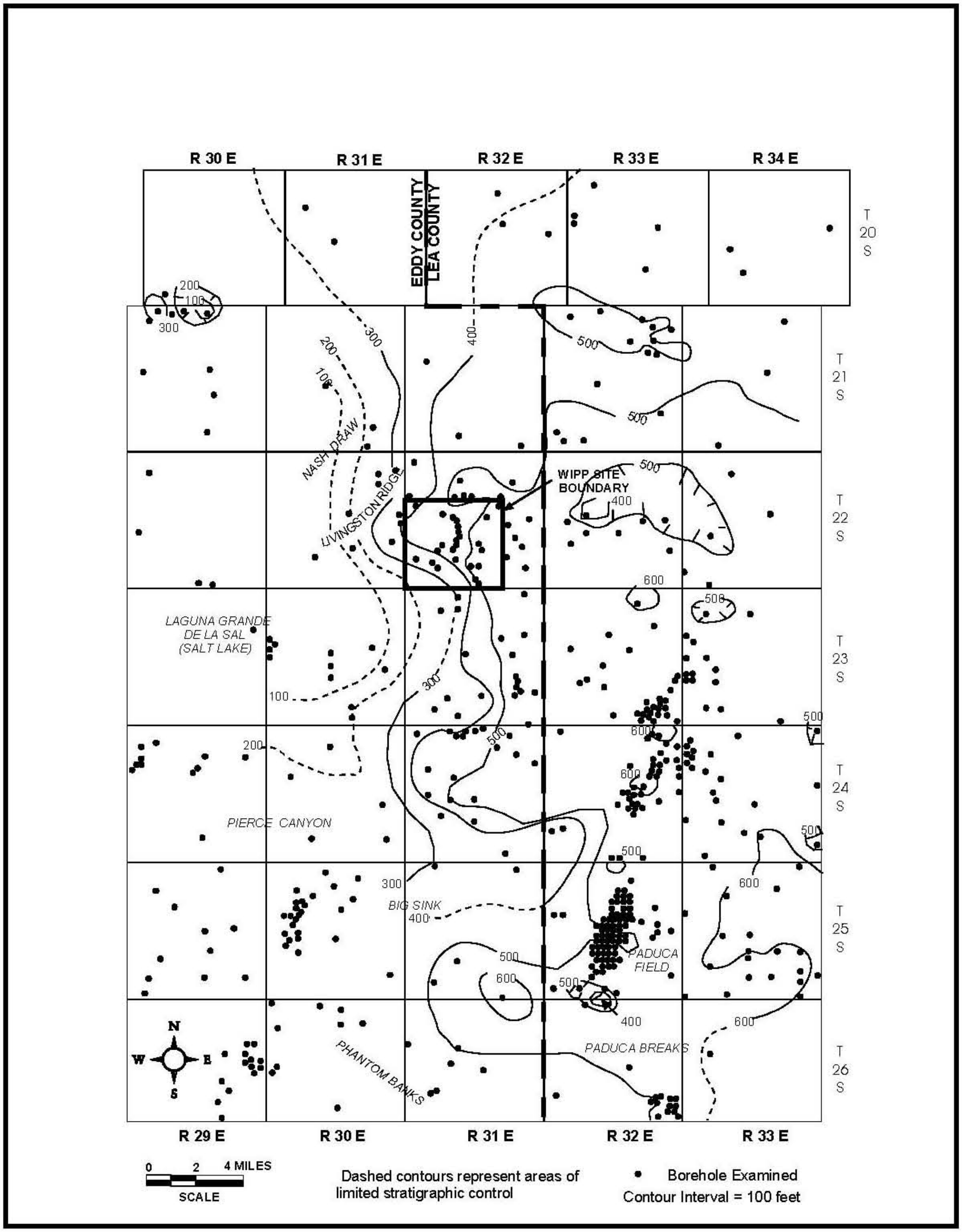


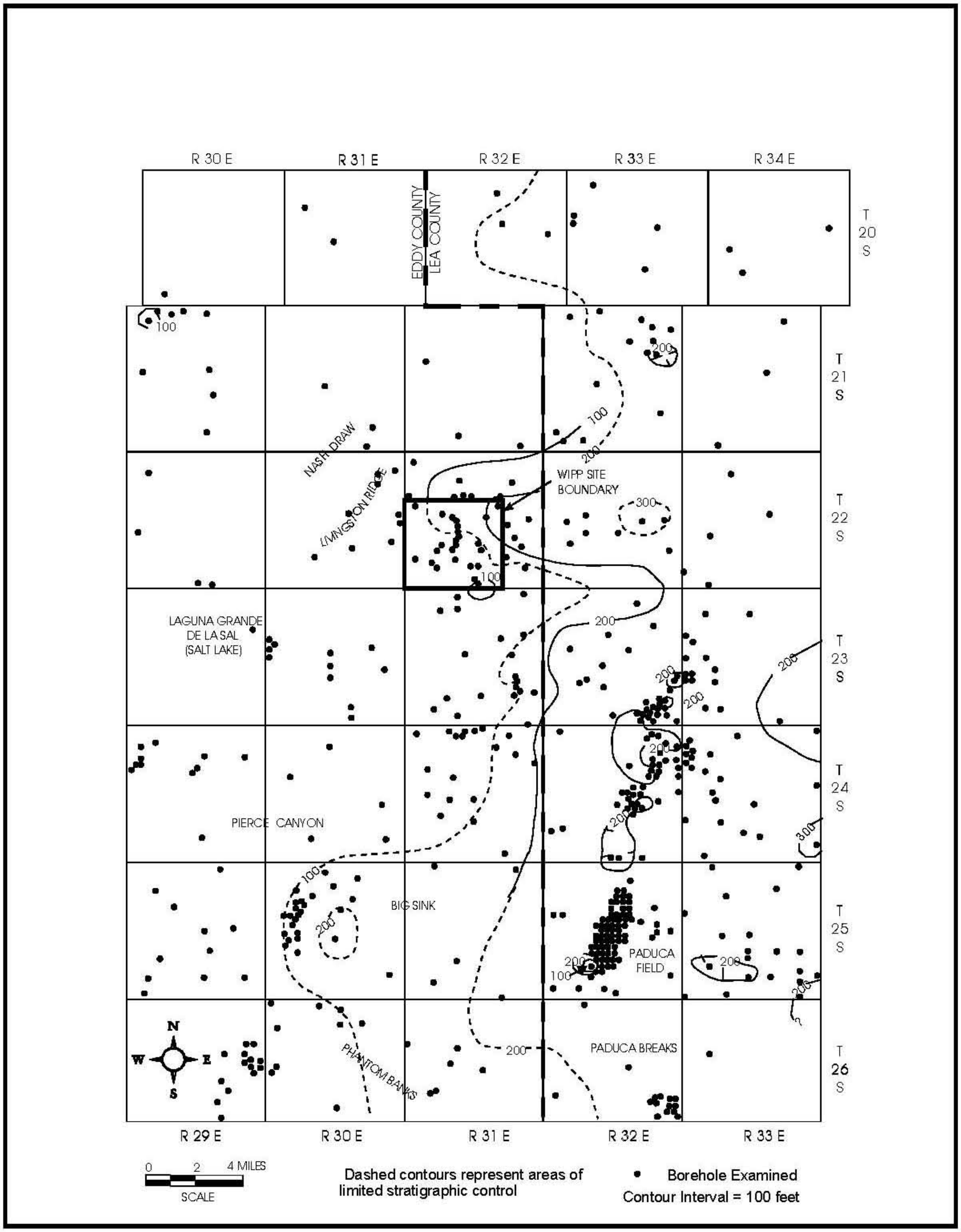
Figure L1-11
Log Character of the Rustler Showing Mudstone-Halite Lateral Relationships

1



2 Figure L1-12
3 Isopach of the Dewey Lake

1



2 Figure L1-13
3 Isopach of the Santa Rosa

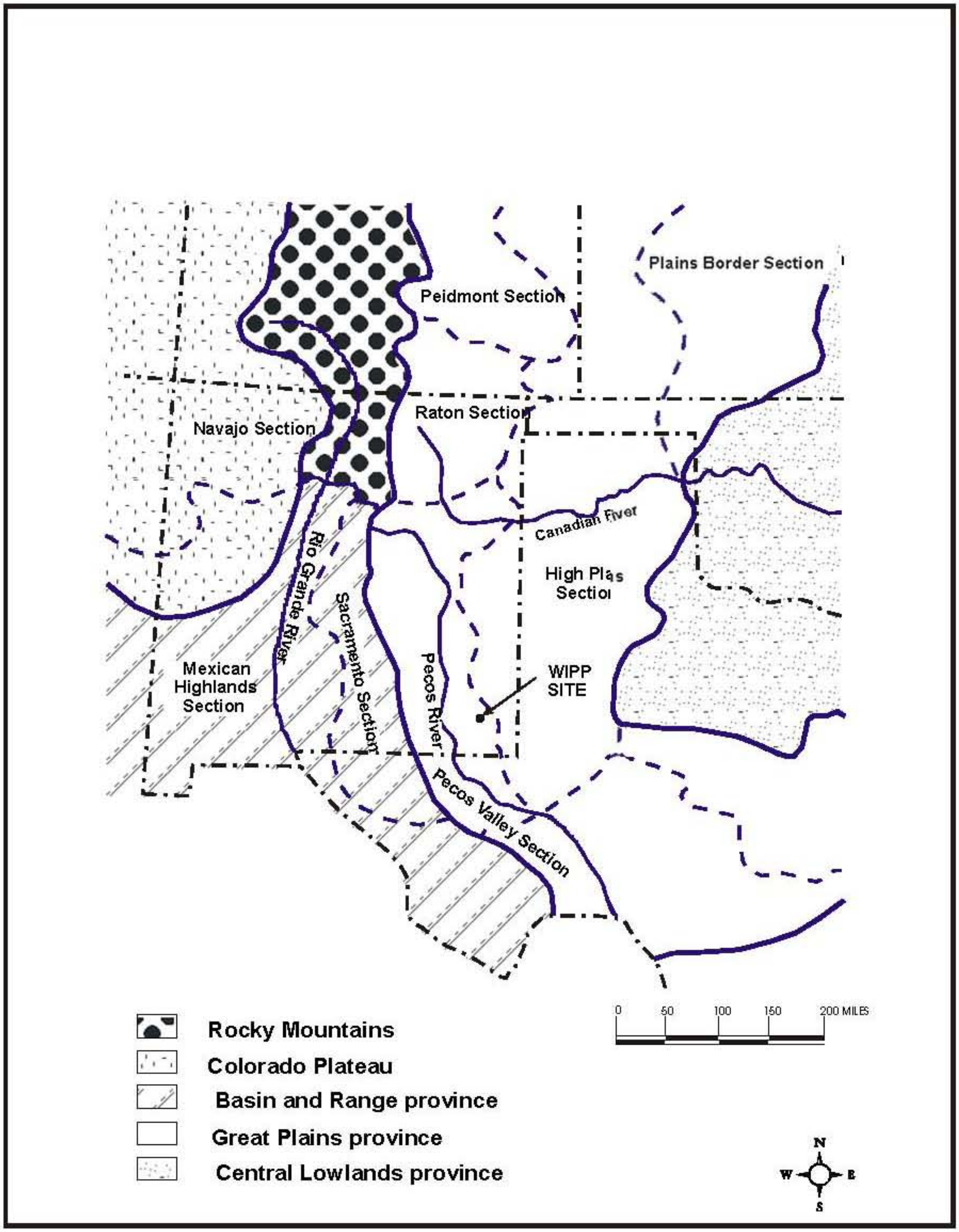


Figure L1-14
Physiographic Provinces and Sections

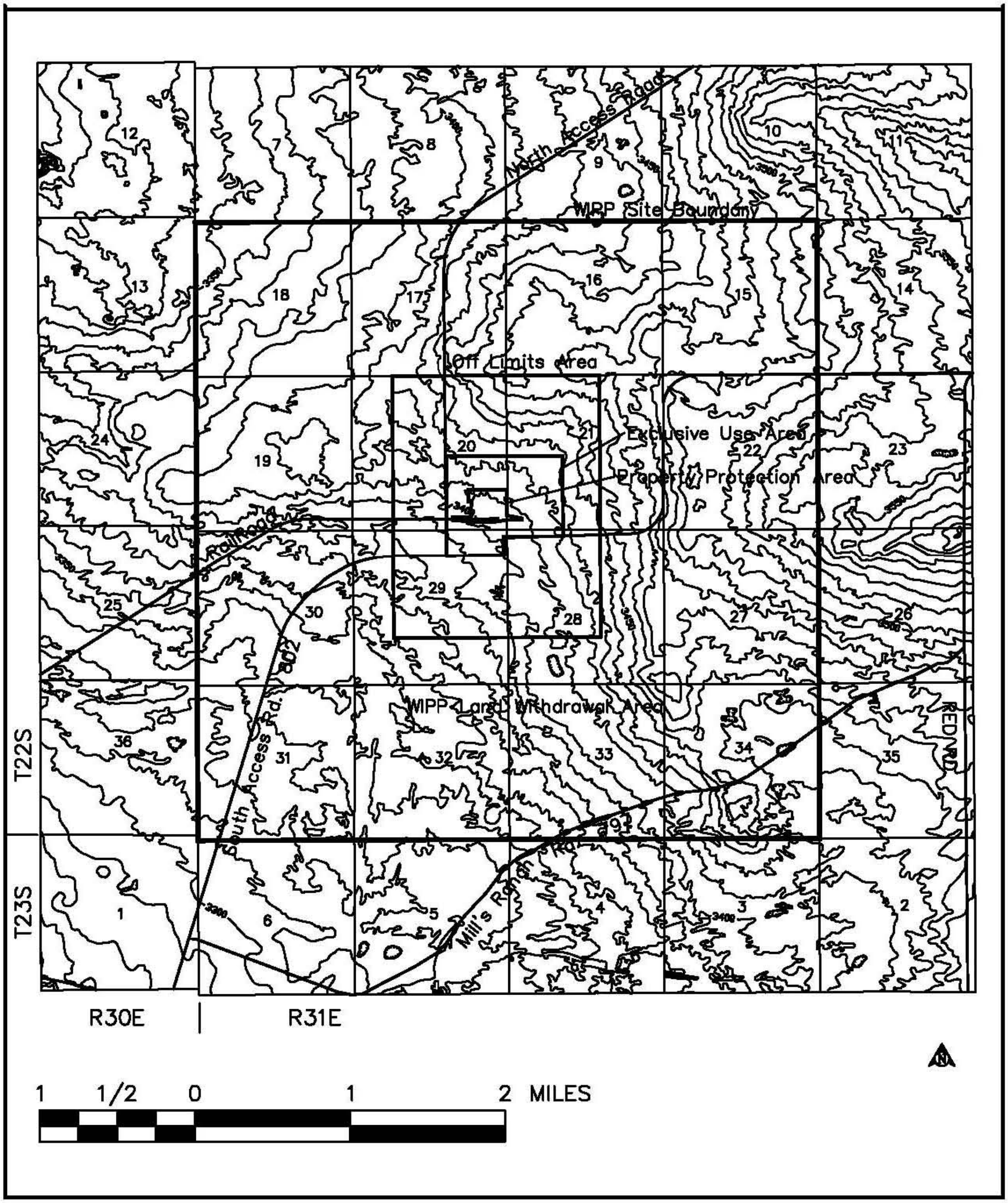


Figure L1-15
Site Topographic Map

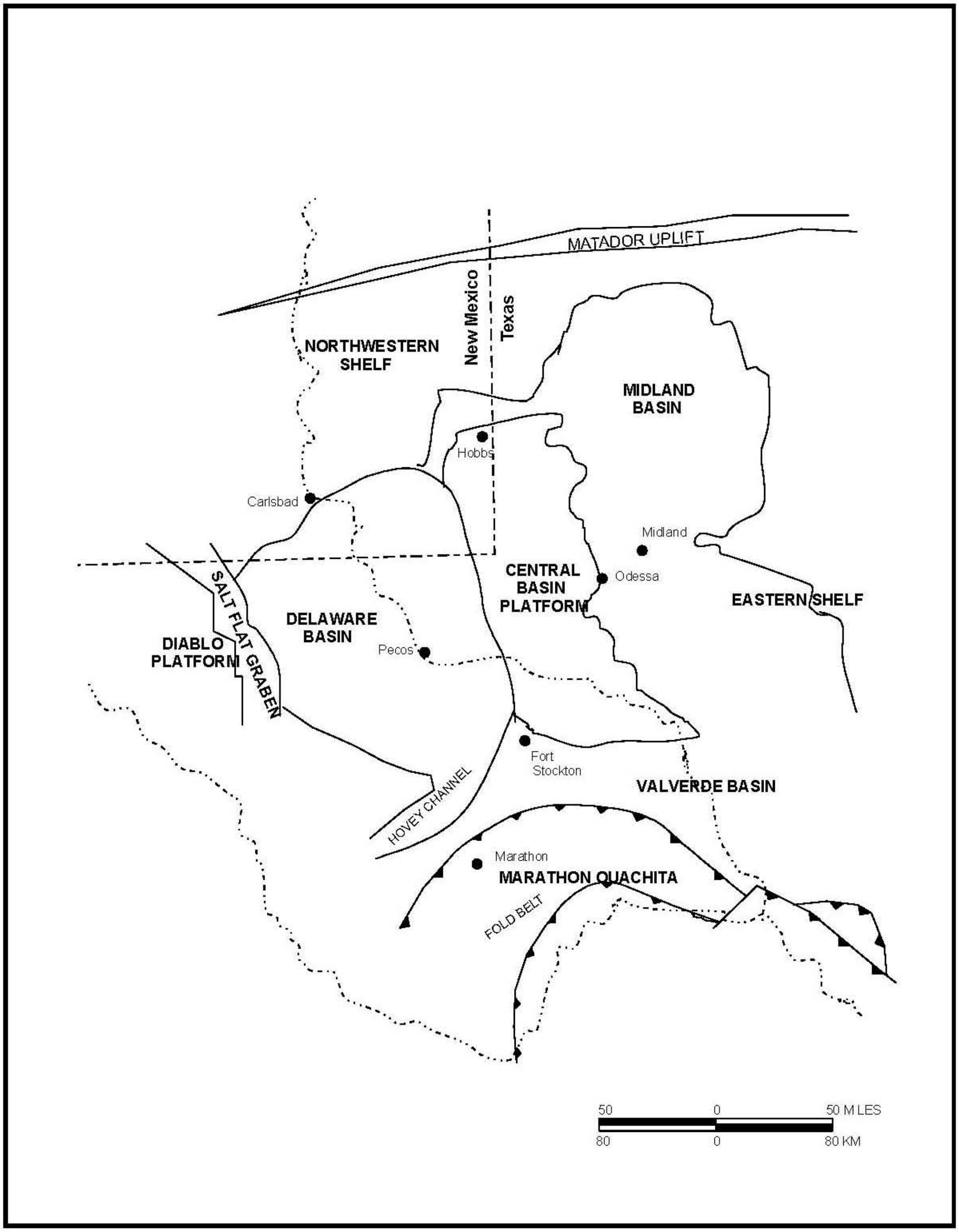


Figure L1-16
Structural Provinces of the Permian Basin Region

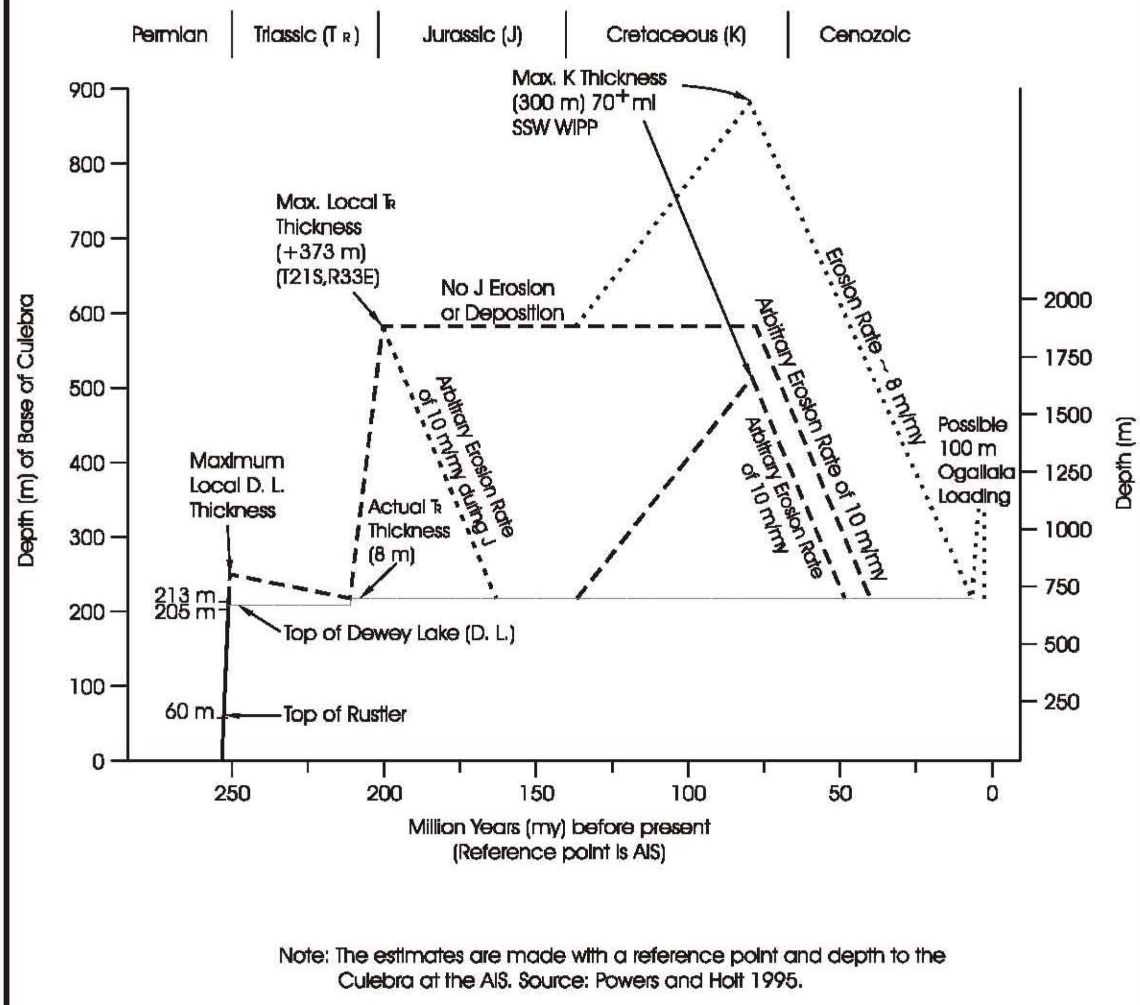


Figure L1-17
Loading and Unloading History Estimated for Base of Culebra

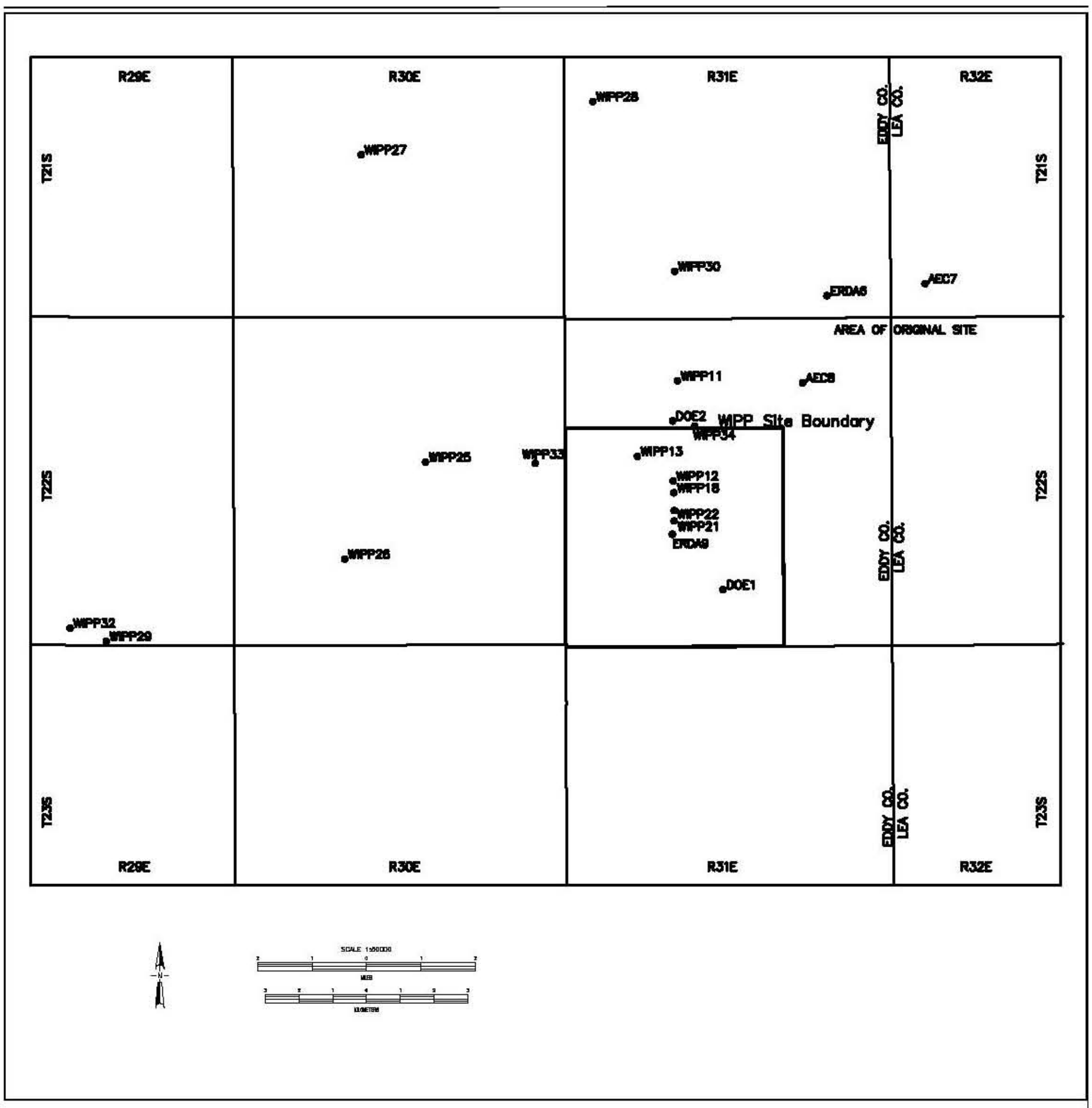


Figure L1-18
Location of Main Stratigraphic Drillholes

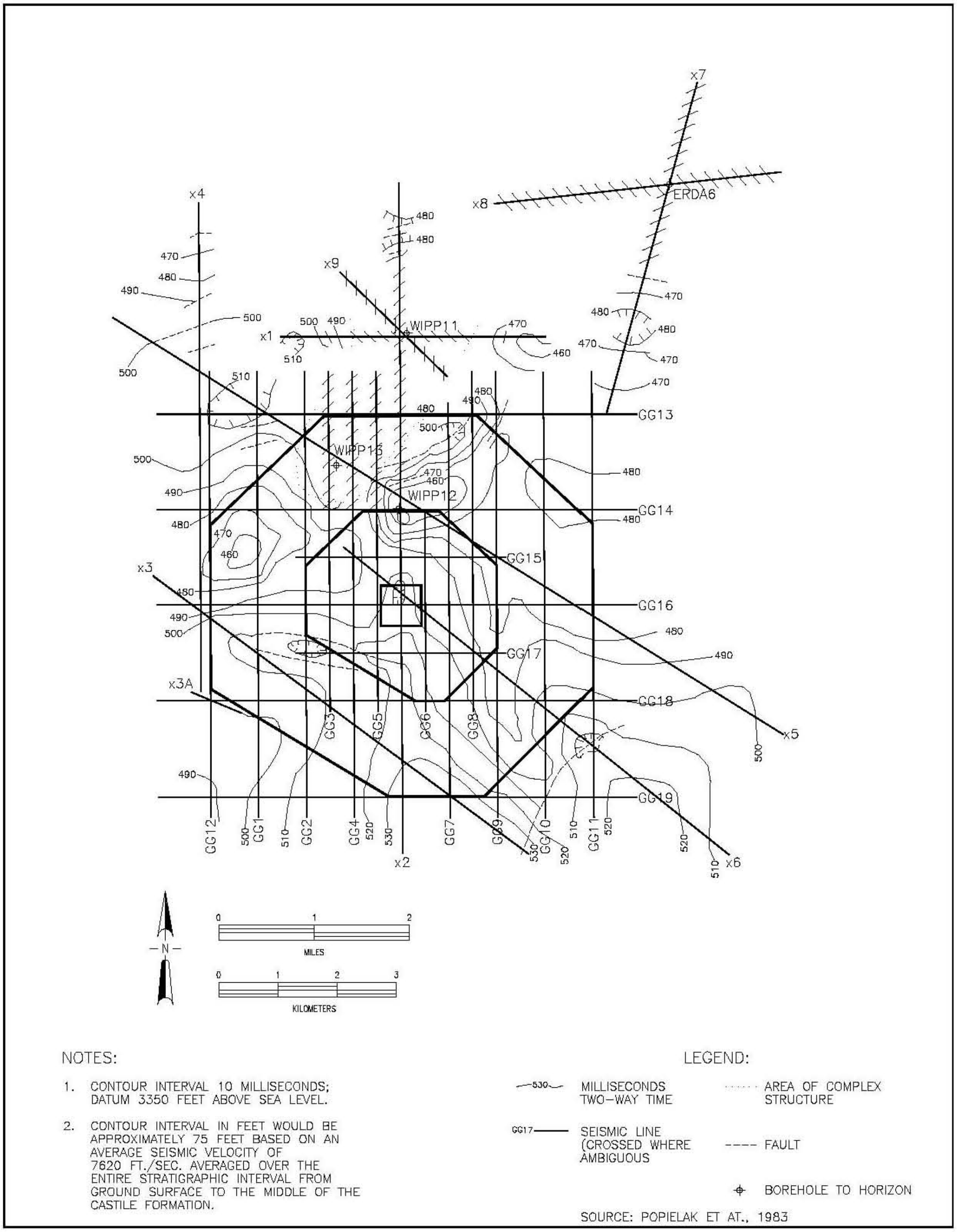


Figure L1-19
Seismic Time Structure of the Middle Castile Formation

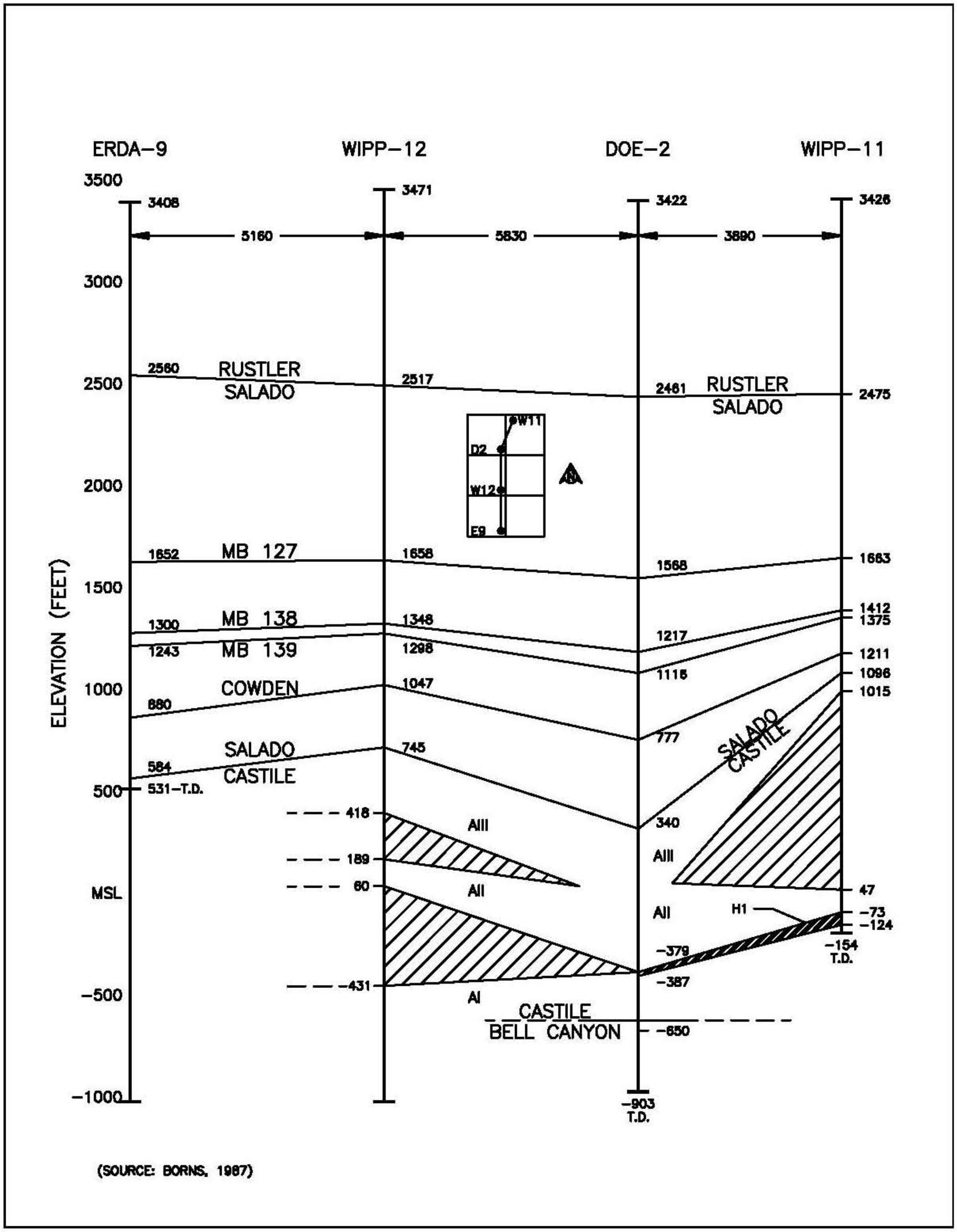


Figure L1-20
Fence Diagram Using DOE-2 and Adjacent Holes

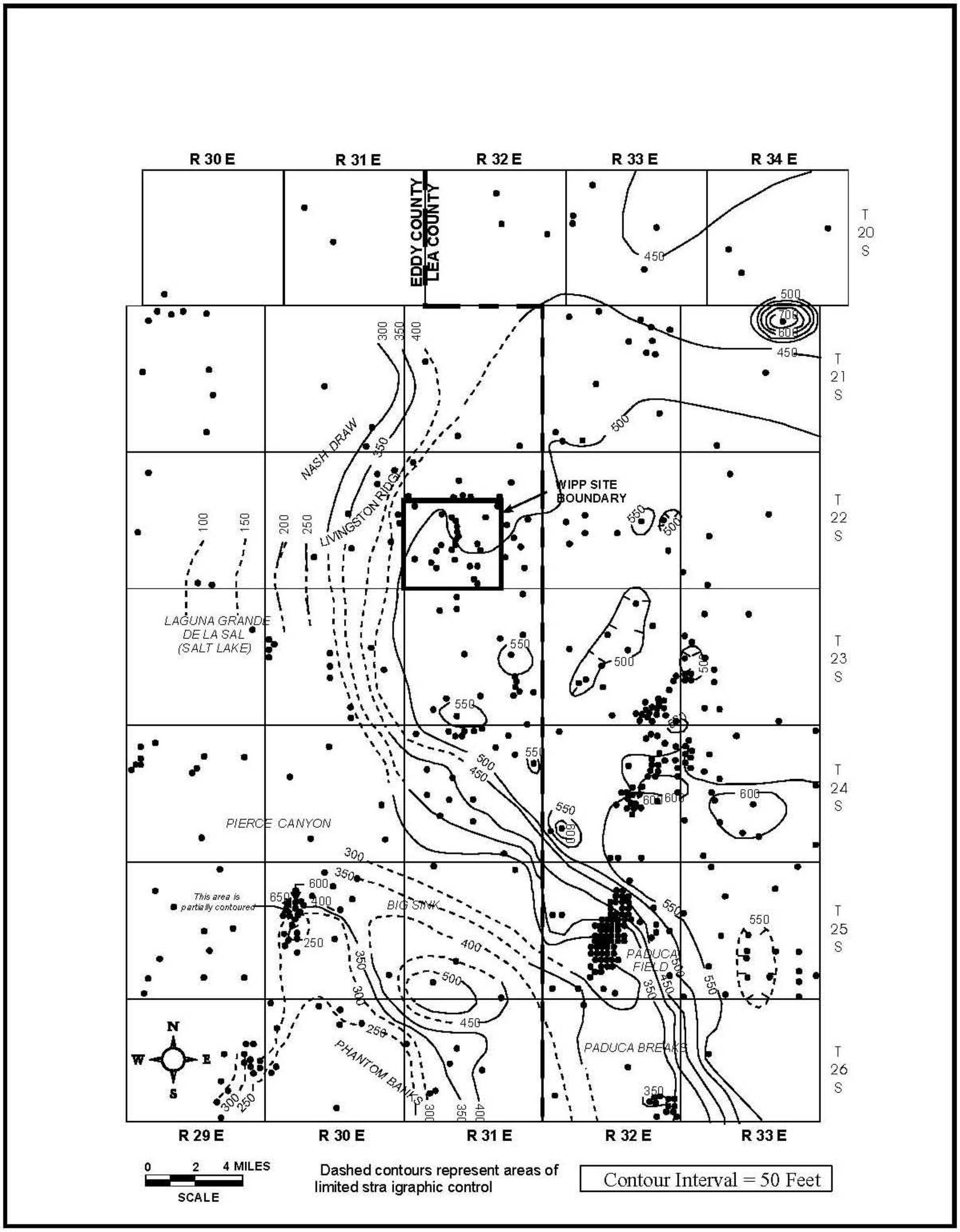


Figure L1-21
Isopach from the Top of the Vaca Triste to the Top of the Salado

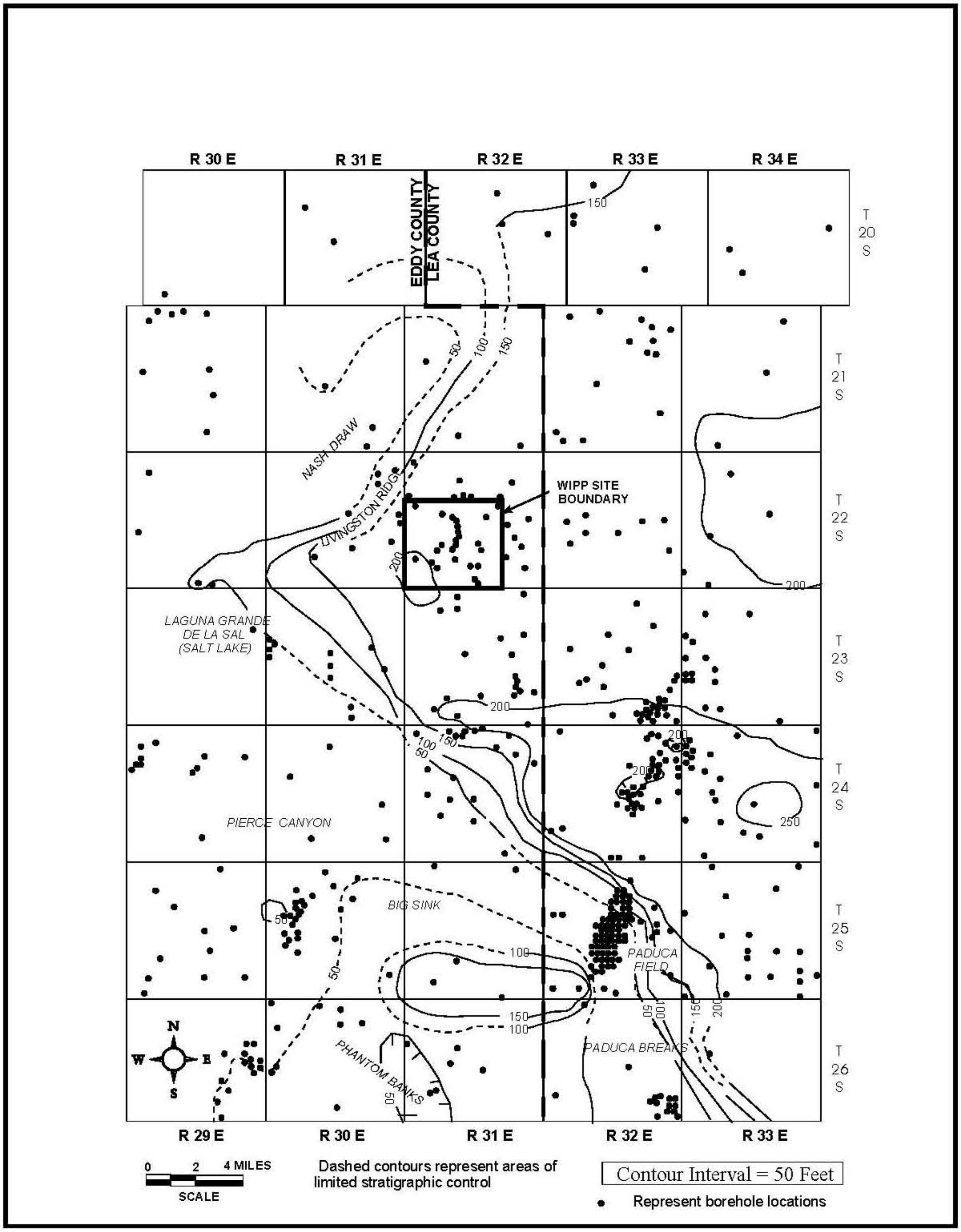


Figure L1-22
Isopach from the Base of MB 103 to the Top of the Salado

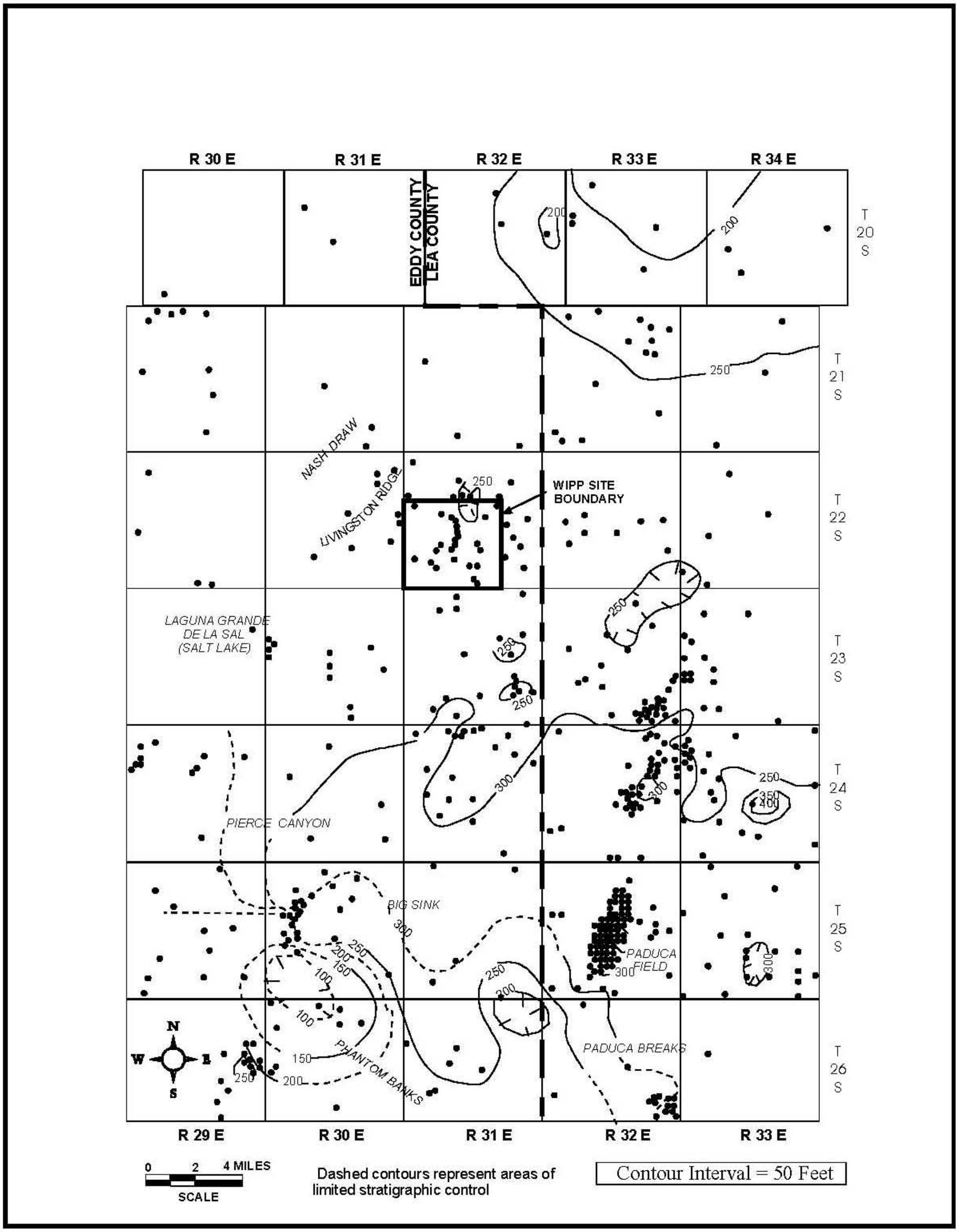


Figure L1-23
Isopach from the Base of MB 123/124 to the Base of the Vaca Triste

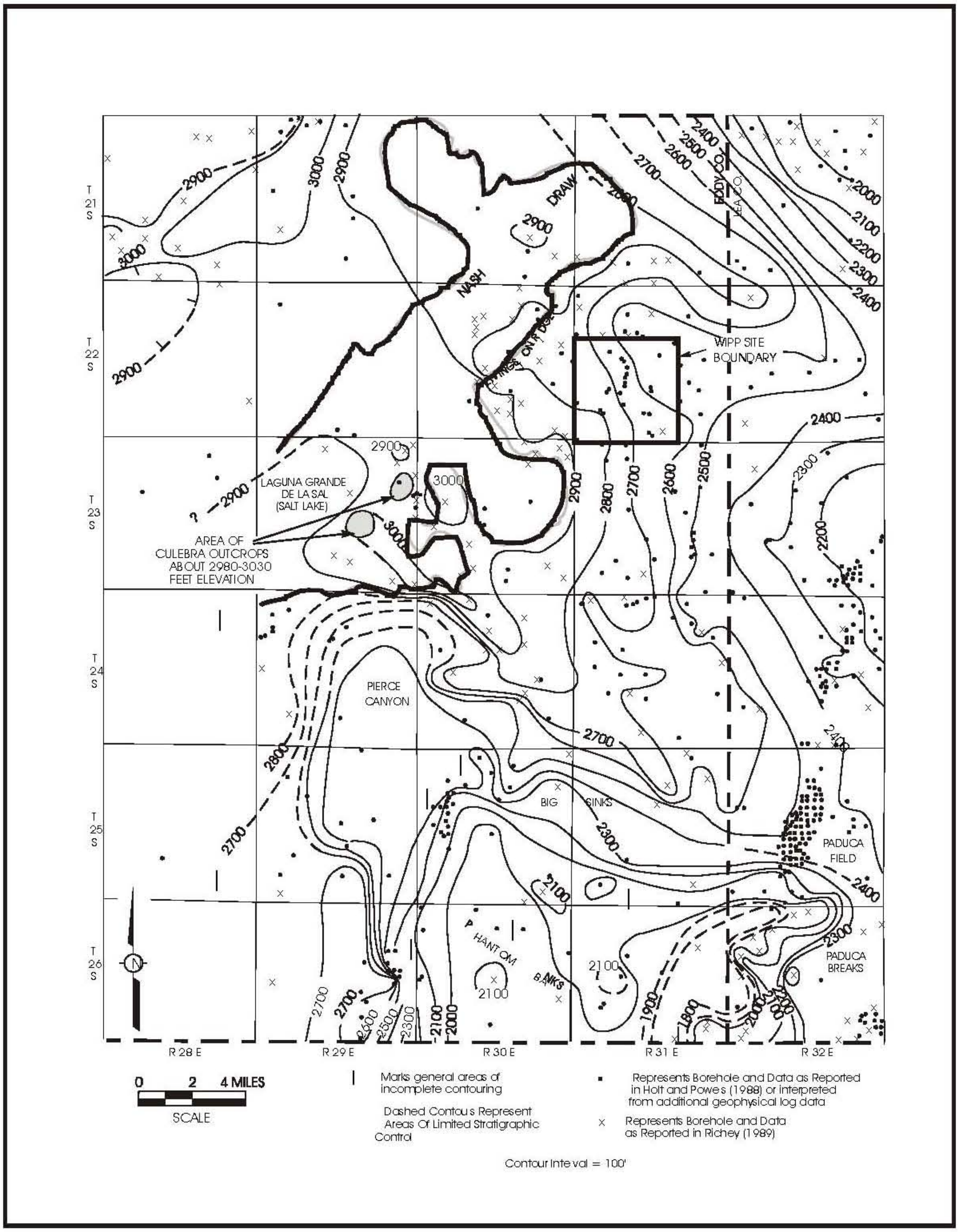


Figure L1-24
Structure Contour Map of Culebra Dolomite Base

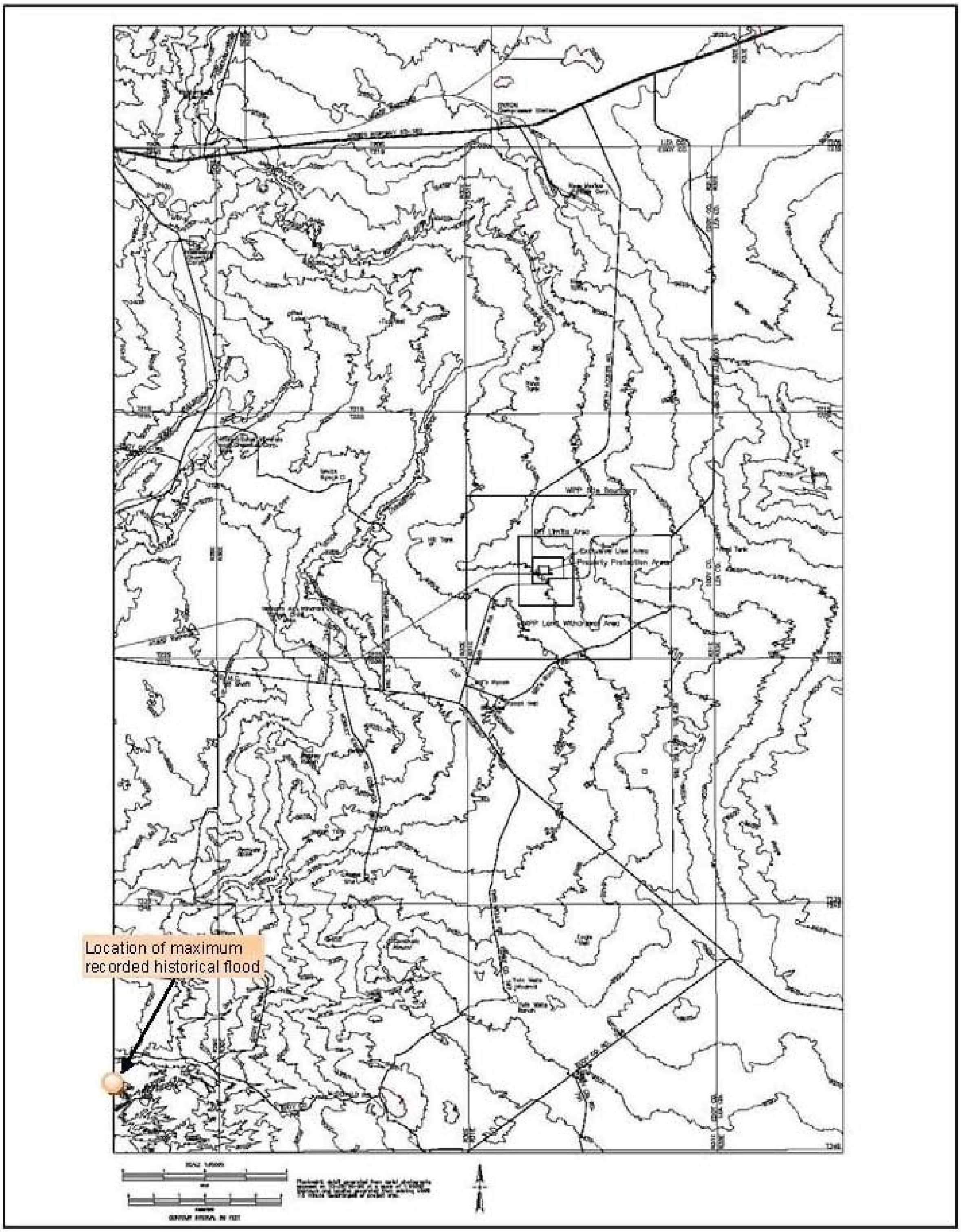


Figure L1-25
Drainage Pattern in the Vicinity of the WIPP Facility

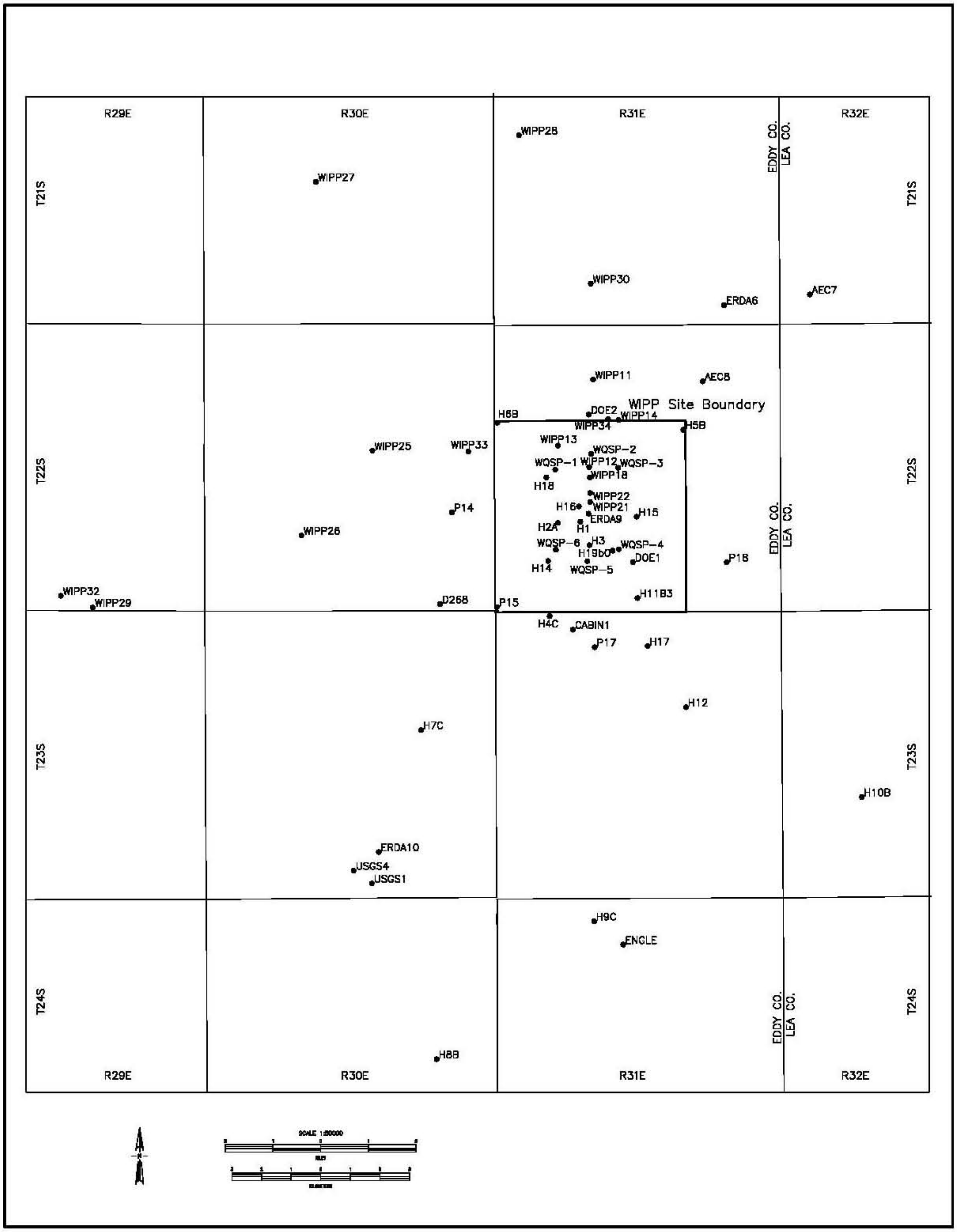
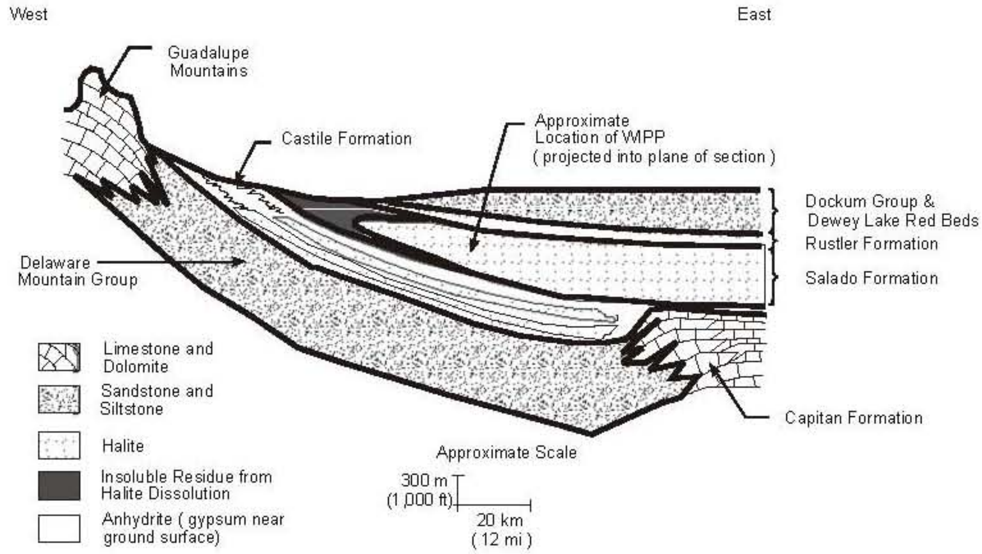
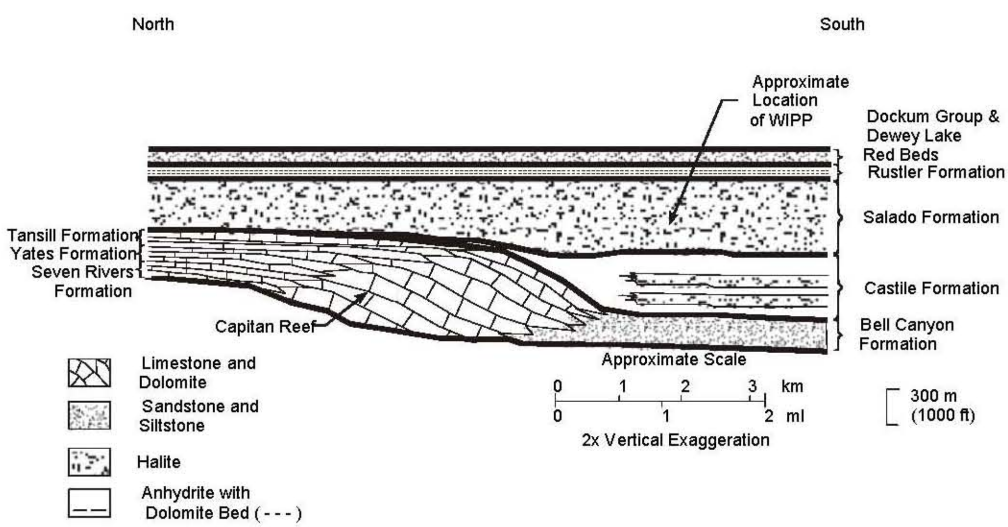


Figure L1-26
Borehole Location Map



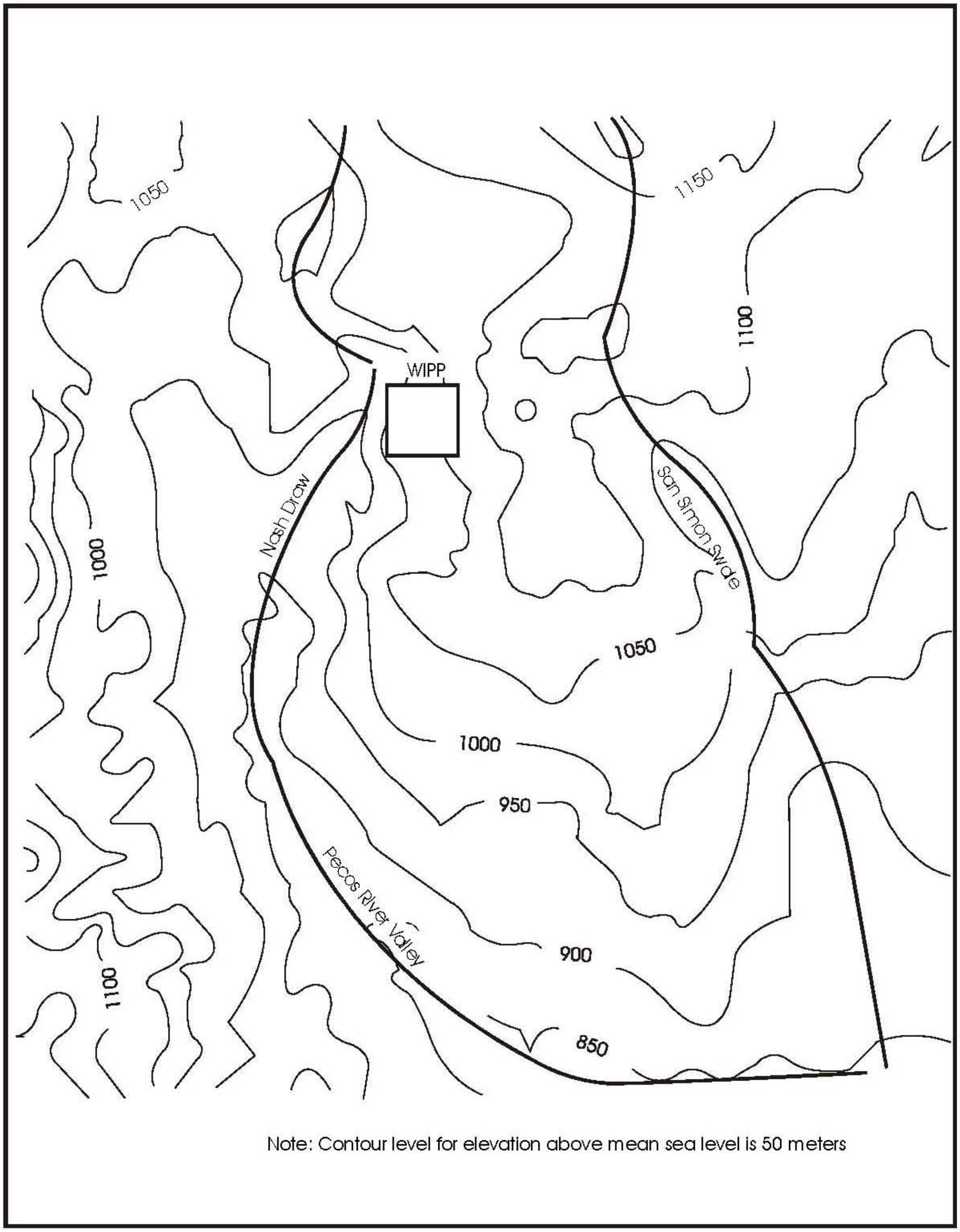
Source: Sandia, 1992, 2, 2-7.

Figure L1-27
Schematic West-East Cross-Section through the North Delaware Basin



Source: Sandia, 1992, 2, 2-8.

Figure L1-28
Schematic North-South Cross-Section through the North Delaware Basin



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2 Figure L1-29
3 Outline of the Groundwater Basin Model Domain on a Topographic Map

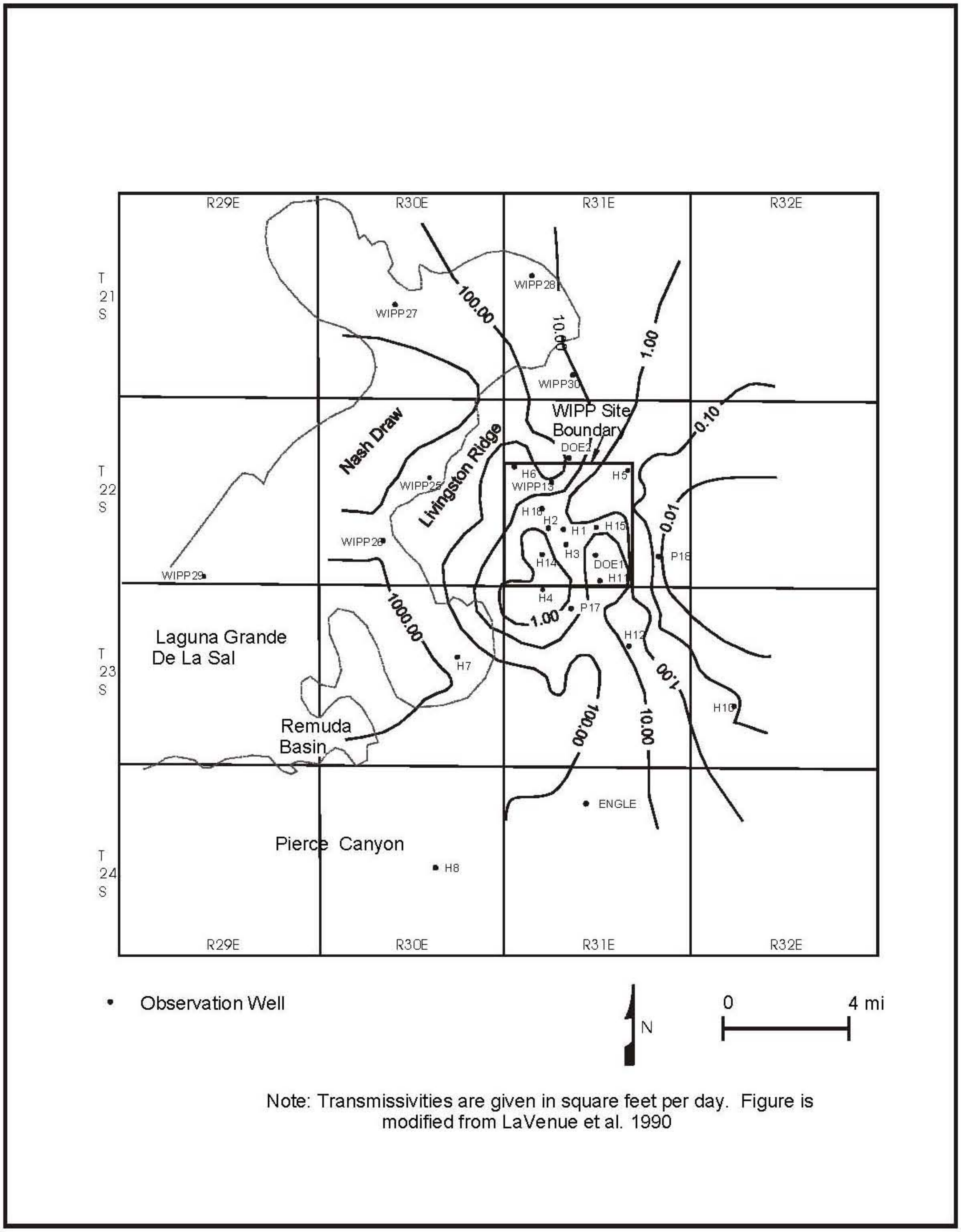


Figure L1-30
Transmissivities of the Culebra

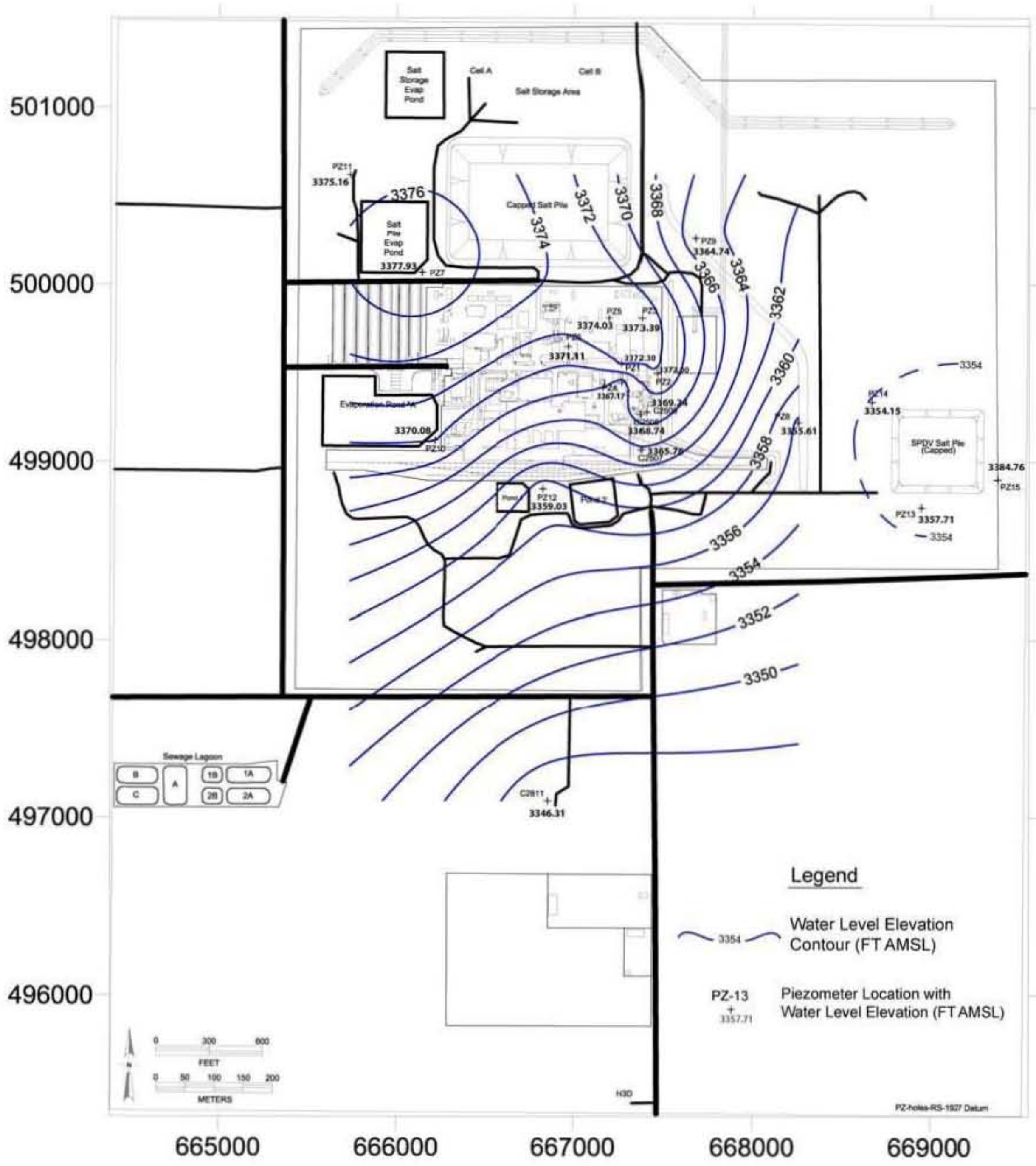


Figure L1-31
Hydraulic Heads in the Culebra

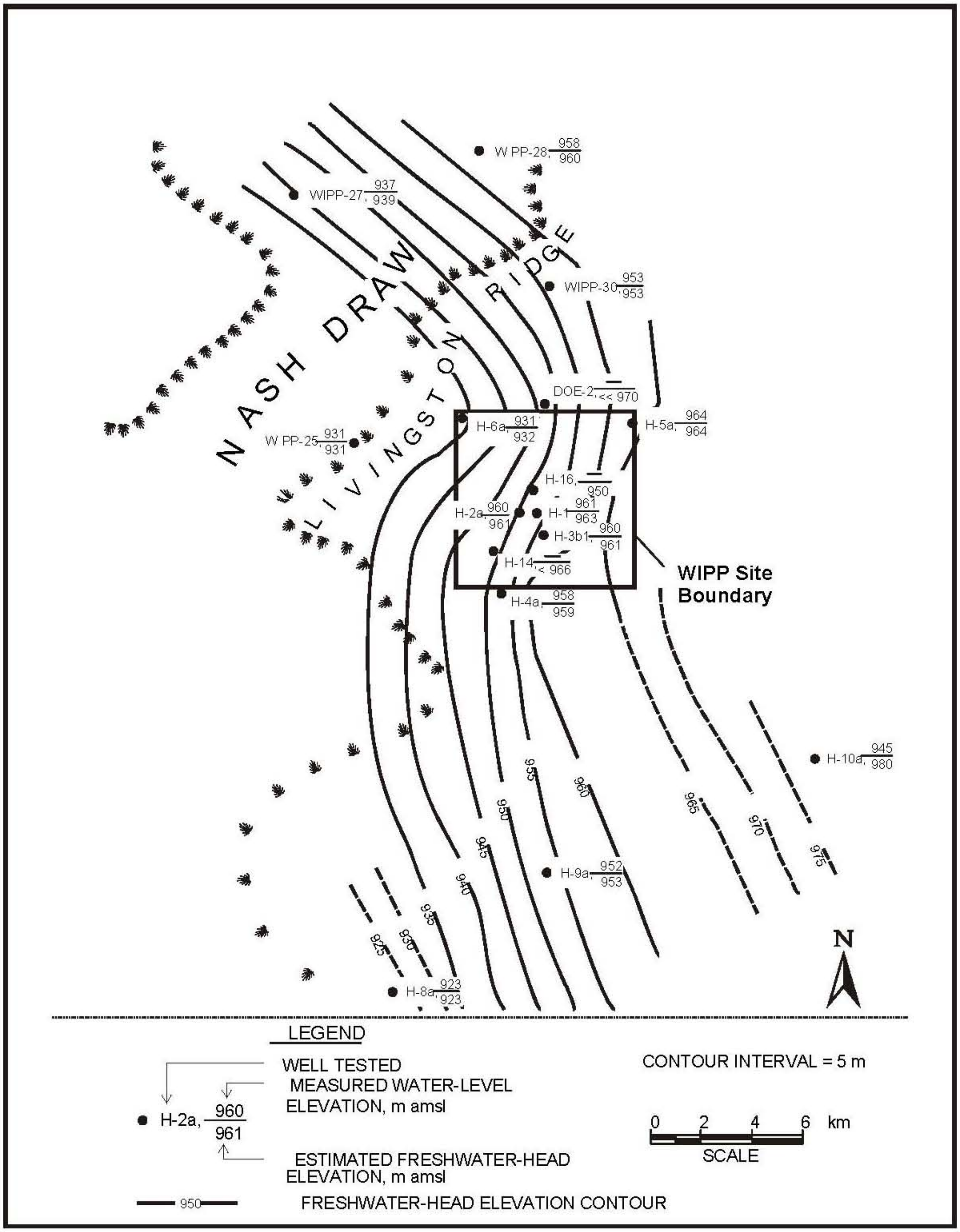


Figure L1-32
Hydraulic Heads in the Magenta

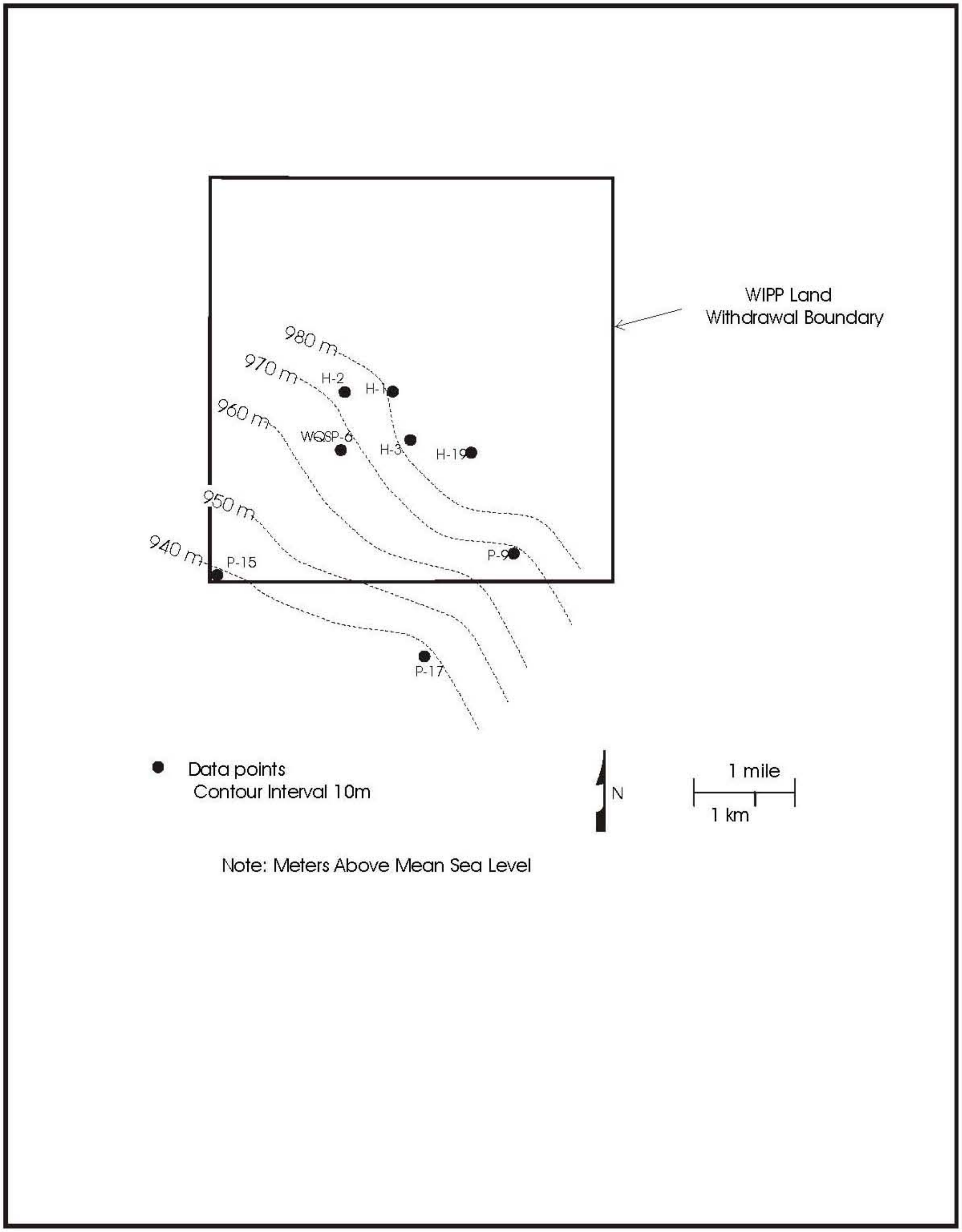


Figure L1-33
Interpreted Dewey Lake Water Table Surface

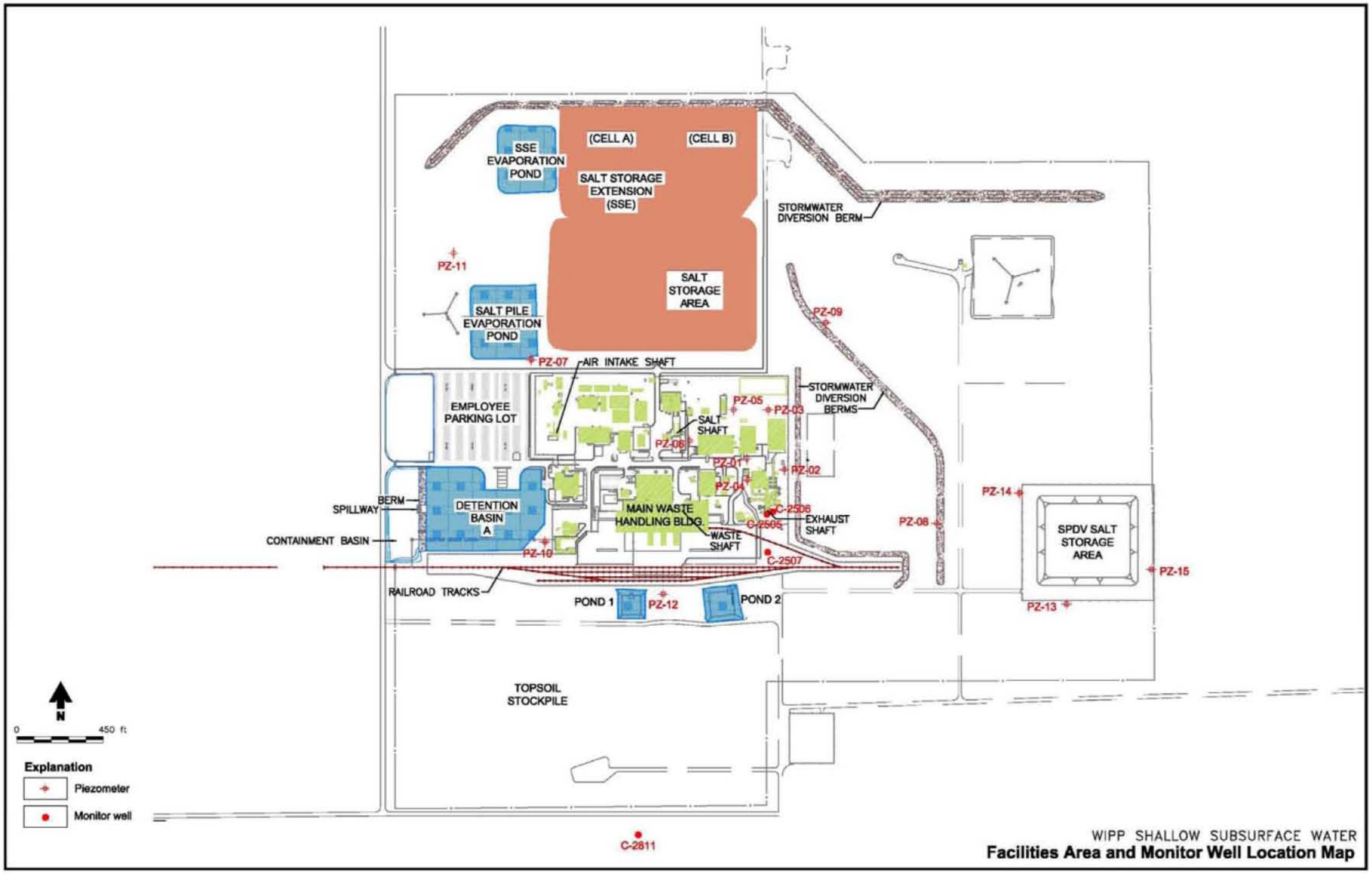


Figure L1-34
Location of Shallow Investigative Wells

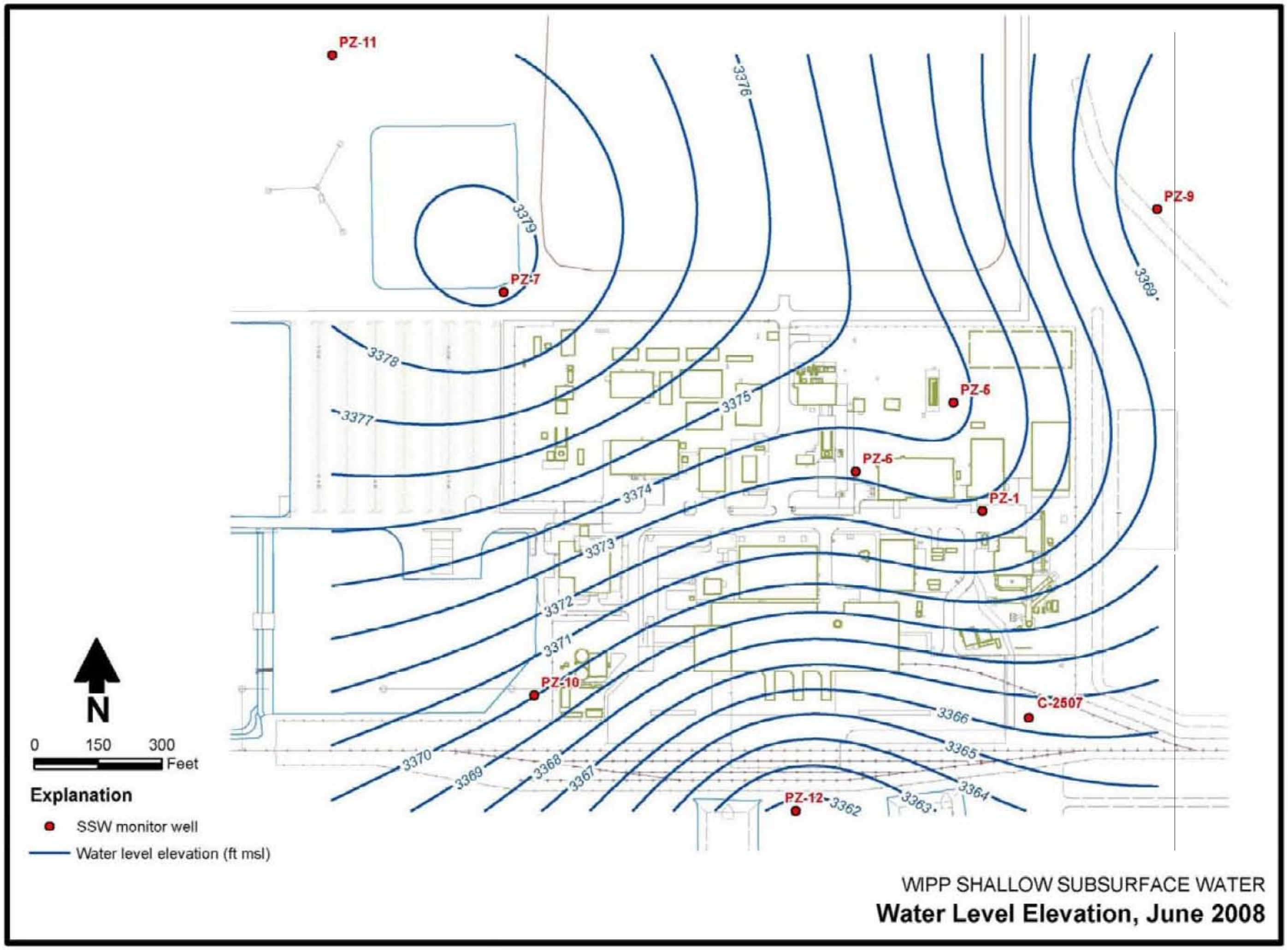


Figure L1-35
WIPP Shallow Subsurface Water

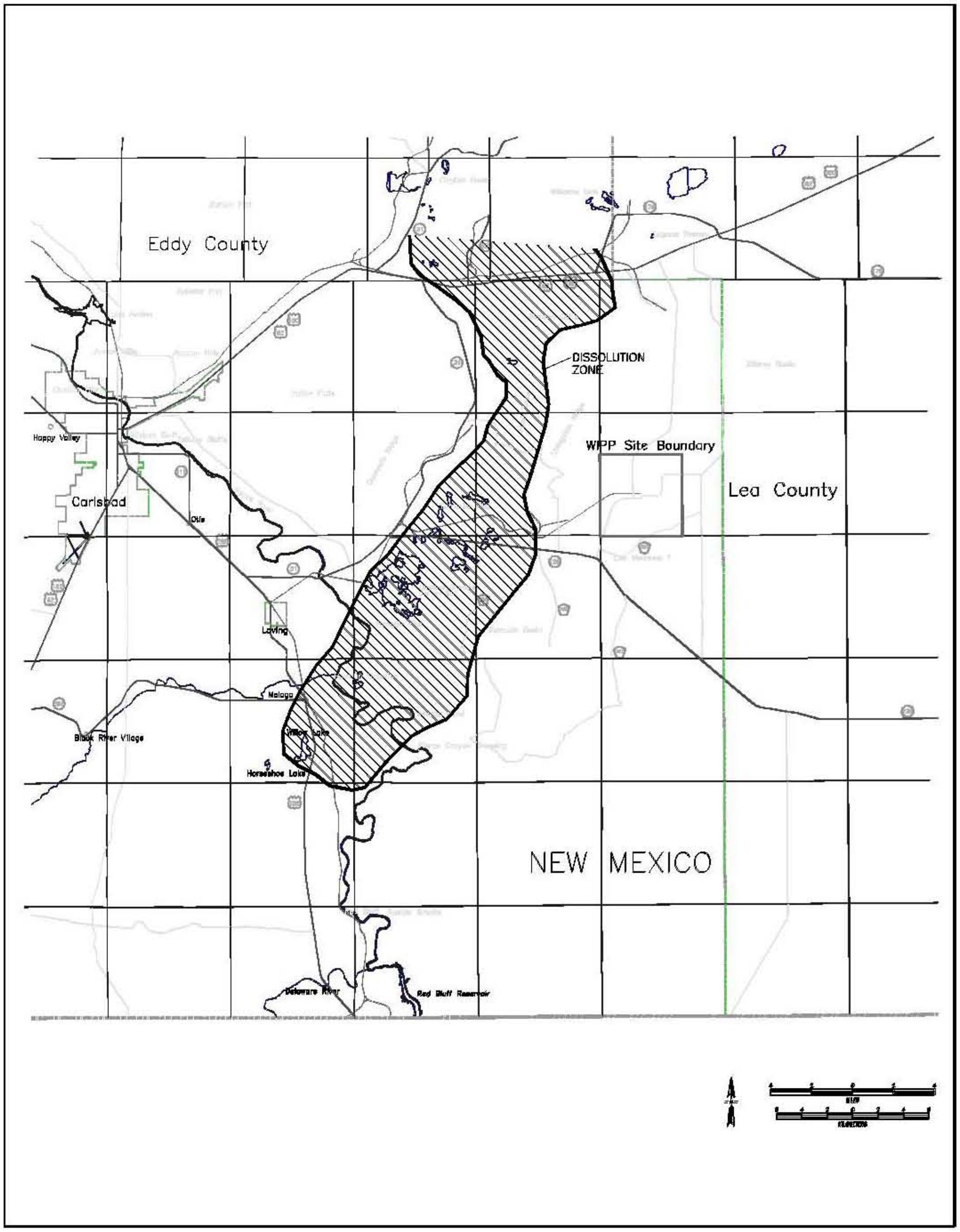


Figure L1-36
Brine Aquifer in Nash Draw

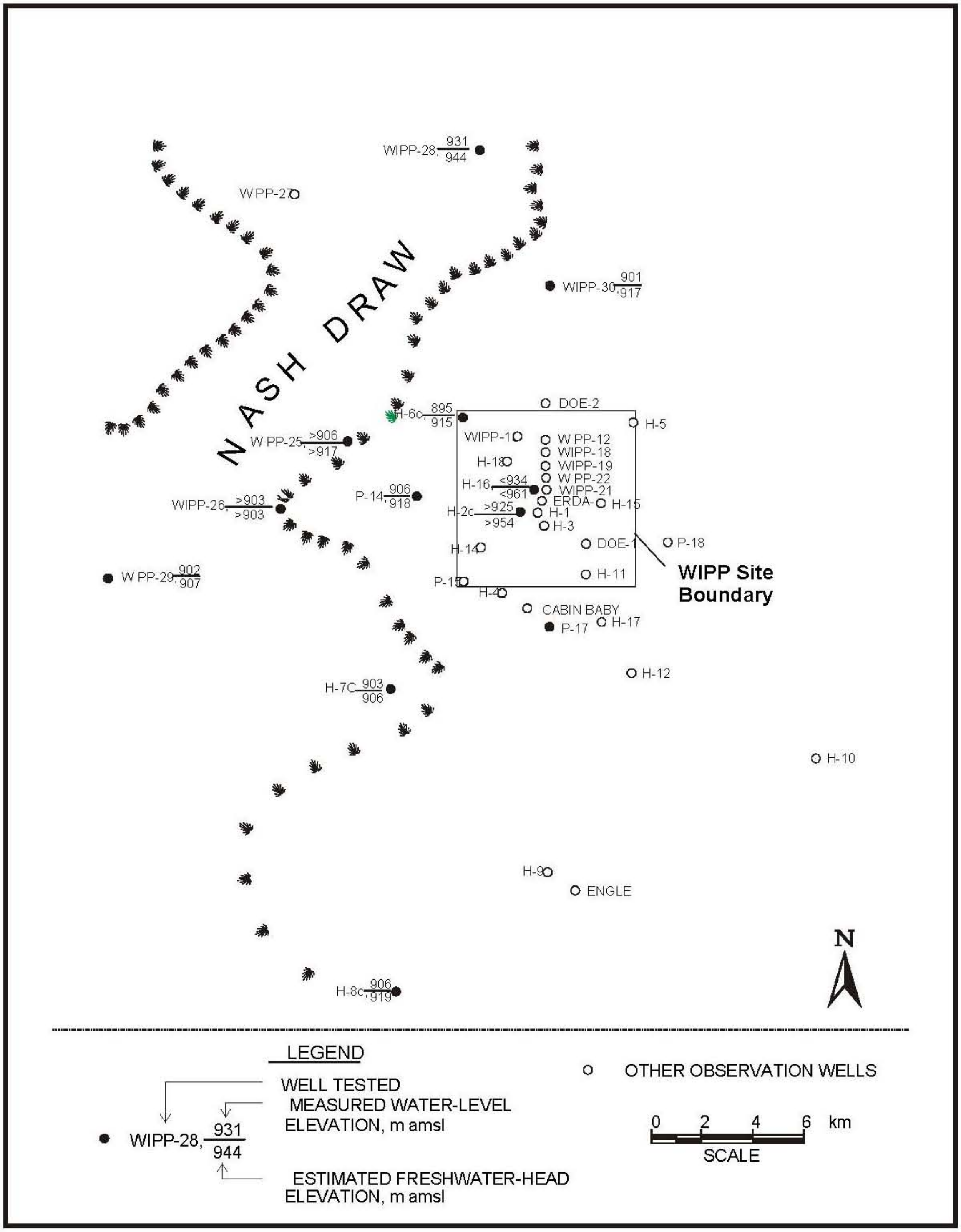


Figure L1-37
Measured Water Levels and Estimated Freshwater Heads of the Los Medaños and Rustler-Salado Contact Zone

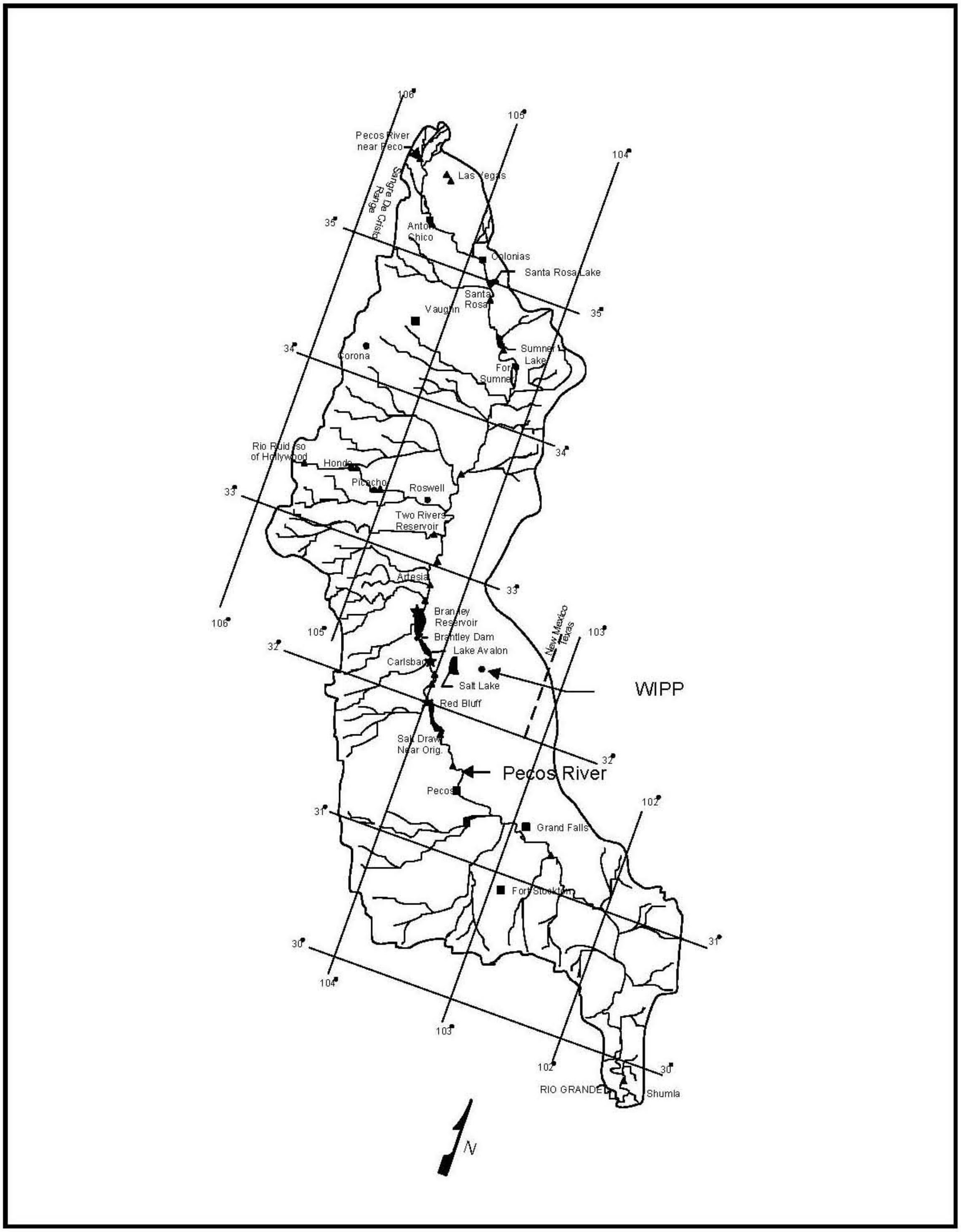
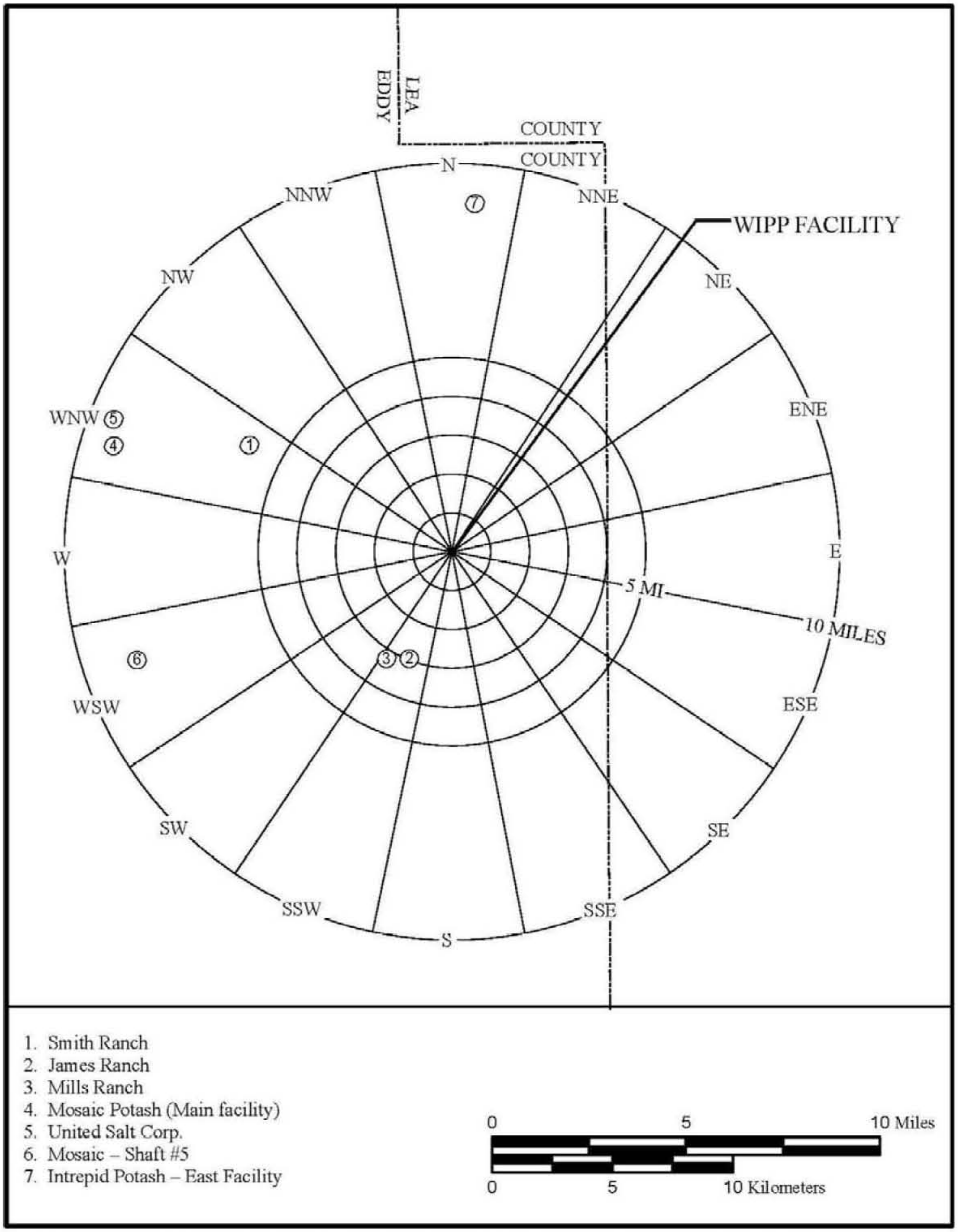
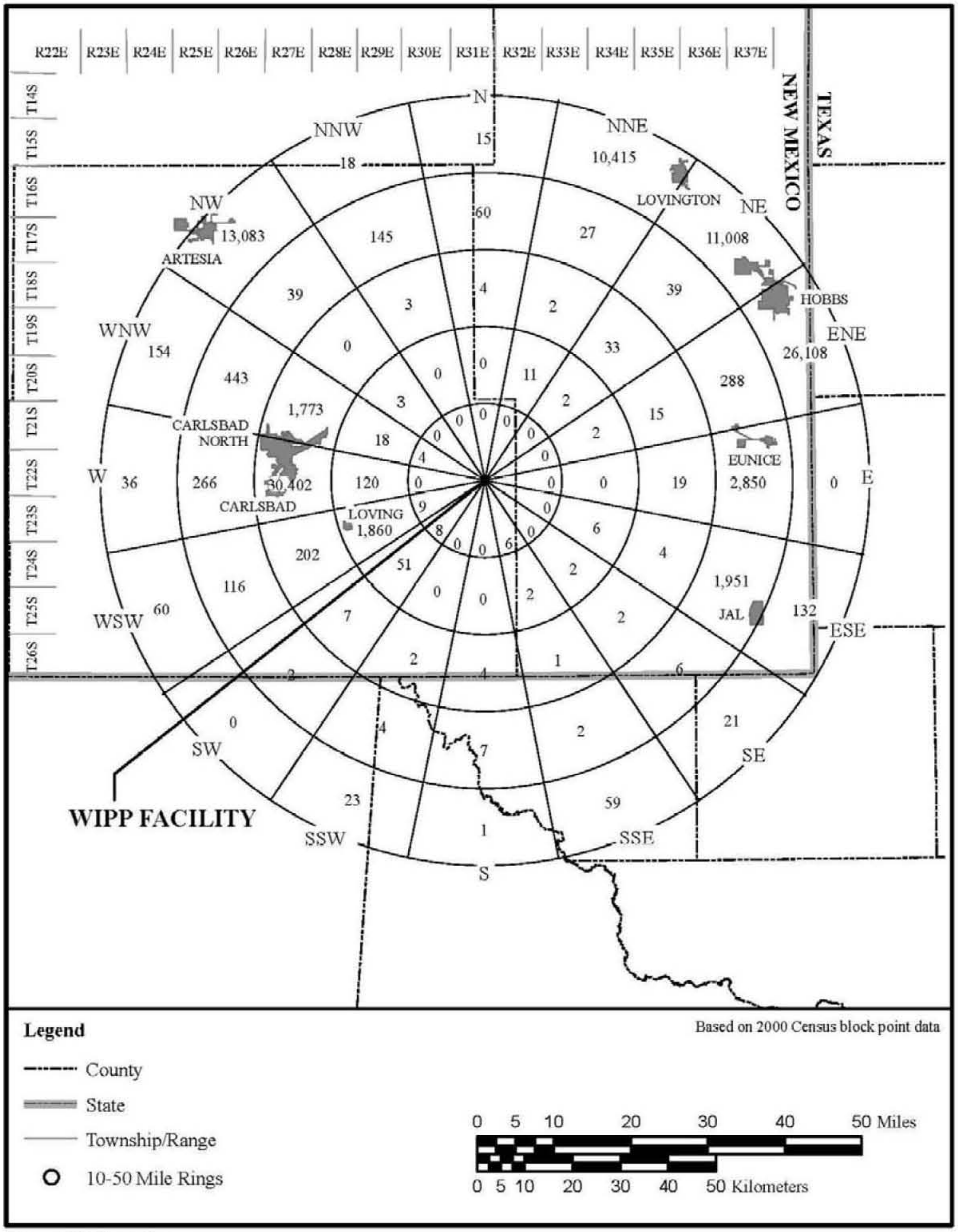


Figure L1-38
Location of Reservoirs and Gauging Stations in the Pecos River Basin



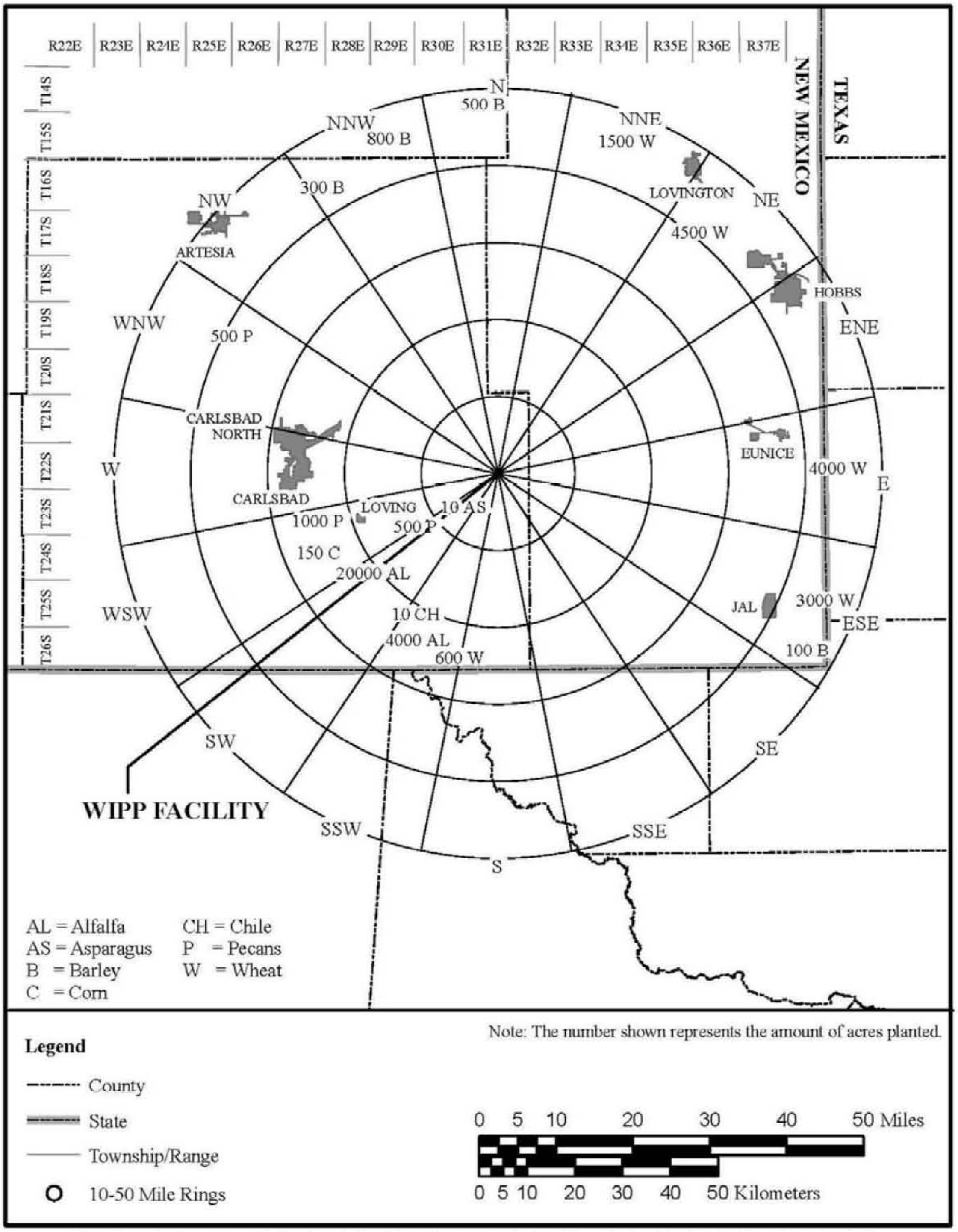
Sources: Hughes, D.L., Delaware Basin Drilling Surveillance; USA PHOTOMAPS; GOOGLE Earth; Eddy County Planning Department; New Mexico Cattle Growers Association; Artesia Alfalfa Growers

Figure L1-39
2007 CY – Active Mines and Inhabited Ranches within a 10-Mile Radius of the WIPP Facility



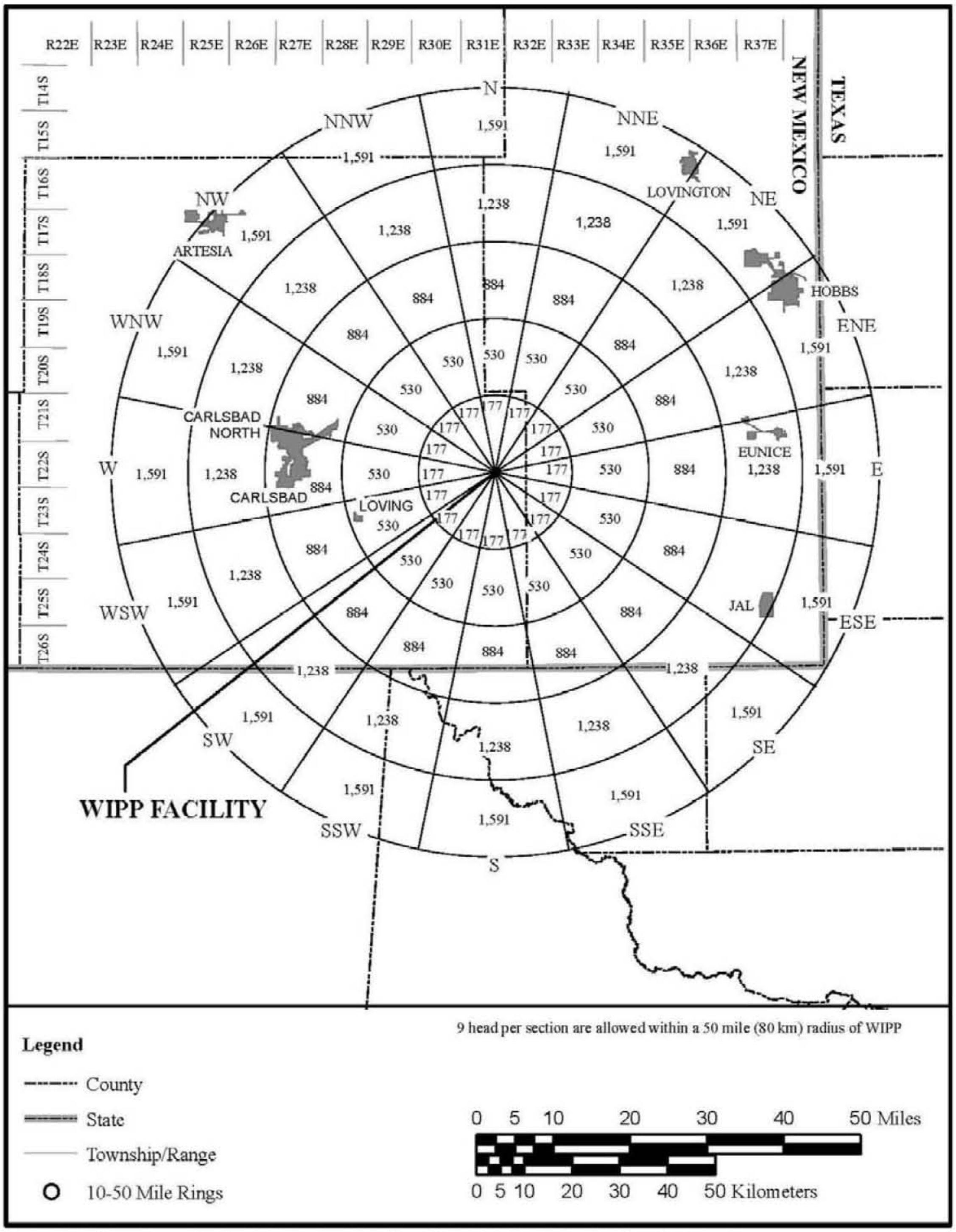
Source: U.S. Census Bureau

Figure L1-40
2000 CY – Population within a 50-Mile Radius of the WIPP Facility



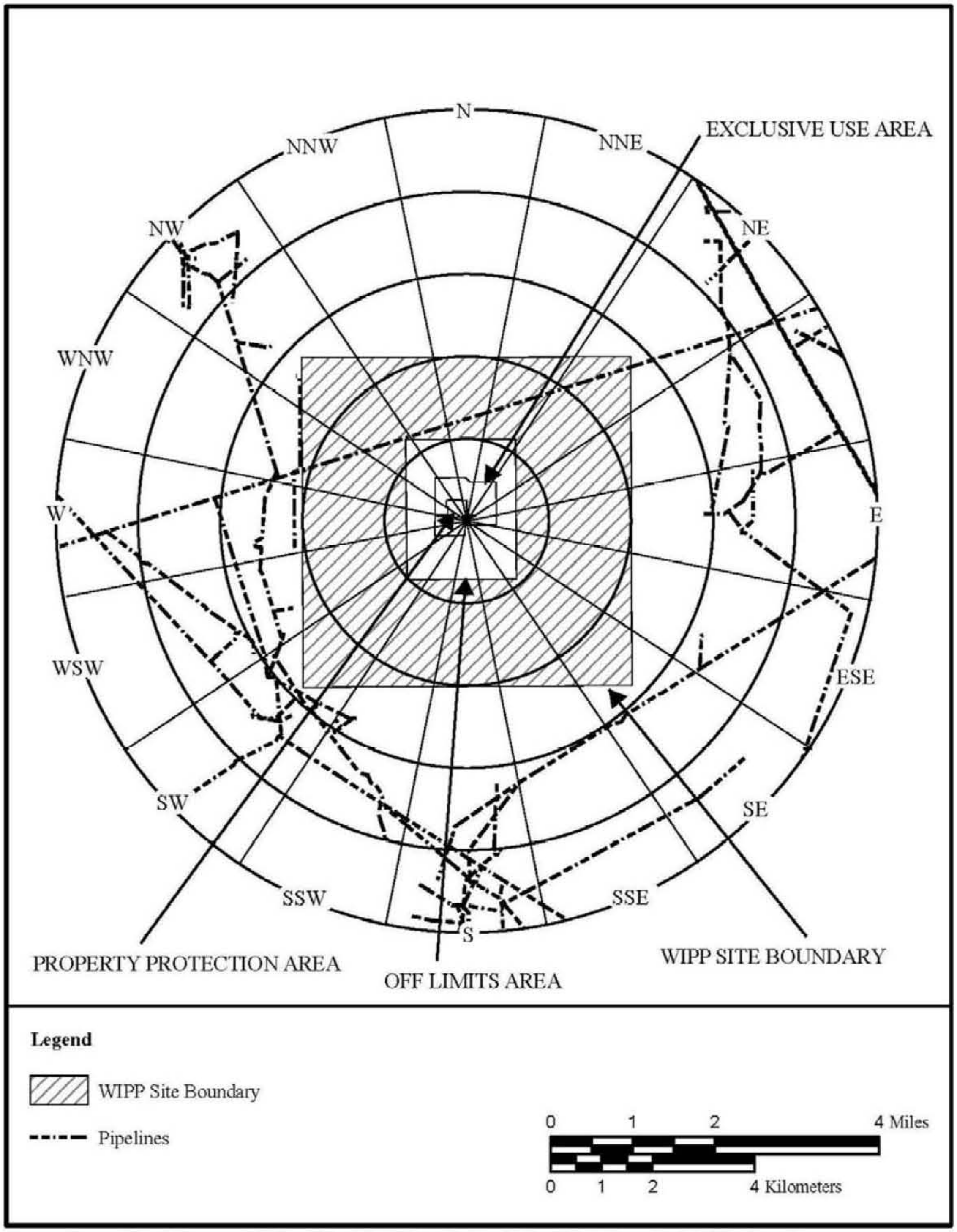
Sources: USDA Farm Service Agency; National Agricultural Statistics Service, Carlsbad New Mexico; New Mexico State University; Eddy County Extension Service; Lea County Extension Service; Texas State Technical College - West Texas.

Figure L1-41
2007 CY – Acres Planted in Edible Agriculture and Commercial Crops within a 50-Mile Radius of the WIPP Facility



Sources: Pavelik, B. Bureau of Land Management; New Mexico Cattle Growers Association; Artesia Alfalfa Growers

Figure L1-42
2007 CY – Maximum Yearly Cattle Density within a 50-Mile Radius of the WIPP Facility



Sources: Bureau of Land Management; El Paso Natural Gas/Mohave Pipeline; Hughes, D.L., Delaware Basin Drilling Surveillance

Figure L1-43
2007 CY – Natural Gas Pipelines within a 5-Mile Radius of the WIPP Facility

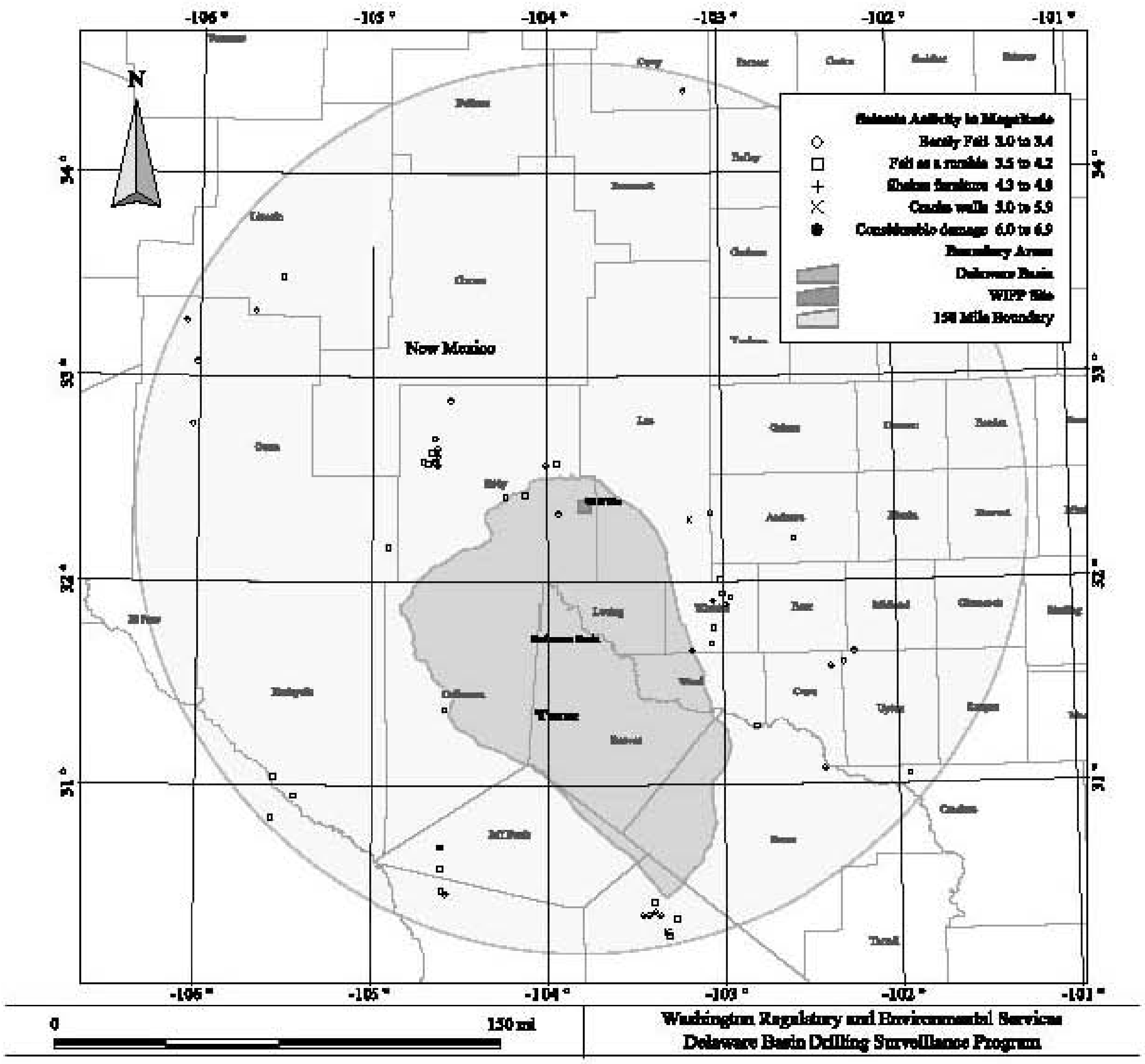


Figure L1-44
Seismic Events Greater Than 3.0 Magnitude for the Period July 1926 to December 2005 Within 150 Miles of the WIPP Facility

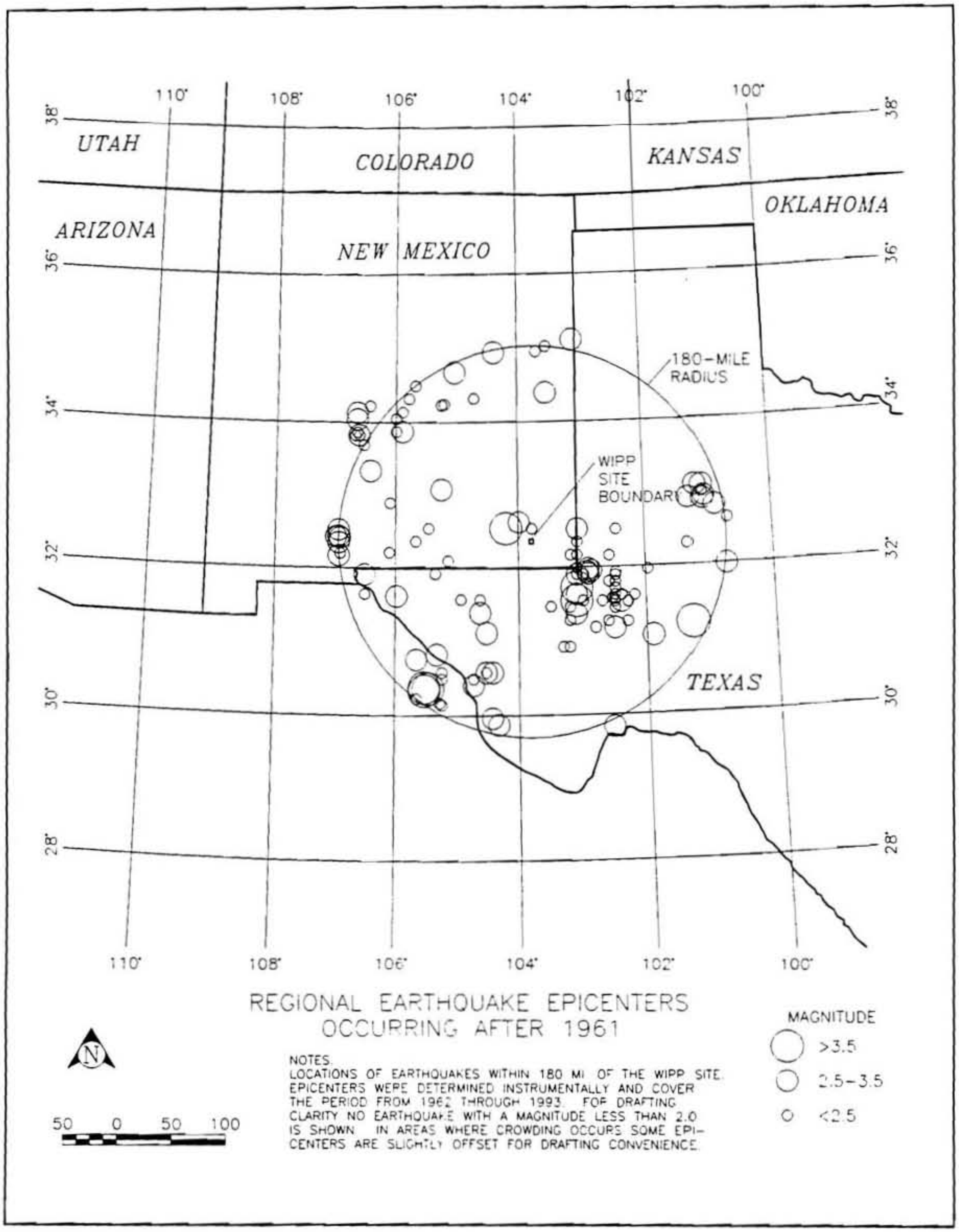


Figure L1-45
Regional Earthquake Epicenters Occurring After 1961

CHAPTER M

INFORMATION FOR SPECIFIC UNITS

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CHAPTER M

INFORMATION FOR SPECIFIC UNITS

Introduction

Management, storage and disposal of transuranic (**TRU**) mixed waste in the Waste Isolation Pilot Plant (**WIPP**) facility is subject to regulation under Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20.4.1 NMAC), Subpart V.

Module III of the permit authorizes the storage and management of contact-handled (**CH**) and remote-handled (**RH**) TRU mixed waste containers in the Waste Handling Building Container Storage Unit (**WHB Unit**) and Parking Area Container Storage Units (**Parking Area Unit**). The technical requirements of 20.4.1.500 NMAC (incorporating 40 CFR §§264.170 to 264.178) are applied to the operation of the WHB Unit and the Parking Area Unit. Permit Attachment M1 describes the container storage units, the TRU mixed waste management facilities and operations, and compliance with the technical requirements of 20.4.1.500 NMAC.

The WIPP is a geologic repository mined within a bedded salt formation, which is defined in 20.4.1.100 NMAC (incorporating 40 CFR §260.10) as a miscellaneous unit. As such, hazardous waste management units (**HWMUs**) within the repository are eligible for permitting according to 20.4.1.101 NMAC (incorporating 40 CFR §260.10), and are regulated under 20.4.1.500 NMAC, Miscellaneous Units.

Module IV of the permit authorizes the management and disposal of CH and RH TRU mixed waste containers in panels, also referred to as underground Hazardous Waste Disposal Units (**HWDUs**). The Disposal Phase will consist of receiving CH and RH TRU mixed waste shipping containers, unloading and transporting the waste containers to the Underground HWDUs, emplacing the waste in the Underground HWDUs, and subsequently achieving closure of the Underground HWDUs in compliance with applicable State and Federal regulations. As required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601), the Permittees shall ensure that the environmental performance standards for a miscellaneous unit, which are applied to the Underground HWDUs in the geologic repository, will be met. Permit Attachment M2 describes the HWDUs, the TRU mixed waste management facilities and operations, and compliance with the technical requirements of 20.4.1.500 NMAC.

APPENDIX M1

CONTAINER STORAGE

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APPENDIX M1

CONTAINER STORAGE

TABLE OF CONTENTS

List of Tables

List of Figures

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APPENDIX M1

CONTAINER STORAGE

Introduction

Management and storage of transuranic (**TRU**) mixed waste in the Waste Isolation Pilot Plant (**WIPP**) facility is subject to regulation under Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20.4.1 NMAC), Subpart V. The technical requirements of 20.4.1.500 NMAC (incorporating 40 CFR §§264.170 to 264.178 are applied to the operation of the Waste Handling Building Container Storage Unit (**WHB Unit**)(Figure M1-1), and the Parking Area Container Storage Unit (**Parking Area Unit**)(Figure M1-2). This Permit Attachment describes the container storage units, the TRU mixed waste management facilities and operations, and compliance with the technical requirements of 20.4.1 NMAC. The configuration of the WIPP facility consists of completed structures, including all buildings and systems for the operation of the facility.

M1-1 Container Storage

The waste containers that will be used at the WIPP facility qualify as “containers,” in accordance with 20.4.1.101 NMAC (incorporating 40 CFR §260.10). That is, they are “portable devices in which a material is stored, transported, treated, disposed of, or otherwise handled.”

M1-1a Containers with Residual Liquids

The Permit Treatment, Storage, and Disposal Facility (**TSDF**) Waste Acceptance Criteria (**WAC**) and the Waste Analysis Plan (Permit Attachment B) prohibit the shipment of liquid waste to the WIPP. This prohibition is enforced as a maximum residual liquids requirement. In no case shall the total liquid equal or exceed one volume percent of the waste container (e.g., drum, standard waste box [**SWB**], or canister). Since the maximum amount of liquid is one percent, calculations made to determine the secondary containment as required by 20.4.1.500 NMAC (incorporating §264.175) are based on ten percent of one percent of the volume of the containers, or one percent of the largest container, whichever is greater.

M1-1b Description of Containers

20.4.1.500 NMAC (incorporating 40 CFR §264.171) requires that containers holding waste be in good condition. Waste containers shall be in good condition prior to shipment from the generator sites, i.e., containers will be of high integrity, intact, and free of surface contamination above DOE limits. The Manager of the DOE Carlsbad Field Office has the authority to suspend a generator’s certification to ship TRU mixed waste to the WIPP facility should the generator fail to meet this requirement. The containers will be certified free of surface contamination above DOE limits upon shipment. This condition shall be verified upon receipt of the waste at WIPP. The level of rigor applied in these areas to ensure container integrity and the absence of external contamination on both ends of the transportation process will ensure that waste containers entering the waste management process line at WIPP meet the applicable Resource Conservation and Recovery Act (**RCRA**) requirements for container condition.

M1-1b(1) CH TRU Mixed Waste Containers

Contact handled (**CH**) TRU mixed waste containers will be either 55-gal (208-L) drums singly or arranged into 7-packs, 85-gal (321-L) drums singly or arranged into 4-packs, 100-gal (379 L) drums singly or arranged into 3-packs, ten-drum overpacks (**TDOP**), or SWBs. A summary description of each CH TRU mixed waste container type is provided below.

Standard 55-Gallon Drums

Standard 55-gal (208-L) drums meet the requirements for U.S. Department of Transportation (**DOT**) specification 7A regulations.

A standard 55-gal (208-L) drum has a gross internal volume of 7.4 cubic feet (ft^3) (0.210 cubic meters (m^3)). Figure M1-3 shows a standard TRU mixed waste drum. One or more filtered vents (as described in Section M1-1d(1)) will be installed in the drum lid to prevent the escape of any radioactive particulates and to eliminate any potential of pressurization.

Standard 55-gal (208-L) drums are constructed of mild steel and may also contain rigid, molded polyethylene (or other compatible material) liners. These liners are procured to a specification describing the functional requirements of fitting inside the drum, material thickness and tolerances, and quality controls and required testing. A quality assurance surveillance program is applied to all procurements to verify that the liners meet the specification.

Standard 55-gal (208-L) drums may be used to collect derived waste.

Standard Waste Boxes

The SWBs meet all the requirements of DOT specification 7A regulations.

One or more filtered vents (as described in Section M1-1d(1)) will be installed in the SWB body and located near the top of the SWB to prevent the escape of any radioactive particulates and to eliminate any potential of pressurization. They have an internal volume of 66.3 ft^3 (1.88 m^3). Figure M1-4 shows a SWB.

The SWB is the largest container that may be used to collect derived waste.

Ten-Drum Overpack

The TDOP is a metal container, similar to a SWB, that meets DOT specification 7A and is certified to be noncombustible and to meet all applicable requirements for Type A packaging. The TDOP is a welded-steel, right circular cylinder, approximately 74 inches (in.) (1.9 meters (m)) high and 71 in. (1.8 m) in diameter (Figure M1-5). The maximum loaded weight of a TDOP is 6,700 pounds (lbs) (3,040 kilograms (kg)). A bolted lid on one end is removable; sealing is accomplished by clamping a neoprene gasket between the lid and the body. One or more filter vents are located near the top of the TDOP on the body to prevent the escape of any radioactive particulates and to eliminate any potential of pressurization. A TDOP may contain up to ten standard 55-gal (208-L) drums or one SWB. TDOPs may be used to overpack drums or SWBs containing CH TRU mixed waste. The TDOP may also be direct loaded with CH TRU mixed waste. Figure M1-5 shows a TDOP.

Eighty-Five Gallon Drum

The 85-gal (321-L) drums meet the requirements for DOT specification 7A regulations. One or more filtered vents (as described in Section M1-1d(1)) will be installed in the 85-gal drum to prevent the escape of any radioactive particulates and to eliminate any potential of pressurization.

85-gal (321-L) drums are constructed of mild steel and may also contain rigid, molded polyethylene (or other compatible material) liners. These liners are procured to a specification describing the functional requirements of fitting inside the drum, material thickness and tolerances, and quality controls and required testing. A quality assurance surveillance program is applied to all procurements to verify that the liners meet the specification.

The 85-gal (321-L) drum, which is shown in Figure M1-6, will be used for overpacking contaminated 55-gal (208 L) drums at the WIPP facility. The 85-gal drum may also be direct loaded with CH TRU mixed waste.

85-gal (321-L) drums may be used to collect derived waste.

100-Gallon Drum

100-gal (379-L) drums meet the requirements for DOT specification 7A regulations.

A 100-gal (379-L) drum has a gross internal volume of 13.4 ft^3 (0.38 m^3). One or more filtered vents (as described in Section M1-1d(1) will be installed in the drum lid or body to prevent the escape of any radioactive particulates and to eliminate any potential of pressurization.

100-gal (379-L) drums are constructed of mild steel and may also contain rigid, molded polyethylene (or other compatible material) liners. These liners are procured to a specification describing the functional requirements of fitting inside the drum, material thickness and tolerances, and quality controls and required testing. A quality assurance surveillance program is applied to all procurements to verify that the liners meet the specification.

100-gal (379-L) drums may be direct loaded.

M1-1b(2) RH TRU Mixed Waste Containers

Remote-Handled (**RH**) TRU mixed waste containers include RH TRU Canisters, which are received at WIPP loaded singly in an RH-TRU 72-B cask, and 55-gallon drums, which are received in a CNS 10-160B cask.

RH TRU Canister

The RH TRU Canister is a steel single shell container which is constructed to be of high integrity. An example canister is depicted in Figure M1-16a. The RH TRU Canister is vented and will have a nominal internal volume of 31.4 ft^3 (0.89 m^3) and shall contain waste packaged in small containers (e.g., drums) or waste loaded directly into the canister.

Standard 55-Gallon Drums

Standard 55-gal (208-L) drums meet the requirements for U.S. Department of Transportation (DOT) specification 7A regulations. A detailed description of a standard 55-gallon drum is provided above. Up to ten 55-gallon drums containing RH TRU mixed waste are arranged on two drum carriage units in the CNS 10-160B cask (up to five drums per drum carriage unit). The drums are transferred to an RH TRU mixed waste Facility Canister that will contain three drums.

M1-1b(3) Container Compatibility

All containers will be made of steel, and some will contain rigid, molded polyethylene liners. The compatibility study, documented in Appendix C1 of the WIPP RCRA Part B Permit Application (DOE, 1997a), included container materials to assure containers are compatible with the waste. Therefore, these containers meet the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.172).

M1-1c Description of the Container Storage Units

M1-1c(1) Waste Handling Building Container Storage Unit (WHB Unit)

The Waste Handling Building (**WHB**) is the surface facility where TRU mixed waste handling activities will take place (Figure M1-1a). The WHB has a total area of approximately 84,000 square feet (ft^2) (7,804 square meters (m^2)) of which 26,151 ft^2 (2,430 m^2) are designated for the waste handling and container storage of CH TRU mixed waste and 17,403 ft^2 (1,617 m^2) are designated for handling and storage of RH TRU mixed waste, as shown in Figures M1-1, M1-14a, and M1-17a, b, c, and d. These areas are being permitted as the WHB Unit. The concrete floors are sealed with a coating that is sufficiently impervious to the chemicals in TRU mixed waste to meet the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.175(b)(1)).

CH Bay Surge Storage Area

The Permittees will coordinate shipments with the generator/storage sites in an attempt to minimize the use of surge storage. However, there may be circumstances causing shipments to arrive that would exceed the maximum capacity of the CH Bay Storage Area. The Permittees may use the CH Bay Surge Storage Area as specified in Module III (see Figure M1-1) only when the maximum capacities in the CH Bay Storage Area (except for the Shielded Storage Room) and the Parking Area Unit are reached and at least one of the following conditions is met:

- Surface or underground waste handling equipment malfunctions prevent the Permittees from moving waste to disposal locations;
- Hoisting or underground ventilation equipment malfunctions prevent the Permittees from moving waste into the underground;
- Power outages cause a suspension of waste emplacement activities;
- Inbound shipment delays are imminent because Parking Area Container Storage Unit Surge Storage is in use; or
- Onsite or offsite emergencies cause a suspension of waste emplacement activities.

The Permittees must notify NMED and those on the e-mail notification list upon using the CH Bay Surge Storage and provide justification for its use.

<u>CH TRU Mixed Waste</u>

The Contact-Handled Packages used to transport TRU mixed waste containers will be received through one of three air-lock entries to the CH Bay of the WHB Unit. The WHB heating, ventilation and air conditioning (**HVAC**) system maintains the interior of the WHB at a pressure lower than the ambient atmosphere to ensure that air flows into the WHB, preventing the inadvertent release of any hazardous or radioactive constituents contamination as the result of a contamination event. The doors at each end of the air lock are interlocked to prevent both from opening simultaneously and equalizing CH Bay pressure with outside atmospheric pressure. The CH Bay houses two TRUPACT-II Docks (**TRUDOCKs**), each equipped with overhead cranes for opening and unloading Contact-Handled Packages. The TRUDOCKs are within the TRUDOCK Storage Area of the WHB Unit.

The cranes are rated to lift the Contact-Handled Packaging lids as well as their contents. The cranes are designed to remain on their tracks and hold their load even in the event of a design-basis earthquake.

Upon receipt and removal of CH TRU mixed waste containers from the Contact-Handled Packaging, the waste containers are required to be in good condition as provided in Permit Module III. The waste containers will be visually inspected for physical damage (severe rusting, apparent structural defects, signs of pressurization, etc.) and leakage to ensure they are good condition prior to storage. Waste containers will also be checked for external surface contamination. If a primary waste container is not in good condition, the Permittees will overpack the container, repair/patch the container in accordance with 49 CFR §173 and §178 (e.g., 49 CFR §173.28), or return the container to the generator. The Permittees may initiate local decontamination, return unacceptable containers to a DOE generator site or send the Contact-Handled Package to the third party contractor. Decontamination activities will not be conducted on containers which are not in good condition, or which are leaking. If local decontamination activities are opted for, the work will be conducted in the WHB Unit on the TRUDOCK. These processes are described in Section M1-1d. The area previously designated as the Overpack and Repair Room will not be used for TRU mixed waste management in any instances.

Once unloaded from the Contact-Handled Packaging, CH TRU mixed waste containers (7-packs, 3-packs, 4-packs, SWBs, or TDOPs) are placed in one of two positions on the facility pallet or on a containment pallet. The waste containers are stacked, on the facility pallets (one- or two-high, depending on weight considerations). Waste on containment pallets will be stacked one-high. The use of facility or containment pallets will elevate the waste at least 6 in. (15 cm) from the floor surface. Pallets of waste will then be relocated to the CH Bay Storage Area of the WHB Unit for normal storage. This CH Bay Storage Area, which is shown in Figure M1-1, will be clearly marked to indicate the lateral limits of the storage area. This CH Bay Storage Area will have a maximum capacity of 13 pallets (4,160 ft^3 [118 m^3]) of TRU mixed waste containers during normal operations.

In addition, four Contact-Handled Packages, containing up to eight 7-packs, 3-packs, 4-packs, SWBs, or four TDOPs, may occupy positions at the TRUDOCKs. If waste containers are left in this area, they will be in the Contact-Handled Package with or without the shipping container lids removed. The maximum volume of waste in containers in four Contact-Handled Packages is 640 ft^3 (18.1 m^3).

The Derived Waste Storage Area of the WHB Unit is on the north wall of the CH Bay. This area will contain containers up to the volume of a SWB for collecting derived waste from all TRU mixed waste handling processes in the WHB Unit. The Derived Waste Storage Area is being permitted to allow containers in size up to a SWB to be used to accumulate derived waste. The volume of TRU mixed waste stored in this area will be up to 66.3 ft^3 (1.88 m^3). The derived waste containers in the Derived Waste Storage Area will be stored on standard drum pallets, which are polyethylene trays with a grated deck, which will elevate the derived waste containers approximately 6 in. (15 cm) from the floor surface, and provide approximately 50 gal (190 L) of secondary containment capacity.

Aisle space shall be maintained in all WHB Unit TRU mixed waste storage areas. The aisle space shall be adequate to allow unobstructed movement of fire-fighting personnel, spill-control equipment, and decontamination equipment that would be used in the event of an off-normal event. An aisle space of 44 in. (1.1 m) between facility pallets will be maintained in all WHB Unit TRU mixed waste storage areas. An aisle space of 60 in. (1.5 m) will be maintained between the west wall of the CH Bay and facility pallets.

The WHB has been designed to meet DOE design and associated quality assurance requirements. Table M1-1 summarizes basic design requirements, principal codes, and standards for the WIPP facility. Appendix D2 of the WIPP RCRA Part B Permit Application (DOE, 1997a) provided engineering design-basis earthquake and tornado reports. The design-basis earthquake report provides the basis for seismic design of WIPP facility structures, including the WHB foundation. The WIPP design-basis earthquake is 0.1 g. The WIPP design-basis tornado includes a maximum windspeed of 183 mi per hr (mi/hr) (294.5 km/hr), which is the vector sum of all velocity components. It is also limited to a translational velocity of 41 mi/hr (66 km/hr) and a tangential velocity of 124 mi/hr (200 km/hr). Other parameters are a radius of maximum wind of 325 ft (99 m), a pressure drop of 0.5 lb per in.^{2} (3.4 kilopascals [kPa]), and a rate-of-pressure drop of 0.09 lb/in.^{2}/s (0.6 kPa/s). A design-basis flood report is not available because flooding is not a credible phenomenon at the WIPP facility. Design calculations for the probable maximum precipitation (**PMP**) event, provided in Appendix D7 of the WIPP RCRA Part B Permit Application (DOE, 1997a), illustrated run-on protection for the WIPP facility.

The following are the major pieces of equipment that will be used to manage CH TRU mixed waste in the container storage units. A summary of equipment capacities, as required by 20.4.1.500 NMAC is included in Table M1-2.

TRUPACT-II Type B Packaging

The TRUPACT-II (Figure M1-8a) is a double-contained cylindrical shipping container 8 ft (2.4 m) in diameter and 10 ft (3 m) high. It meets NRC Type B shipping container requirements and has successfully completed rigorous container-integrity tests. The payload consists of approximately 7,265 lbs (3,300 kg) gross weight in up to fourteen 55-gal (208-L) drums, eight 85-gal (322-L) drums, six 100-gal (379-L) drums, two SWBs, or one TDOP.

HalfPACT Type B Packaging

The HalfPACT (Figure M1-8b) is a double-contained right cylindrical shipping container 7.8 ft (2.4 m) in diameter and 7.6 ft (2.3 m) high. It meets NRC Type B shipping container requirements and has successfully completed rigorous container-integrity tests. The payload consists of approximately 7,600 lbs (3,500 kg) gross weight in up to seven 55-gal (208-L) drums, one SWB, or four 85-gallon drums.

Unloading Docks

Each TRUDOCK is designed to accommodate up to two Contact-Handled Packages. The TRUDOCK functions as a work platform, providing TRU mixed waste handling personnel easy access to the container during unloading operations (see Figure M1-1a) (Also see Drawing 41-M-001-W in Appendix D3 of the WIPP RCRA Part B Permit Application (DOE, 1997a)).

Forklifts

Forklifts will be used to transfer the Contact-Handled Packages into the WHB Unit and may be used to transfer palletized CH TRU mixed waste containers to the facility transfer vehicle. Another forklift will be used for general-purpose transfer operations. This forklift has attachments and adapters to handle individual TRU mixed waste containers, if required.

Cranes and Adjustable Center-of-Gravity Lift Fixtures

At each TRUDOCK, an overhead bridge crane is used with a specially designed lift fixture for disassembly of the Contact-Handled Packages. Separate lifting attachments have been specifically designed to accommodate SWBs and TDOPs. The lift fixture, attached to the crane, has built-in level indicators and two counterweights that can be moved to adjust the center of gravity of unbalanced loads and to keep them level.

Facility or Containment Pallets

The facility pallet is a fabricated steel unit designed to support 7-packs, 4-packs, or 3-packs of drums, SWBs, or TDOPs, and has a rated load of 25,000 lbs. (11,430 kg). The facility pallet will accommodate up to four 7-packs, four 3-packs, or four 4-packs of drums or four SWBs (in two stacks of two units), two TDOPs, or any combination thereof. Loads are secured to the facility pallet during transport to the emplacement area. Facility pallets are shown in Figure M1-10. Fork pockets in the side of the pallet allow the facility pallet to be lifted and transferred by forklift to prevent direct contact between TRU mixed waste containers and forklift tines. This arrangement reduces the potential for puncture accidents. Facility pallets may also be moved by facility transfer vehicles. WIPP facility operational documents define the operational load of the facility pallet to ensure that the rated load of a facility pallet is not exceeded.

Containment pallets are fabricated units having a containment capacity of at least ten percent of the volume of the containers and designed to support a minimum of either a single drum, a single SWB or a single TDOP. The pallets will have a rated load capacity of equal to or greater than the gross weight limit of the container(s) to be supported on the pallet. Loads are secured to the containment pallet during transport. A typical containment pallet is shown in Figure M1-10a. Fork pockets in the side of the pallet allow the containment pallet to be lifted and transferred by forklift. WIPP facility operational documents define the operational load of the containment pallet to assure that the rated load of a containment pallet is not exceeded.

Facility Transfer Vehicle

The facility transfer vehicle is a battery or electric powered automated vehicle that either operates on tracks or has an on-board guidance system that allows the vehicle to operate on the floor of the WHB. It is designed with a flat bed that has adjustable height capability and may transfer waste payloads on facility pallets or off the facility pallet stands in the CH Bay storage area, and on and off the waste shaft conveyance by raising and lowering the bed (see Figure M1-11).

RH TRU Mixed Waste

The RH TRU mixed waste is handled and stored in the RH Complex of the WHB Unit which comprises the following locations: RH Bay (12,552 ft^2 (1,166 m^2)), the Cask Unloading Room (382 ft^2 (36 m^2)), the Hot Cell (1,841 ft^2 (171 m^2)), the Transfer Cell (1,003 ft^2 (93 m^2)) (Figures M1-17a, b and c), and the Facility Cask Loading Room (1,625 ft^2 (151 m^2)) (Figure M1-17d).

The RH Bay (Figure M1-14a) is a high-bay area for receiving casks and subsequent handling operations. The trailer carrying the RH-TRU 72-B or CNS 10-160B shipping cask (Figures M1-18, M1-19, M1-20 and M1-21) enters the RH Bay through a set of double doors on the east side of the WHB. The RH Bay houses the Cask Transfer Car. The RH Bay is served by the RH Bay

Overhead Bridge Crane used for cask handling and maintenance operations. Storage in the RH Bay occurs in the RH-TRU 72-B or CNS 10-160B casks. The storage occurs after the trailer containing the cask is moved into the RH Bay and prior to moving the cask into the Cask Unloading Room to stage the waste for disposal operations. A maximum of two loaded casks and one 55-gallon drum for derived waste (156 ft^3 (4.4 m^3)) may be stored in the RH Bay.

The Cask Unloading Room (Figure M1-17a) provides for transfer of the RH-TRU 72-B cask to the Transfer Cell, or the transfer of drums from the CNS 10-160B cask to the Hot Cell. Storage in the Cask Unloading Room will occur in the RH-TRU 72-B or CNS 10-160B casks. Storage in this area typically occurs at the end of a shift or in an off-normal event that results in the suspension of waste handling operations. A maximum of one cask (74 ft^3 (2.1 m^3)) may be stored in the Cask Unloading Room.

The Hot Cell (Figure M1-17b) is a concrete shielded room in which drums of RH TRU mixed waste will be transferred remotely from the CNS 10-160B cask, staged in the Hot Cell, and loaded into a Facility Canister. The loaded Facility Canister is then lowered from the Hot Cell into the Transfer Cell Shuttle Car containing a Shielded Insert. Storage in the Hot Cell occurs in either drums or Facility Canisters. Drums that are stored are either on the drum carriage unit that was removed from the CNS 10-160B cask or in a Facility Canisters. A maximum of 12 55-gallon drums and one 55-gallon drum for derived waste (94.9 ft^3 (2.7 m^3)) may be stored in the Hot Cell.

The Transfer Cell (Figure M1-17c) houses the Transfer Cell Shuttle Car, which moves the RH-TRU 72-B cask or Shielded Insert into position for transferring the canister to the Facility Cask. Storage in this area typically occurs at the end of a shift or in an off-normal event that results in the suspension of a waste handling evolution. A maximum of one canister (31.4 ft^3 (0.89 m^3)) may be stored in the Transfer Cell in the Transfer Cell Shuttle Car.

The Facility Cask Loading Room (Figure M1-17d) provides for transfer of a canister to the Facility Cask for subsequent transfer to the waste shaft conveyance and to the Underground Hazardous Waste Disposal Unit (**HWDU**). The Facility Cask Loading Room also functions as an air lock between the Waste Shaft and the Transfer Cell. Storage in this area typically occurs at the end of a shift or in an off-normal event that results in the suspension of waste handling operations. A maximum of one canister (31.4 ft^3 (0.89 m^3)) may be stored in the Facility Cask (Figure M1-23) in the Facility Cask Loading Room.

Following is a description of major pieces of equipment that are used to manage RH TRU mixed waste in the WHB Unit. A summary of equipment capacities, as required by 20.4.1.500 NMAC, is included in Table M1-3.

<u>Casks</u>

The RH-TRU 72-B cask (Figure M1-20) is a cylinder designed to meet U.S. Department of Transportation (**DOT**) Type B shipping container requirements. It consists of a separate inner vessel within a stainless steel, lead-shielded outer cask protected by impact limiters at each end, made of stainless steel skins filled with polyurethane foam. The inner vessel is made of stainless steel and provides an internal containment boundary and a cavity for the payload. Neither the outer cask nor the inner vessel is vented. Payload capacity of each RH-TRU 72-B shipping cask is 8,000 lbs (3,628 kg). The payload consists of a canister of RH TRU mixed waste, which may contain up to 31.4 ft^3 (0.89 m^3) of directly loaded waste or waste in smaller containers.

The CNS 10-160B cask (Figure M1-21) is designed to meet DOT Type B container requirements and consists of two carbon steel shells and a lead shield, welded to a carbon steel bottom plate. A 12-gauge stainless steel thermal shield surrounds the cask outer shell, which is equipped with two steel-encased, rigid polyurethane foam impact limiters attached to the top and bottom of the cask. The CNS 10-160B cask is not vented. Payload capacity of each CNS 10-160B cask is 14,500 lbs (6,577 kg). The payload consists of up to ten 55-gallon drums.

Shielded Insert

The Shielded Insert (Figure M1-30) is specifically designed to be used in the Transfer Cell to hold and transport loaded Facility Canisters from the Hot Cell until loaded into the Facility Cask. The Shielded Insert, designed and constructed similar to the RH-TRU 72-B shipping cask, has a 29 in. inside diameter with an inside length of 130.5 in. to accommodate the Facility Canister, which is 28.5 in. in diameter by 117.5 in. long. The Shielded Insert is installed on and removed from the Transfer Cell Shuttle Car in the same manner as the RH-TRU 72-B shipping cask.

CNS 10-160B Drum Carriage

The CNS 10-160B drum carriage (Figure M1-25) is a steel device used to handle drums in the CNS 10-160B cask. The drum carriages are stacked two high in the CNS 10-160B cask during shipment. They are removed from the cask using a below-the-hook lifting device termed a pentapod. The drum carriage is rated to lift up to five drums with a maximum weight of 1000 pounds each.

RH Bay Overhead Bridge Crane

In the RH Bay, an overhead bridge crane is used to lift the cask from the trailer and place it on the Cask Transfer Car. It is also used to remove the impact limiters from the casks and the outer lid of the RH-TRU 72-B cask.

Cask Lifting Yoke

The lifting yoke is a lifting fixture that attaches to the RH Bay Overhead Bridge Crane and is designed to lift and rotate the RH-TRU 72-B cask onto the Cask Transfer Car.

Cask Transfer Cars

The Cask Transfer Cars (Figures M1-22a and M1-22b) are self-propelled, rail-guided vehicles, that transport casks between the RH Bay and the Cask Unloading Room.

6.25 Ton Grapple Hoist

A 6.25 Ton Grapple Hoist is used to hoist the canister from the Transfer Cell Shuttle Car into the Facility Cask.

Facility Canister

The Facility Canister is a cylindrical container designed to hold three 55-gallon drums of either RH TRU waste or dunnage (Figure M1-16).

Facility Cask

The Facility Cask body consists of two concentric steel cylinders. The annulus between the cylinders is filled with lead, and gate shield valves are located at either end. Figure M1-23 provides an outline configuration of the Facility Cask. The canister is placed inside the Facility Cask for shielding during canister transfer from the RH Complex to the Underground HWDU for emplacement.

Facility Cask Transfer Car

The Facility Cask Transfer Car (Figure M1-24) is a self-propelled rail car that is used to move the Facility Cask between the Facility Cask Loading Room and the Shaft Station in the underground.

Hot Cell Bridge Crane

The Hot Cell Bridge Crane, outfitted with a rotating block and the Hot Cell Facility Grapple, will be used to lift the CNS 10-160B lid and the drum carriage units from the cask located in the Cask Unloading Room, into the Hot Cell. The Hot Cell Bridge Crane is also used to lift the empty Facility Canisters into place within the Hot Cell, move loaded drums into the Facility Canister, and lower loaded Facility Canisters into the Transfer Cell.

Overhead Powered Manipulator

The Overhead Powered Manipulator is used in the Hot Cell to lift individual drums from the drum carriage unit and lower each drum into the Facility Canister and support miscellaneous Hot Cell operations.

Manipulators

There is a maximum of two operational sets of fixed Manipulators in the Hot Cell. The Manipulators collect swipes of drums as they are being lifted from the drum carriage unit and transfer the swipes to the Shielded Material Transfer Drawer and support Hot Cell operations.

Shielded Material Transfer Drawer

The Shielded Material Transfer Drawer is used to transfer swipe samples obtained by the fixed Manipulators to the Hot Cell Gallery for radiological counting and transferring small equipment into and out of the Hot Cell.

Closed-Circuit Television Cameras

The Closed-Circuit Television Camera system is used to monitor operations throughout the Hot Cell and Transfer Cell. These cameras are used to perform inspections of waste containers and waste management areas. This camera system is operated from the shielded room in the Facility Cask Loading Room and Hot Cell Gallery. The camera system will have a video recording capability as an operational aid. This video recording capability will be available in the Transfer Cell by December 31, 2006, and in the Hot Cell prior to the initial receipt of RH TRU waste in the Hot Cell. The Transfer Cell may be used without video recording capability before December 31, 2006.

Transfer Cell Shuttle Car

The Transfer Cell Shuttle Car (Figure M1-31) positions the loaded RH-TRU 72-B cask and Shielded Insert within the Transfer Cell.

Cask Unloading Room Crane

The Cask Unloading Room Crane lifts and suspends the RH-TRU 72-B cask or Shielded Insert from the Transfer Car and lowers the cask or Shielded Insert into the Transfer Cell Shuttle Car.

Facility Cask Rotating Device

The Facility Cask Rotating Device, a floor mounted hydraulically operated structure, is designed to rotate the Facility Cask from the horizontal position to the vertical position for waste canister loading and then back to the horizontal position after the waste canister has been loaded into the Facility Cask (Figure M1-32).

M1-1c(2) Parking Area Container Storage Unit (Parking Area Unit)

The parking area south of the WHB (see Figure M1-2) will be used for storage of waste containers within sealed shipping containers awaiting unloading. The area extending south from the WHB within the fenced enclosure identified as the Controlled Area on Figure M1-2 is defined as the Parking Area Unit. The Parking Area Unit provides storage space for up to 6,734 ft^3 (191 m^3) of TRU mixed waste, contained in up to 40 loaded Contact-Handled Packages and 8 Remote-Handled Packages. Secondary containment and protection of the waste containers from standing liquid are provided by the Contact-Handled or Remote-Handled Packaging. Wastes placed in the Parking Area Unit will remain sealed in their Contact-Handled or Remote-Handled Packages, at all times while in this area.

The Nuclear Regulatory Commission (**NRC**) Certificate of Compliance requires that sealed Contact-Handled or Remote-Handled Packages which contain waste be vented every 60 days to avoid unacceptable levels of internal pressure. During normal operations the maximum residence time of any one container in the Parking Area Unit is typically five days. Therefore, during normal waste handling operations, no Contact-Handled or Remote-Handled Packages will require venting while located in the Parking Area Unit. Any off-normal event which results in the need to store a waste container in the Parking Area Unit for a period of time approaching fifty-nine (59) days shall be handled in accordance with Section M1-1e(2) of this Permit Attachment. Under no circumstances shall a Contact-Handled or Remote-Handled Package be stored in the Parking Area Unit for more than fifty-nine (59) days after the date that the inner containment vessel of the Contact-Handled or Remote-Handled Package was sealed at the generator site.

Parking Area Surge Storage

The Permittees will coordinate shipments with the generator/storage sites in an attempt to minimize the use of surge storage. However, there may be circumstances causing shipments to arrive that would exceed the maximum capacity of the Parking Area. The Permittees may use the Parking Area Surge Storage as specified in Module III (see Figure M1-2) only when the maximum capacity in the Parking Area is reached and at least one of the following conditions is met:

- Surface or underground waste handling equipment malfunctions prevent the Permittees from moving waste to disposal locations;
- Hoisting or underground ventilation equipment malfunctions prevent the Permittees from moving waste into the underground;
- Power outages cause a suspension of waste emplacement activities;
- Inbound shipment delays are imminent because the Parking Area is full (not applicable to RH TRU waste shipments); or
- Onsite or offsite emergencies cause a suspension of waste emplacement activities.

The Permittees must notify NMED and those on the e-mail notification list upon using the Parking Area Surge Storage and provide justification for its use.

M1-1d Container Management Practices

20.4.1.500 NMAC (incorporating 40 CFR §264.173) requires that containers be managed in a manner that does not result in spills or leaks. Containers are required to be closed at all times, unless waste is being placed in the container or removed. Because containers at the WIPP will contain radioactive waste, safety concerns require that containers be continuously vented to obviate the buildup of gases within the container. These gases could result from radiolysis, which is the breakdown of moisture by radiation. The vents, which are nominally 0.75 in. (1.9 centimeters [cm]) in diameter, are generally installed on or near the lids of the containers. These vents are filtered so that gas can escape while particulates are retained.

TRU mixed waste containers, containing off-site waste, are never opened at the WIPP facility. Derived waste containers are kept closed at all times unless waste is being added or removed.

Off-normal events could interrupt normal operations in the waste management process line. These off normal events fall into the following categories:

- Waste management system equipment malfunctions
- Waste shipments with unacceptable levels of surface contamination
- Hazardous Waste Manifest discrepancies that are not immediately resolved
- A suspension of emplacement activities for regulatory reasons

Shipments of waste from the generator sites will be stopped in any event which results in an interruption to normal waste handling operations that exceeds three days.

Prior to receipt of TRU mixed waste at the WIPP facility, waste operators will be thoroughly trained in the safe use of TRU mixed waste handling and transport equipment. The training will include both classroom training and on-the-job training.

M1-1d(1) Derived Waste

The WIPP facility operational philosophy is to introduce no new hazardous chemical components into TRU mixed waste or TRU mixed waste residues that could be present in the controlled area. This will be accomplished principally through written procedures and the use of Safe Work Permits (**SWP**)[1] and Radiological Work Permits (**RWP**)[2] which govern the activities within a controlled area involving TRU mixed waste. The purpose of this operating philosophy is to avoid generating TRU mixed waste that is compositionally different than the TRU mixed waste shipped to the WIPP facility for disposal.

Some additional TRU mixed waste, such as used personal protective equipment, swipes, and tools, may result from decontamination operations and off-normal events. Such waste will be assumed to be contaminated with RCRA-regulated hazardous constituents in the TRU mixed waste containers from which it was derived. Derived waste may be generated as the result of

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[1] SWPs are prepared to assure that any hazardous work (not already covered by a procedure) is performed with due precaution. SWPs are issued by the Permittees after a job supervisor completes the proper form detailing the job location, work description, personnel involved, specific hazards involved, and protective requirements. The Permittees review the form, check on the adequacy of the protective measures, and if sufficient, approve the work permit. Conditions of the SWPs must be met while any hazardous work is proceeding. Examples of activities covered by the SWP program include confined space entry, overhead work, and work on energized equipment.

[2] RWPs are used to control entry into and performance of work within. Managers responsible for work within a CA must generate a work permit that specifies the work scope, limiting conditions, dosimetry, respiratory protection, protective clothing, specific worker qualifications, and radiation safety technician support. RWPs are approved by the Permittees after thorough review. No work can proceed in a CA without a valid RWP.

decontamination activities during the waste handling process. Should decontamination activities be performed, water and a cleaning agent such as those listed in Permit Attachment F will be used. Derived waste will be considered acceptable for management at the WIPP facility, because any TRU mixed waste shipped to the facility will have already been determined to be acceptable and because no new constituents will be added. Data on the derived waste will be entered into the WWIS database. Derived waste will be contained in standard DOT approved Type A containers.

The Safety Analysis Report (DOE 1997b) for packaging requires the lids of TRU mixed waste containers to be vented through high efficiency particulate air (**HEPA**)-grade filters to preclude container pressurization caused by gas generation and to prevent particulate material from escaping. Filtered vents used in CH TRU mixed waste containers (55-gal (208-L) drums, 85-gal (321 L) drums, 100-gal (379-L) drums, TDOPs, and SWBs) have an orifice approximately 0.375-in. (9.53-millimeters) in diameter through which internally generated gas may pass. The filter media can be any material (e.g., composite carbon, sintered metal).

As each derived waste container is filled, it will be closed with a lid containing a HEPA-grade. filter and moved to an Underground Hazardous Waste Disposal Unit (**HWDU**) using the same equipment used for handling TRU mixed waste.

M1-1d(2) <u>CH TRU Mixed Waste Handling</u>

CH TRU mixed waste containers will arrive by tractor-trailer at the WIPP facility in sealed shipping containers (e.g., TRUPACT-IIs or HalfPACTs) (see Figure M1-12), at which time they will undergo security and radiological checks and shipping documentation reviews. A forklift will remove the Contact-Handled Packages and will transport them a short distance through an air lock that is designed to maintain differential pressure in the WHB. The forklift will place the shipping containers at one of the two TRUDOCKs in the TRUDOCK Storage Area of the WHB Unit, where an external survey of the Contact-Handled Package inner vessel (see Figure M1-8a and M1-8b) will be performed as the outer containment vessel lid is lifted. The inner vessel lid will be lifted under the TRUDOCK Vent Hood System (**VHS**), and the contents will be surveyed during and after this lift. The TRUDOCK VHS[3] is attached to the Contact-Handled Package to

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[3] The TRU mixed waste container headspace may contain radiologically contaminated airborne dust particles.

1. Without the TRUDOCK VHS, a potential mechanism will exist to spread contamination (if present) in the immediate CH TRU mixed waste handling area, because lid removal will immediately expose headspace gases to prevailing air currents induced by the building ventilation system.
2. With the VHS, a confined and controlled set of prevailing air currents will be induced by the system blower. The TRUDOCK VHS will function as a local exhaust system to effectively control radiologically contaminated airborne dust particles (and VOCs) at essentially atmospheric pressure conditions.

   Functionally, the TRUDOCK VHS will draw the TRU mixed waste container headspace gases, convey them through a HEPA filter, and ultimately duct them through the WHB exhaust ventilation system. VOCs will pass through the HEPA filter and will be conveyed to the ventilation exhaust duct system. The system principally consists of a functional aggregation of 1) vent hood assembly, 2) HEPA filter assemblies (to capture any airborne radioactive particles), 3) blower (to provide forced airflow), 4) ductwork, and 5) flexible hose.

provide atmospheric control and confinement of headspace gases at their source. It also prevents potential personnel exposure and facility contamination due to the spread of radiologically contaminated airborne dust particles and minimizes personnel exposure to VOCs.

Contamination surveys at the WIPP facility are based in part on radiological surveys used to indicate potential releases of hazardous constituents from containers by virtue of detection of radioactive contamination (see Permit Attachment I3). Radiological surveys may be applicable to most hazardous constituent releases except the release of gaseous VOCs from TRU mixed waste containers. Radiological surveys provide the WIPP facility with a very sensitive method of indicating the potential release of nongaseous hazardous constituents through the use of surface sampling (swipes) and radioactivity counting. Radiological surveys are used in addition to the more conventional techniques such as visual inspection to identify spills.

Under normal operations, it is not expected that the waste containers will be externally contaminated or that removable surface contamination on the shipping package or the waste containers will be in excess of the DOE's free release limits (i.e.; < 20 disintegrations per minute (**dpm**)[4] per 100 cm^2 alpha or < 200 dpm per 100 cm^2 beta/gamma). In such a case, no further decontamination action is needed. The shipping package and waste container will be handled through the normal process. However, should the magnitude of contamination exceed the free release limits, yet still fall within the criteria for small area "spot" decontamination (i.e., less than or equal to 100 times the free release limit and less than or equal to 6 ft^2 [0.56 m^2]), the shipping package or the waste container will be decontaminated. Decontamination activities will not be conducted on containers which are not in good condition, or containers which are leaking. Containers which are not in good condition, and containers which are leaking, will be overpacked, repaired/patched in accordance with 49 CFR §173 and §178 (e.g., 49 CFR §173.28), or returned to the generator. In addition, if during the waste handling process at the WIPP a waste container is breached, it will be overpacked, repaired/patched in accordance with 49 CFR §173 and §178 (e.g., 49 CFR §173.28), or returned to the generator. Should WIPP structures or equipment become contaminated, waste handling operations in the affected area will be immediately suspended.

Decontamination activities will use water and cleaning agents (see Permit Attachment F) so as to not generate any waste that cannot be considered derived waste. Items that are radiologically contaminated are also assumed to be contaminated with the hazardous wastes that are in the container involved in the spill or release. A complete listing of these waste components can be obtained from the WIPP Waste Identification System (**WWIS**), as described in Permit Attachment B, for the purpose of characterizing derived waste.

It is assumed that the process of decontamination will remove the hazardous waste constituents along with the radioactive waste constituents. To provide verification of the effectiveness of the

[4] The unit "dpm" stands for "disintegration per minute" and is the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

removal of hazardous waste constituents, once a contaminated surface is demonstrated to be radiologically clean, the "swipe" will be sent for analysis for hazardous constituents. The use of these confirmation analyses is as follows:

For waste containers, the analyses becomes documentation of the condition of the container at the time of emplacement. The presence of hazardous waste constituents on a container after decontamination will be at trace levels and will likely not be visible and will not pose a threat to human health or the environment. These containers will be placed in the underground without further action once the radiological contamination is removed unless there is visible evidence of hazardous waste spills or hazardous waste on the container and this contamination is considered likely to be released prior to emplacement in the underground.

For area contamination, once the area is cleaned up and is shown to be radiologically clean, it will be sampled for the presence of hazardous waste residues. If the area is large, a sampling plan will be developed which incorporates the guidance of EPA's SW 846 in selecting random samples over large areas. Selection of constituents for sampling analysis will be based on information (in the WWIS) about the waste that was spilled and information on cleanup procedures. If the area is small, swipes will be used. If the results of the analysis show that residual contamination remains, a decision will be made whether further cleaning will be beneficial or whether final clean up shall be deferred until closure. For example, if hazardous constituents react with the floor coating and are essentially nonremovable without removing the coating, then clean up will be deferred until closure when the coatings will be stripped. In any case, appropriate notations will be entered into the operating record to assure proper consideration of formerly contaminated areas at the time of closure. Furthermore, measures such as covering, barricading, and/or placarding will be used as needed to mark areas that remain contaminated.

Small area decontamination, if needed, will occur in the area in which it is detected for contamination that is less than 6 ft^2 (0.56 m^2) in area and is less than 100 times the free release limit. The free release limit is defined by DOE Orders as alpha contamination less than 20 dpm/100 cm^2 and beta-gamma contamination less than 200 dpm/100 cm^2. Overpacking would occur in the event the WIPP staff damages an otherwise intact container during handling activities. In such a case, a radiological boundary will be established, inside which all activities are carefully controlled in accordance with the protocols for the cleanup of spills or releases. A plan of recovery will be developed and executed, including overpacking the damaged container in either a 85-gal (321 L) drum, SWB, or a TDOP. The overpacked container will be properly labeled and sent underground for disposal. The area will then be decontaminated and verified to be free of contamination using both radiological and hazardous waste sampling techniques (essentially, this is done with "swipes" of the surface for counting in sensitive radiation detection equipment or, if no radioactivity is present, by analysis for hazardous waste by an offsite laboratory).

In the event a large area contamination is discovered within a Contact-Handled Package during unloading, the waste will be left in the Contact-Handled Package and the shipping container will be resealed. The DOE considers such contamination problems the responsibility of the shipping site. Therefore, the shipper will have several options for disposition. These are as follows:

- The Contact-Handled Package can be returned to the shipper for decontamination and repackaging of the waste. Such waste would have to be re-approved prior to shipment to the WIPP.

- Shipment to another DOE site for management in the event the original shipper does not have suitable facilities for decontamination. If the repairing site wishes to return the waste to WIPP, the site will have to meet the characterization requirements of the WAP.

- The waste could go to a third (non-DOE) party for decontamination. In such cases, the repaired shipment would go to the original shipper and be recertified prior to shipment to the WIPP.

Written procedures specify materials, protocols, and steps needed to put an object into a safe configuration for decontamination of surfaces. A RWP will always be prepared prior to decontamination activities. TRU mixed waste products from decontamination will be managed as derived waste.[5]

The TRUPACT-II may hold up to two 7-packs, two 4-packs, two 3-packs, two SWBs, or one TDOP. A HalfPACT may hold seven 55-gal (208-L) drums, one SWB, or four 85-gallon drums. An overhead bridge crane will be used to remove the contents of the Contact-Handled Package and place them on a facility pallet. The containers will be visually inspected for physical damage (severe rusting, apparent structural defects, signs of pressurization, etc.) and leakage to ensure they are in good condition prior to storage. Waste containers will also be checked for external surface contamination. If a primary waste container is not in good condition, the Permittees will overpack the container, repair/patch the container in accordance with 49 CFR §173 and §178 (e.g., 49 CFR §173.28), or return the container to the generator.

For inventory control purposes, TRU mixed waste container identification numbers will be verified against the Uniform Hazardous Waste Manifest and the WWIS. Inconsistencies will be resolved with the generator before TRU mixed waste is emplaced. Discrepancies that are not resolved within 15 days will be reported to the NMED in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.72).

Each facility pallet has two recessed pockets to accommodate two sets of 7-packs, two sets of 4-packs, two sets of 3-packs, or two SWBs stacked two-high, two TDOPs, or any combination thereof. Each stack of waste containers will be secured prior to transport underground (see

[5] Note that the DOE had previously proposed use of an Overpack and Repair Room to deal with major decontamination and overpacking activities. The DOE has eliminated the need for this area by: 1) limiting the size of contamination events that will be dealt with as described in this section, and 2) by performing overpacking at the point where a need for overpacking is identified instead of moving the waste to another area of the WHB. This strategy minimizes the spread of contamination.

Figure M1-10). A forklift or the facility transfer vehicle will transport the loaded facility pallet to the conveyance loading room located adjacent to the Waste Shaft. The conveyance loading room serves as an air lock between the CH Bay and the Waste Shaft, preventing excessive air flow between the two areas. The facility transfer vehicle will be driven onto the waste shaft conveyance deck, where the loaded facility pallet will be transferred to the waste shaft conveyance, and the facility transfer vehicle will be backed off. Containers of CH TRU mixed waste (55-gal (208 L) drums, SWBs, 85-gal (321 L) drums, 100-gal (379-L) drums, and TDOPs) can be handled individually, if needed, using the forklift and lifting attachments (i.e., drum handlers, parrot beaks).

The waste shaft conveyance will lower the loaded facility pallet to the Underground HWDUs. Figure M1-13 is a flow diagram of the CH TRU mixed waste handling process.

M1-1d(3) RH TRU Mixed Waste Handling

The RH TRU mixed waste will be received in the RH-TRU 72-B cask or CNS 10-160B cask loaded on a trailer, as illustrated in process flow diagrams in Figures M1-26 and M1-27, respectively. These are shown schematically in Figures M1-28 and M1-29. Upon arrival at the gate, external radiological surveys, security checks, shipping documentation reviews are performed and the Uniform Hazardous Waste Manifest is signed. The generator’s copy of the Uniform Hazardous Waste Manifest is returned to the generator. Should the results of the contamination survey exceed acceptable levels, the shipping cask and transport trailer remain outside the WHB in the Parking Area Unit, and the appropriate radiological boundaries (i.e., ropes, placards) are erected around the shipping cask and transport trailer. A determination will be made whether to return the cask to the originating site or to decontaminate the cask.

Following cask inspections, the shipping cask and trailer are moved into the RH Bay or held in the Parking Area Unit. The waste handling process begins in the RH Bay where the impact limiter(s) are removed from the shipping cask while it is on the trailer. Additional radiological surveys are conducted on the end of the cask previously protected by the impact limiter(s) to verify the absence of contamination. The cask is unloaded from the trailer using the RH Bay Overhead Bridge Crane and placed on a Cask Transfer Car.

RH-TRU 72-B Cask Unloading

The Cask Transfer Car then moves the RH-TRU 72-B cask to a work stand in the RH Bay. The work stand allows access to the head area of the RH-TRU 72-B cask for conducting radiological surveys, performing physical inspections or minor maintenance, and decontamination, if necessary. The outer lid bolts on the RH-TRU 72-B cask are removed, and the outer lid is removed to provide access to the lid of the cask inner containment vessel. The RH-TRU 72-B cask is moved into the Cask Unloading Room by a Cask Transfer Car and is positioned under the Cask Unloading Room Bridge Crane. The Cask Unloading Room Bridge Crane attaches to the RH-TRU 72-B cask and lifts and suspends the RH-TRU 72-B cask to clear the Cask Transfer Car. The RH-TRU 72-B cask is aligned over the Cask Unloading Room port.

The Cask Unloading Room shield valve is opened, and the cask is lowered through the port into the Transfer Cell Shuttle Car. The Cask Unloading Room Bridge Crane is unhooked and retracted, and the Cask Unloading Room shield valve is closed. After the cask is lowered into the Transfer Cell Shuttle Car, the bolts on the lid of the cask inner containment vessel are loosened by a robotic Manipulator. The Transfer Cell Shuttle Car is then aligned directly under the Transfer Cell shield valve in preparation for removing the inner vessel lid and transferring the canister to the Facility Cask. Operations in the Transfer Cell are monitored by closed-circuit video cameras.

Using the remotely-operated fixed 6.25 Ton Grapple Hoist in the Facility Cask Loading Room, the inner vessel lid is lifted clear of the RH-TRU 72-B cask, and the robotic Manipulator takes swipe samples and places them in a swipe delivery system for counting outside the Transfer Cell. If found to be contaminated above acceptable levels, the Permittees have the option to decontaminate or return the RH TRU Canister to the generator/storage site or another site for remediation. If no contamination is found, the Transfer Cell Shuttle Car moves a short distance, and the inner vessel lid is lowered onto a stand on the Transfer Cell Shuttle Car. The canister is transferred to the Facility Cask as described below.

CNS 10-160B Cask Unloading

After the lid bolts are removed, the CNS 10-160B cask is moved using the Cask Transfer Car from the RH Bay into the Cask Unloading Room and centered beneath the Hot Cell shield plug port. The Cask Unloading Room shield door is closed, and the inner and outer Hot Cell shield plugs are removed simultaneously and set aside on the floor of the Hot Cell using the remotely operated Hot Cell Bridge Crane. The Hot Cell Bridge Crane is then lowered through the Hot Cell port and is connected to the CNS 10-160B cask lid rigging or lifting device. The Hot Cell Bridge Crane lifts the CNS 10-160B cask lid through the Hot Cell port and sets the lid aside on the Hot Cell floor.

Operations in the Hot Cell are monitored by closed-circuit television cameras. The drum carriage unit lifting fixture (hereafter referred to as lifting fixture) is attached to the Hot Cell Bridge Crane and lowered through the Hot Cell port. The lifting fixture is connected to the upper drum carriage unit contained in the CNS 10-160B cask. The Hot Cell Bridge Crane lifts the upper drum carriage unit from the CNS 10-160B cask through the port into the Hot Cell and sets it near the Hot Cell inspection station. The Hot Cell Bridge Crane again lowers the lifting fixture through the Hot Cell port and connects to the lower drum carriage unit. The Hot Cell Bridge Crane lifts the lower drum carriage unit from the CNS 10-160B cask through the port into the Hot Cell and sets it near the upper drum carriage unit.

The Hot Cell Bridge Crane lifts the CNS 10-160B cask lid from the Hot Cell floor, lowers it through the Hot Cell port and onto the top of the CNS 10-160B cask. The inner and outer Hot Cell shield plugs are replaced simultaneously. The Cask Unloading Room shield door is opened, and the CNS 10-160B cask is moved into the RH Bay using the Cask Transfer Car. The CNS 10-160B cask is inspected and surveyed, the lid and impact limiter are reinstalled on the CNS 10-160B cask, and it is prepared for transportation off-site.

The Hot Cell Bridge Crane connects to an empty Facility Canister, places it into a sleeve at the inspection station, and removes the canister lid. The Overhead Powered Manipulator or Hot Cell Crane lifts one drum from the drum carriage unit. The Hot Cell Manipulators collect swipe samples from the drum and transfer the swipes via the Transfer Drawer to the Hot Cell Gallery for counting. If the 55-gallon drums are contaminated, the Permittees may decontaminate the 55-gallon drums or return them to the generator/storage site or another site for remediation. The drum identification number is recorded, and the recorded numbers are verified against the WWIS. If there are any discrepancies, the drum(s) in question are stored within the Hot Cell, and the generator/storage site is contacted for resolution. Discrepancies that are not resolved within 15 days will be reported to the NMED as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.72).

Either the Overhead Powered Manipulator or Hot Cell Bridge Crane lowers the drum into the Facility Canister. This process is repeated to place three drums in the Facility Canister. The Hot Cell Bridge Crane or powered Manipulator lifts the canister lid and places it onto the Facility Canister. The lid is locked in place using a Manipulator. Each CNS 10-160B cask shipment will contain up to ten drums. Drums will be managed in sets of three. If there is a tenth drum, it will be placed in a Facility Canister or stored until WIPP receipt of the next CNS 10-160B cask shipment. The Hot Cell Bridge Crane lifts the Facility Canister and lowers it into the Transfer Cell.

To prepare to transfer a loaded Facility Canister from the Hot Cell to the Transfer Cell, a Shielded Insert is placed onto a Cask Transfer Car in the RH Bay. The Cask Transfer Car is then moved into the Cask Unloading Room and positioned under the Cask Unloading Room Bridge Crane. The Bridge Crane attaches to the Shielded Insert. The Cask Unloading Room Bridge Crane lifts and suspends the Shielded Insert clear of the Cask Transfer Car. The Shielded Insert is aligned over the Cask Unloading Room port. The floor valve is opened, and the Shielded Insert is lowered into the Transfer Cell Shuttle Car. The Cask Unloading Room Bridge Crane is unhooked and retracted, and the Cask Unloading Room shield valve is closed. The Shielded Insert is positioned under the Hot Cell port.

The Hot Cell Bridge Crane lifts a loaded, closed Facility Canister and positions it over the Hot Cell port. The Hot Cell shield valve is opened, and the crane lowers the Facility Canister through the port into the Shielded Insert positioned in the Transfer Cell Shuttle Car in the Transfer Cell. The Hot Cell Bridge Crane is disconnected from the Facility Canister and raised until the crane hook clears the Hot Cell shield valve. The Hot Cell shield valve is then closed.

Transfer of Disposal Canister into the Facility Cask

The transfer of a canister into the Facility Cask from the Transfer Cell is monitored by closed-circuit television cameras. The Transfer Cell Shuttle Car positions the RH-TRU 72-B cask or Shielded Insert under the Facility Cask Loading Room port and the shield valve is opened. Then the remotely operated 6.25 Ton Grapple Hoist attaches to the canister, and the canister is lifted through the open shield valve into the vertically-oriented Facility Cask located on the Cask Transfer Car in the Facility Cask Loading Room. During this cask-to-cask transfer, the telescoping port shield is in contact with the underside of the Facility Cask to assure shielding continuity, as does the shield bell located above the Facility Cask.

For canisters received at the WIPP from the generator site in a RH-TRU 72-B cask, the identification number is verified using cameras, which also provide images of the canister surfaces during the lifting operation. Identification numbers are verified against the WWIS. If there are any discrepancies, the canister is returned to the RH-TRU 72-B cask, returned to the Parking Area Unit, and the generator is contacted for resolution. Discrepancies that are not resolved within 15 days will be reported to the NMED as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.72). As the canister is being lifted from the RH-TRU 72-B cask into the Facility Cask, additional swipe samples may be taken.

Transfer of the Canister to the Underground

When the canister is fully within the Facility Cask, the lower shield valve is closed. The 6.25 Ton Grapple Hoist detaches from the canister and is raised until the 6.25 Ton Grapple Hoist clears the Facility Cask, at which time the upper shield valve is closed. The 6.25 Ton Grapple Hoist and shield bell are then raised clear of the Facility Cask, and the telescoping port shield is retracted. The Facility Cask Rotating Device rotates the Facility Cask until it is in the horizontal position on the Facility Cask Transfer Car. The shield doors on the Facility Cask Loading Room are opened, and the facility Cask Transfer Car moves onto the waste shaft conveyance and is lowered to the waste Shaft Station underground. At the waste Shaft Station underground, the Facility Cask Transfer Car moves the Facility Cask from the waste shaft conveyance. A forklift is used to remove the Facility Cask from the Facility Cask Transfer Car and to transport the Facility Cask to the Underground HWDU.

Returning the Empty Cask

The empty RH-TRU 72-B cask or Shielded Insert is returned to the RH Bay by reversing the process. In the RH Bay, swipe samples are collected from inside the empty cask. If necessary, the inside of the cask is decontaminated. The RH-TRU 72-B cask lids are replaced, and the cask is replaced on the trailer using the RH Bay Bridge Crane. The impact limiters are replaced, and the trailer and the RH-TRU 72-B cask are then moved out of the RH Bay. The Shielded Insert is stored in the RH Bay until needed.

M1-1e Inspections

Inspection of containers and container storage area are required by 20.4.1.500 NMAC (incorporating 40 CFR §264.174). These inspections are described in this section.

M1-1e(1) WHB Unit

The waste containers in storage will be inspected visually or by closed-circuit television camera prior to each movement and, at a minimum, weekly, to ensure that the waste containers are in good condition and that there are no signs that a release has occurred. Waste containers will be visually inspected for physical damage (severe rusting, apparent structural defects, signs of pressurization, etc.) and leakage. If a primary waste container is not in good condition, the Permittees will overpack the container, repair/patch the container in accordance with 49 CFR §173 and §178 (e.g., 49 CFR §173.28), or return the container to the generator. This visual inspection of CH TRU mixed waste containers shall not include the center drums of 7-packs and waste containers positioned such that visual observation is precluded due to the arrangement of waste assemblies on the facility pallets. If waste handling operations should stop for any reason with containers located at the TRUDOCK while still in the Contact-Handled Package, primary waste container inspections will not be accomplished until the containers of waste are removed from the Contact-Handled Package. If the lid to the Contact-Handled Package inner container vessel is removed, radiological checks (swipes of Contact-Handled Package inner surfaces) will be used to determine if there is contamination within the Contact-Handled Package. Such contamination could indicate a waste container leak or spill. Using radiological surveys, a detected spill or leak of a radioactive contamination from a waste container will also be assumed to be a hazardous waste spill or release.

Waste containers residing within a Contact-Handled Package are not inspected, as described in the first bullet in Section M1-1e(2).

Waste containers will be inspected prior to reentering the waste management process line for downloading to the underground. Waste containers stored in this area will be inspected at least once weekly.

Loaded RH-TRU 72-B and CNS 10-160B casks will be inspected when present in the RH Bay. Physical or closed-circuit television camera inspections of the RH Complex are conducted as described in Table D-1a. Canisters loaded in an RH-TRU 72-B cask are inspected in the Transfer Cell during transfer from the cask to the Facility Cask. Waste containers received in CNS 10-160B casks are inspected in the Hot Cell during transfer from the cask to the Facility Canister by camera and/or visual inspection (through shield windows).

M1-1e(2) <u>Parking Area Unit</u>

Inspections will be conducted in the Parking Area Unit at a frequency not less than once weekly when waste is present. These inspections are applicable to loaded, stored Contact-Handled and Remote-Handled Packages. The perimeter fence located at the lateral limit of the Parking Area Unit, coupled with personnel access restrictions into the WHB, will provide the needed security. The perimeter fence and the southern border of the WHB shall mark the lateral limit of the Parking Area Unit (Figure M1-2). Inspections of the Contact-Handled or Remote-Handled Packages stored in the Parking Area Unit will focus on the inventory and integrity of the shipping containers and the spacing between Contact-Handled and Remote-Handled Packages. This spacing will be maintained at a minimum of four feet.

Contact-Handled and Remote-Handled Packages located in the Parking Area Unit will be inspected weekly during use and prior to each reuse.

Inspection of waste containers is not possible when the containers are in their shipping container (e.g., casks, TRUPACT-II or HalfPACTs). Inspections can be accomplished by bringing the shipping containers into the WHB Unit and opening them and lifting the waste containers out for inspection. The DOE, however, believes that removing containers strictly for the purposes of inspection results in unnecessary worker exposures and subjects the waste to additional handling. The DOE has proposed that waste containers need not be inspected at all until they are ready to be removed from the shipping container for emplacement underground. Because shipping containers are sealed and are of robust design, no harm can come to the waste while in the shipping containers and the waste cannot leak or otherwise be released to the environment. Contact-Handled or Remote-Handled Packages shall be opened every 60 days for the purposes of venting, so that the longest waste would be uninspected would be for 60 days from the date that the inner containment vessel of the Contact-Handled or Remote-Handled Package was closed at the generator site. Venting the Contact-Handled or Remote-Handled Packages involves removing the outer lid and installing a tool in the port of the inner lid.

The following strategy will be used for inspecting waste containers that will be retained within their shipping containers for an extended period of time:

- If the reason for retaining the TRU mixed waste containers in the shipping container is due to an unresolved manifest discrepancy, the DOE will return the shipment to the generator prior to the expiration of the 60 day NRC venting period or within 30 days after receipt at the WIPP, whichever comes sooner. In this case, no inspections of the internal containers will be performed. The stored Contact-Handled or Remote-Handled Package will be inspected weekly as described above.

- If the reason for retaining the TRU mixed waste containers in the Contact-Handled or Remote-Handled Package is due to an equipment malfunction that prevents unloading the waste in the WHB Unit, the DOE will return the shipment to the generator prior to the expiration of the 60 day NRC venting period. In this case, the DOE would have to ship the TRU mixed waste containers back with sufficient time for the generator to vent the shipment within the 60 day limit. In this case, no inspections of the internal containers will be performed. The stored Contact-Handled or Remote-Handled Package will be inspected weekly as described above.

- If the reason for retaining the TRU mixed waste containers is due to an equipment malfunction that prevents the timely movement of the waste containers into the underground, the waste containers will be kept in the Contact-Handled or Remote-Handled Package until day 30 (after receipt at the WIPP) or the expiration of the 60 day limit, whichever comes sooner. At that time the Contact-Handled or Remote-Handled Package will be moved into the WHB. Contact-Handled TRU mixed waste containers will be removed and placed in one of the permitted storage areas in the WHB Unit. The Remote-Handled Package will be vented, however, the containers will not be removed from the shipping package. If there is no additional space within the permitted storage areas of the WHB Unit, the DOE will discuss an emergency permit with the NMED for the purposes of storing the waste elsewhere in the WHB Unit. Waste containers will be inspected when removed from the Contact-Handled Packaging and weekly while in storage in the WHB Unit. Contact-Handled or Remote-Handled Packages will be inspected weekly while they contain TRU mixed waste containers as discussed above.

The DOE believes that this strategy minimizes both the amount of shipping that is necessary and the amount of waste handling, while maintaining a reasonable inspection schedule. The DOE will stop shipments of waste for any equipment outage that will extend beyond three days.

M1-1f Containment

The WHB Unit has concrete floors, which are sealed with a coating that is designed to resist all but the strongest oxidizing agents. Such oxidizing agents do not meet the TSDF-WAC and will not be accepted in TRU mixed waste at the WIPP facility. Therefore, TRU mixed wastes pose no compatibility problems with respect to the WHB Unit floor. The floor coating consists of Carboline® 1340 clear primer-sealer on top of prepared concrete, Carboline® 191 primer epoxy, and Carboline® 195 surface epoxy. The manufacturer's chemical resistance guide shows "Very Good" for acids and "Excellent" for alkalies, solvents, salt, and water. Uses are indicated for nuclear power plants, industrial equipment and components, chemical processing plants, and pulp and paper mills for protection of structural steel and concrete. During the Disposal Phase, should the floors need to be re-coated, any floor coating used in the WHB Unit TRU mixed waste handling areas will be compatible with the TRU mixed waste constituents and will have chemical resistance at least equivalent to the Carboline® products. Figure M1-1 shows where TRU mixed waste handling activities discussed in this section occur.

During normal operations, the floor of the storage areas within the WHB Unit shall be visually inspected on a weekly basis to verify that it is in good condition and free of obvious cracks and gaps. Floor areas of the WHB Unit in use during off-normal events will be inspected prior to use and weekly thereafter. All TRU mixed waste containers located in the permitted storage areas shall be elevated at least 6 in. (15 cm) from the surface of the floor. TRU mixed waste containers that have been removed from Contact-Handled or Remote-Handled Packaging shall be stored at a designated storage area inside the WHB Unit so as to preclude exposure to the elements.

Secondary containment at the CH Bay Storage Area inside the WHB Unit shall be provided by the WHB Unit floor (See Figure M1-1). The WHB Unit is engineered such that during normal operations, the floor capacity is sufficient to contain liquids upon release. Secondary Containment at the Derived Waste Storage Area of the WHB Unit will be provided by a polyethylene standard drum pallet. The Parking Area Unit and TRUDOCK Storage Area of the WHB Unit require no engineered secondary containment since no waste is to be stored there unless it is protected by the Contact-Handled or Remote-Handled Packaging.

Calculations to determine the floor surface area required to provide secondary containment in the event of a release are based on the maximum quantity of liquid which could be present within ten percent of one percent of the volume of all the containers or one percent of the capacity of the largest single container, whichever is greater.

Secondary containment at storage locations inside the RH Bay and Cask Unloading Room is provided by the cask. Secondary containment at storage locations inside the Transfer Cell is provided by the RH-TRU 72-B cask or Shielded Insert. Secondary containment at storage locations in the Facility Cask Loading Room is provided by the Facility Cask. In the Hot Cell, waste containers are stored in either the drum carriage unit or in canister sleeves. The Lower Hot Cell provides secondary containment as described in section M1-f(2). In addition, the RH Bay, Hot Cell, and Transfer Cell contain 220-gallon (833-L) (Hot Cell), 11,400-gallon (43,152-L) (RH Bay), and 220-gallon (833-L) (Transfer Cell) sumps, respectively, to collect any liquids.

M1-1f(1) Secondary Containment Requirements for the WHB Unit

The maximum volume of TRU mixed waste on facility pallets that will be stored in the CH Bay Storage and Surge Storage Areas of the WHB is 18 facility pallets @ 2 TDOPs per pallet = 36 TDOPs of waste. 36 TDOPs @ 1,200 gal (4,540 L) per TDOP = 43,200 gal (163,440L) waste container capacity. 43,200 gal (163,440 L) x ten percent of the total volume = 4,320 gal (16,344 L) of waste. Since 4,320 gal (16,344 L) is greater than 1,200 gal (4,540 L), the configuration of possible TDOPs in the storage area is used for the calculation of secondary containment requirements. 4,320 gal (16,344 L) of liquid x one percent liquids = 43.2 gal (163.4 L) of liquid for which secondary containment is needed.

The maximum volume of TRU mixed waste that will be stored in the Derived Waste Storage Area of the WHB Unit is one SWB. 1 SWBs @ 496 gal (1,878 L) per SWB = 496 gal (1,878 L) waste container capacity. Since the maximum storage volume of 496 gal (1,878 L) is equal to the volume of the largest single container, the volume of the a single SWB is used for the calculation of secondary containment requirements. 496 gal (1,878 L) of liquid x one percent liquids = 4.96 gal (18.8 L) of liquid for which secondary containment is needed.

The maximum volume of TRU mixed waste that will be stored in the Hot Cell is 13 RH TRU drums @ 55 gal (210 L) per drum = 715 (2,730 L) of waste in drums. 715 gal (2,730 L) of waste x ten percent of total volume = 71.5 gal (273 L) of waste. Secondary containment for liquids will need to have a capacity of 71.5 gal (273 L). Since 71.5 gal (273 L) is less than the volume of the single container of 235 gal (890 L) therefore, the larger volume is used for determining the secondary containment requirements. 235 gal (890 L) of waste x one percent liquids = 2.35 gal (8.9 L) of liquid needed for secondary containment.

The maximum volume of TRU mixed waste that will be stored in the Transfer Cell is one RH-TRU 72-B Canister or one Facility Canister @ 235 gal (890 L) per canister x ten percent of total volume = 23.5 gal (8.90 L) of waste. Since 23.5 gal (8.90 L) is less than the volume of the single container of 235 gal (890 L) therefore, the larger volume is used for determining the secondary containment requirements. 235 gal (890 L) of waste x one percent liquids = 2.35 gal (8.9 L) of liquid needed for secondary containment.

M1-1f(2) Secondary Containment Description

The following is a calculation of the surface area the quantities of liquid would cover. Using a conversion factor of 0.1337 ft^3/gal (0.001 m^3/L) and assuming the spill is 0.0033 ft (0.001 m) thick, the following calculation can be used:

gallons × cubic feet per gallon ÷ thickness in feet = area covered in square feet

CH Bay Storage Area

$$43.2 \text{ gal} \times 0.1337 \text{ ft}^3/\text{gal} \div 0.0033 \text{ ft} = 1{,}750 \text{ ft}^2 \ (162.7 \text{ m}^2)$$

Hot Cell

$$2.35 \text{ gal} \times 0.1337 \text{ ft}^3/\text{gal} \div 0.0033 \text{ ft} = 95 \text{ ft}^2 \ (8.8 \text{ m}^2)$$

Transfer Cell

$$2.35 \text{ gal} \times 0.1337 \text{ ft}^3/\text{gal} \div 0.0033 \text{ ft} = 95 \text{ ft}^2 \ (8.8 \text{ m}^2)$$

The WHB Unit has 33,175 ft^2 (3,082 m^2) of floor space, the CH Bay Storage Area has 26,151 ft^2 (2,430 m^2) of floor space. The CH Bay Storage Area requires 1,750 ft^2 (162.7 m^2) for containment, Thus, the floor area of the CH Bay Storage Area of the WHB Unit provide sufficient secondary containment to contain a release of ten percent of one percent of the volume of all of the containers, or one percent of the capacity of the largest container, whichever is greater.

The Hot Cell and Transfer Cell are the only portions of the RH Complex managing RH TRU mixed waste outside of casks or canisters. The Hot Cell has 1,841 ft^2 (171 m^2) of floor space and the Transfer Cell has 1,003 ft^2 (93 m^2) of floor space. The Hot Cell and Transfer Cell require only 95 ft^2 for containment, therefore there is sufficient floor space to contain a release of ten percent of one percent of containers in these storage areas.

In addition, both the Hot Cell and the Transfer Cell each contain a 220 gal (833 L) sump that will collect any liquids that spill from containers.

Derived Waste Storage Area

The derived waste containers in the Derived Waste Storage Area will be stored on standard drum pallets, which provides approximately 50 gal (190 L) of secondary containment capacity. Thus the secondary containment capacity of the standard drum pallet is sufficient to contain a release of ten percent of one percent of the largest container (4.96 gal or 18.8 L).

Parking Area Unit

Containers of TRU mixed waste to be stored in the Parking Area Unit will be in Contact-Handled or Remote-Handled Packages. There will be no additional requirements for engineered secondary containment systems.

M1-1g Special Requirements for Ignitable, Reactive, and Incompatible Waste

Special requirements for ignitable, reactive, and incompatible waste are addressed in 20.4.1.500 NMAC (incorporating 40 CFR §§264.176 and 264.177). Permit Module II precludes ignitable, reactive, or incompatible waste at the WIPP. No additional measures are required.

M1-1h Closure

Clean closure is planned in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.178) for all permitted container storage areas. The applicable areas and the plans for clean closure are detailed in Permit Attachment I.

M1-1i Control of Run On

The WHB Unit is located indoors which prevents run-on from a precipitation event. In addition, the CH TRU containers are stored on facility pallets, containment pallets, or standard drum pallets, which elevate the CH TRU mixed waste containers at least 6 in. (15 cm) off the floor, or in Contact-Handled or Remote-Handled Packages, so that any firewater released in the building will not pool around containers. Within the RH Bay, Cask Unloading Room, Transfer Cell, and Facility Cask Loading Room, waste containers are stored in casks or Shielded Inserts and protected from any potential run on. Any firewater released in the building will not pool around the waste containers as they are stored in casks, or Shielded Inserts. Within the Hot Cell, there is no source of water during operations. However, control of run-on is provided by the Lower Hot Cell, which lies below a sloped floor surrounded by a grating and canister sleeves in the Hot Cell above.

In the Parking Area Unit, the containers of TRU mixed waste are always in Contact-Handled or Remote-Handled Packages which protect them from precipitation and run on. Therefore, the WIPP container storage units will comply with the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.175(b)(4)).

References

DOE, 1997a. Resource Conservation and Recovery Act Part B Permit Application, Waste Isolation Pilot Plant (WIPP), Carlsbad, New Mexico, Rev. 6.5, 1997.

DOE, 1997b. Waste Isolation Pilot Plant Safety Analysis Report (DOE/WIPP-95-2065, Rev. 1), U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1997.

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TABLES

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TABLE M1-1
BASIC DESIGN REQUIREMENTS, PRINCIPAL CODES, AND STANDARDS

	Structure/Supports			Liquid and Process Air Handling Processing and storage equipment							Air Hdlg Ducting & Fans	HVAC filters		Mechanical Handling Equipment			Instrumentation and Electrical			Quality Assurance Program	
					Piping & Valves																
	DBE DBT ACI-318 AISC	ANSI A58.1	Site-specific Require-ments	Vessel ASME VIII NFPA[e]	ANSI BBB,1 NFPA[e]	UP	Pumps API-610 NFPA[e]	Storage Tanks API-650 or API-620	Heat Exchgrs ASME VIII TEMA	All Other Equip-ment Mfrs Std	ARI SMACNA AMCA	Pre-filters ASHRAE 52.68	HEPA Filters MIL F 51068C ANSI N 509 ANSI N 510	Crane and Related equipment CMAA	CMAA AISC AWS	All Other Equip-meant Mfrs STD	A-NE	ANSI Sods or Nat'l Elect-trial Code	IA/ Mfrs Std	ANSI/ASME NQA-1 and Supple-ments	Com. and Industry Practices
Design Class I	X		a	X f			X	X	X		X c	X c,d	X c	X	X		X	X		X	
Design Class Ii	a,b	X	a	X	X		X	X	X		X c	X c	X c	X	X			X	X	X	
Design Class Iiia	a	X	a	a	X		a			X	X c	X c	X c	a	a	X		X	X	X	
Design Class Iii		X	g		a	X				X	X	X	X			X		X	X		X

X = Minimum Requirements
[a] Requirements to be determined on a case-by-case basis.
[b] Required for structure and supports needed for confinement and control of radioactivity.
[c] Except structures and supports that are designed to withstand a design-basis earthquake (DBE)/design-basis tornado (DBT) when specified in column 1 of this table.
[d] Underwriter's Laboratory (UL) Class I Listed.
[e] For fire-protection systems.
[f] American Society for Mechanical Engineers (ASME) III for other Class I vessels.
[g] Design of underground structures, mining equipment, and facilities are basically governed by the MSHA and experience in local mines.

ACI = American Concrete Institute
AISC = American Institute of Steel Construction
AMCA = Air Moving and Conditioning Association
ANSI = American National Standards Institute
API = American Petroleum Institute
ARI = Air Conditioning and Refrigeration Institute
ASHRAE = American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.
AWS = American Welding Society
CMAA = Crane Manufacturers Association
DBE = Design-basis earthquake
DBT = Design-basis tornado
HEPA = High-efficiency particulate air
HVAC = Heating, Ventilation, and Air-Conditioning
A = Institute of Electronics and Electronic Engineers
IA = Instrument Society of America
MFR = Manufacturer
MIL = Military (specification)
MSHA = Mine Safety and Health Administration
NFPA = National Fire Protection Association
NQA = Nuclear Quality Assurance (Standard)
SMACNA = Sheet Metal and Air Conditioning Contractors National Association, Inc.
STD = Standard
TEMA = Tubular Exchanger Manufacturers Association
UP = Uniform Plumbing Code

TABLE M1-2
WASTE HANDLING EQUIPMENT CAPACITIES

CAPACITIES FOR EQUIPMENT	
CH Bay overhead bridge crane	12,000 lbs.
CH Bay forklifts	26,000 lbs.
Facility Pallet	25,000 lbs.
Adjustable center-of-gravity lift fixture	10,000 lbs.
Facility Transfer Vehicle	30,000 lbs.
MAXIMUM GROSS WEIGHTS OF CONTAINERS	
Seven-pack of 55-gallon drums	7,000 lbs.
Four-pack of 85-gallon drums	4,500 lbs.
Three-pack of 100-gallon drums	3,000 lbs.
Ten-drum overpack	6,700 lbs.
Standard waste box	4,000 lbs.
MAXIMUM NET EMPTY WEIGHTS OF EQUIPMENT	
TRUPACT-II	13,140 lbs.
HalfPACT	10,500 lbs.
Adjustable center of gravity lift fixture	2,500 lbs.
Facility pallet	4,120 lbs.

TABLE M1-3
RH TRU MIXED WASTE HANDLING EQUIPMENT CAPACITIES

CAPACITIES FOR EQUIPMENT	
RH Bay Overhead Bridge Crane	140 tons main hoist 25 tons auxiliary hoist
RH-TRU 72-B Cask Transfer Car	20 tons
CNS 10-160B Cask Transfer Car	35 tons
Transfer Cell Shuttle Car	29 tons
Hot Cell Bridge Crane	15 tons
Overhead Powered Manipulator	2.5 tons
Facility Cask Rotating Device	No specific load rating
Cask Unloading Room Crane	25 tons
6.25 Ton Grapple Hoist	6.25 tons
Facility Cask Transfer Car	40 tons
MAXIMUM GROSS WEIGHTS OF RH TRU CONTAINERS	
RH TRU Canister	8,000 lbs
55-Gallon Drum	1,000 lbs
Facility Canister	10,000 lbs
MAXIMUM NET EMPTY WEIGHTS OF EQUIPMENT	
RH-TRU 72-B Cask	37,000 lbs
CNS 10-160B Cask	57,500 lbs
Facility Cask	67,700 lbs
Shielded Insert	26,300 lbs

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FIGURES

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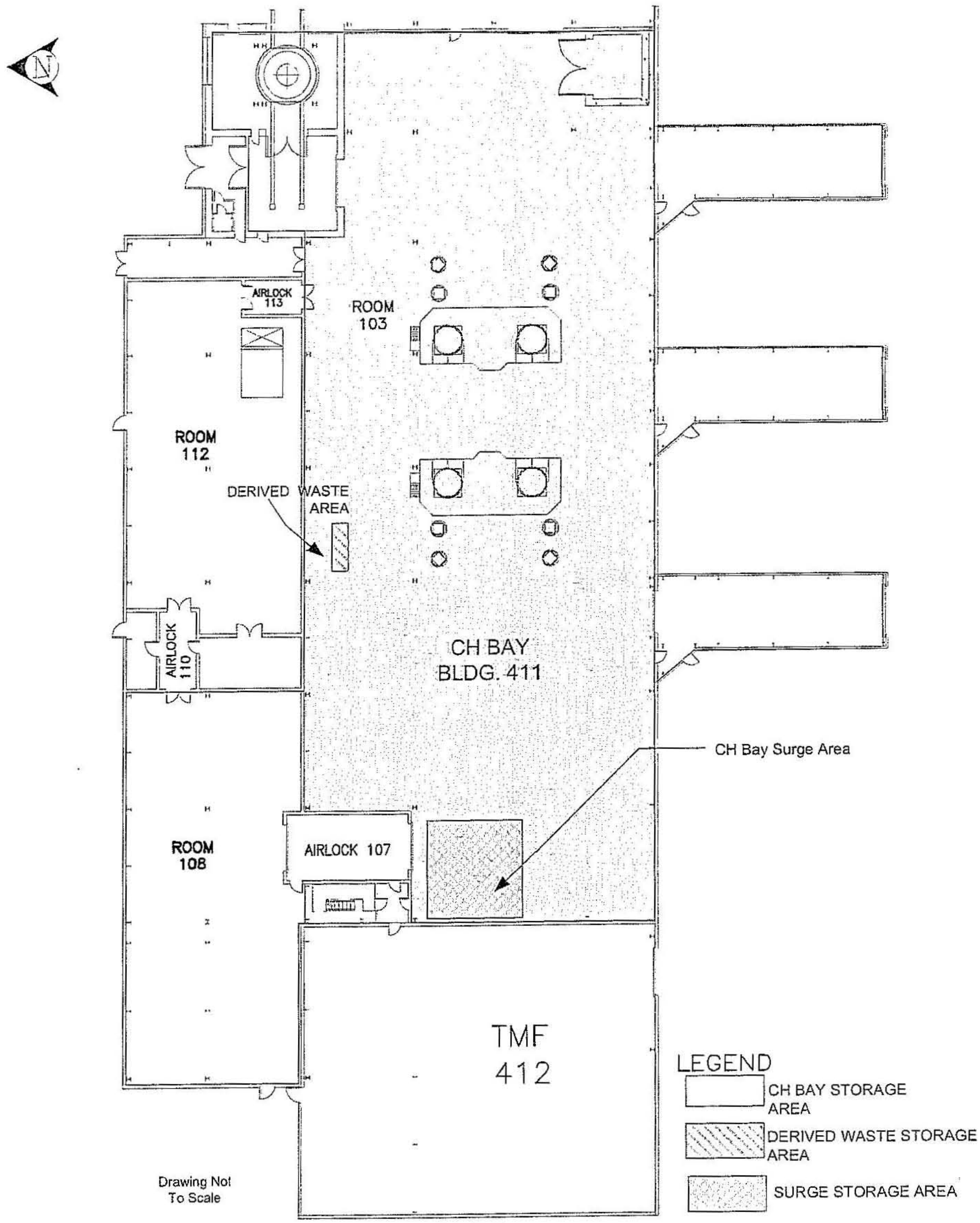
1 

2 Figure M1-1
3 Waste Handling Building - CH TRU Mixed Waste Container Storage and Surge Areas

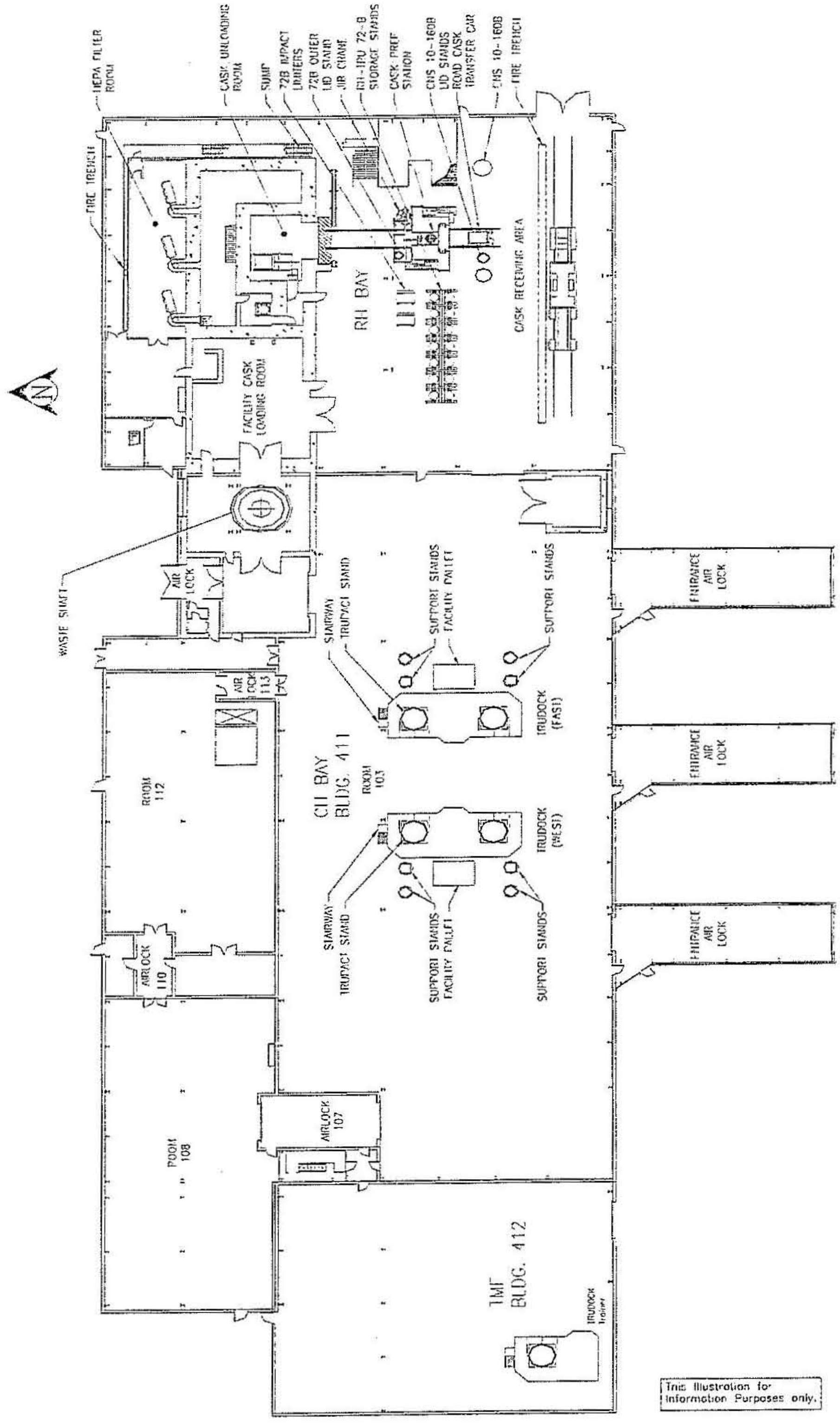


Figure M1-1a
Waste Handling Building Plan (Ground Floor)

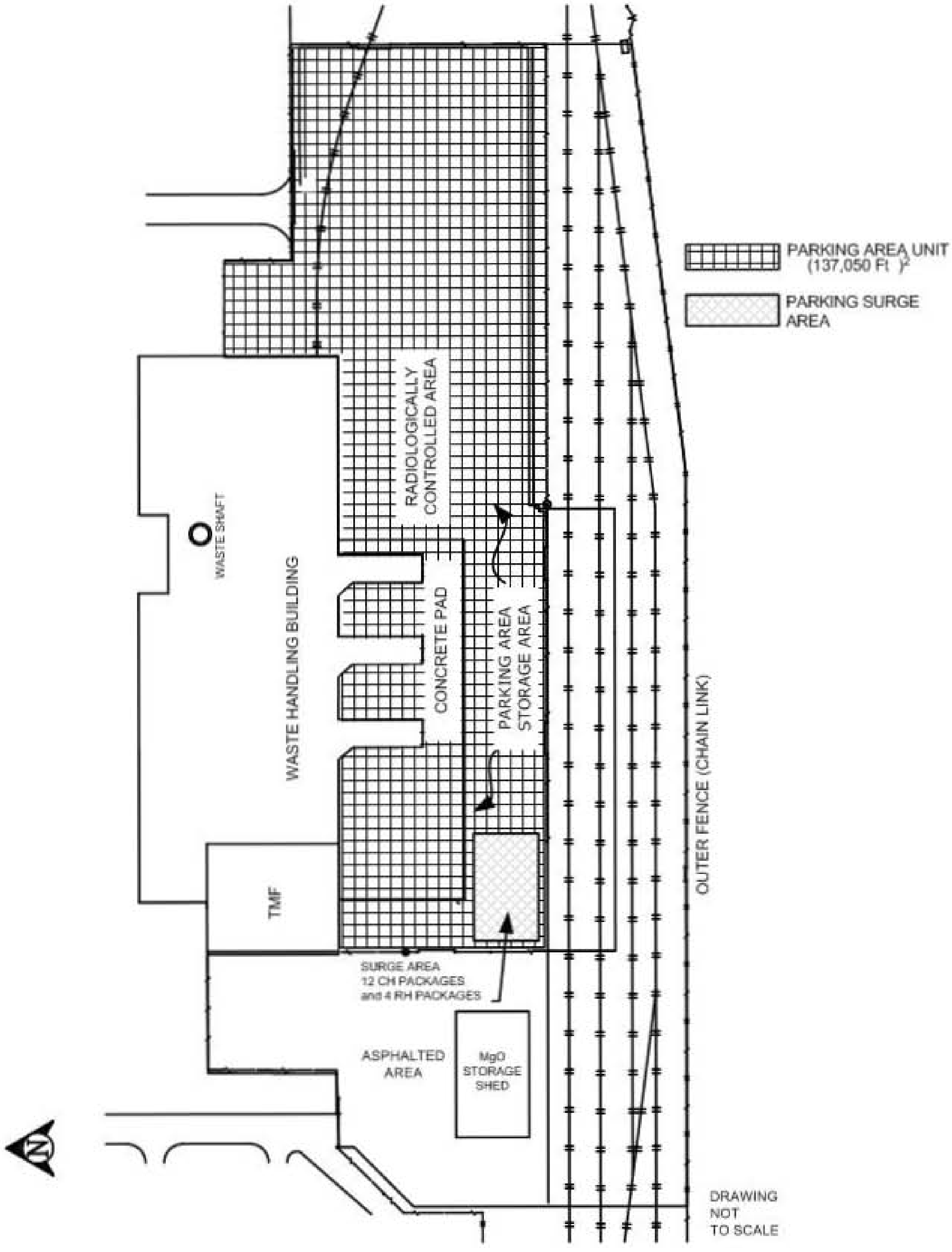


Figure M1-2
Parking Area - Container Storage and Surge Areas

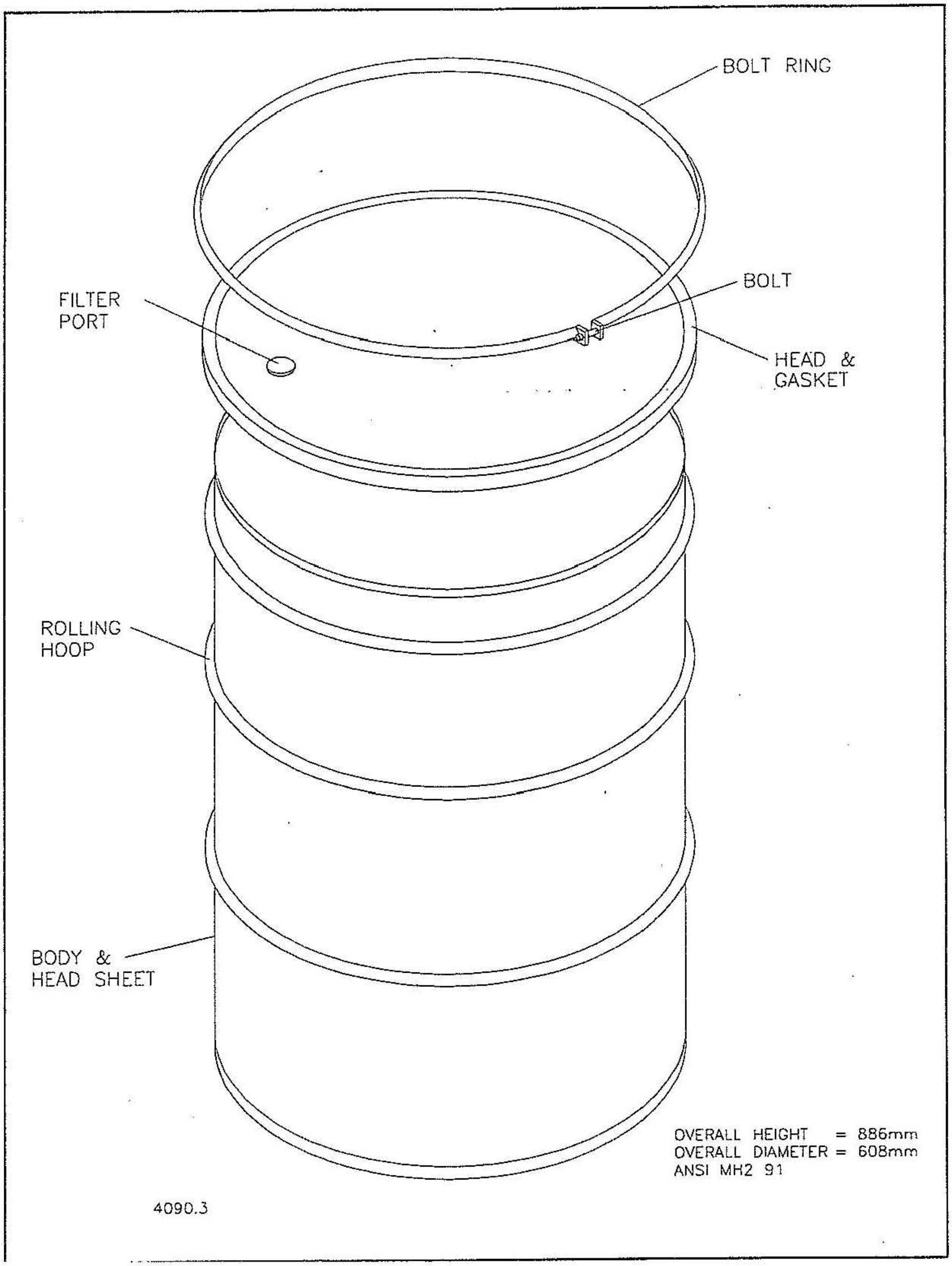


Figure M1-3
Standard 55-Gallon Drum (Typical)

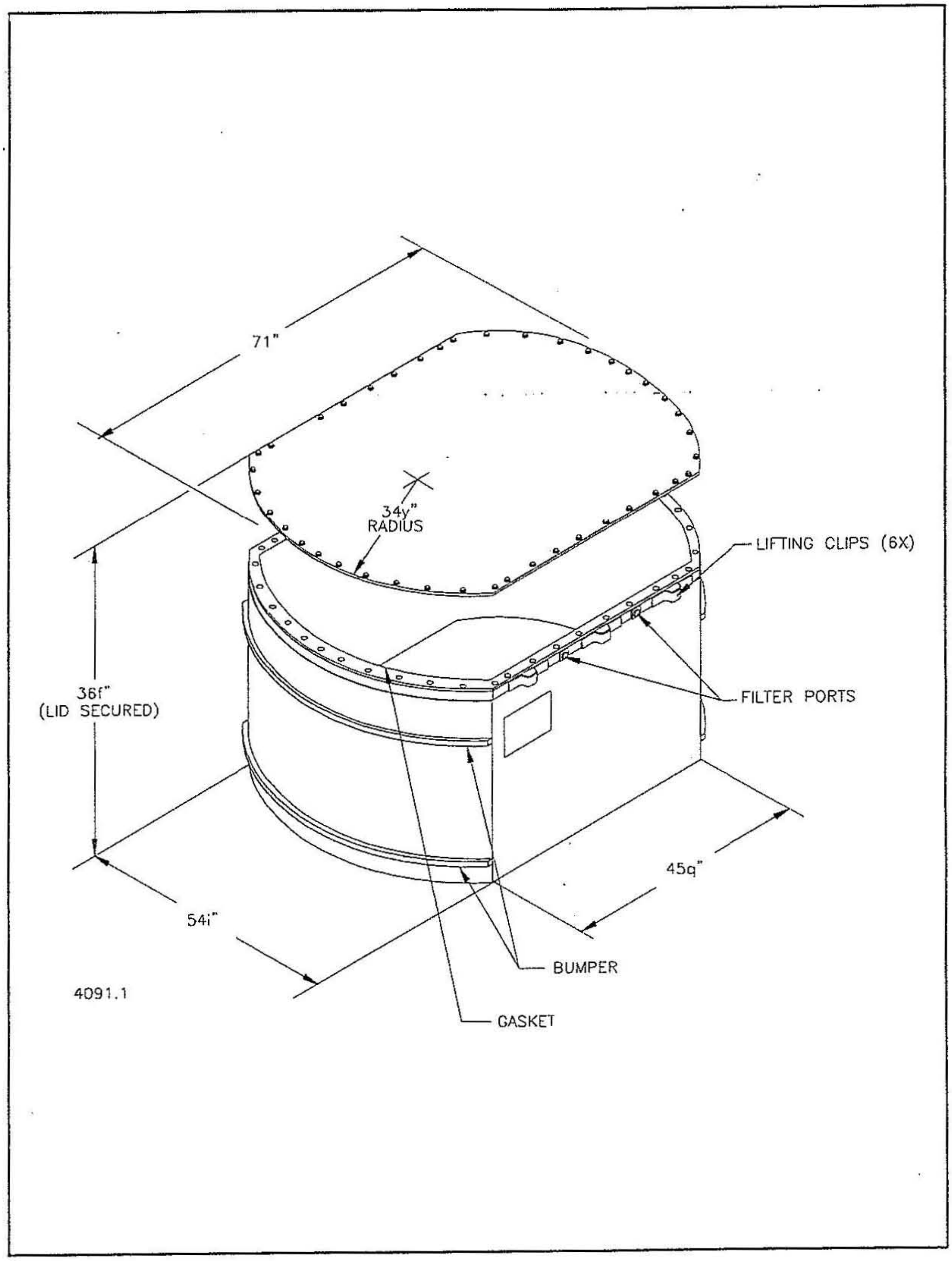


Figure M1-4
Standard Waste Box

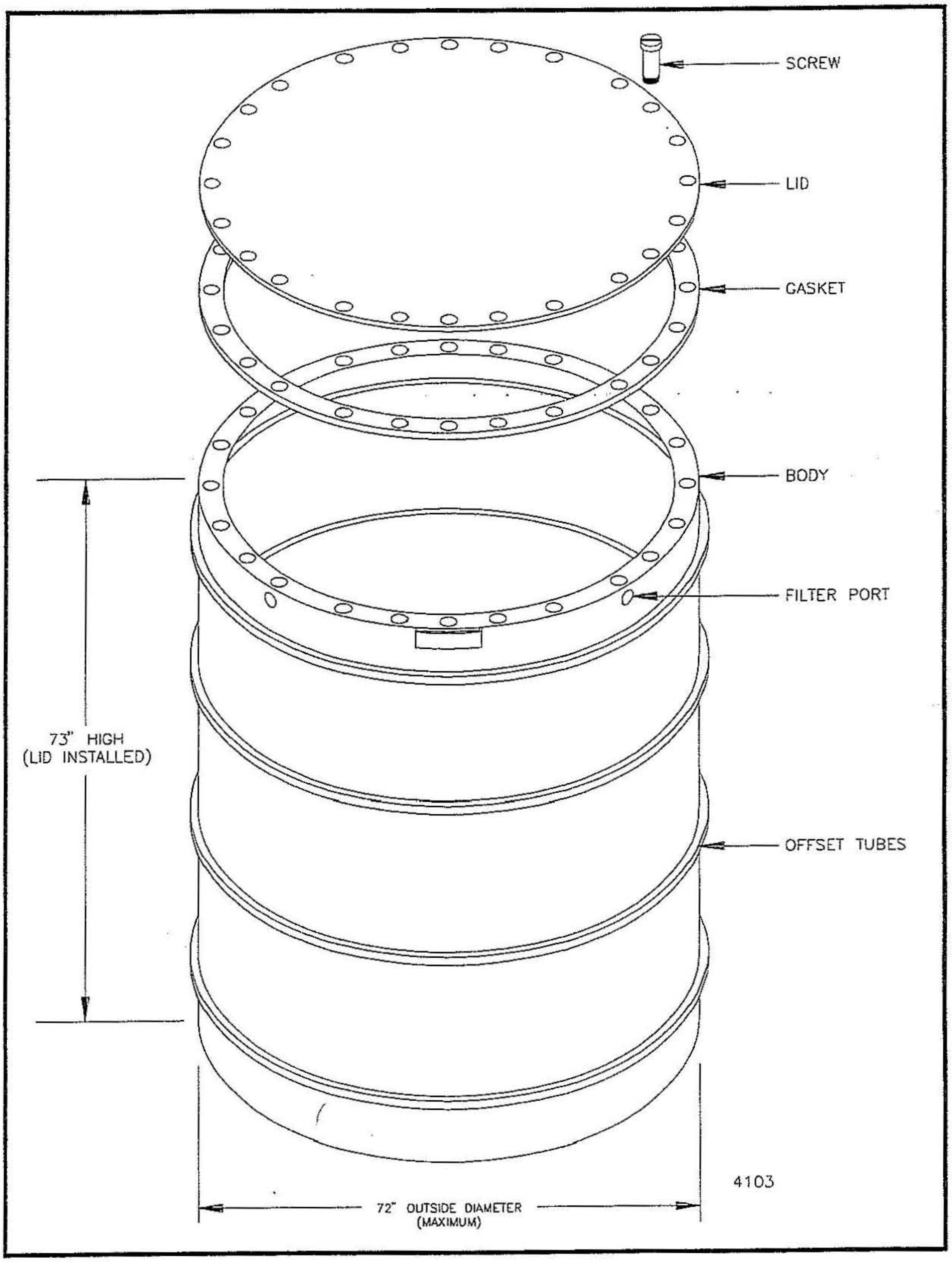


Figure M1-5
Ten-Drum Overpack

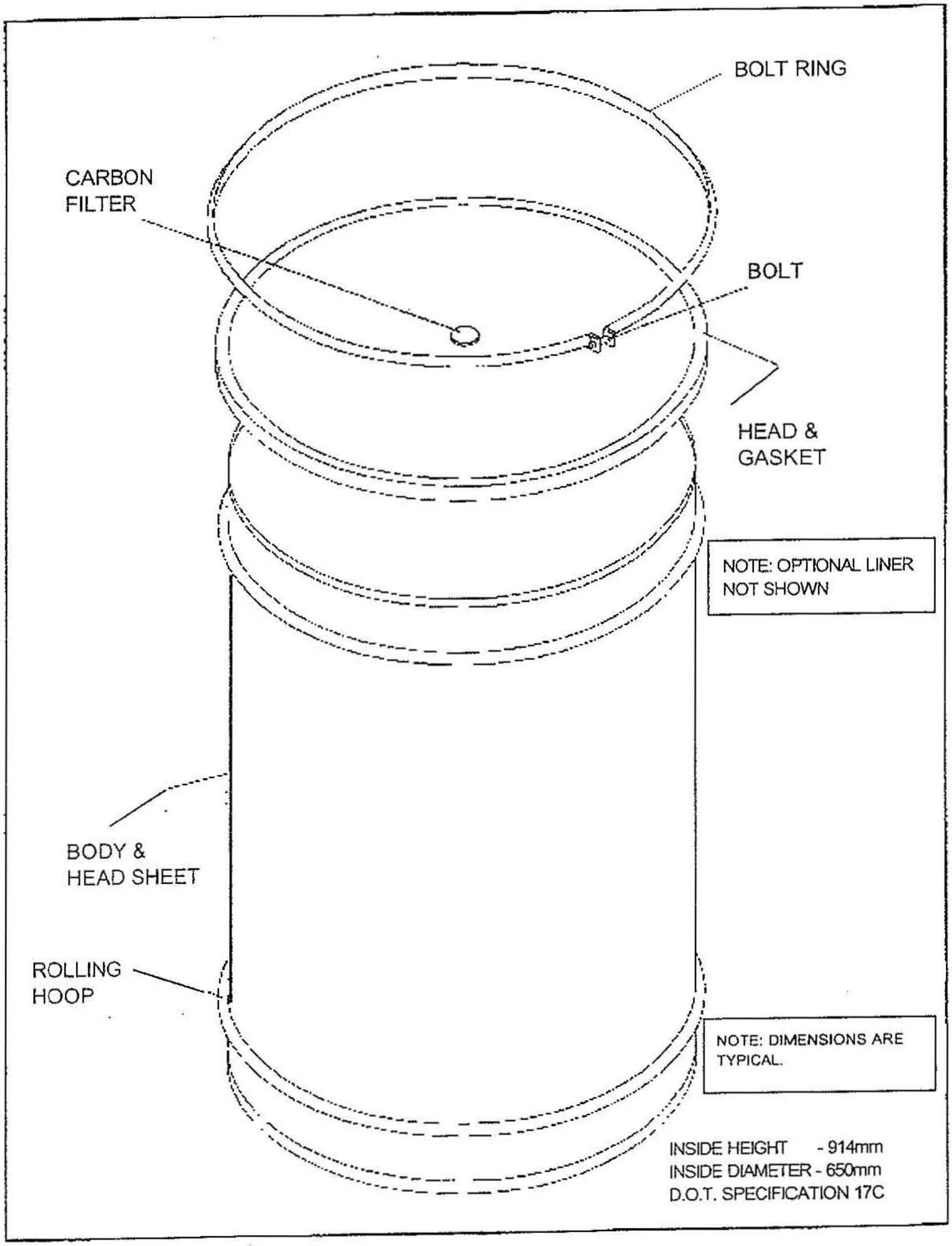


Figure M1-6
85-Gallon Drum

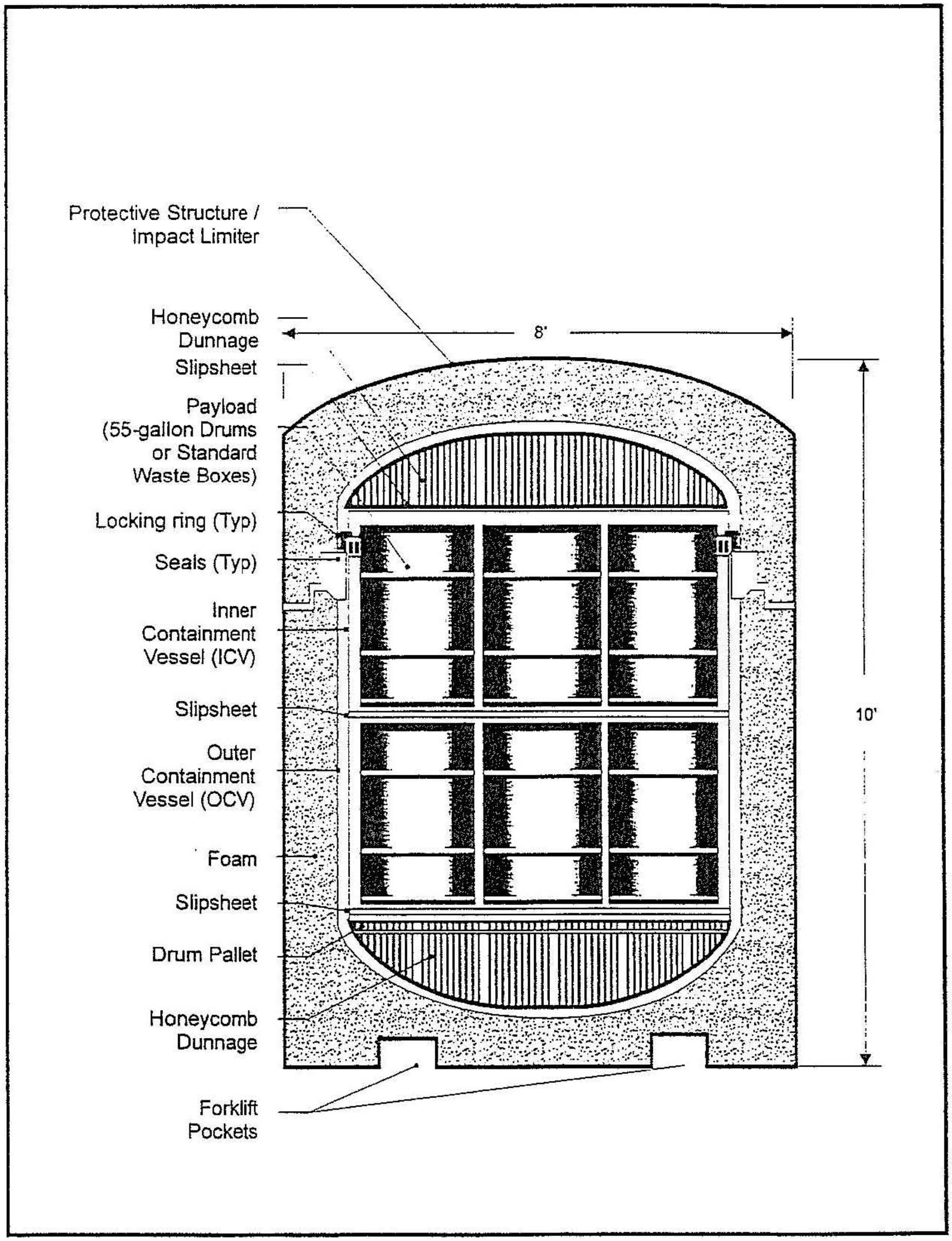


Figure M1-8a
TRUPACT-II Shipping Container for CH Transuranic Mixed Waste (Schematic)

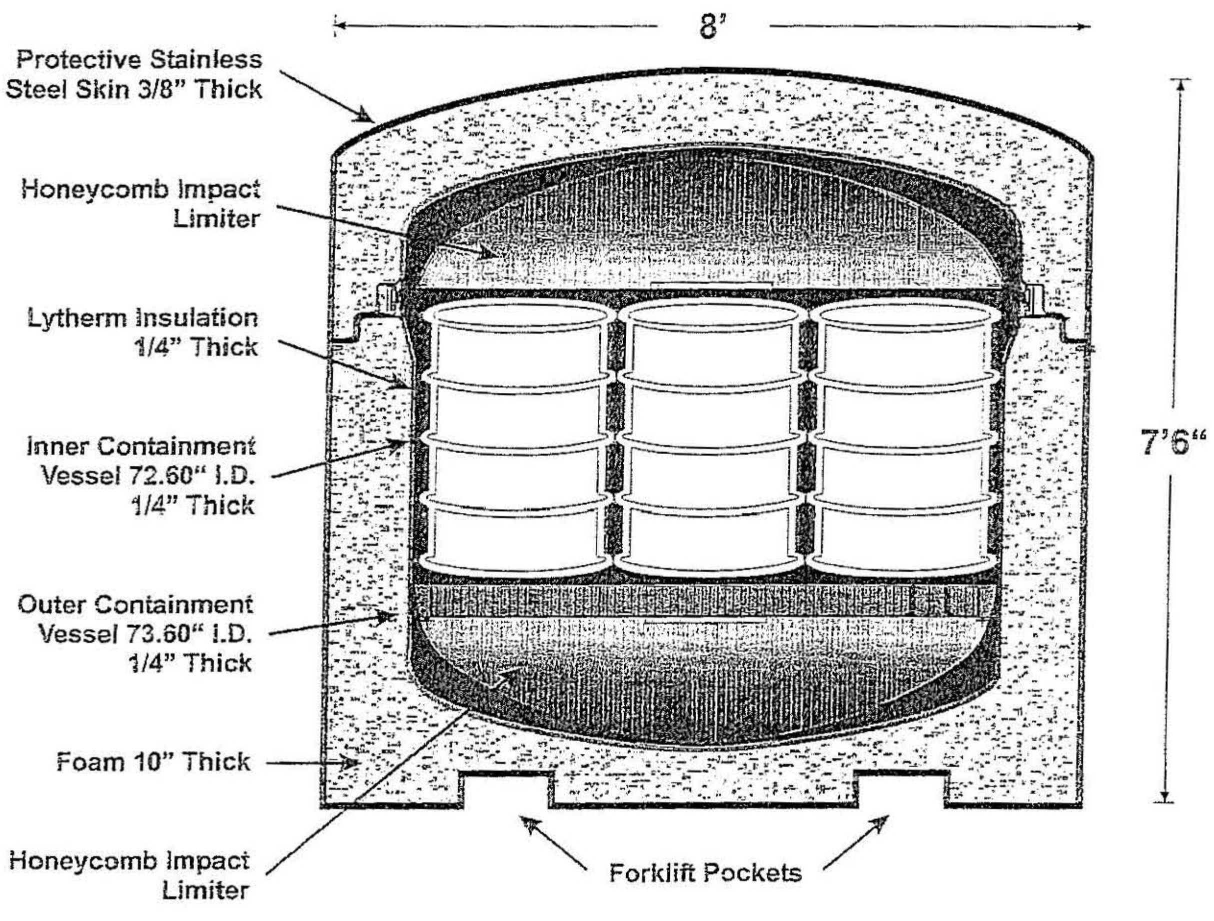


Figure M1-8b
Typical HalfPACT Shipping Container for CH Transuranic Mixed Waste (Schematic)

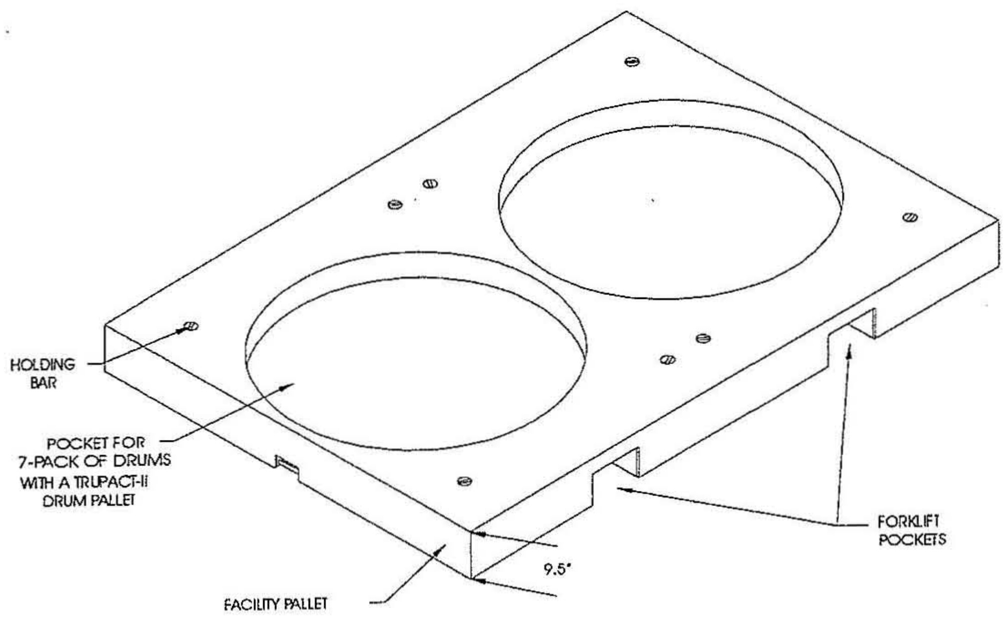


Figure M1-10
Facility Pallet for Seven-Pack of Drums

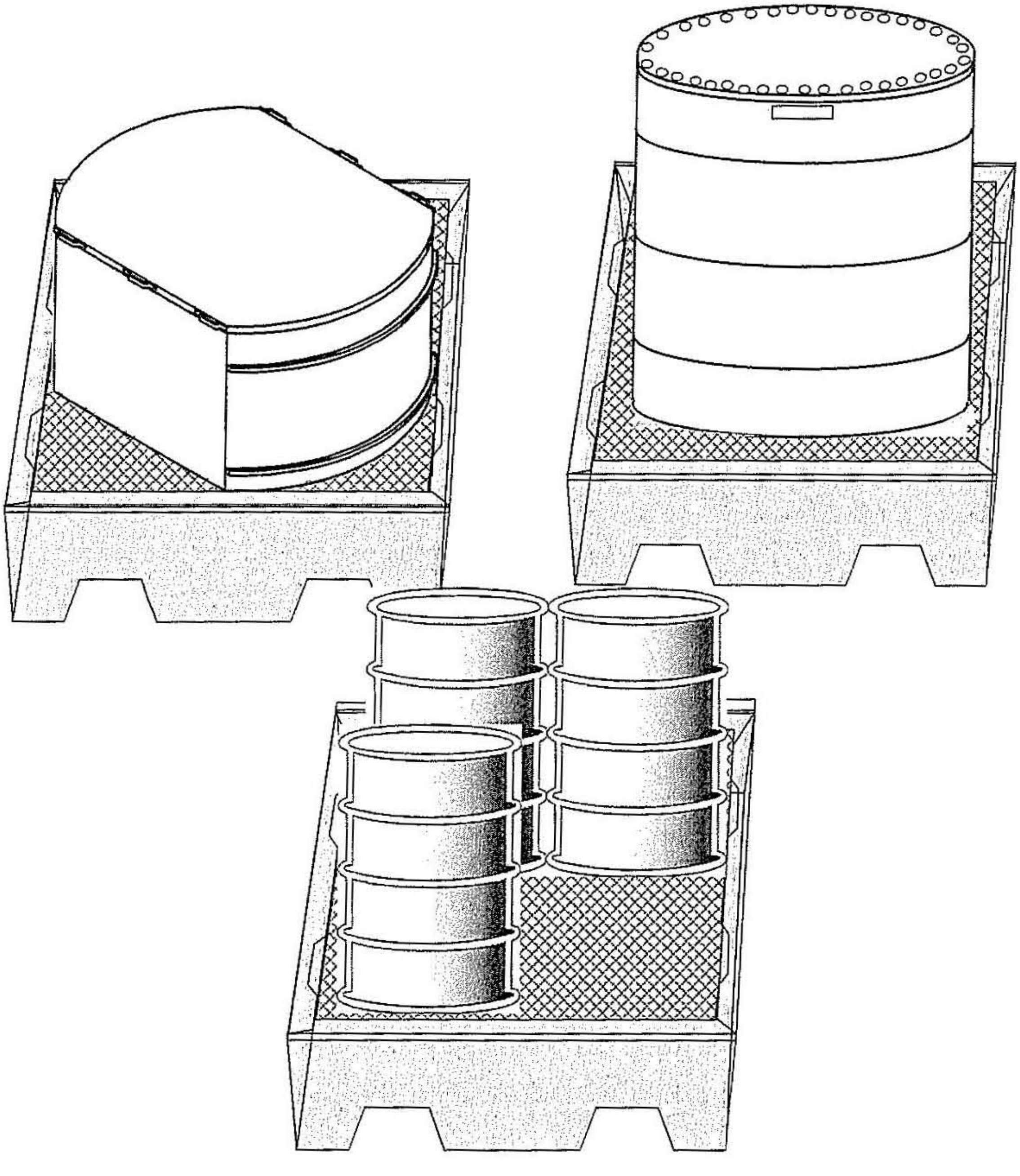


Figure M1-10a
Typical Containment Pallet

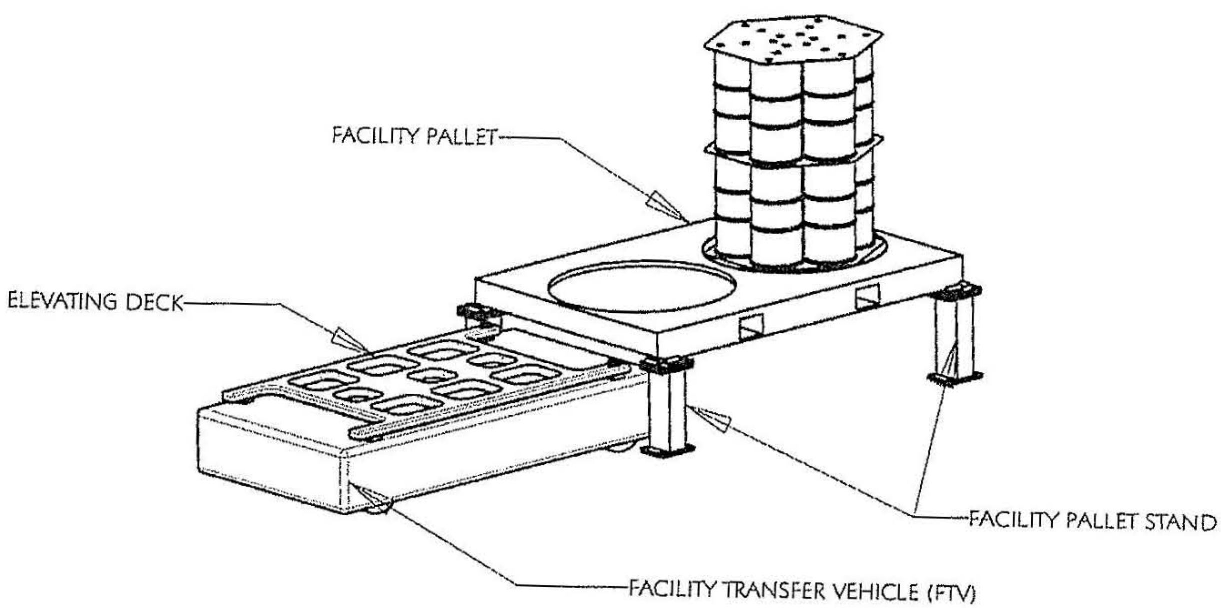


Figure M1-11
Facility Transfer Vehicle, Facility Pallet, and Typical Pallet Stand

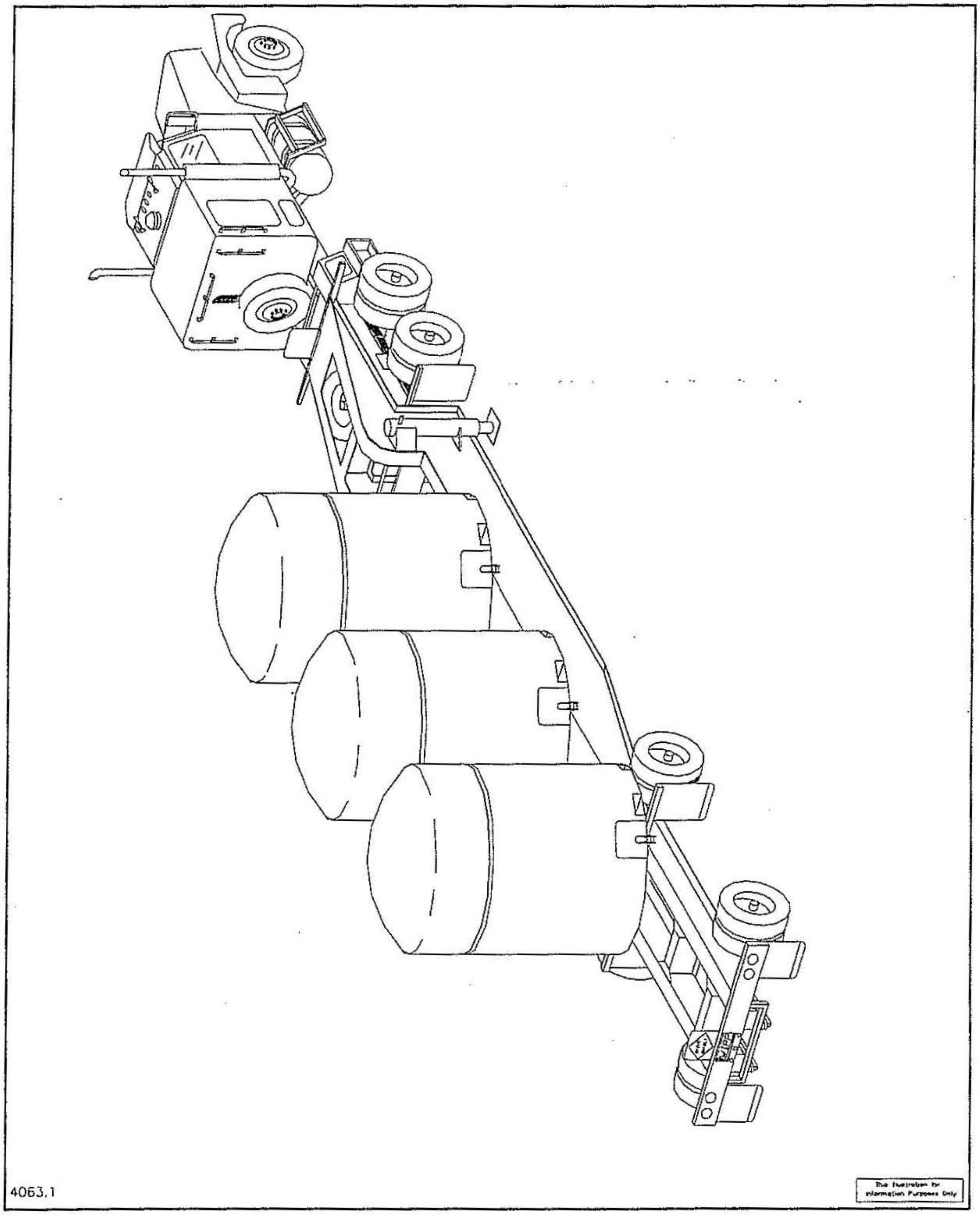
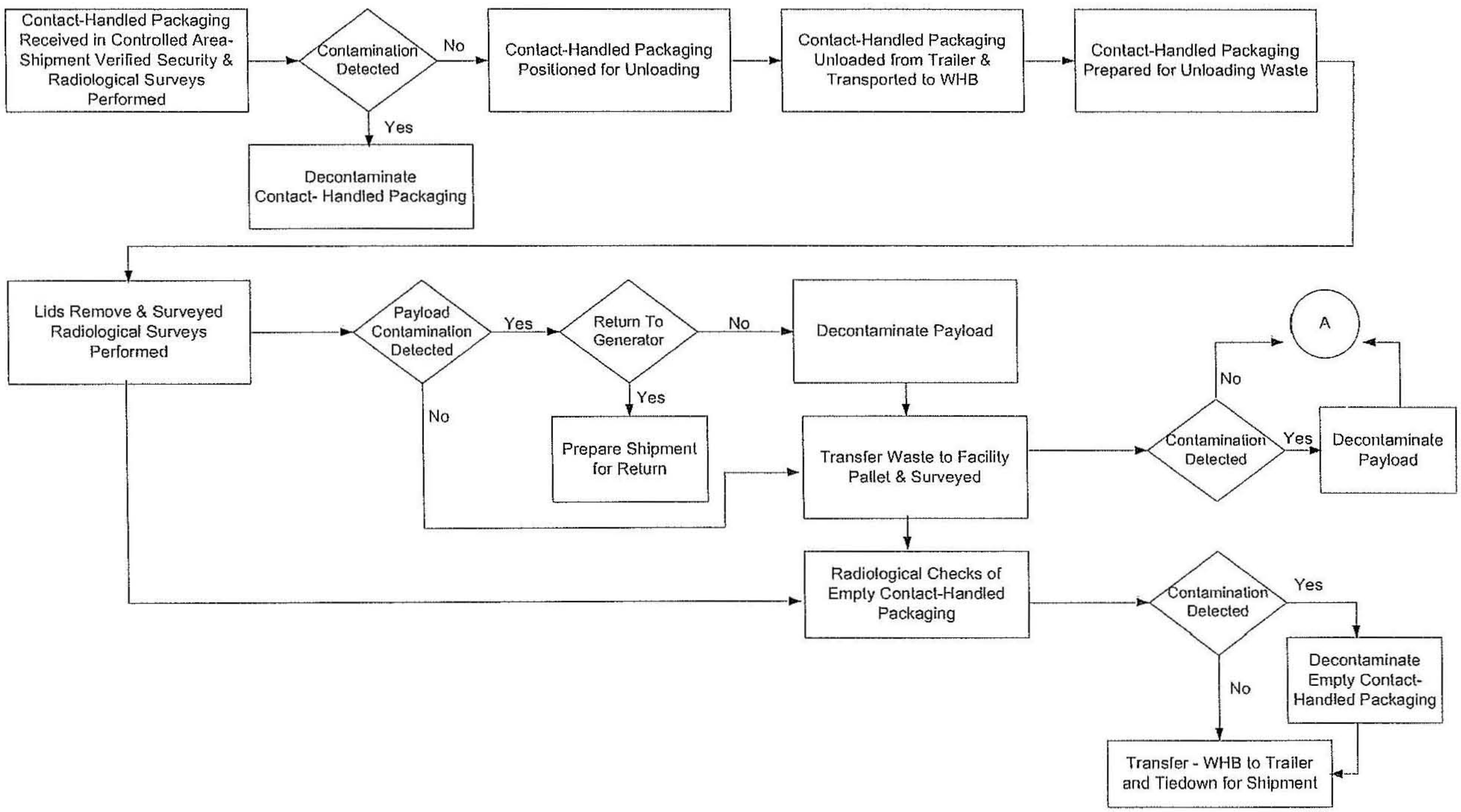


Figure M1-12
TRUPACT-II Containers on Trailer



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2 Figure M1-13
3 WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram

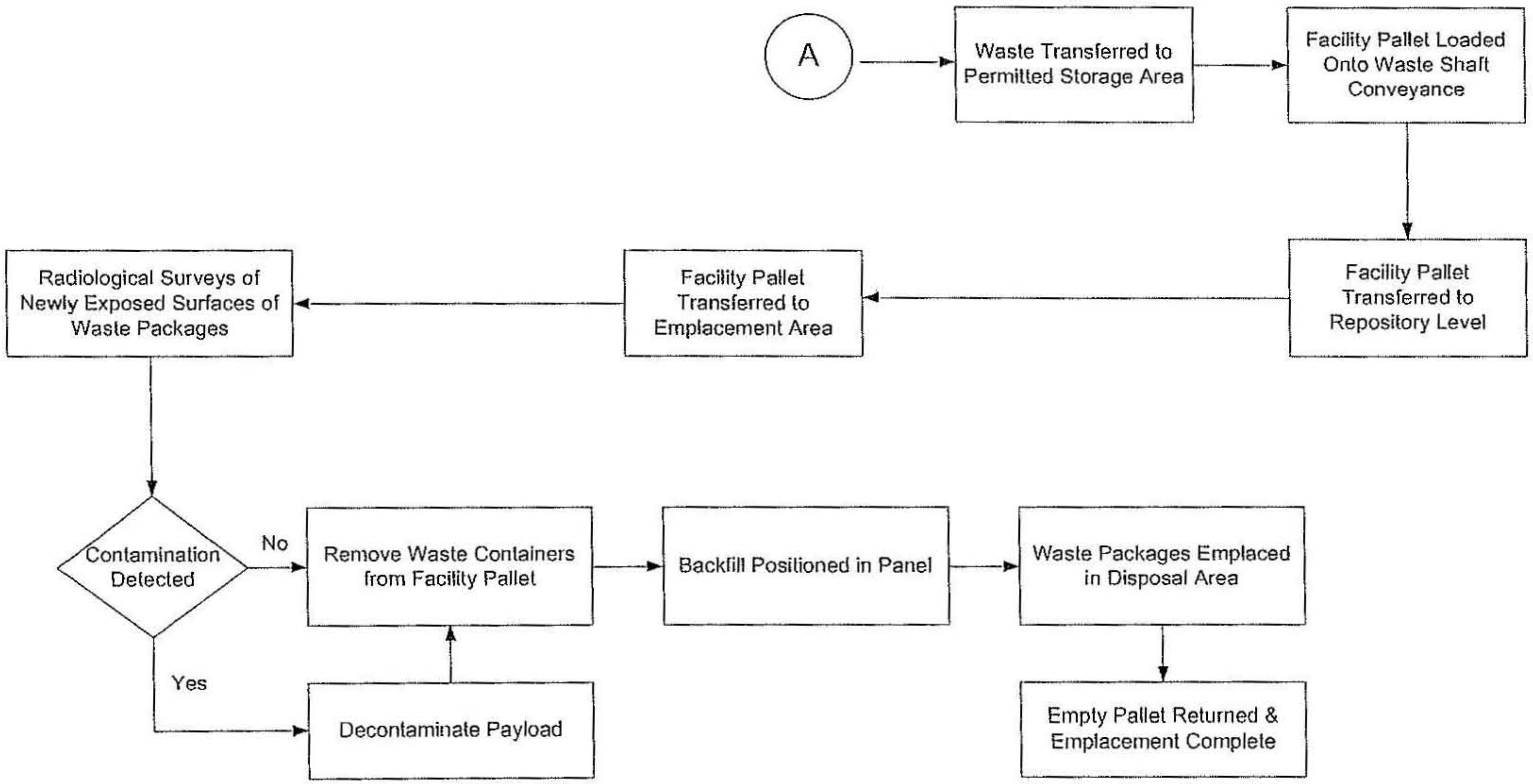


Figure M1-13
WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram (Continued)

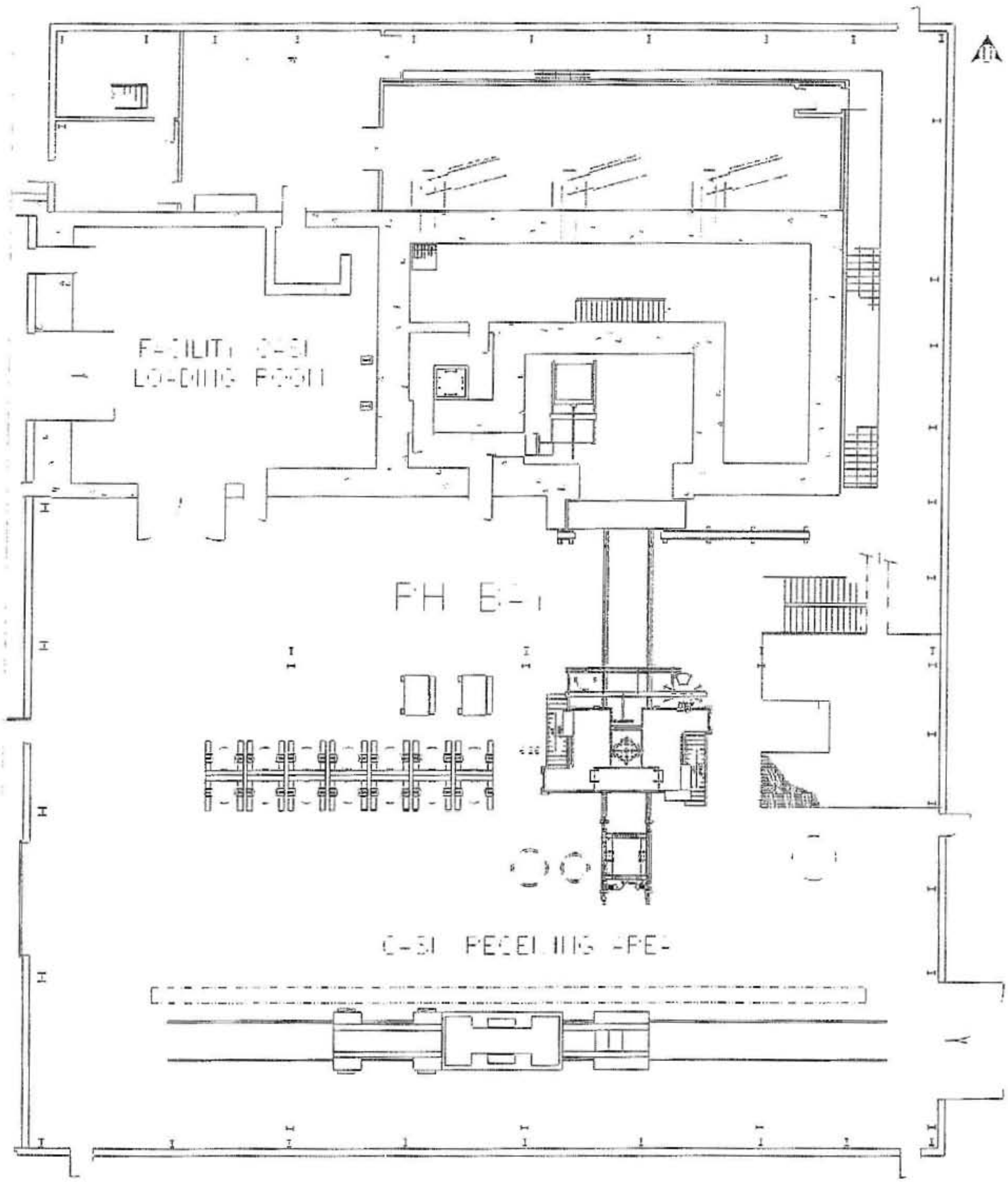


Figure M1-14a
RH Bay Ground Floor

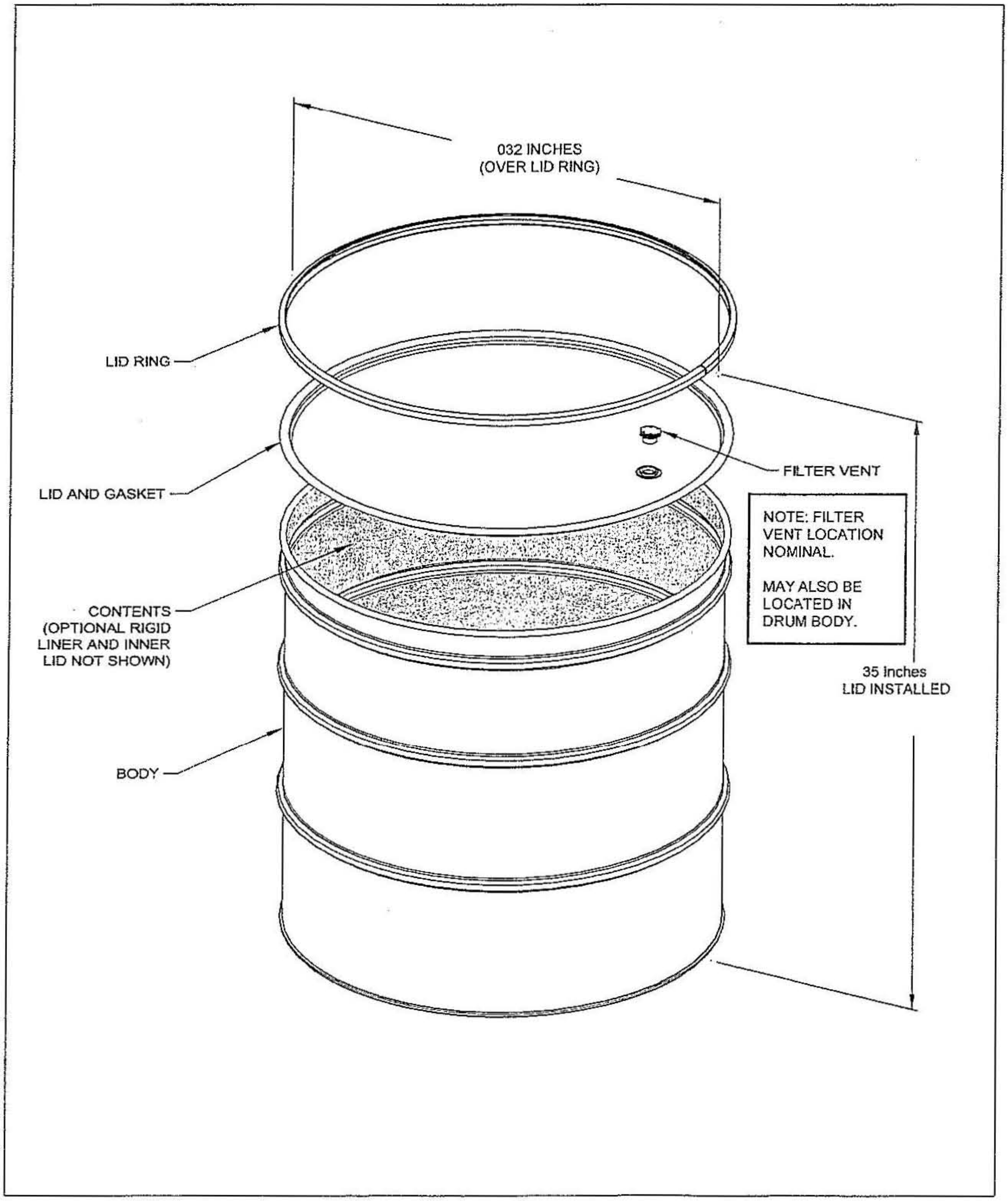


Figure M1-15
100-Gallon Drum

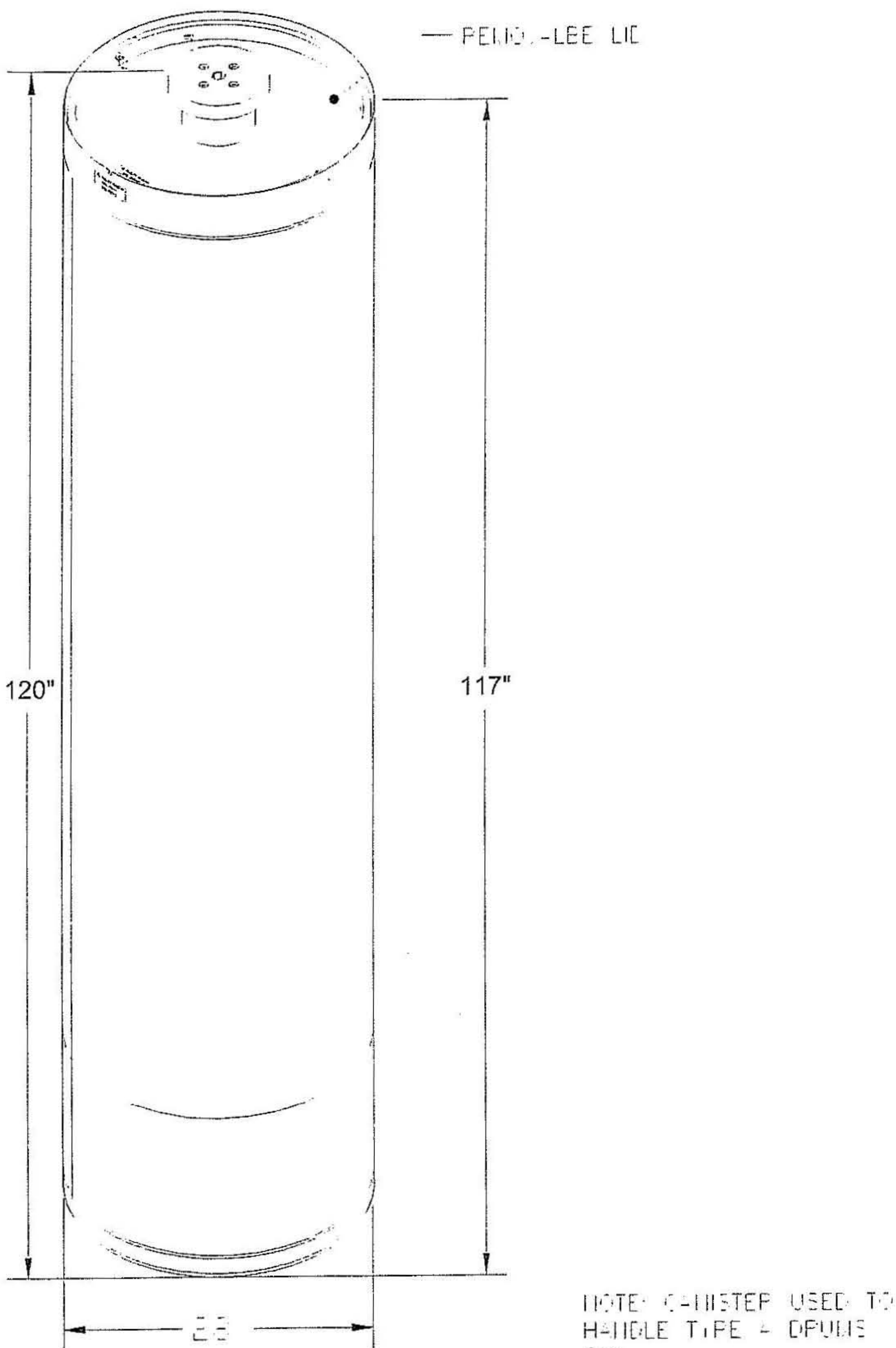


Figure M1-16
Facility Canister Assembly

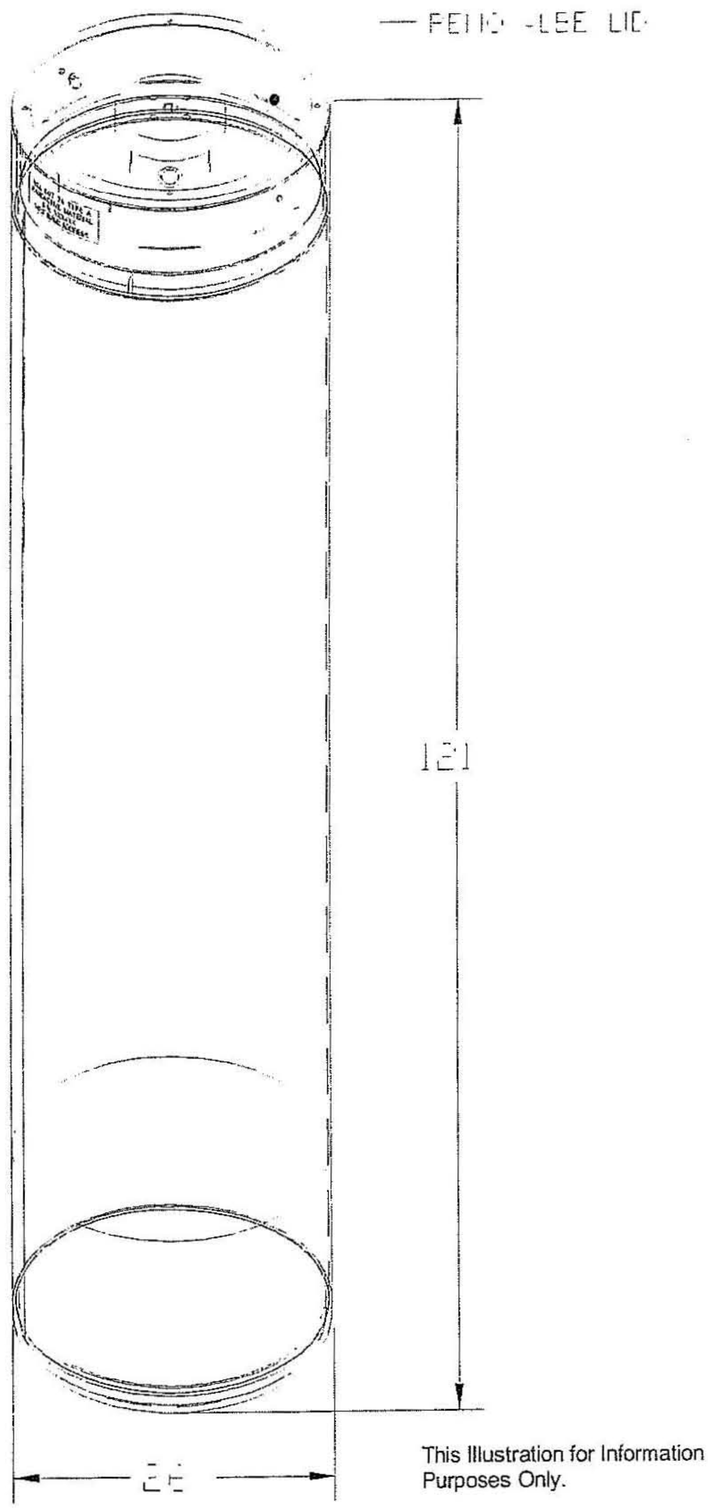


Figure M1-16a
RH-TRU 72-B Canister Assembly

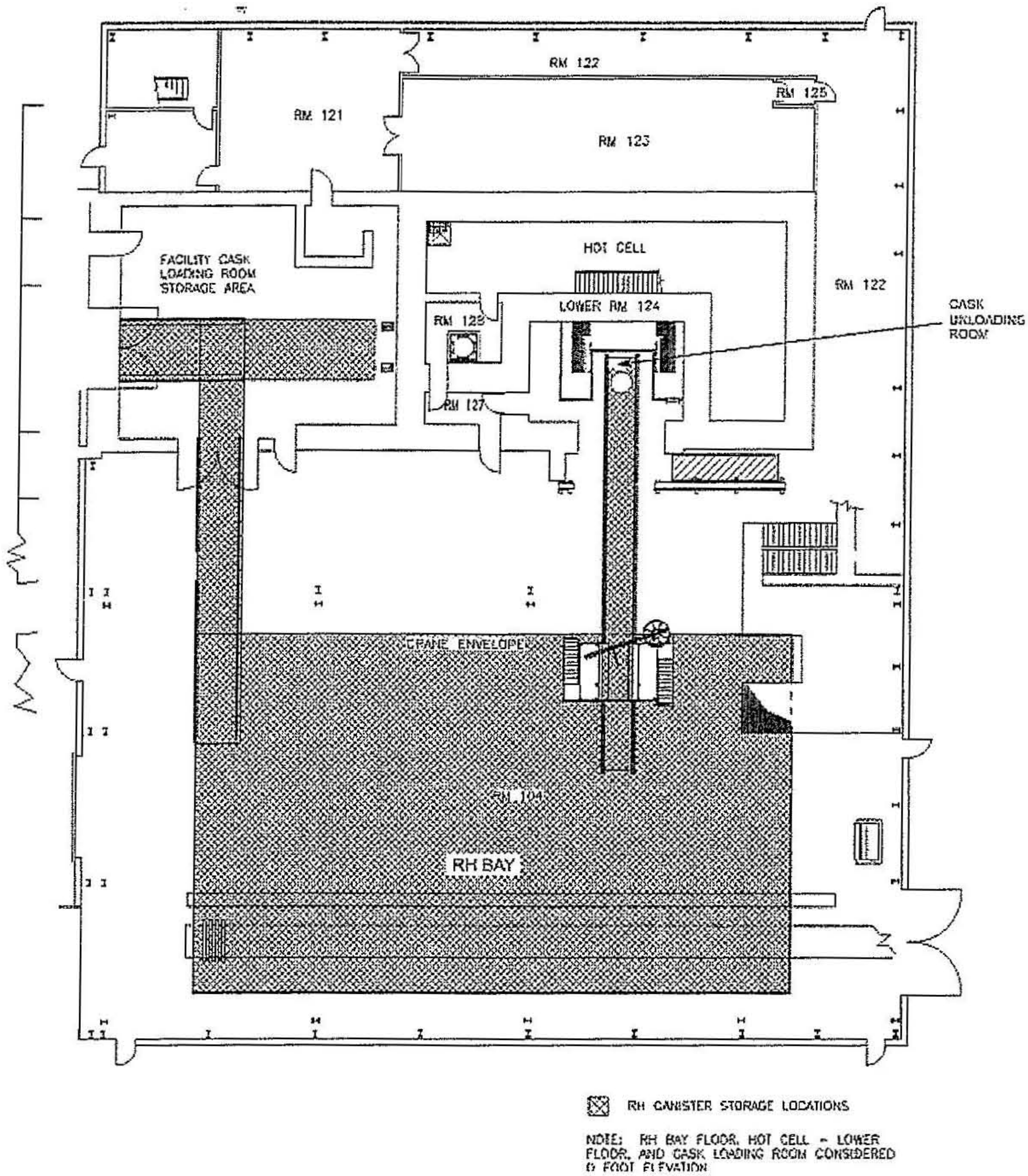


Figure M1-17a
RH Bay, Cask Unloading Room, Hot Cell, Facility Cask Loading Room

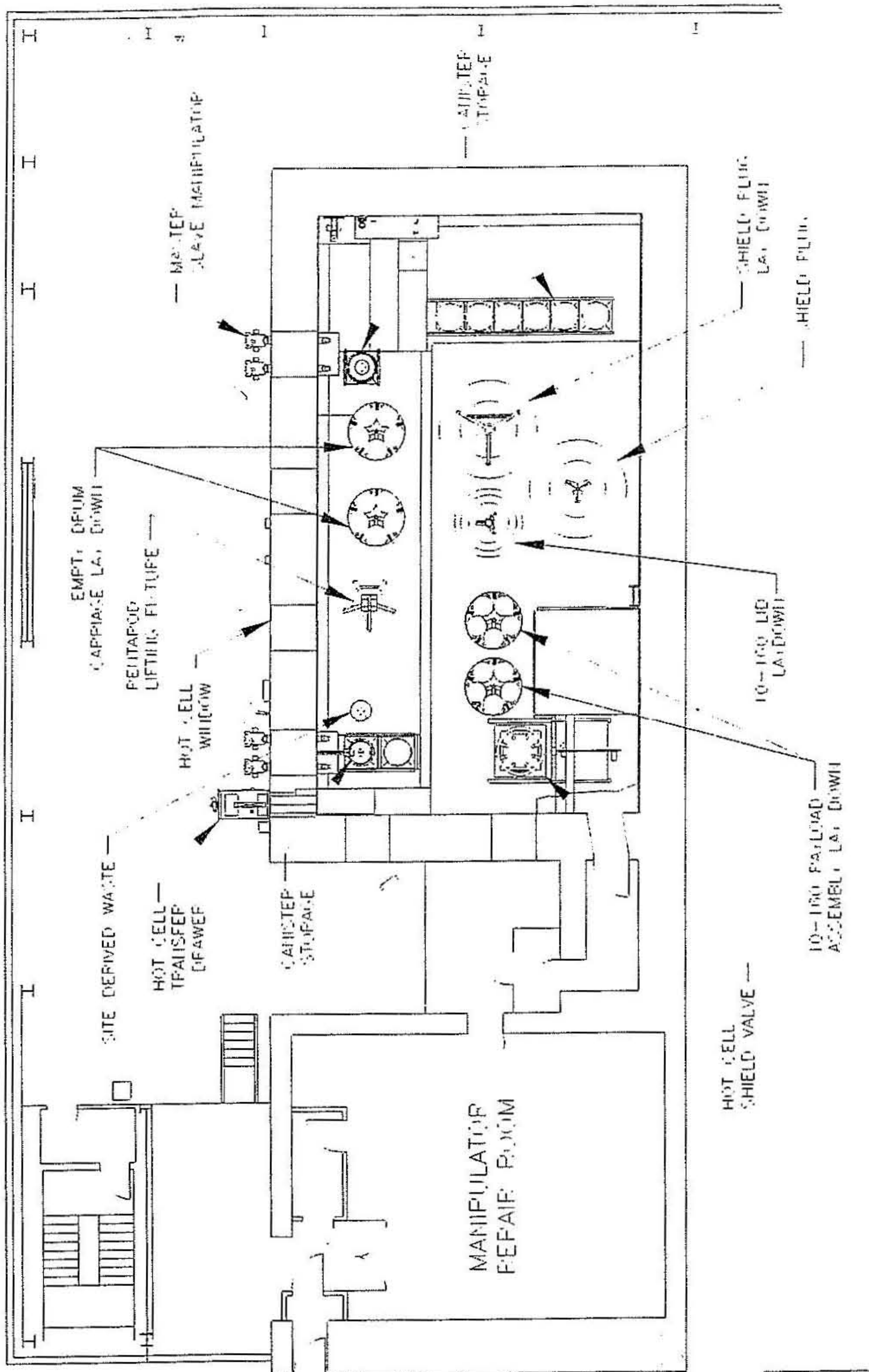


Figure M1-17b
RH Hot Cell Storage Area

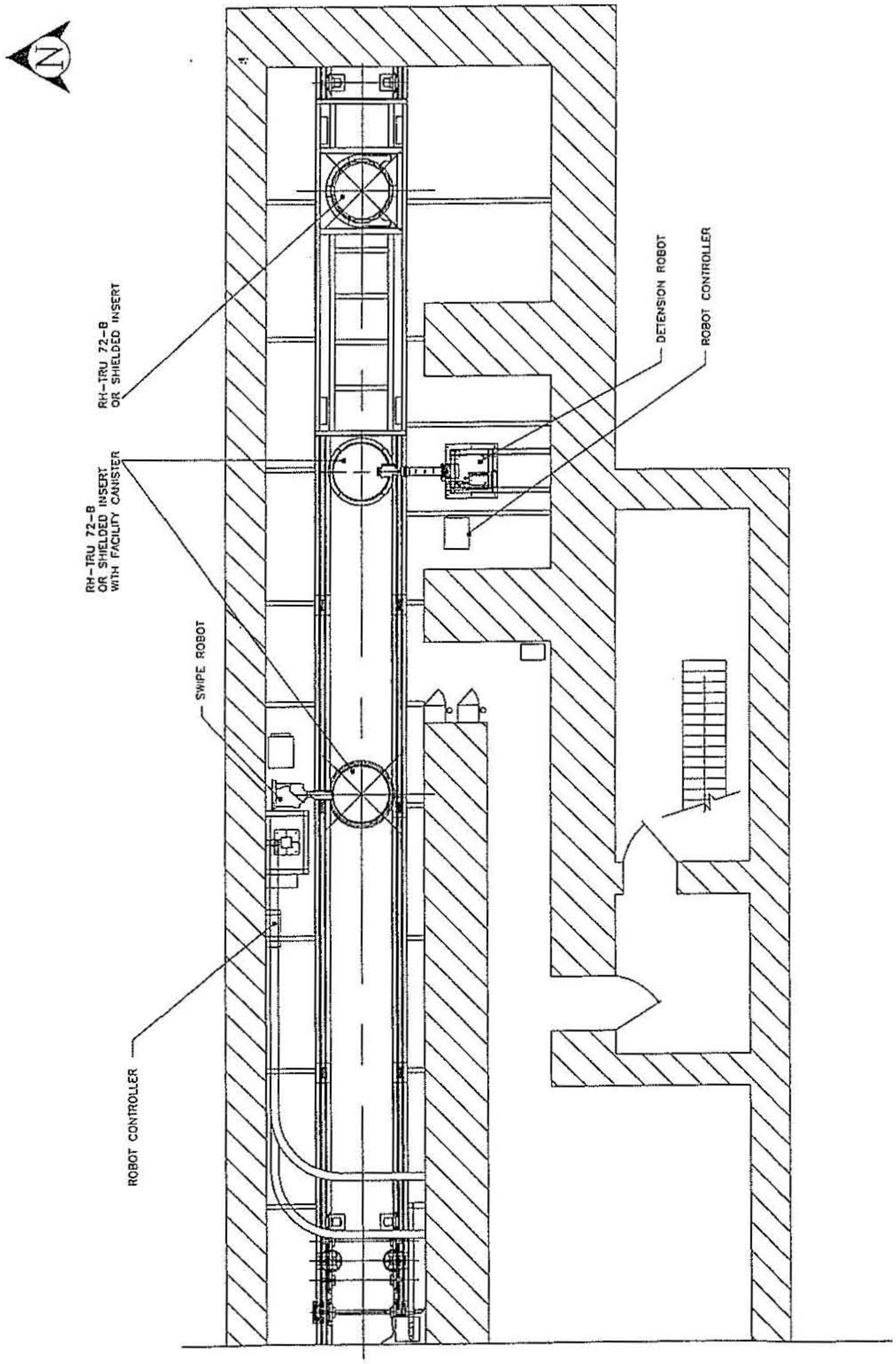


Figure M1-17c
RH Canister Transfer Cell Storage Area

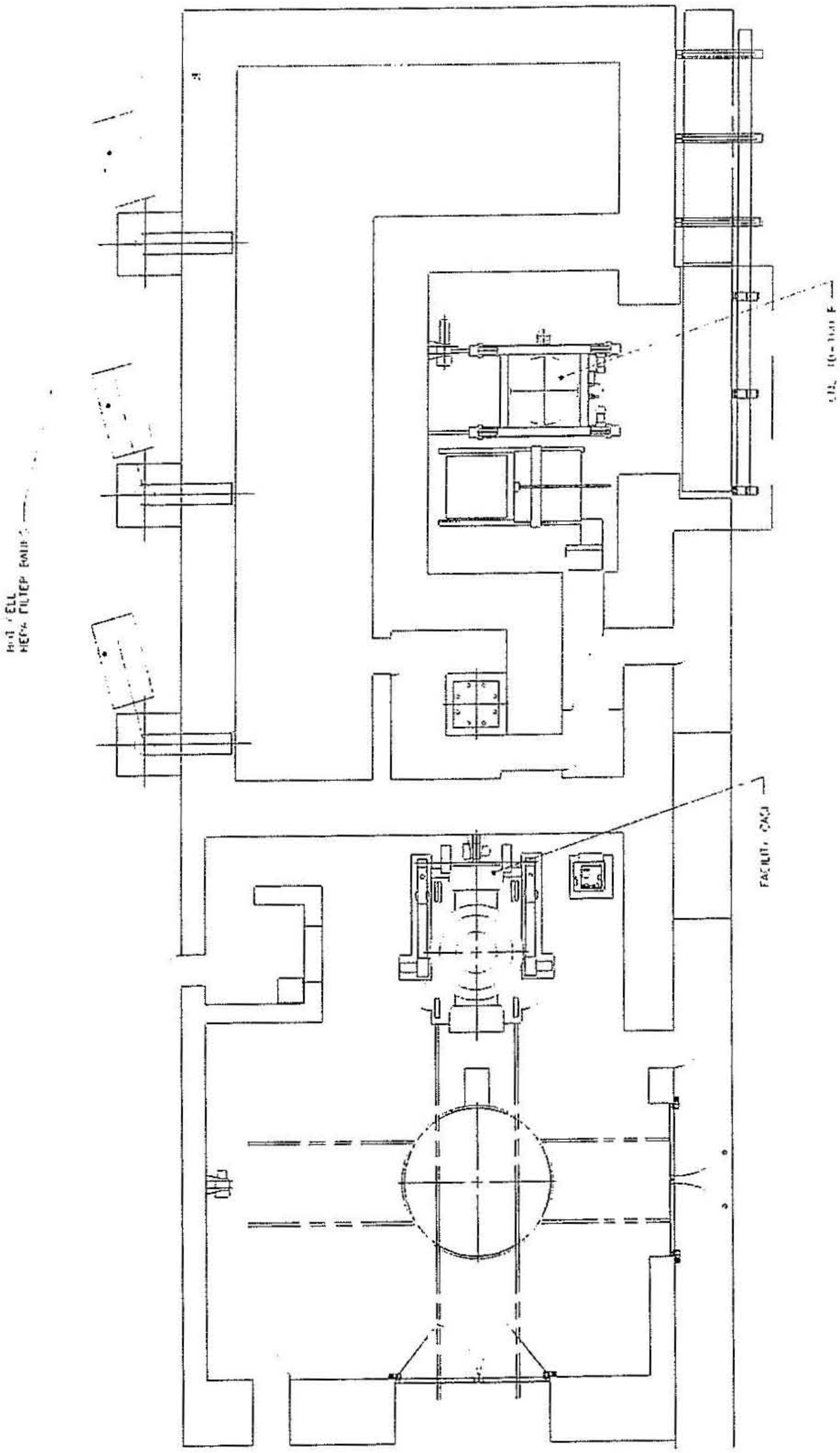


Figure M1-17d
RH Facility Cask Loading Room Storage Area

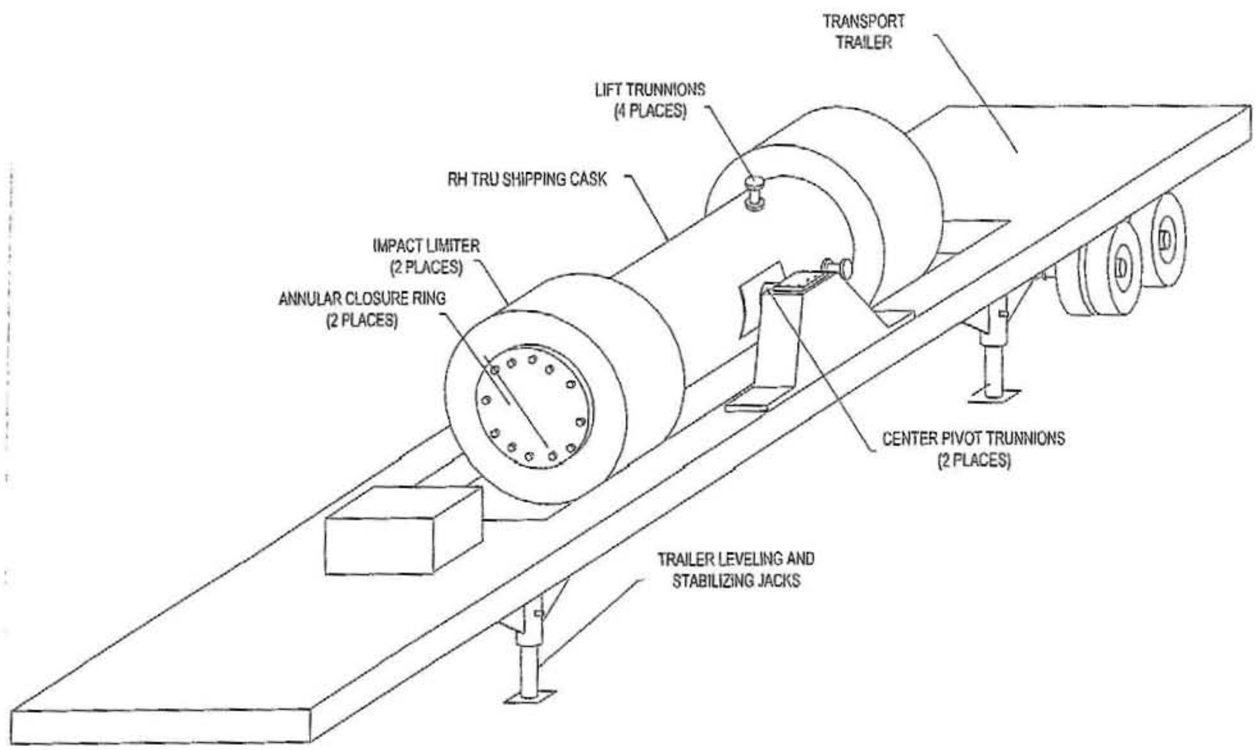


Figure M1-18
RH-TRU 72-B Shipping Cask on Trailer

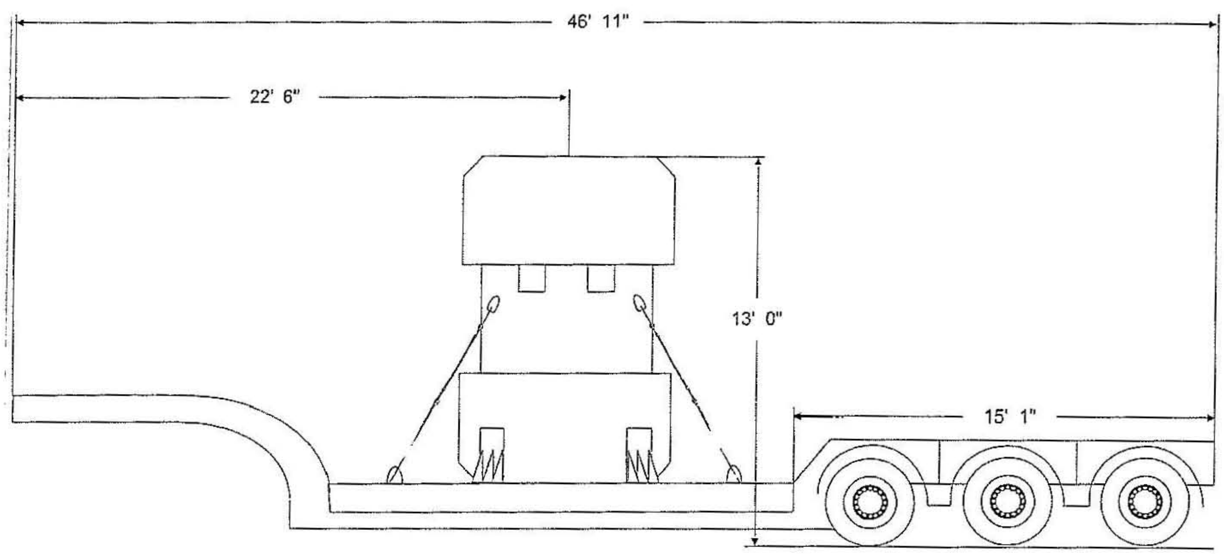


Figure M1-19
CNS 10-160B Shipping Cask on Trailer

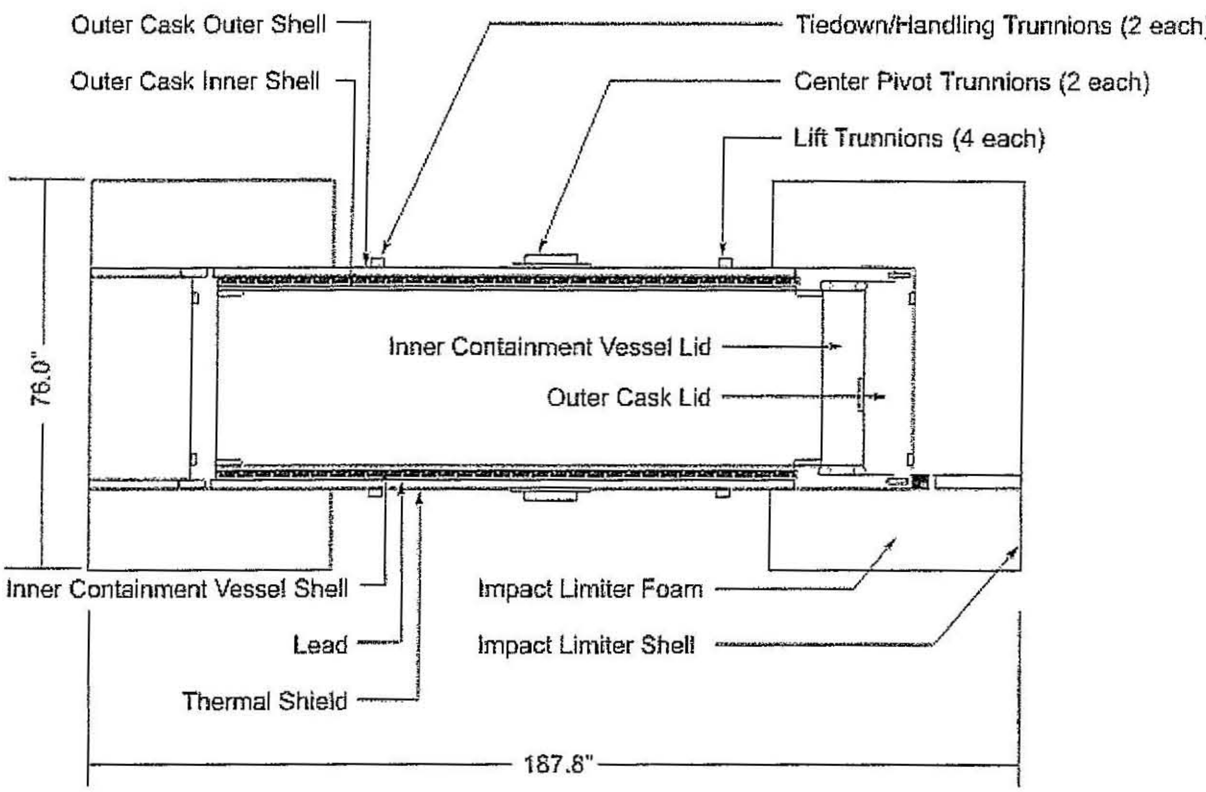


Figure M1-20
RH-TRU 72-B Shipping Cask for RH Transuranic Waste (Schematic)

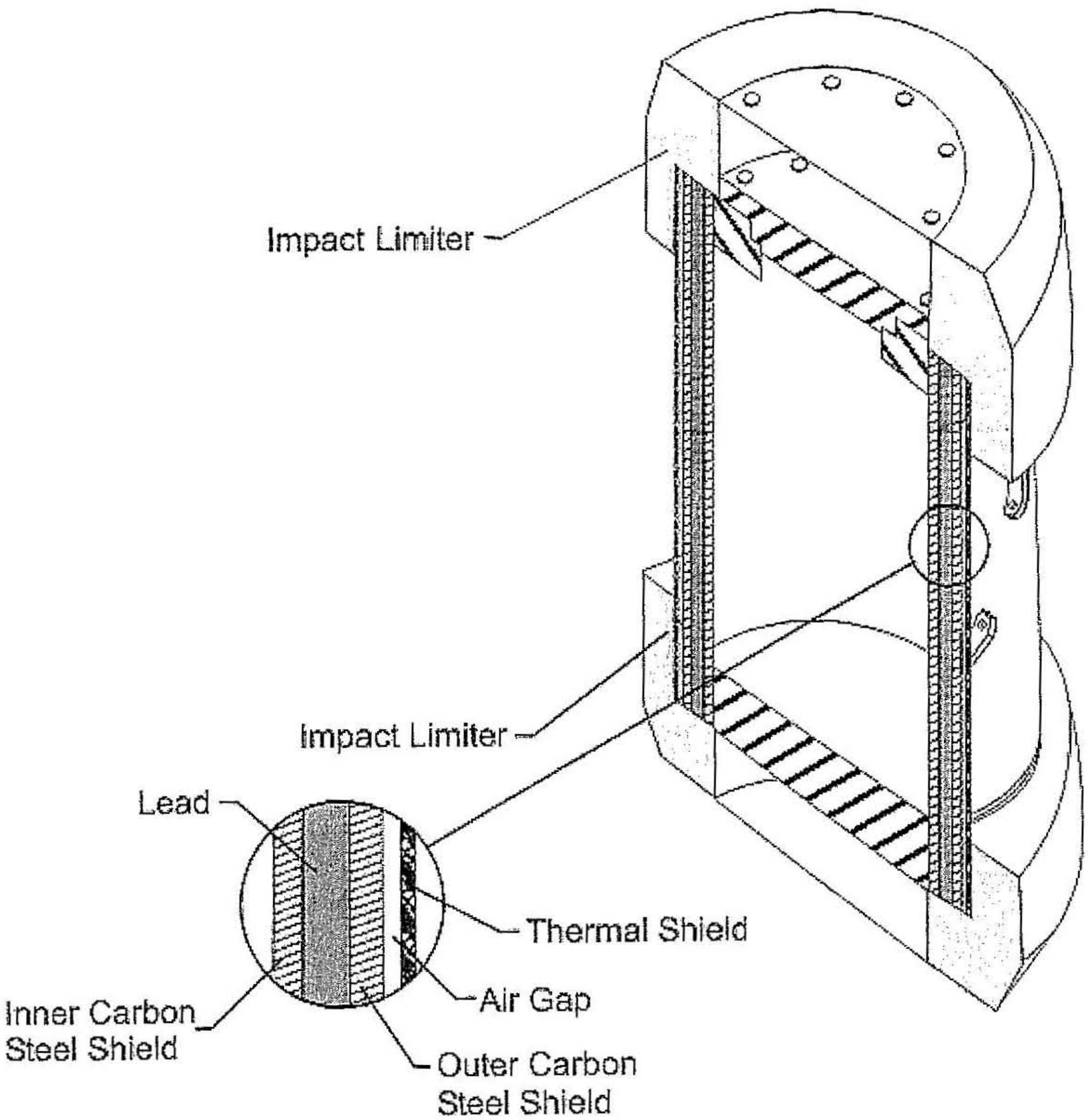


Figure M1-21
CNS 10-160B Shipping Cask for RH Transuranic Waste (Schematic)

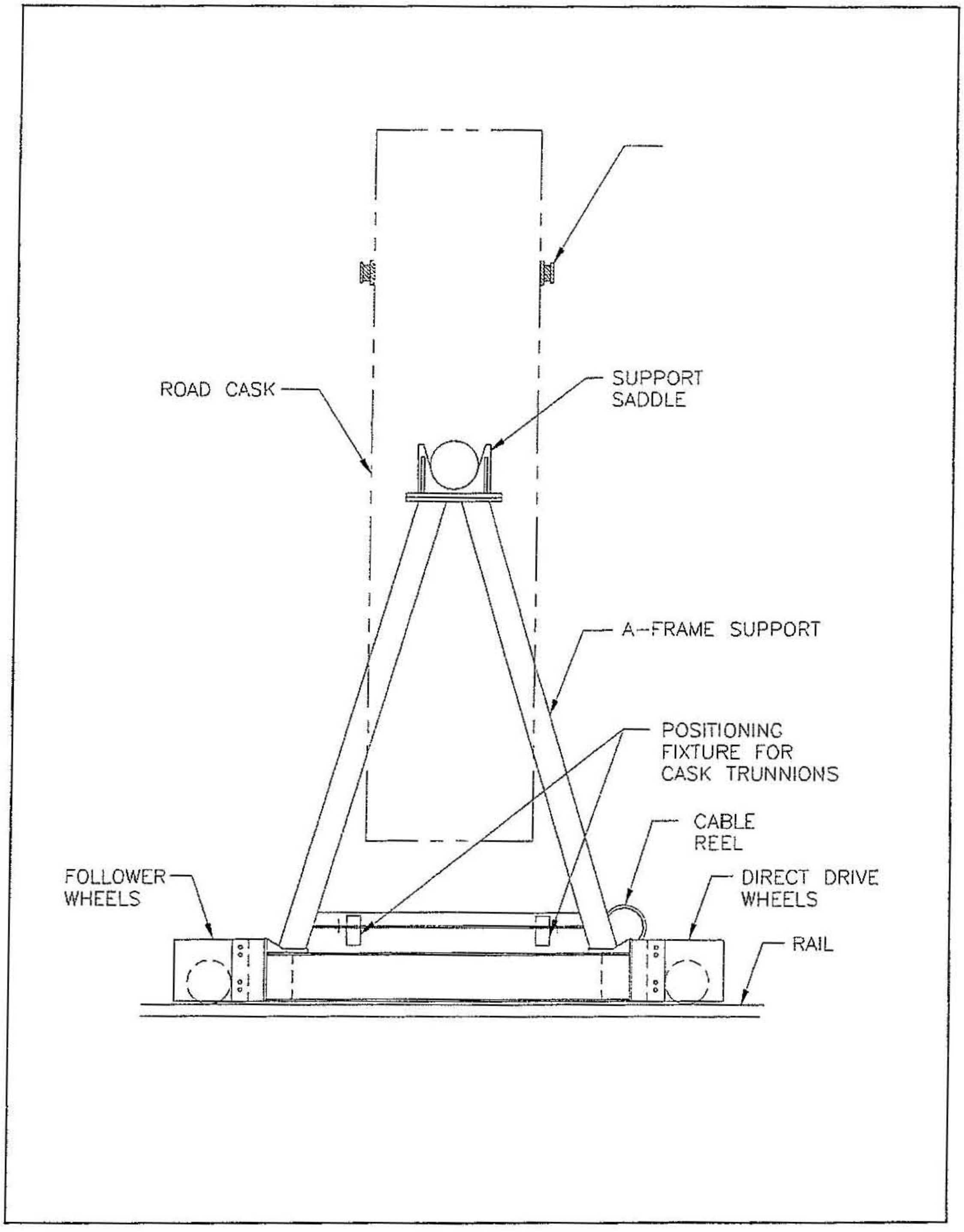
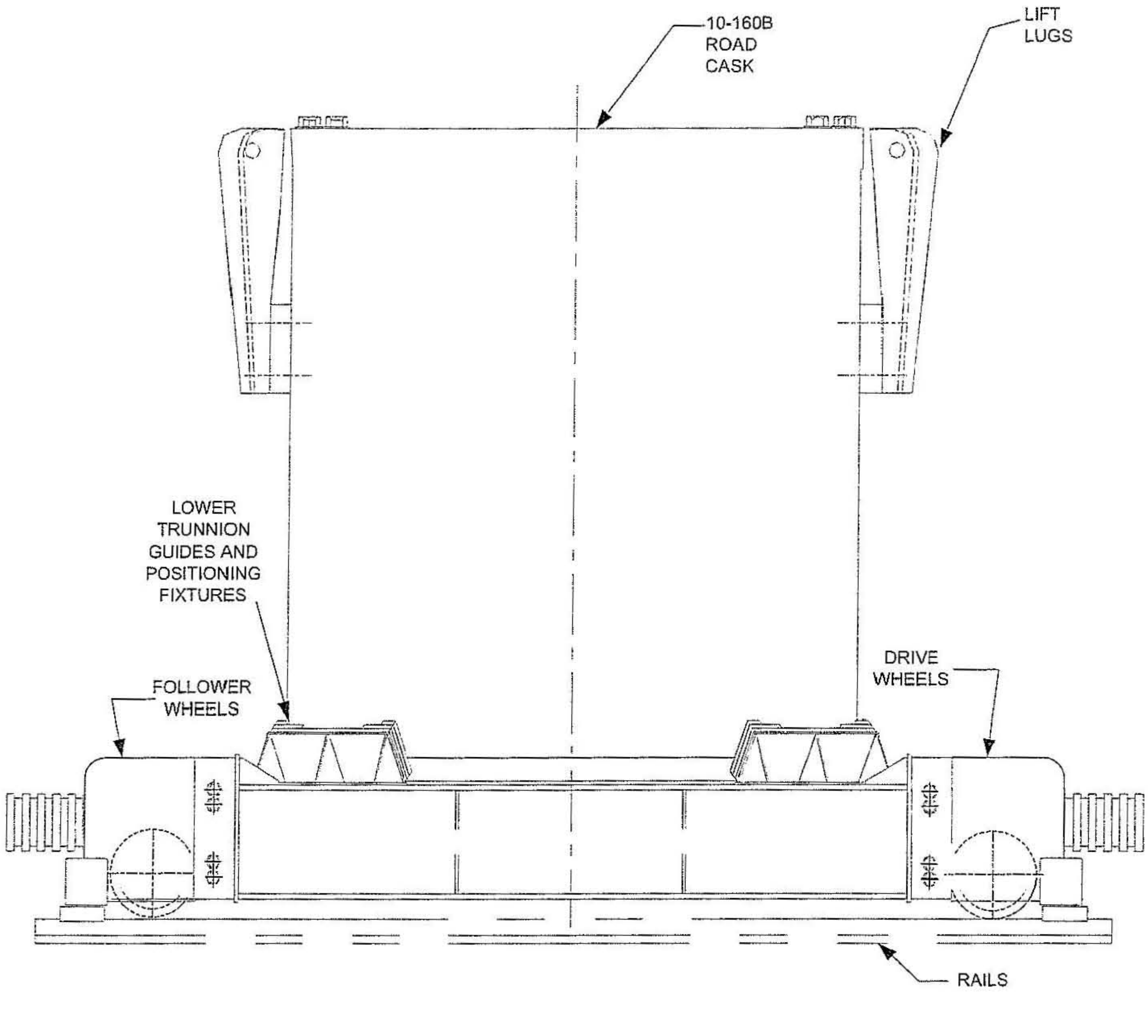


Figure M1-22a
RH-TRU 72-B Cask Transfer Car



This Illustration for Information Purposes Only

Figure M1-22b
CNS 10-160B Cask Transfer Car

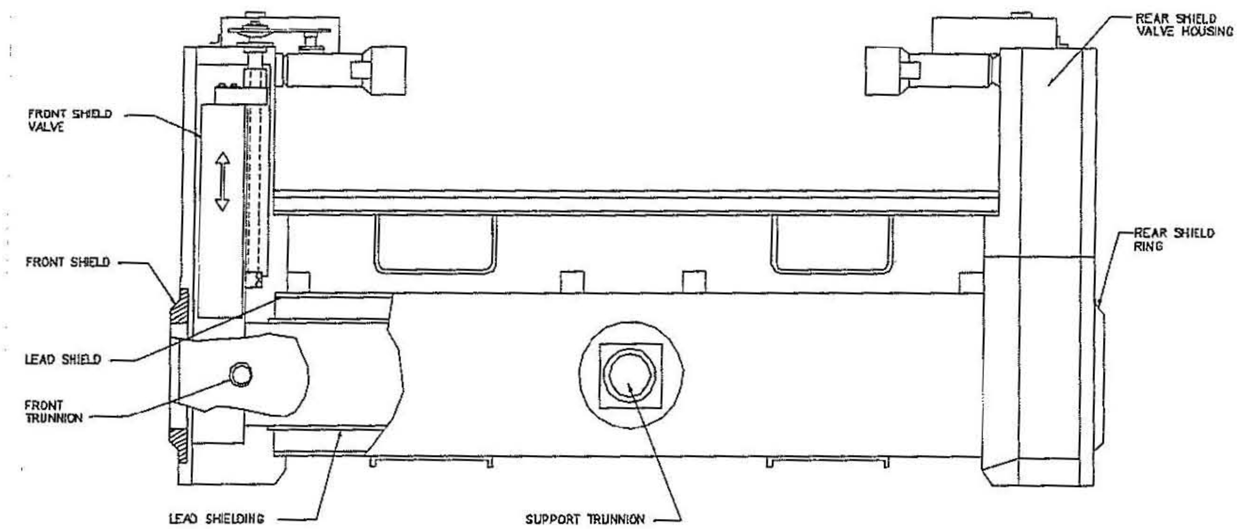


Figure M1-23
RH Transuranic Waste Facility Cask

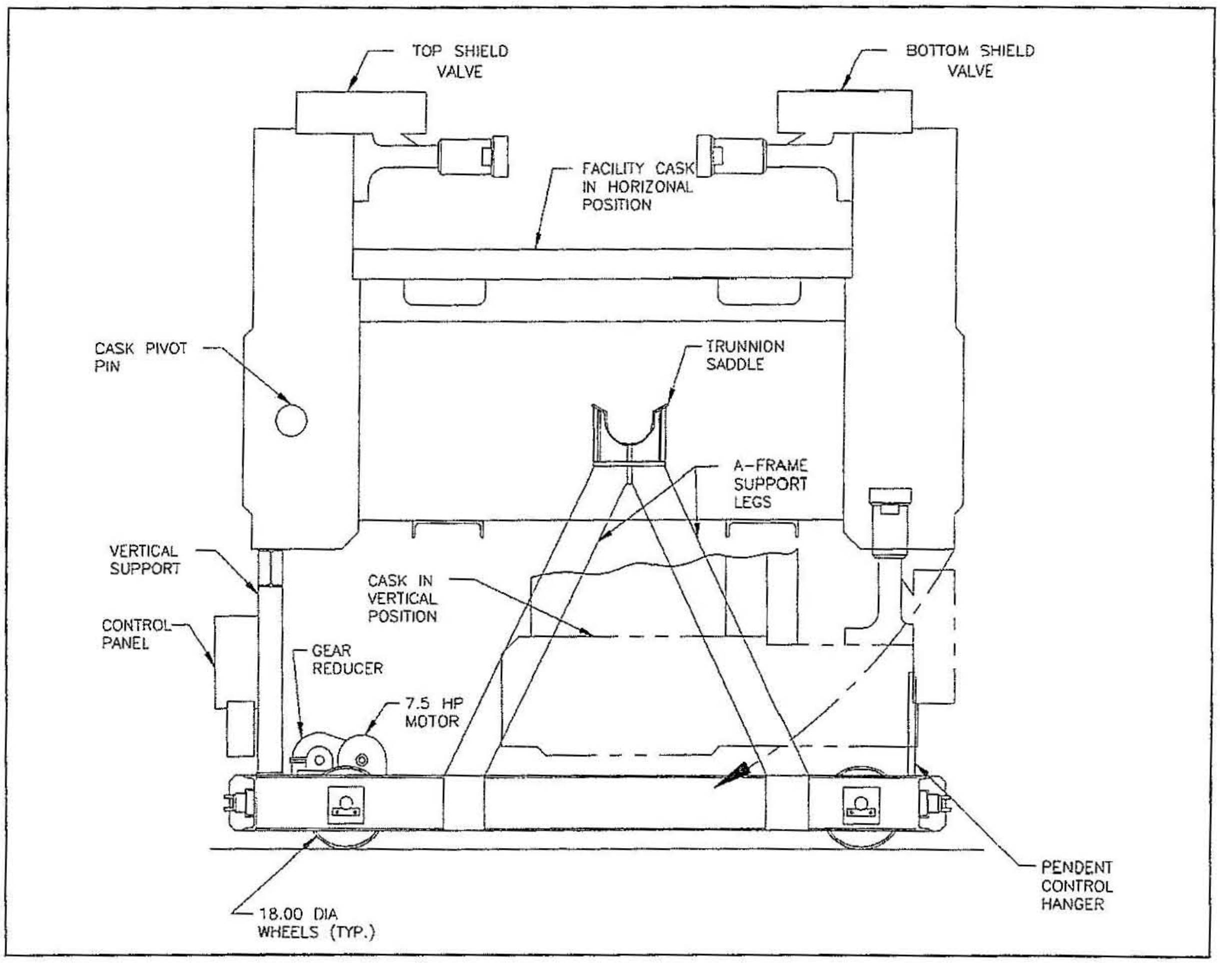


Figure M1-24
RH Facility Cask Transfer Car (Side View)

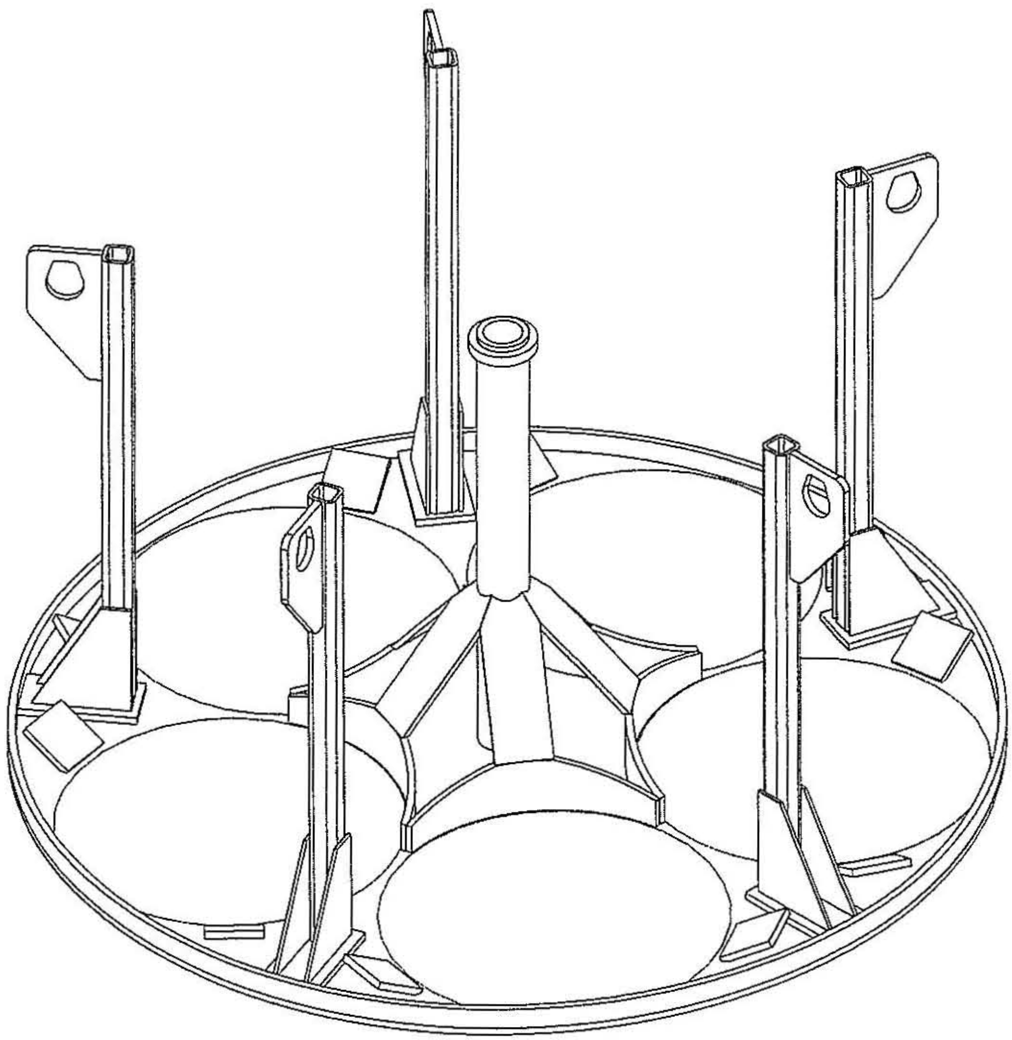


Figure M1-25
CNS 10-160B Drum Carriage

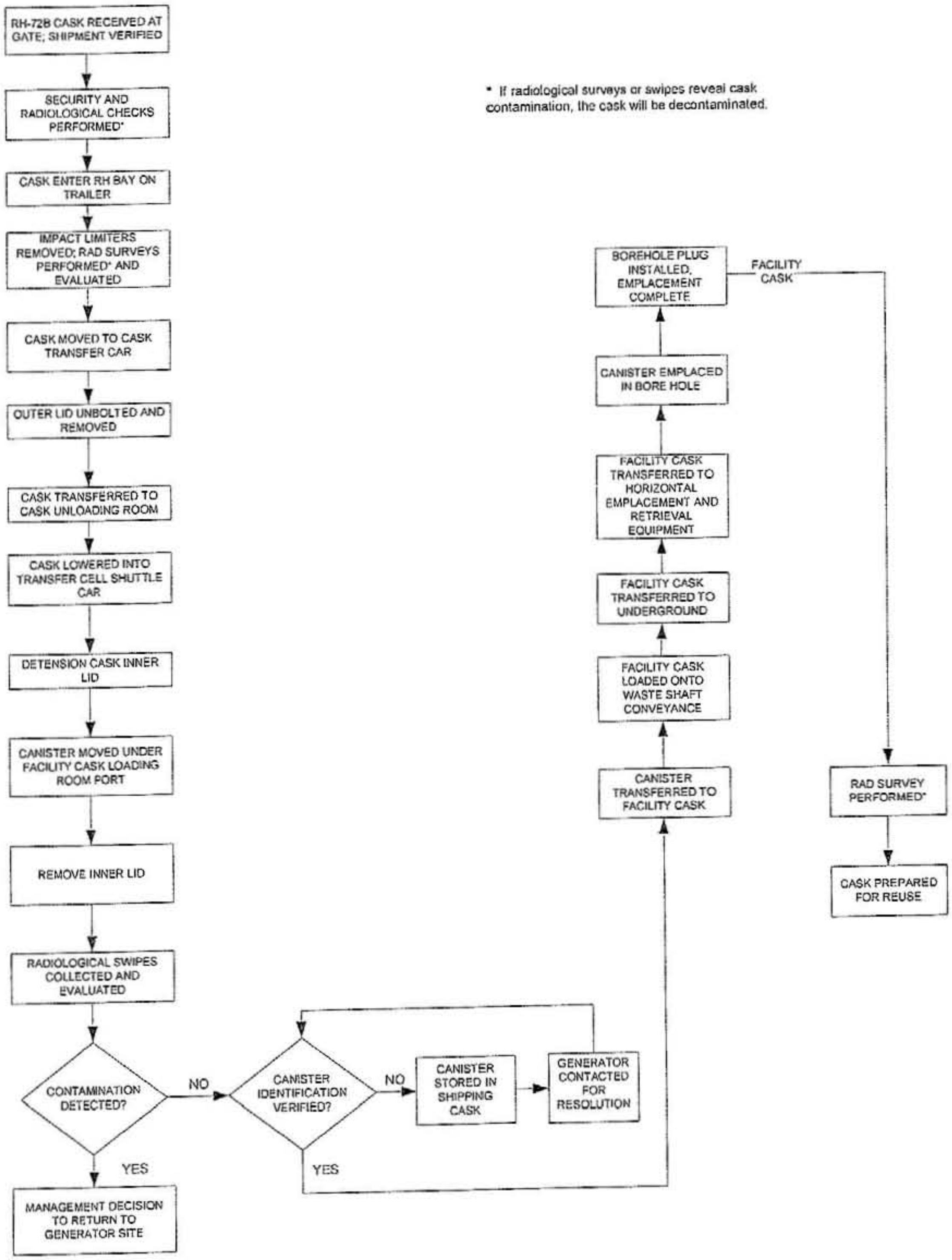


Figure M1-26
Surface and Underground RH Transuranic Mixed Waste Process Flow Diagram for
RH-TRU 72-B Shipping Cask

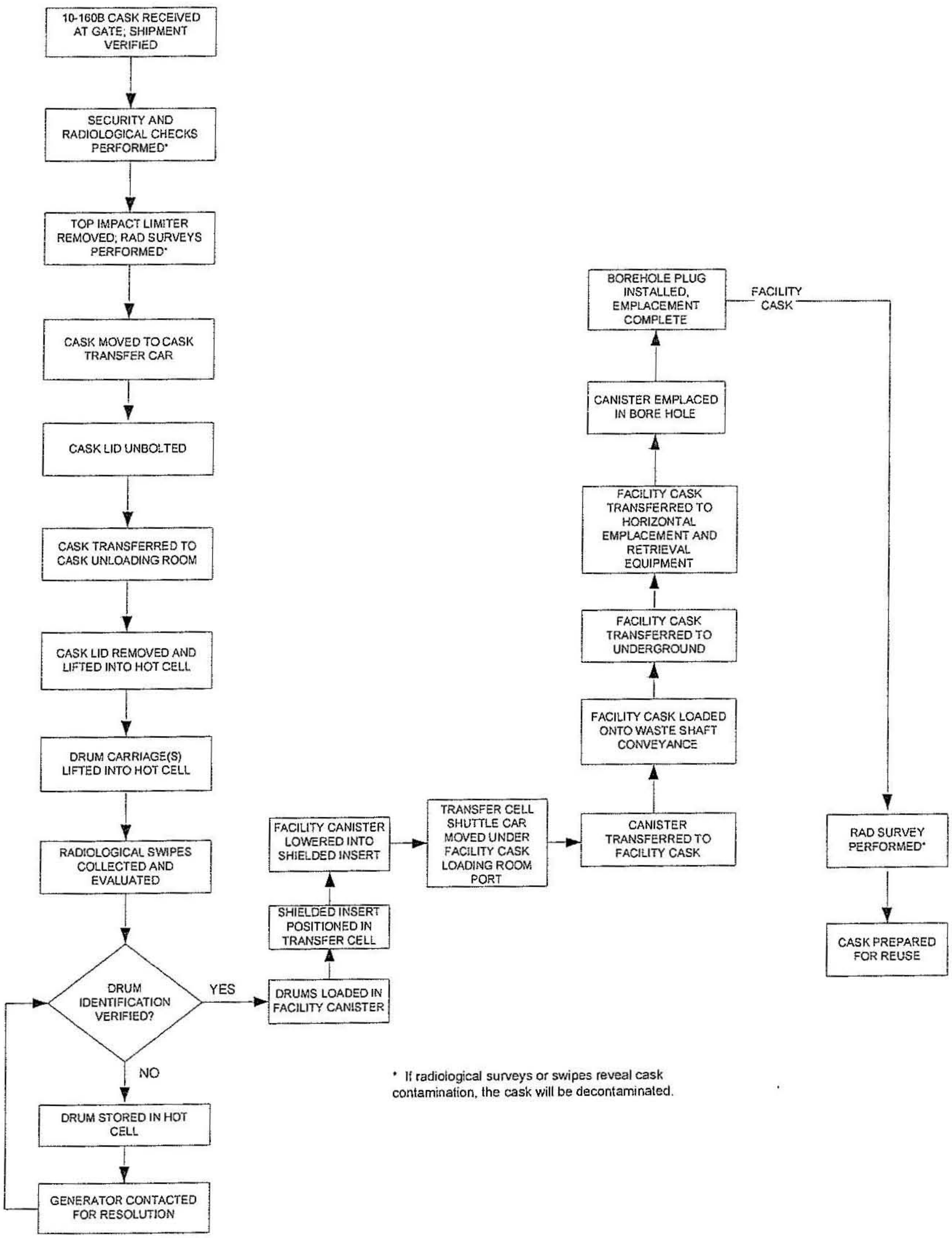


Figure M1-27
Surface and Underground RH Transuranic Mixed Waste Process Flow Diagram for CNS 10-160B Shipping Cask

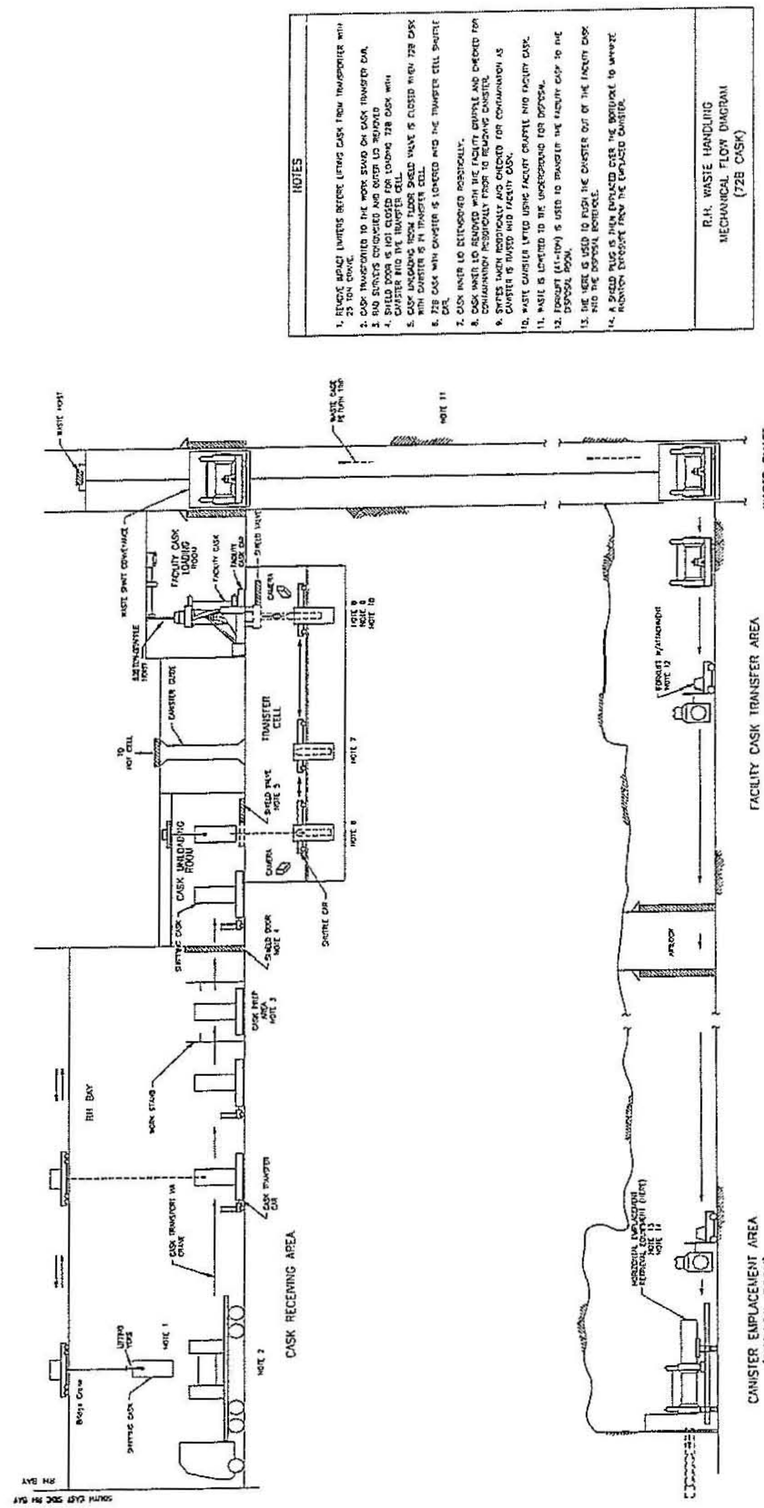


Figure M1-28
Schematic of the RH Transuranic Mixed Waste Process for RH-TRU 72-B Shipping Cask

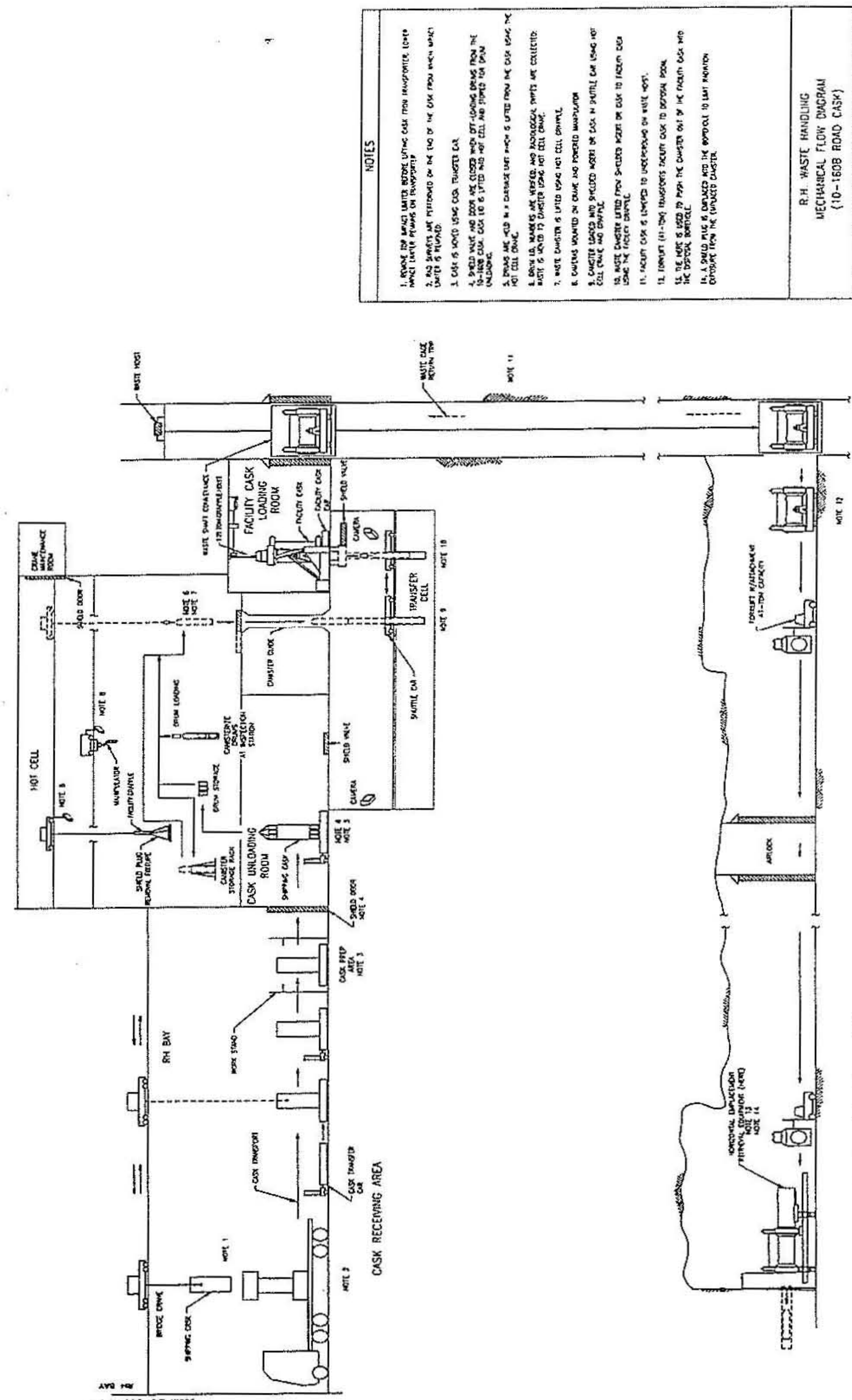


Figure M1-29
Schematic of the RH Transuranic Mixed Waste Process for CNS 10-160B Shipping Cask

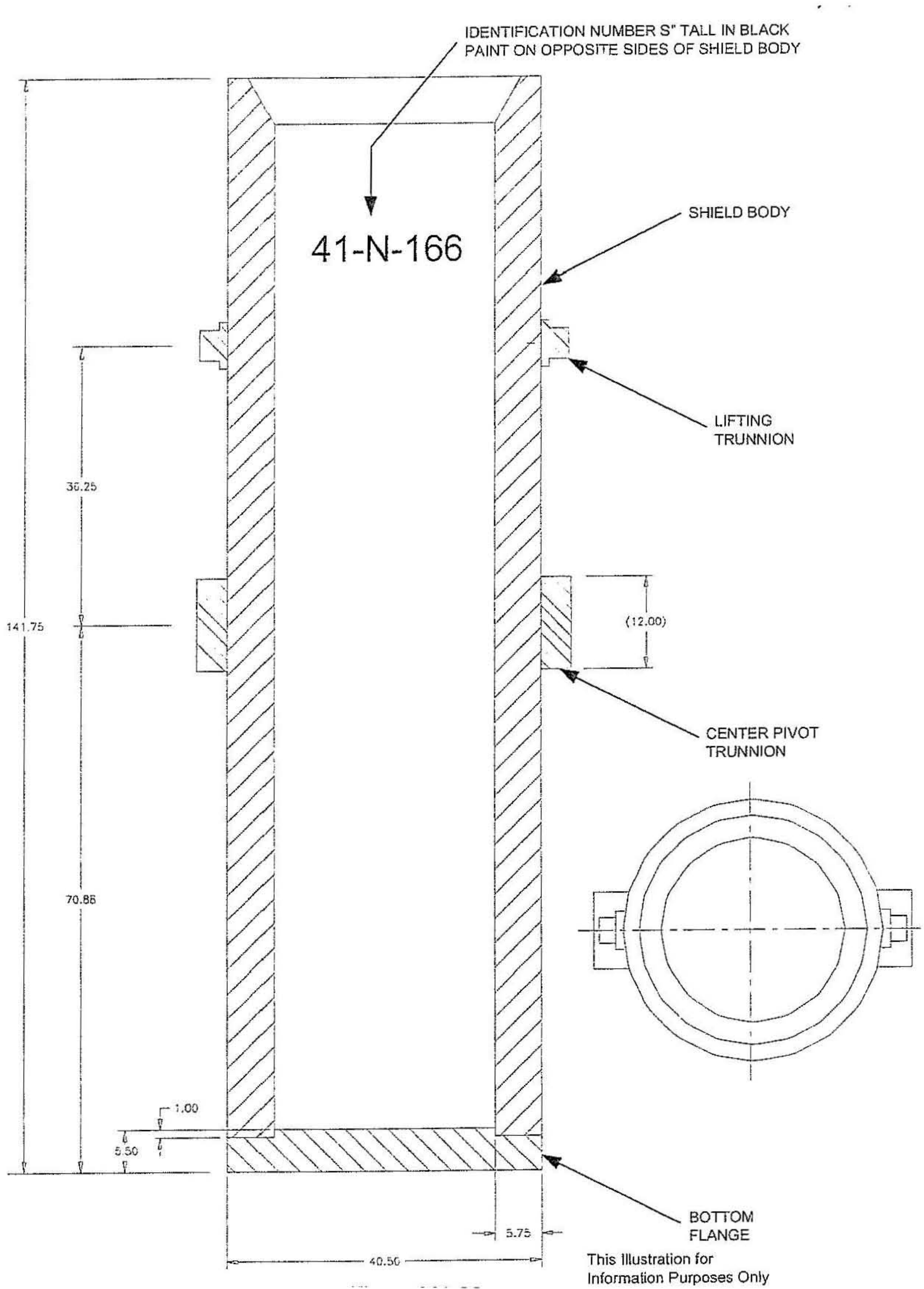


Figure M1-30
RH Shielded Insert Assembly

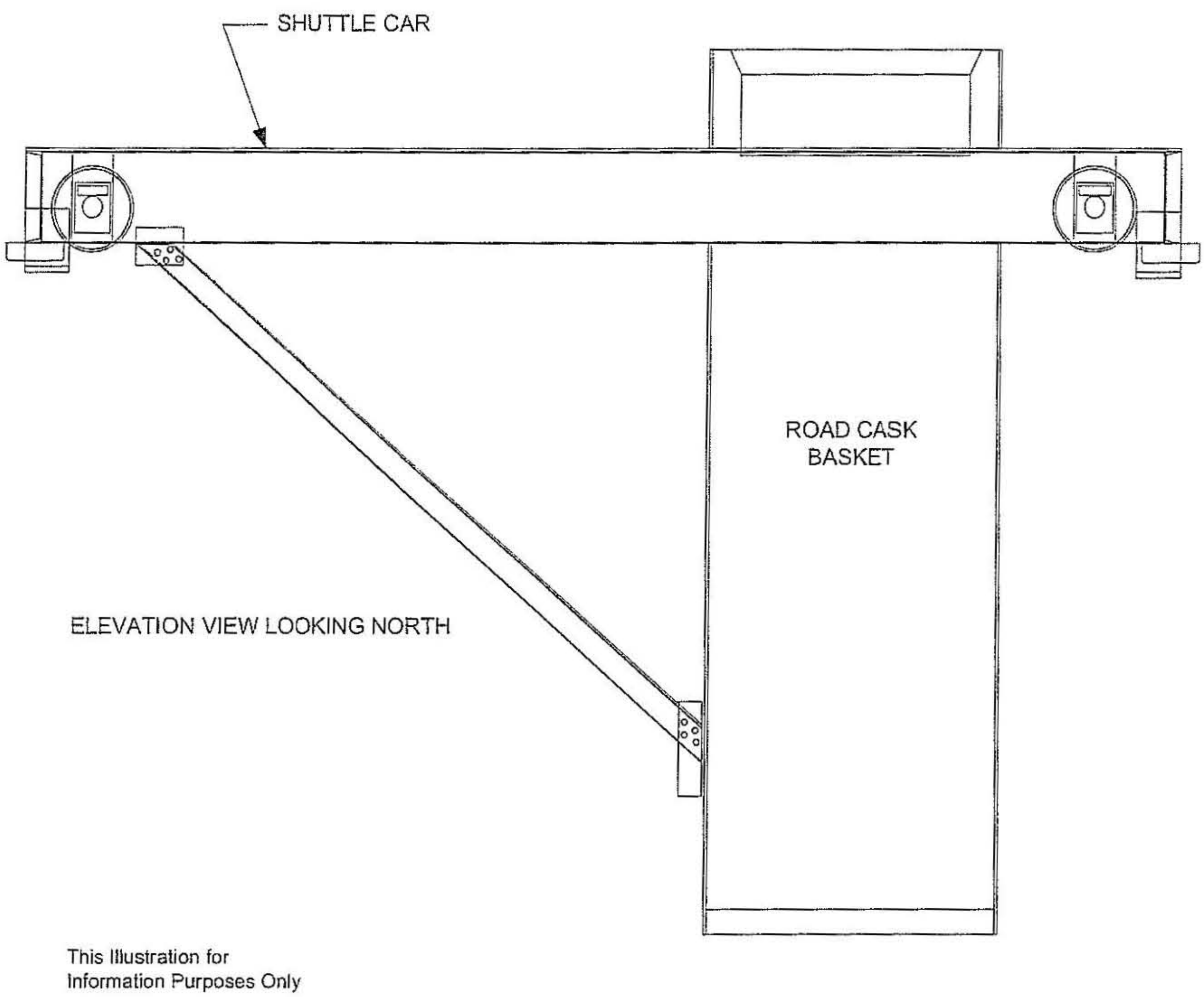


Figure M1-31
Transfer Cell Shuttle Car

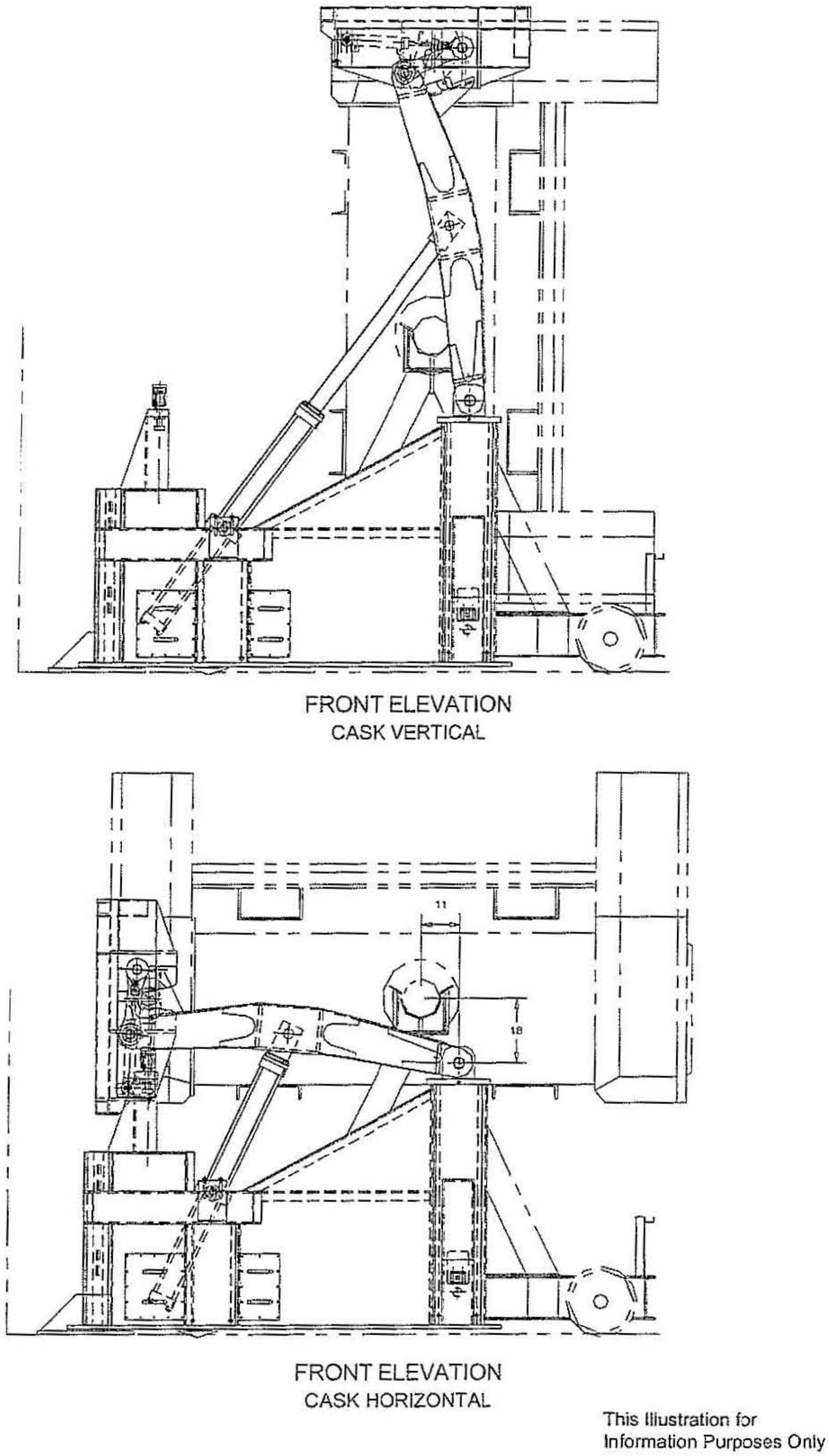


Figure M1-32
Facility Rotating Device

APPENDIX M2

GEOLOGIC REPOSITORY

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APPENDIX M2

GEOLOGIC REPOSITORY

TABLE OF CONTENTS

List of Tables

List of Figures

APPENDIX M2

GEOLOGIC REPOSITORY

M2-1 Description of the Geologic Repository

Management, storage, and disposal of transuranic (**TRU**) mixed waste in the Waste Isolation Pilot Plant (**WIPP**) geologic repository is subject to regulation under Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20.4.1 NMAC), Subpart V. The WIPP is a geologic repository mined within a bedded salt formation, which is defined in 20.4.1.101 NMAC (incorporating 40 CFR §260.10) as a miscellaneous unit. As such, HWMUs within the repository are eligible for permitting according to 20.4.1.101 NMAC (incorporating 40 CFR §260.10), and are regulated under 20.4.1.500 NMAC, Miscellaneous Units.

As required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601), the Permittees shall ensure that the environmental performance standards for a miscellaneous unit, which are applied to the Underground Hazardous Waste Disposal Units (**HWDUs**) in the geologic repository, will be met.

The Disposal Phase will consist of receiving contact-handled (**CH**) and remote-handled (**RH**) TRU mixed waste shipping containers, unloading and transporting the waste containers to the Underground HWDUs, emplacing the waste in the Underground HWDUs, and subsequently achieving closure of the Underground HWDUs in compliance with applicable State and Federal regulations.

The WIPP geologic repository is mined within a 2,000-feet (ft) (610-meters (m))-thick bedded-salt formation called the Salado Formation. The Underground HWDUs (miscellaneous units) are located 2,150 ft (655 m) beneath the ground surface. TRU mixed waste management activities underground will be confined to the southern portion of the 120-acre (~~48.5~~48.6 hectares) mined area during the Disposal Phase. During the ~~initial~~ second term of this Permit, disposal of ~~containers of CH~~ TRU mixed waste will occur only in ~~the seven HWDUs designated as~~ Panels 5 through 8 and in any currently active panel ~~1-7~~ (~~See~~ Figure M2-1). RH TRU mixed waste disposal began~~may begin~~ in Panel 4. ~~In the future, the Permittees may request a P~~p~~ermit to dispose of containers of CH and RH TRU mixed waste in additional panels that meet the definition of the HWDU in Permit Module IV. In addition, t~~The Permittees may also request in the future a ~~P~~permit to allow disposal of containers of TRU mixed waste in ~~the north-south entries marked as E-300, E-140, W-30, and W-170, between S-1600 and S-3650. These~~ areas ~~are referred to as the disposal area access drifts and have been designated as~~ Panels 9 and 10 ~~in~~ (Refer to Figure M2-1). This Renewal Application ~~Permit, during its initial 10-year term, authorizes~~ allows for the excavation of Panels ~~2~~1 through 10 and the disposal of waste in Panels 1 through ~~7~~8.

Panels 1 through ~~7~~8 will consist of seven rooms and two access drifts each. Panels 9 and 10 have yet to be designed. Access drifts connect the rooms and have the same cross section (see Section M2-2a(3)). The closure system installed in each HWDU after it is filled will prevent anyone from entering the HWDU and will stop ventilation airflow. The point of compliance for air emissions from the Underground is Sampling Station VOC-A, as defined in Renewal Application Chapter N (~~Confirmatory~~ Volatile Organic Compound Monitoring Plan). Sampling Station VOC-A is the location where the concentration of volatile organic compounds (VOCs) in the air emissions from the Underground HWDUs will be measured and then compared to the VOC concentration of concern as required in Renewal Application Chapter N. ~~by Permit Module IV.~~

Four shafts connect the underground area with the surface. The Waste Shaft Conveyance headframe and hoist are located within the Waste Handling Building (**WHB**) and will be used to transport containers of TRU mixed waste, equipment, and materials to the repository horizon. The waste hoist can also be used to transport personnel. The Air Intake Shaft and the Salt Handling Shaft provide ventilation to all areas of the mine except for the Waste Shaft Station. This area is ventilated by the Waste Shaft itself. The Salt Handling Shaft is also used to hoist mined salt to the surface and serves as the principal personnel transport shaft. The Exhaust Shaft serves as a common exhaust air duct for all areas of the mine. The relationship between the WIPP surface facility, the four shafts, and the geologic repository horizon is shown on Figure M2-2.

The HWDUs identified as Panels 1 through ~~7~~8 (Figure M2-1) provide room for up to ~~4,582,750~~ 4,929,745 cubic feet (ft^3) (~~129,750~~139,340 cubic meters (m^3)) of CH TRU mixed waste. The CH TRU mixed waste containers ~~(typically, 7-packs and standard waste boxes (**SWBs**))~~ may be stacked up to three-high across the width of the room. The maximum volume capacity for CH TRU mixed-waste in Panel 8 is 662,150 ft^3 (18,750m^3). The maximum volume capacity for RH TRU mixed-waste in Panel 8 is 22,950 ft^3 (7,080m^3).

Panels 4 through ~~7~~8 provide room for up to ~~70,100~~93,050 ft^3 (~~1,985~~2,635 m^3) of RH TRU mixed waste. RH TRU mixed waste may be disposed of in up to 730 boreholes per panel. ~~At a minimum, t~~These boreholes shall be drilled on nominal ~~eight~~8-foot (2.4 m) centers, horizontally, about mid-height in the ribs of a disposal room. The thermal loading from RH TRU mixed waste ~~shall~~ will not exceed 10 kilowatts per acre when averaged over the area of a panel, as shown in Renewal Application Appendix M3 (Drawing Number 51-W-214W Underground Facilities Typical Disposal Panel), plus ~~one hundred~~100 feet of each of a Panel's adjoining barrier pillars. See Table M2-1 for CH and RH TRU waste volume capacities for each Panel.

The WIPP facility is located in a sparsely populated area with site conditions favorable to isolation of TRU mixed waste from the biosphere. Geologic and hydrologic characteristics of the site related to its TRU mixed waste isolation capabilities are discussed in Section D-9a(1) of the WIPP RCRA Part B Permit Application (DOE, 1997). Hazard prevention programs are described in Permit Attachment E. Contingency and emergency response actions to minimize impacts of unanticipated events, such as spills, are described in Permit Attachment F. The closure plan for the WIPP facility is described in Permit Attachment I.

M2-2 Geologic Repository Design and Process Description

M2-2a Geologic Repository Design and Construction

The WIPP facility, when operated in compliance with the Permit, will ensure safe operations and be protective of human health and the environment.

As a part of the design validation process, geomechanical tests were conducted in SPDV test rooms. During the tests, salt creep rates were measured. Separation of bedding planes and fracturing were also observed. Consequently, a ground-control strategy was implemented. The ground-control program at the WIPP facility mitigates the potential for roof or rib falls and maintains normal excavation dimensions, as long as access to the excavation is possible.

M2-2a(1) CH TRU Mixed Waste Handling Equipment

The following are the major pieces of equipment used to manage CH TRU waste in the geologic repository. A summary of equipment capacities, as required by 20.4.1.500 NMAC is included in Table M2-1.

Facility Pallets

The facility pallet is a fabricated steel unit designed to support 7-packs, 3-packs, or 4-packs of drums, SWBs, or ten-drum overpacks (**TDOPs**), and has a rated load of 25,000 pounds (lbs.) (11,430 kilograms (kg)). The facility pallet will accommodate up to four 7-packs, four 3-packs, or four 4-packs of drums, four SWBs (in two stacks of two units), or two TDOPs. Loads are secured to the facility pallet during transport to the emplacement area. Facility pallets are shown in Figure M2-3. Fork pockets in the side of the pallet allow the facility pallet to be lifted and transferred by forklift to prevent direct contact between TRU mixed waste containers and forklift tines. This arrangement reduces the potential for puncture accidents. WIPP facility operational documents define the operational load of the facility pallet to ensure that the rated load of a facility pallet is not exceeded.

Backfill

Magnesium oxide (**MgO**) will be used as a backfill in order to provide chemical control over the solubility of radionuclides in order to comply with the requirements of 40 CFR §191.13. The MgO backfill will be purchased prepackaged in the proper containers for emplacement in the underground. Purchasing prepackaged backfill eliminates handling and placement problems associated with bulk materials, such as dust creation. In addition, prepackaged materials will be easier to emplace, thus reducing potential worker exposure to radiation. Should a backfill container be breached, MgO is benign and cleanup is simple. No hazardous waste would result from a spill of backfill.

The MgO backfill will be managed in accordance with Specification D-0101 (MgO Backfill Specification) and WP05-WH1025 (CH Waste Downloading and Emplacement). These documents are kept on file at the WIPP facility by the Permittees.

Backfill will be handled in accordance with standard operating procedures. Typical emplacement configurations are shown in Figures M2-5 and M2-5a.

Quality control will be provided within standard operating procedures to record that the correct number of sacks are placed and that the condition of the sacks is acceptable.

Backfill placed in this manner is protected until exposed when sacks are broken during creep closure of the room and compaction of the backfill and waste. Backfill in sacks utilizes existing techniques and equipment and eliminates operational problems such as dust creation and introducing additional equipment and operations into waste handling areas. There are no mine operational considerations (e.g. ventilation flow and control) when backfill is placed in this manner.

The Waste Shaft Conveyance

The hoist systems in the shafts and all shaft furnishings are designed to resist the dynamic forces of the hoisting system and to withstand a design-basis earthquake of 0.1 g. Appendix D2 of the WIPP RCRA Part B Permit Application (DOE, 1997) provided engineering design-basis earthquake report which provides the basis for seismic design of WIPP facility structures. The waste hoist is equipped with a control system that will detect malfunctions or abnormal operations of the hoist system (such as overtravel, overspeed, power loss, circuitry failure, or starting in a wrong direction) and will trigger an alarm that automatically shuts down the hoist.

The waste hoist moves the Waste Shaft Conveyance and is a multirope, friction-type hoist. A counterweight is used to balance the waste shaft conveyance. The waste shaft conveyance (outside dimensions) is 30 ft (9 m) high by 10 ft (3 m) wide by 15 ft (4.5 m) deep and can carry a payload of 45 tons (40,824 kg). During loading and unloading operations, it is steadied by fixed guides. The hoist's maximum rope speed is 500 ft (152.4 m) per min.

The Waste Shaft hoist system has two sets of brakes, with two units per set, plus a motor that is normally used to stop the hoist. The brakes are designed so that either set, acting alone, can stop a fully loaded conveyance under all emergency conditions.

The Underground Waste Transporter

The underground waste transporter is a commercially available diesel-powered tractor. The trailer was designed specifically for the WIPP for transporting facility pallets from the waste shaft conveyance to the Underground HWDU in use. This transporter is shown in Figure M2-6.

Underground Forklifts

CH TRU mixed waste containers loaded on slipsheets will be removed from the facility pallets using forklifts with a push-pull attachment (Figure M2-7) attached to the forklift-truck front carriage. The push-pull attachment grips the edge of the slipsheet (on which the waste containers sit) to pull the containers onto the platen. After the forklift moves the waste containers to the emplacement location, the push-pull attachment pushes the containers into position. The use of the push-pull attachment prevents direct contact between waste containers and forklift tines. SWBs and TDOPs may also be removed from the facility pallet by using forklifts equipped with special adapters for these containers. These special adapters will prevent direct contact between SWBs or TDOPs and forklift tines. In addition, the low clearance forklift that is used to emplace MgO may be used to emplace waste if necessary.

M2-2a(2) Shafts

The WIPP facility uses four shafts: the Waste Shaft, the Salt Handling Shaft, the Air Intake Shaft, and the Exhaust Shaft. These shafts are vertical openings that extend from the surface to the repository level.

The Waste Shaft is located beneath the WHB and is 19 to 20 ft (5.8 to 6.1 m) in diameter. The Salt Handling Shaft, located north of the Waste Shaft beneath the salt handling headframe, is 10 to 12 ft (3 to 3.6 m) in diameter. Salt mined from the repository horizon is removed through the Salt Handling Shaft. The Salt Handling Shaft is the main personnel and materials hoist and also serves as a secondary-supply air duct for the underground areas. The Air Intake Shaft, northwest of the WHB, varies in diameter from 16 ft 7 in. (4.51 m) to 20 ft 3 in. (6.19 m) and is the primary source of fresh air underground. The Exhaust Shaft, east of the WHB, is 14 to 15 ft (4.3 to 4.6 m) in diameter and serves as the exhaust duct for the underground air.

Openings excavated in salt experience closure because of salt creep (or time-dependent deformation at constant load). The closure affects the design of all of the openings discussed in this section. Underground excavation dimensions, therefore, are nominal, because they change with time. The unlined portions of the shafts have larger diameters than the lined portions, which allows for closure caused by salt creep. Each shaft includes a shaft collar, a shaft lining, and a shaft key section. The Final Design Validation Report in Appendix D1 of the WIPP RCRA Part B Permit Application (DOE, 1997) discusses the shafts and shaft components in greater detail.

The reinforced-concrete shaft collars extend from the surface to the top of the underlying consolidated sediments. Each collar serves to retain adjacent unconsolidated sands and soils and to prevent surface runoff from entering the shafts. The shaft linings extend from the base of the collar to the top of the salt beds approximately 850 ft (259 m) below the surface. Grout injected behind the shaft lining retards water seeping into the shafts from water-bearing formations, and the liner is designed to withstand the natural water pressure associated with these formations. The shaft liners are concrete, except in the Salt Handling Shaft, where a steel shaft liner has been grouted in place.

The shaft key is a circular reinforced concrete section emplaced in each shaft below the liner in the base of the Rustler and extending about 50 ft (15 m) into the Salado. The key functions to resist lateral pressures and assures that the liner will not separate from the host rocks or fail under tension. This design feature also aids in preventing the shaft from becoming a route for groundwater flow into the underground facility.

On the inside surface of each shaft, excluding the Salt Handling Shaft, there are three water-collection rings: one just below the Magenta, one just below the Culebra, and one at the lowermost part of the key section. These collection rings will collect water that may seep into the shaft through the liner. The Salt Handling Shaft has a single water collection ring in the lower part of the key section. Water collection rings are drained by tubes to the base of the shafts where the water is accumulated.

WIPP shafts and other underground facilities are, for all practical purposes, dry. Minor quantities of water (which accumulate in some shaft sumps) are insufficient to affect the waste disposal area. This water is collected, brought to the surface, and disposed of in accordance with current standards and regulations.

The Waste Shaft is protected from precipitation by the roof of the waste shaft conveyance headframe tower. The Exhaust Shaft is configured at the top with a 14 ft- (4.3 m-) diameter duct that diverts air into the exhaust filtration system or to the atmosphere, as appropriate. The Salt Handling and Air Intake Shaft collars are open except for the headframes. Rainfall into the shafts is evaporated by ventilation air.

M2-2a(3) Subsurface Structures

The subsurface structures in the repository, located at 2,150 ft (655 m) below the surface, include the HWDUs, the northern experimental areas, and the support areas. Appendix D3 of the WIPP RCRA Part B Permit Application (DOE, 1997) provided details of the underground layout. Figure M2-8 shows the proposed waste emplacement configuration for the HWDUs.

The status of important underground equipment, including fixed fire-protection systems, the ventilation system, and contamination detection systems, will be monitored by a central monitoring system, located in the Support Building adjacent to the WHB. Backup power will be provided as discussed in Permit Attachment E. The subsurface support areas are constructed and maintained to conform to Federal mine safety codes.

Underground Hazardous Waste Disposal Units (HWDUs)

During the ~~initial~~ terms of this and the preceding Permit, the volume of CH TRU mixed waste emplaced in the repository will not exceed ~~4,582,750~~4,920,745 ft^3 (~~129,750~~139,340 m^3) and the volume of RH TRU mixed waste shall not exceed ~~70,100~~93,050 ft^3 (~~1,985~~2,635 m^3). CH TRU mixed waste will be disposed of in up to ~~7~~four Underground HWDUs identified as Panels ~~1~~5 through ~~7~~8 and in any currently active panel. The RH TRU mixed waste may be disposed of in Panels 4 through ~~7~~8.

Main entries and cross cuts in the repository provide access and ventilation to the HWDUs. The main entries link the shaft pillar/service area with the TRU mixed waste management area and are separated by pillars. Normal entries are 12 ft (3.7 m) to 13 ft (4.0 m) high and 14 ft (4.3 m) to 16 ft (4.9) wide. Each of the Underground HWDUs labeled Panels 1 through 7 will have seven rooms. The locations of these HWDUs are shown in Figure M2-1. The rooms will have nominal dimensions of 13 ft (4.0 m) high by 33 ft (10 m) wide by 300 ft (91 m) long and will be supported by 100 ft- (30 m-) wide pillars.

As currently planned, future Permits may allow disposal of TRU mixed waste containers in three additional panels, identified as Panels 8, 9, and 10. Disposal of TRU mixed waste in Panels 8, 9, and 10 is prohibited under this Permit. If waste volumes disposed of in the eight panels fail to reach the stated design capacity, the Permittees may request a Permit to allow disposal of TRU mixed waste in the four main entries and crosscuts adjacent to the waste panels (referred to as the disposal area access drifts). These areas are labeled Panels 9 and 10 in Figure M2-1. This Permit allows only the construction of Panels 9 and 10 and prohibits disposal of TRU mixed waste in Panels 9 and 10. A permit modification or future permit would be submitted describing the condition of those drifts and the controls exercised for personnel safety and environmental protection while disposing of waste in these areas. These areas have the following nominal dimensions:

E-300 will be mined to be 14 ft (4.3 m) to 16 ft (4.9 m) wide and 12 ft (3.7 m) to 13 ft (4.0 m) high
E-140 is mined to 25 ft (7.6 m) wide by 13 ft (4 m) high
W-030 and W-170 will be similar to E-300.

All extend from S-1600 to S-3650 (i.e., 2050 ft long [625 m]). Crosscuts (east-west entries) will be 20 ft (6.1 m) wide by 13 ft (4 m) high by 470 ft (143 m) long. The layout of these excavations is shown on Figure M2-1.

Panel 1 is the first HWMU to be used for waste disposal and was excavated from 1986 through 1988. The panels may be mined in the following order:
Panel 10 (disposal area access drift)
Panel 2
Panel 9 (disposal area access drift)
Panel 3
Panel 4
Panel 5
Panel 6
Panel 7
Panel 8

Underground Facilities Ventilation System

The underground facilities ventilation system will provide a safe and suitable environment for underground operations during normal WIPP facility operations. The underground system is designed to provide control of potential airborne contaminants in the event of an accidental release or an underground fire.

The main underground ventilation system is divided into four separate flows (Figure M2-9): one flow serving the mining areas, one serving the northern experimental areas, one serving the disposal areas, and one serving the Waste Shaft and station area. The four main airflows are recombined near the bottom of the Exhaust Shaft, which serves as a common exhaust route from the underground level to the surface.

Underground Ventilation System Description

The underground ventilation system consists of six centrifugal exhaust fans, two identical HEPA-filter assemblies arranged in parallel, isolation dampers, a filter bypass arrangement, and associated ductwork. The six fans, connected by the ductwork to the underground exhaust shaft so that they can independently draw air through the Exhaust Shaft, are divided into two groups. One group consists of three main exhaust fans, two of which are utilized to provide the nominal air flow of 425,000 standard ft^3 per min (SCFM) throughout the WIPP facility underground during normal operation. One main fan may be operated in the alternate mode to provide 260,000 SCFM underground ventilation flow. These fans are located near the Exhaust Shaft. The second group consists of the remaining three filtration fans, and each can provide 60,000 SCFM of air flow. These fans, located at the Exhaust Filter Building, are capable of being employed during the filtration mode, where exhaust is diverted through HEPA filters, or in the reduced or minimum ventilation mode where air is not drawn through the HEPA filters. In order to ensure the miscellaneous unit environmental performance standards are met, a minimum running annual average exhaust rate of 260,000 SCFM will be maintained.

The underground mine ventilation is designed to supply sufficient quantities of air to all areas of the repository. During normal operating mode (simultaneous mining and waste emplacement operations), approximately 140,000 actual ft^3 (3,962 m^3) per min can be supplied to the panel area. This quantity is necessary in order to support the level of activity and the pieces of diesel equipment that are expected to be in operation.

At any given time during waste emplacement activities, there may be significant activities in multiple rooms in a panel. For example, one room may be receiving CH TRU mixed waste containers, another room may be receiving RH TRU mixed waste canisters, and the drilling of RH TRU mixed waste emplacement boreholes may be occurring in another room. The remaining rooms in a panel will either be completely filled with waste; be idle, awaiting waste handling operations; or being prepared for waste receipt. A minimum ventilation rate of 35,000 ft^3 (990 m^3) per minute will be maintained in each room where waste disposal is taking place when workers are present in the room. This quantity of air is required to support the numbers and types of diesel equipment that are expected to be in operation in the area, to support the underground personnel working in that area, and to exceed a minimum air velocity of 60 ft (18 m) per minute as specified in the WIPP Ventilation Plan. The remainder of the air is needed in order to account for air leakage through inactive rooms.

Air will be routed into a panel from the intake side. Air is routed through the individual rooms within a panel using underground bulkheads and air regulators. Bulkheads are constructed by erecting framing of rectangular steel tubing and screwing galvanized sheet metal to the framing. Bulkhead members use telescoping extensions that are attached to framing and the salt which adjust to creep. Rubber or sheet metal attached to the bulkhead on one side and the salt on the other completes the seal of the ventilation. Where controlled airflow is required, a louver-style damper on a slide-gate (sliding panel) regulator is installed on the bulkhead. Personnel access is available through most bulkheads, and vehicular access is possible through selected bulkheads. Vehicle roll-up doors in the panel areas are not equipped with warning bells or strobe lights since these doors are to be used for limited periodic maintenance activities in the return air path. Flow is also controlled using brattice cloth barricades. These consist of chainlink fence that is bolted to the salt and covered with brattice cloth; and are used in instances where the only flow control requirement is to block the air. A brattice cloth air barricade is shown in Figure M2-11. Ventilation will be maintained only in all active rooms within a panel until waste emplacement activities are completed and the panel-closure system is installed. The air will be routed simultaneously through all the active rooms within the panel. The rooms that are filled with waste will be isolated from the ventilation system, while the rooms that are actively being filled will receive a minimum of 35,000 SCFM of air when workers are present to assure worker safety. After all rooms within a panel are filled, the panel will be closed using a closure system described Permit Attachment I and Permit Attachment I1.

Once a disposal room is filled and is no longer needed for emplacement activities, it will be barricaded against entry and isolated from the mine ventilation system by removing the air regulator bulkhead and constructing chain link/brattice cloth barricades at each end. There is no requirement for air for these rooms since personnel and/or equipment will not be in these areas.

The ventilation path for the waste disposal side is separated from the mining side by means of air locks, bulkheads, and salt pillars. A pressure differential is maintained between the mining side and the waste disposal side to ensure that any leakage is towards the disposal side. The pressure differential is produced by the surface fans in conjunction with the underground air regulators.

<u>Underground Ventilation Modes of Operation</u>

The underground ventilation system is designed to perform under two types of operation: normal (the HEPA exhaust filtration system is bypassed), and filtered (the exhaust is filtered through the HEPA filtration system, if radioactive contaminants are detected or suspected.

Overall, there are six possible modes of exhaust fan operation:

- 2 main fans in operation
- 1 main fan in operation
- 1 filtration fan in filtered operation
- 1 filtration fan in unfiltered operation

- 2 filtration fans in unfiltered operation
- 1 main and 1 filtration fan (unfiltered) in operation

Under some circumstances (such as power outages and maintenance activities, etc.), all mine ventilation may be discontinued for short periods of time.

In the normal mode, two main surface exhaust fans, located near the Exhaust Shaft, will provide continuous ventilation of the underground areas. All underground flows join at the bottom of the Exhaust Shaft before discharge to the atmosphere.

Outside air will be supplied to the mining areas and the waste disposal areas through the Air Intake Shaft, the Salt Handling Shaft, and access entries. A small quantity of outside air will flow down the Waste Shaft to ventilate the Waste Shaft station. The ventilation system is designed to operate with the Air Intake Shaft as the primary source of fresh air. Under these circumstances, sufficient air will be available to simultaneously conduct all underground operations (e.g., waste handling, mining, experimentation, and support). Ventilation may be supplied by operating one main exhaust fan, or one or two filtration exhaust fans, or an combination of the three.

If the nominal flow of 425,000 cfm (12,028 m^3/min) is not available (i.e., only one of the main ventilation fans is available) underground operations may proceed, but the number of activities that can be performed in parallel may be limited depending on the quantity of air available. Ventilation may be supplied by operating one or two of the filtration exhaust fans. To accomplish this, the isolation dampers will be opened, which will permit air to flow from the main exhaust duct to the filter outlet plenum. The filtration fans may also be operated to bypass the HEPA plenum. The isolation dampers of the filtration exhaust fan(s) to be employed will be opened, and the selected fan(s) will be switched on. ln this mode, underground operations will be limited, because filtration exhaust fans cannot provide sufficient airflow to support the use of diesel equipment.

In the filtration mode, the exhaust air will pass through two identical filter assemblies, with only one of the three Exhaust Filter Building filtration fans operating (all other fans are stopped). This system provides a means for removing the airborne particulates that may contain radioactive and hazardous waste contaminants in the reduced exhaust flow before they are discharged through the exhaust stack to the atmosphere. The filtration mode is activated manually or automatically if the radiation monitoring system detects abnormally high concentrations of airborne radioactive particulates (an alarm is received from the continuous air monitor in the exhaust drift of the active waste panel) or a waste handling incident with the potential for a waste container breach is observed. The filtration mode is not initiated by the release of gases such as VOCs.

<u>Underground Ventilation Normal Mode Redundancy</u>

The underground ventilation system has been provided redundancy in normal ventilation mode by the addition of a third main fan. Ductwork leading to that new fan ties into the existing main exhaust duct. Documentation for this addition of a third fan and associated ductwork will be submitted to NMED before receipt of TRU mixed waste.

Electrical System

The WIPP facility uses electrical power (utility power) supplied by the regional electric utility company. If there is a loss of utility power, TRU mixed waste handling and related operations will cease.

Backup, alternating current power will be provided on site by two 1,100-kilowatt diesel generators. These units provide 480-volt power with a high degree of reliability. Each of the diesel generators can carry predetermined equipment loads while maintaining additional power reserves. Predetermined loads include lighting and ventilation for underground facilities, lighting and ventilation for the TRU mixed waste handling areas, and the Air Intake Shaft hoist. The diesel generator can be brought on line within 30 minutes either manually or from the control panel in the Central Monitoring Room (CMR).

Uninterruptible power supply units are also on line providing power to predetermined monitoring systems. These systems ensure that the power to the radiation detection system for airborne contamination, the local processing units, the computer room, and the CMR will always be available, even during the interval between the loss of off-site power and initiation of backup diesel generator power.

M2-2a(4) RH TRU Mixed Waste Handling Equipment

The following are the major pieces of equipment used to manage RH TRU mixed waste in the geologic repository. A summary of equipment capacities is included in Table M2-3.

The Facility Cask Transfer Car

The Facility Cask Transfer Car is a self-propelled rail car (Figure M2-14) that operates between the Facility Cask Loading Room and the geologic repository. After the Facility Cask is loaded, the Facility Cask Transfer Car moves onto the waste shaft conveyance and is then transported underground. At the underground waste shaft station, the Facility Cask Transfer Car proceeds away from the waste shaft conveyance to provide forklift access to the Facility Cask.

Horizontal Emplacement and Retrieval Equipment

The Horizontal Emplacement and Retrieval Equipment (**HERE**) (Figure M2-15) emplaces canisters into a borehole in a room wall of an Underground HWDU. Once the canisters have been emplaced, the HERE then fills the borehole opening with a shield plug.

M2-2b Geologic Repository Process Description

Prior to receipt of TRU mixed waste at the WIPP facility, waste operators will be thoroughly trained in the safe use of TRU mixed waste handling and transport equipment. The training will include both classroom training and on-the-job training.

RH TRU Mixed Waste Emplacement

The Facility Cask Transfer Car is loaded onto the waste shaft conveyance and is lowered to the waste shaft station underground. At the waste shaft station underground, the Facility Cask is moved from the waste shaft conveyance by the Facility Cask Transfer Car (Figure M2-16). A forklift is used to remove the Facility Cask from the Facility Cask Transfer Car and to transport the Facility Cask to the Underground HWDU. There, the Facility Cask is placed on the HERE (Figure M2-17). The HERE is used to emplace the RH TRU mixed waste canister into the borehole. The borehole will be visually inspected for obstructions prior to aligning the HERE and emplacement of the RH TRU mixed waste canister. The Facility Cask is moved forward to mate with the shield collar, and the transfer carriage is advanced to mate with the rear Facility Cask shield valve. The shield valves on the Facility Cask are opened, and the transfer mechanism advances to push the canister into the borehole. After retracting the transfer mechanism into the Facility Cask, the forward shield valve is closed, and the transfer mechanism is further retracted into its housing. The transfer mechanism is moved to the rear, and the shield plug carriage containing a shield plug is placed on the emplacement machine. The transfer mechanism is used to push the shield plug into the Facility Cask. The front shield valve is opened, and the shield plug is pushed into the borehole (Figure M2-18). The transfer mechanism is retracted, the shield valves close on the Facility Cask, and the Facility Cask is removed from the HERE.

A shield plug is a concrete filled cylindrical steel shell (Figure M2-21) approximately 61 in. long and 29 in. in diameter, made of concrete shielding material inside a 0.24 in. thick steel shell with a removable pintle at one end. Each shield plug has integral forklift pockets and weighs approximately 3,750 lbs. The shield plug is inserted with the pintle end closest to the HERE to provide the necessary shielding , limiting the borehole radiation dose rate at 30 cm to less than 10 mrem per hour for a canister surface dose rate of 100 rem/hr . Additional shielding is provided at the direction of the Radiological Control Technician based on dose rate surveys following shield plug emplacement. This additional shielding is provided by the manual emplacement of one or more shield plug supplemental shielding plates and a retainer (Figures M2-19 and M2-20).

The amount of RH TRU mixed waste disposal in each panel is limited based on thermal and geomechanical considerations and shall not exceed 10 kilowatts per acre as described in Permit Attachment M2-1. RH TRU mixed waste emplacement boreholes shall be drilled in the ribs of the panels at a nominal spacing of 8 ft (2.4 m) center-to-center, horizontally.

Figures M1-26 and M1-27 are flow diagrams of the RH TRU mixed waste handling process for the RH-TRU 72-B and CNS 10-160B casks, respectively.

CH TRU Mixed Waste Emplacement

CH TRU mixed waste containers will arrive by tractor-trailer at the WIPP facility in sealed shipping containers (e.g., TRUPACT-IIs or HalfPACTs), at which time they will undergo security and radiological checks and shipping documentation reviews. The trailers carrying the shipping containers will be stored temporarily at the Parking Area Container Storage Unit

(Parking Area Unit). A forklift will remove the Contact Handled Packages from the transport trailers and will transport them into the Waste Handling Building Container Storage Unit for unloading of the waste containers. Each TRUPACT-II may hold up to two 7-packs, two 4-packs, two 3-packs, two SWBs, or one TDOP. Each HalfPACT may hold up to seven 55-gal (208 L) drums, one SWB, or four 85-gal (321 L) drums. An overhead bridge crane will be used to remove the waste containers from the Contact Handled Packaging and place them on a facility or containment pallet. Each facility pallet has two recessed pockets to accommodate two sets of 7-packs, two sets of 3-packs, two sets of 4-packs, two SWBs stacked two-high, or two TDOPs. Each stack of waste containers will be secured prior to transport underground (see Figure M2-3). A forklift or the facility transfer vehicle will transport the loaded facility pallet to the conveyance loading room adjacent to the Waste Shaft. The facility transfer vehicle will be driven onto the waste shaft conveyance deck, where the loaded facility pallet will be transferred to the waste shaft conveyance, and the facility transfer vehicle will be backed off. Containers of CH TRU mixed waste (55-gal (208 L) drums, SWBs, 85-gal (321 L) drums, 100-gal (379 L) drums, and TDOPs) can be handled individually, if needed, using the forklift and lifting attachments (i.e., drum handlers, parrot beaks).

The waste shaft conveyance will lower the loaded facility pallet to the underground. At the waste shaft station, the CH TRU underground transporter will back up to the waste shaft conveyance, and the facility pallet will be transferred from the waste shaft conveyance onto the transporter (see Figure M2-6). The transporter will then move the facility pallet to the appropriate Underground HWDU for emplacement.

A forklift in the HWDU near the waste stack ~~will be~~is used to remove the waste containers from the facility pallets and to place them in the waste stack using a push-pull attachment. The waste ~~will be~~is emplaced room by room in Panels 1 through ~~7~~8 and any other active disposal room. Each panel will be closed off when filled. If a waste container is damaged during the Disposal Phase, it will be immediately overpacked or repaired. The CH TRU mixed waste containers will be continuously vented. The filter vents will allow aspiration, preventing internal pressurization of the container and minimizing the buildup of flammable gas concentrations.

Once a waste panel is mined and any initial ground control established, flow regulators will be constructed to assure adequate control over ventilation during waste emplacement activities. The first room to be filled with waste will be Room 7, which is the one that is farthest from the main access ways. A ventilation control point will be established for Room 7 just outside the exhaust side of Room 6. This ventilation control point will consist of a bulkhead with a ventilation regulator. When RH TRU mixed waste canister emplacement is completed in a room, CH TRU mixed waste emplacement can begin in that room. Stacking of CH waste will begin at the ventilation control point and proceed down the access drift, through the room and up the intake access drift until the entrance of Room 6 is reached. At that point, a brattice cloth and chain link barricade will be emplaced. This process will be repeated for Room 6, and so on until Room 1 is filled. At that point, the panel closure system will be constructed.

The emplacement of CH TRU mixed waste into the HWDUs will typically be in the order received and unloaded from the Contact Handled Packaging. There is no specification for the amount of space to be maintained between the waste containers themselves, or between the waste containers and the walls. Containers will be stacked in the best manner to provide stability for the stack (which is up to three containers high) and to make best use of available space. It is anticipated that the space between the wall and the container could be from 8 to 18 in. (20 to 46 cm). This space is a function of disposal room wall irregularities, container type, and sequence of emplacement. Bags of backfill will occupy some of this space. Space is required over the stacks of containers to assure adequate ventilation for waste handling operations. A minimum of 16 in. (41 cm) was specified in the Final Design Validation Report (Appendix D1, Chapter 12 of the WIPP RCRA Part B Permit Application (DOE, 1997)) to maintain air flow. Typically, the space above a stack of containers will be 36 to 48 in. (90 to 122 cm). However 18 in. (0.45 m) will contain backfill material consisting of bags of Magnesium Oxide (MgO). Figure M2-8 shows a typical container configuration, although this figure does not mix containers on any row. Such mixing, while inefficient, will be allowed to assure timely movement of waste into the underground. No aisle space will be maintained for personnel access to emplaced waste containers. No roof maintenance behind stacks of waste is planned.

The anticipated schedule for the filling of each of the Underground HWDUs known as Panels 1 through 7 is shown in Permit Attachment I, Table I-1. Panel closure in accordance with the Closure Plan in Permit Attachment I and Permit Attachment I1 is estimated to require an additional 150 days.

Figure M2-12 is a flow diagram of the CH TRU mixed waste handling process.

M2-3 Waste Characterization

TRU mixed waste characterization is described in Permit Attachment B.

M2-4 Treatment Effectiveness

TRU mixed waste treatment, as defined in 20.4.1.101 NMAC (incorporating 40 CFR §260.10), for which a permit is required, will not be performed at the WIPP facility.

M2-5 Maintenance, Monitoring, and Inspection

M2-5a Maintenance

M2-5a(1) Ground-Control Program

The ground-control program at the WIPP facility will ensure that any room in an HWDU in which waste will be placed will be sufficiently supported to assure compliance with the applicable portions of the Land Withdrawal Act (**LWA**), which requires a regular review of roof-support plans and practices by the Mine Safety and Health Administration (**MSHA**). Support is installed to the requirements of 30 CFR §57, Subpart B.

M2-5b Monitoring

M2-5b(1) Groundwater Monitoring

Groundwater monitoring for the WIPP Underground HWDUs will be conducted in accordance with Module V and Permit Attachment L of this permit.

M2-5b(2) Geomechanical Monitoring

The geomechanical monitoring program at the WIPP facility is an integral part of the ground-control program (See Figure M2-13). HWDUs, drifts, and geomechanical test rooms will be monitored to provide confirmation of structural integrity. Geomechanical data on the performance of the repository shafts and excavated areas will be collected as part of the geotechnical field-monitoring program. The results of the geotechnical investigations will be reported annually. The report will describe monitoring programs and geomechanical data collected during the previous year.

M2-5b(2)(a) Description of the Geomechanical Monitoring System

The Geomechanical Monitoring System (**GMS**) provides in situ data to support the continuous assessment of the design for underground facilities. Specifically, the GMS provides for:

- Early detection of conditions that could affect operational safety
- Evaluation of disposal room closure that ensures adequate access
- Guidance for design modifications and remedial actions
- Data for interpreting the behavior of underground openings, in comparison with established design criteria

The instrumentation in Table M2-2 is available for use in support of the geomechanical program.

The minimum instrumentation for each of the eight panels will be one borehole extensometer installed in the roof at the center of each disposal room. The roof extensometers will monitor the dilation of the immediate salt roof beam and possible bed separations along clay seams. Additional instrumentation will be installed as conditions warrant.

Remote polling of the geomechanical instrumentation will be performed at least once every month. This frequency may be increased to accommodate any changes that may develop.

The results from the remotely read instrumentation will be evaluated after each scheduled polling. Documentation of the results will be provided annually in the Geotechnical Analysis Report.

Data from remotely read instrumentation will be maintained as part of a geotechnical instrumentation system. The instrumentation system provides for data maintenance, retrieval, and presentation. The Permittees will retrieve the data from the instrumentation system and verify data accuracy by confirming the measurements were taken in accordance with applicable instructions and equipment calibration is known. Next, the Permittees will review the data after each polling to assess the performance of the instrument and of the excavation. Anomalous data will be investigated to determine the cause (instrumentation problem, error in recording, changing rock conditions). The Permittees will calculate various parameters such as the change between successive readings and deformation rates. This assessment will be reported to the Permittees' cognizant ground control engineer and operations personnel. The Permittees will investigate unexpected deformation to determine if remediation is needed.

The stability of an open panel excavation is generally determined by the rock deformation rate. The excavation may be unstable when there is a continuous increase in the deformation rate that cannot be controlled by the installed support system. The Permittees will evaluate the performance of the excavation. These evaluations assess the effectiveness of the roof support system and estimate the stand-up time of the excavation. If an open panel shows the trend is toward adverse (unstable) conditions, the results will be reported to determine if it is necessary to terminate waste disposal activities in the open panel. This report of the trend toward adverse conditions in an open HWDU will also be provided to the Secretary of the NMED within seven (7) calendar days of issuance of the report.

M2-5b(2)(b) System Experience

Much experience in the use of geomechanical instrumentation was gained as the result of performance monitoring of Panel 1, which began at the time of completion of the panel excavation in 1988. The monitoring system installed at that time involved simple measurements and observations (e.g., vertical and horizontal convergence rates, and visual inspections). Minimal maintenance of instrumentation is required, and the instrumentation is easily replaced if it malfunctions. Conditions throughout Panel 1 are well known. The monitoring program continues to provide data to compare the performance of Panel 1 with that established elsewhere in the underground. Panel 1 performance is characterized by the following:

- The development of bed separations and lateral shifts at the interfaces of the salt and the clays underlying the anhydrites "a" and "b."
- Room closures. A closure due only to the roof movement will be separated from the total closure.
- The behavior of the pillars.
- Fracture development in the roof and floor.
- Distribution of load on the support system.

Roof conditions are assessed from observation boreholes and extensometer measurements. Measurements of room closure, rock displacements, and observations of fracture development in the immediate roof beam are made and used to evaluate the performance of a panel. A description of the Panel 1 monitoring program was presented to the members of the Geotechnical Experts Panel (in 1991) who concurred that it was adequate to determine deterioration within the rooms and that it will provide early warning of deteriorating conditions.

The assessment and evaluation of the condition of WIPP excavations is an interactive, continuous process using the data from the monitoring programs. Criteria for corrective action are continually reevaluated and reassessed based on total performance to date. Actions taken are based on these analyses and planned utilization of the excavation. Because WIPP excavations are in a natural geologic medium, there is inherent variability from point to point. The principle adopted is to anticipate potential ground control requirements and implement them in a timely manner rather than to wait until a need arises.

M2-5b(3) Volatile Organic Compound Monitoring

The volatile organic compound monitoring for the WIPP Underground HWDUs will be conducted in accordance with Module IV and Permit Attachment N of this permit.

M2-5c Inspection

The inspection of the WIPP Underground HWDUs will be conducted in accordance with Module II and Permit Attachment D of this permit.

References

DOE, 1997. Resource Conservation and Recovery Act Part B Permit Application, Waste Isolation Pilot Plant (WIPP), Carlsbad, New Mexico, Revision 6.5, 1997.

TABLES

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TABLE M2-1
CH TRU MIXED WASTE HANDLING EQUIPMENT CAPACITIES

CAPACITIES FOR EQUIPMENT	
Facility Pallet	25,000 lbs.
Facility Transfer Vehicle	26,000 lbs.
Underground transporter	28,000 lbs.
Underground fork lift	12,000 lbs.
MAXIMUM GROSS WEIGHTS OF CONTAINERS	
Seven-pack of 55-gallon drums	7,000 lbs.
Four-pack of 85-gallon drums	4,500 lbs.
Three-pack of 100-gallon drums	3,000 lbs.
Ten-drum overpack	6,700 lbs.
Standard waste box	4,000 lbs.
MAXIMUM NET EMPTY WEIGHTS OF EQUIPMENT	
TRUPACT-II	13,140 lbs.
HalfPACT	10,5000 lbs.
Facility pallet	4,120 lbs.

TABLE M2-2
INSTRUMENTATION USED IN SUPPORT OF THE GEOMECHANICAL MONITORING SYSTEM

INSTRUMENT TYPE	FEATURES	PARAMETER MEASURED	RANGE
Borehole Extensometer	The extensometer provides for monitoring the deformation parallel to the borehole axis. Units suitable for up to 5 measurements anchors in addition to the reference head. Maximum borehole depths shall be 50 feet.	Cumulative Deformation	0-2 inches
Borehole Television Camera	Closed circuit television may be used for monitoring areas otherwise inaccessible, such as boreholes or shafts.	Video Image	N/A
Convergence Points and Tape Extensometers	Mechanically anchored eyebolts to which a portable tape extensometer is attached.	Cumulative Deformation	2-50 feet
Convergence Meters	Includes wire and sonic meters. Mounted on rigid plates anchored to the rock surface.	Cumulative Deformation	2-50 feet
Inclinometers	Both vertical and horizontal inclinometers are used. Traversing type of system in which a probe is moved periodically through casing located in the borehole whose inclination is being measured.	Cumulative Deformation	0-30 degrees
Rock Bolt Load Cells	Spool type units suitable for use with rock bolts. Tensile stress is inferred from strain gauges mounted on the surface of the spool.	Load	0-300 kips
Earth Pressure Cells	Installed between concrete keys and rock. Preferred type is a hydraulic pressure plate connected to a vibrating wire transmitter.	Lithostatic Pressure	0-1000 psi
Piezometer Pressure Transducers	Located in shafts and of robust design and construction. Periodic checks on operability required.	Fluid Pressure	0-500 psi
Strain Gauges	Installed within the concrete shaft key. Suitably sealed for the environment. Two types used--surface mounted and embedded.	Cumulative Deformation	0-3000 µin/in (embedded) 0-2500 µin/in (surface)

TABLE M2-3
RH TRU MIXED WASTE HANDLING EQUIPMENT CAPACITIES

Capacities for Equipment	
41-Ton Forklift	82,000 lbs
Maximum Gross Weights of RH TRU Containers	
RH TRU Facility Canister	10,000 lbs
55-Gallon Drum	1,000 lbs
RH TRU Canister	8,000 lbs
Maximum Net Empty Weights of Equipment	
Facility Cask	67,700 lbs

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FIGURES

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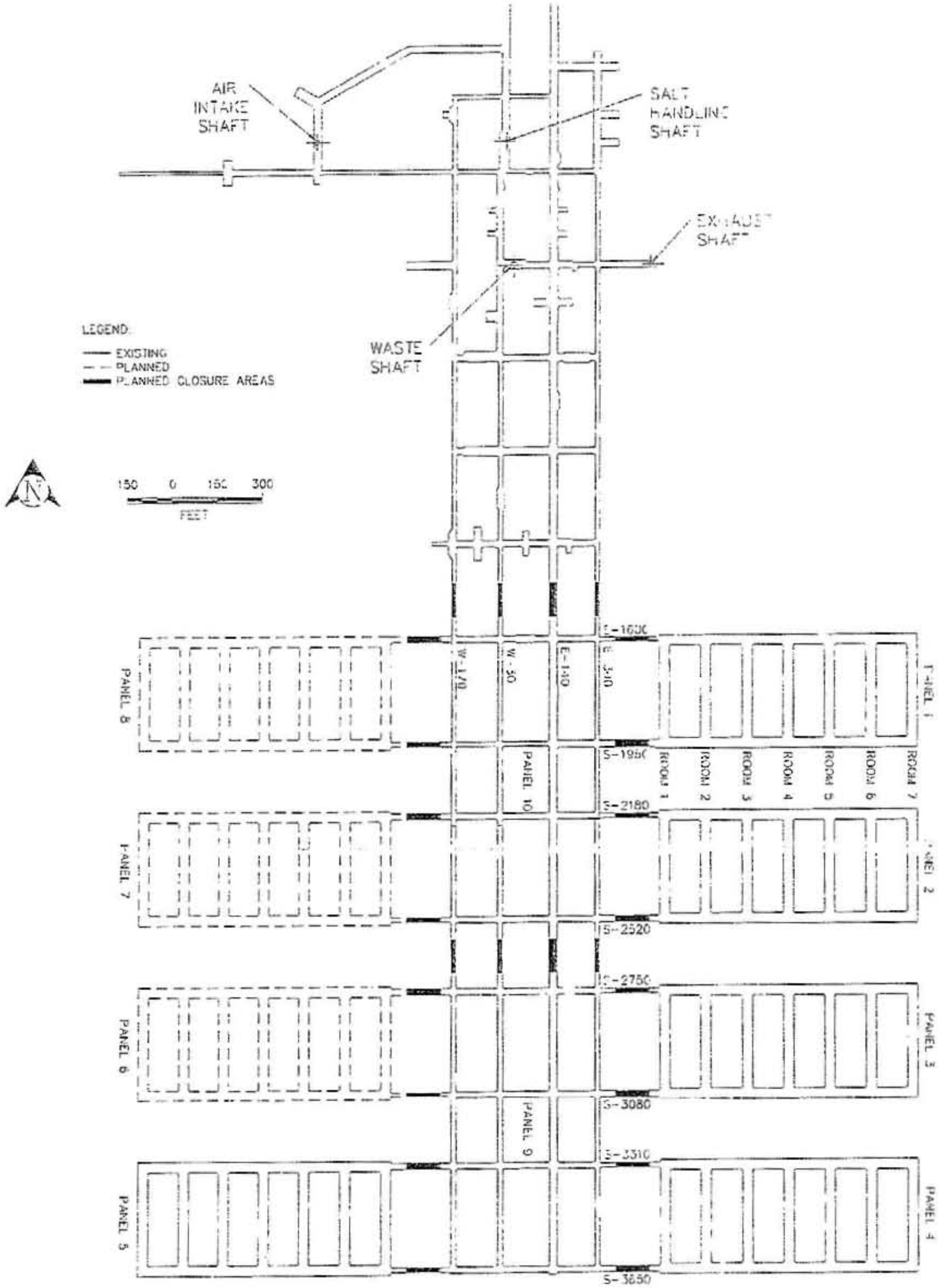


Figure M2-1
Repository Horizon

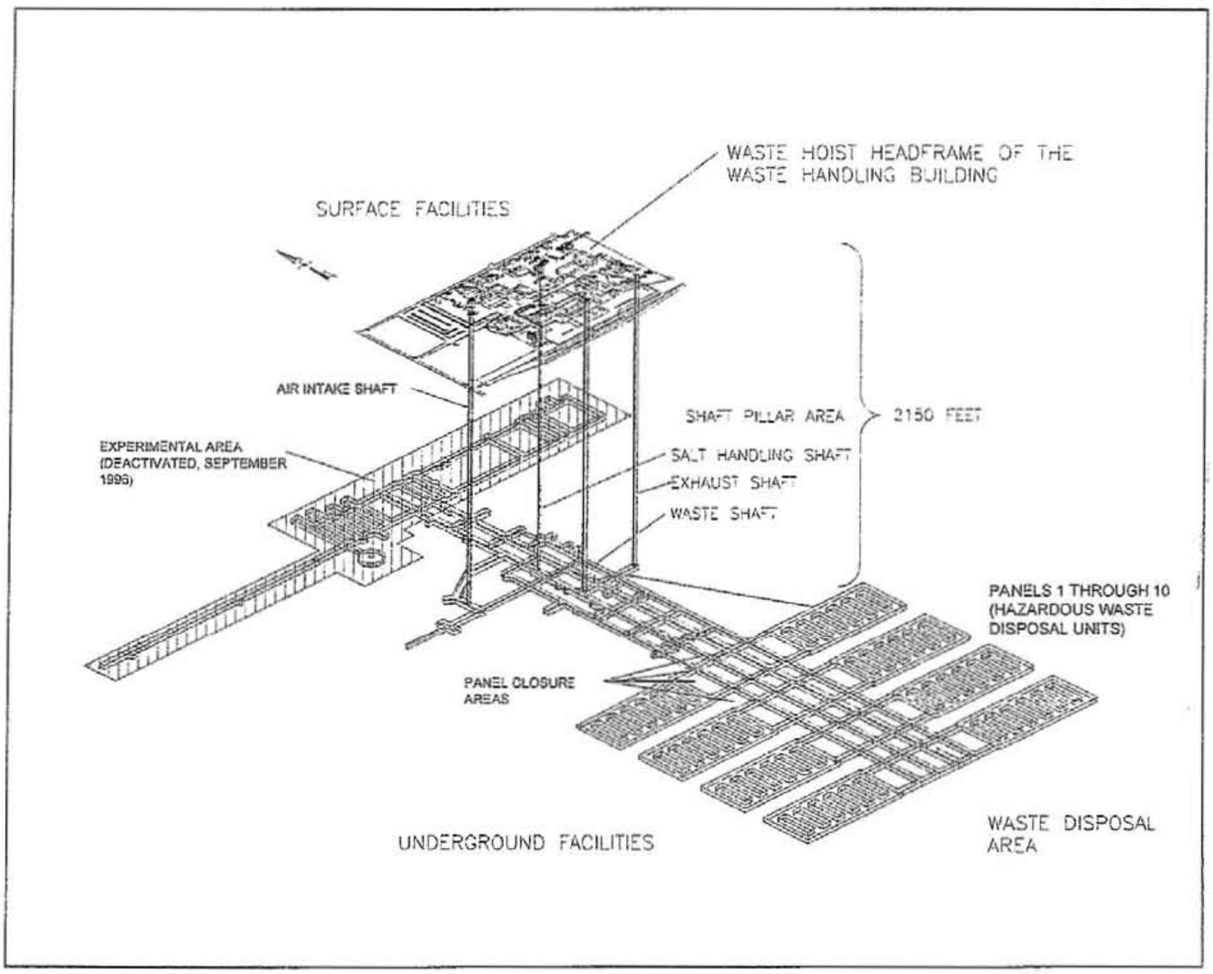


Figure M2-2
Spatial View of the Miscellaneous Unit and Waste Handling Facility

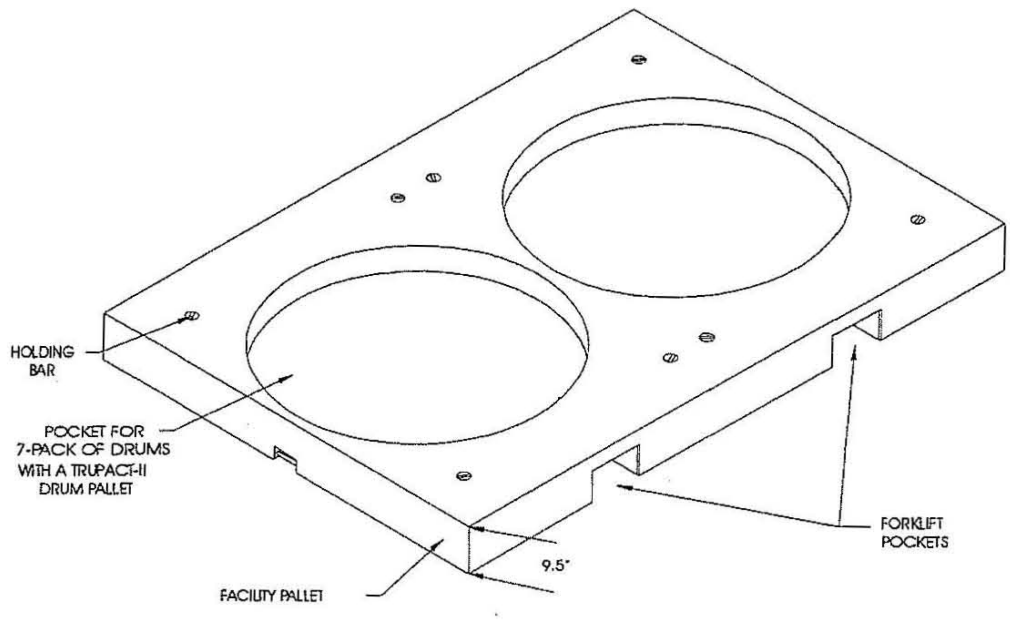


Figure M2-3
Facility Pallet for Seven-Pack of Drums

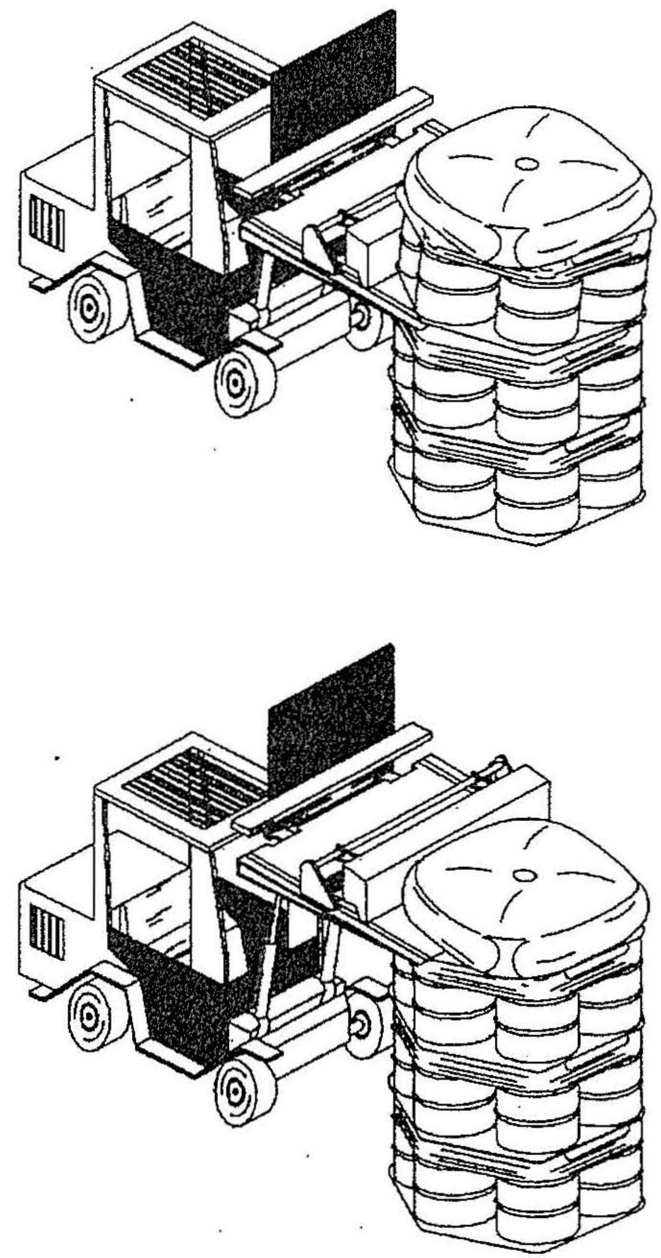


Figure M2-5
Typical Backfill Sacks Emplaced on Drum Stacks

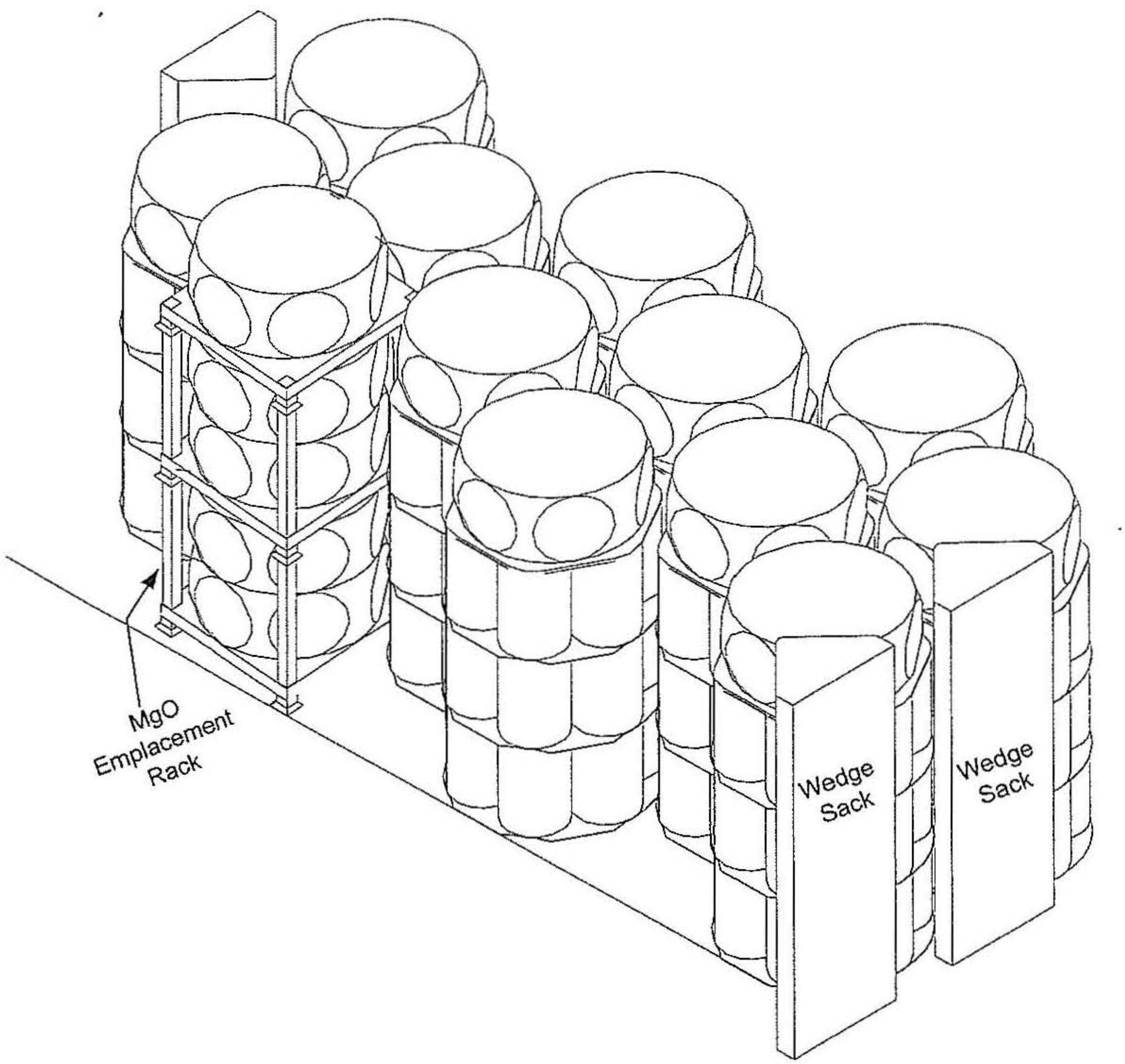


Figure M2-5a
Potential MgO Emplacement Configurations

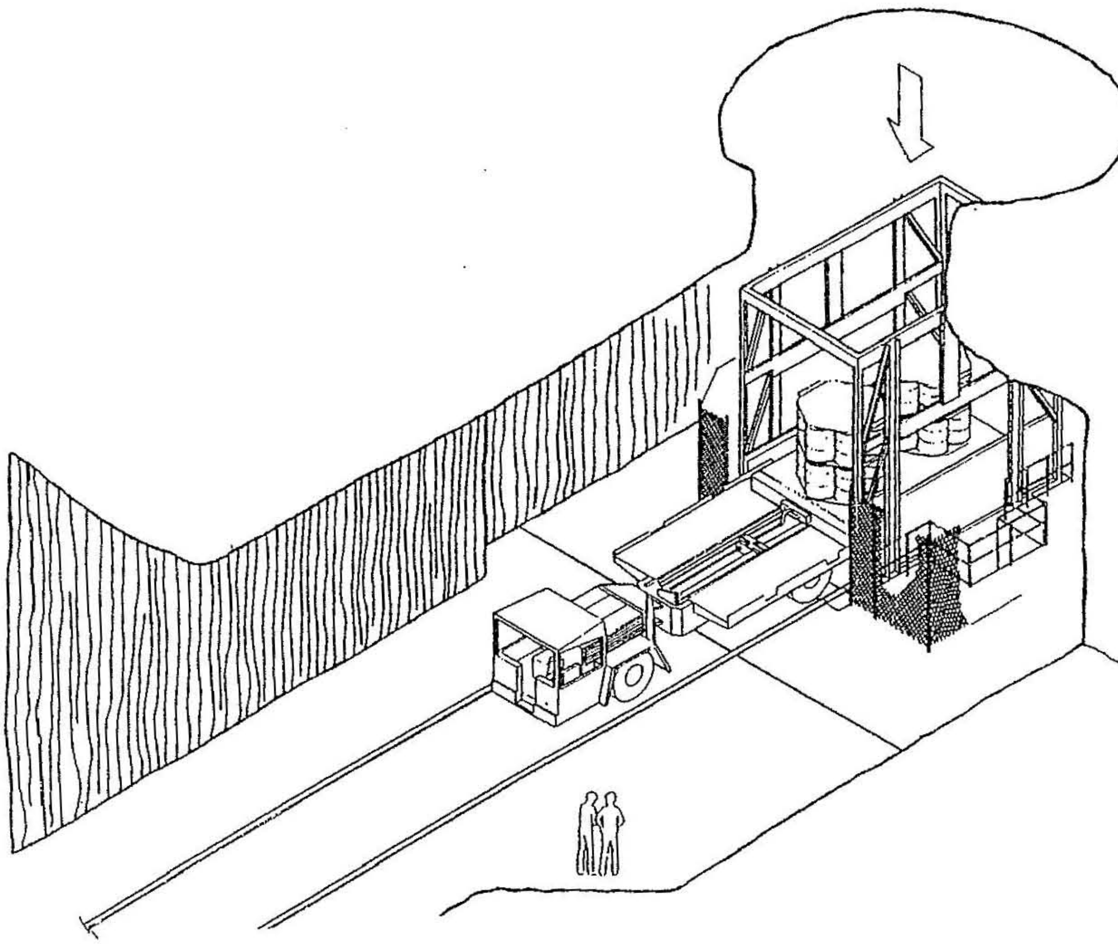


Figure M2-6
Waste Transfer Cage to Transporter

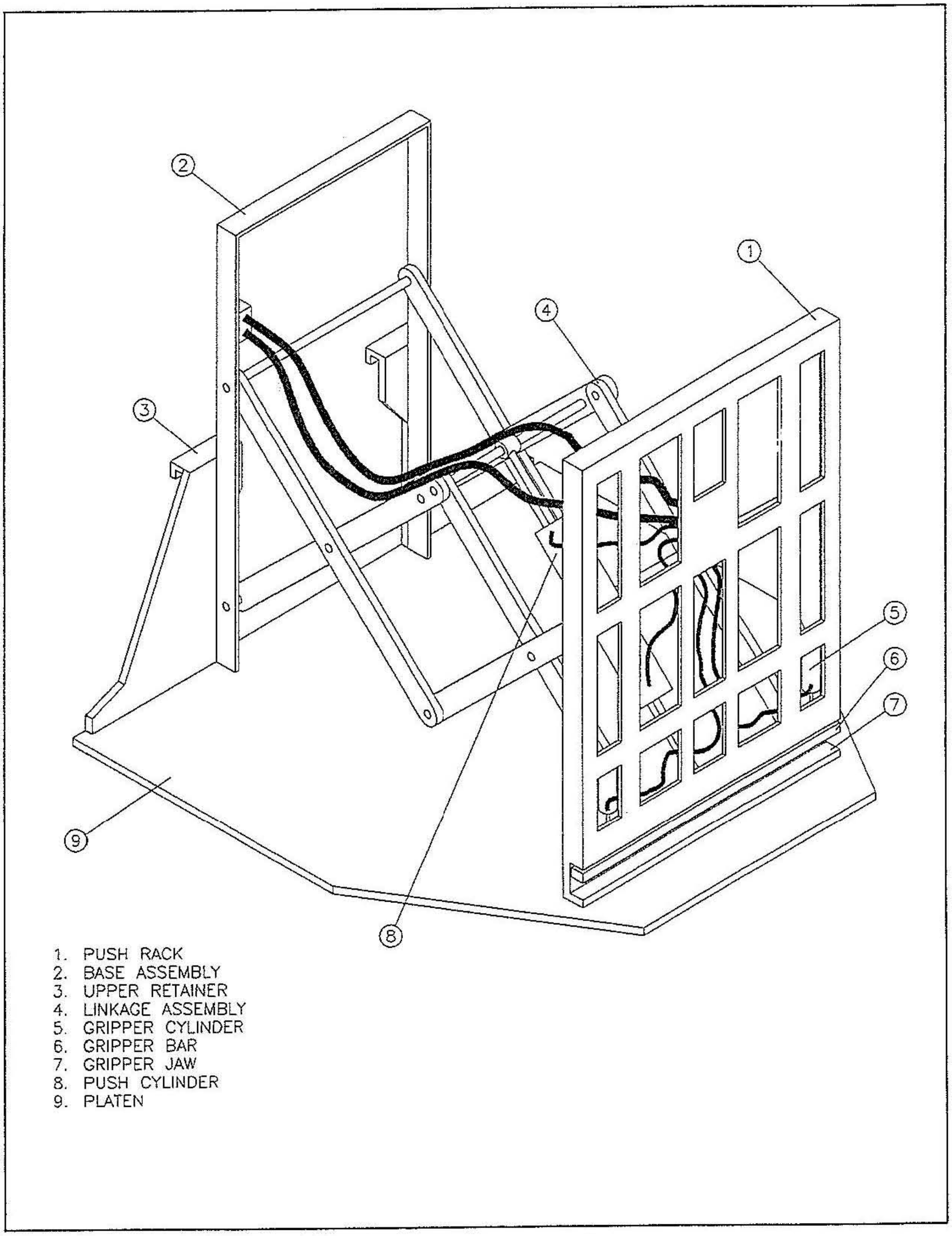


Figure M2-7
Push-Pull Attachment to Forklift to Allow Handling of Waste Containers

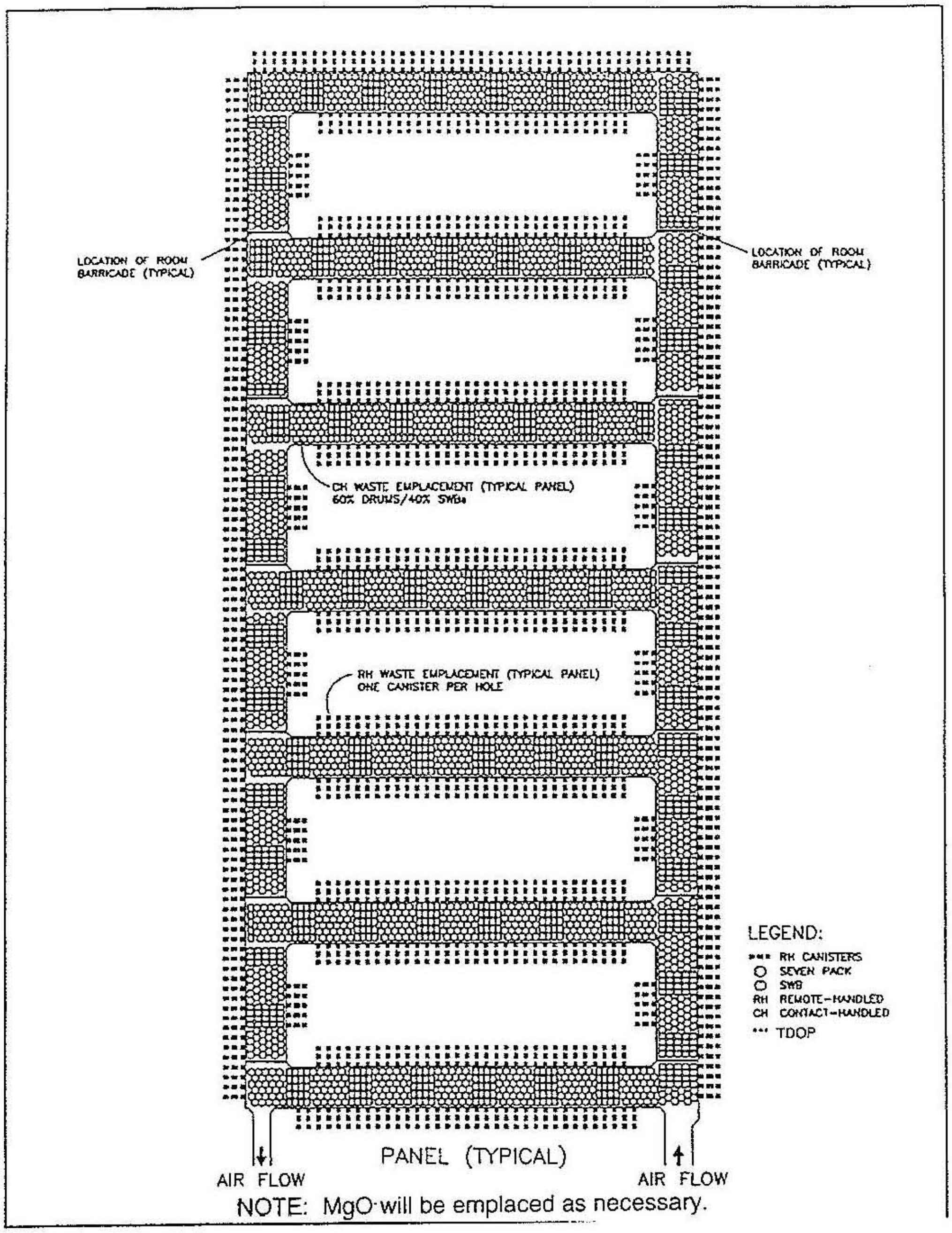


Figure M2-8
Typical RH and CH Transuranic Mixed Waste Container Disposal Configuration

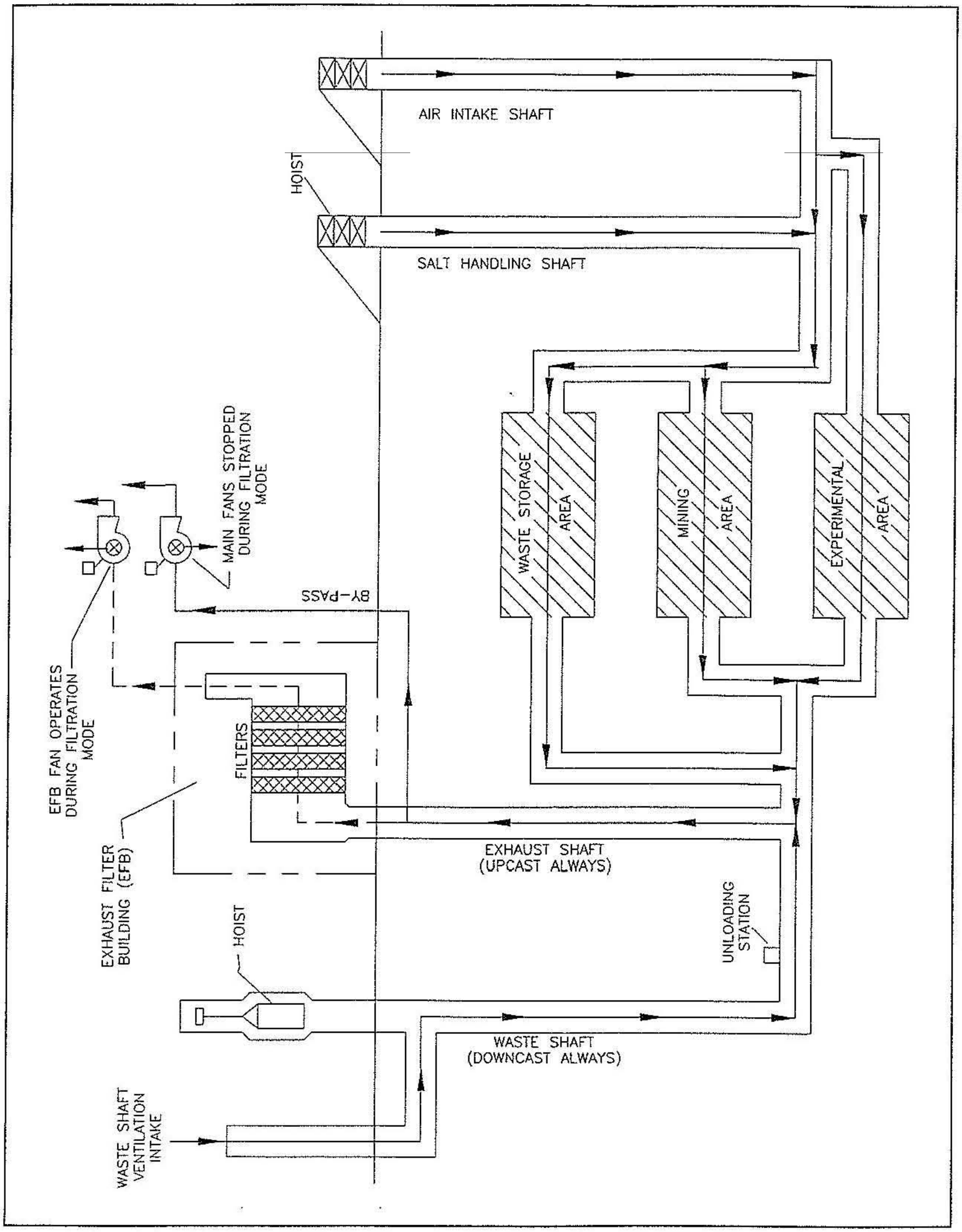


Figure M2-9
Underground Ventilation System Airflow

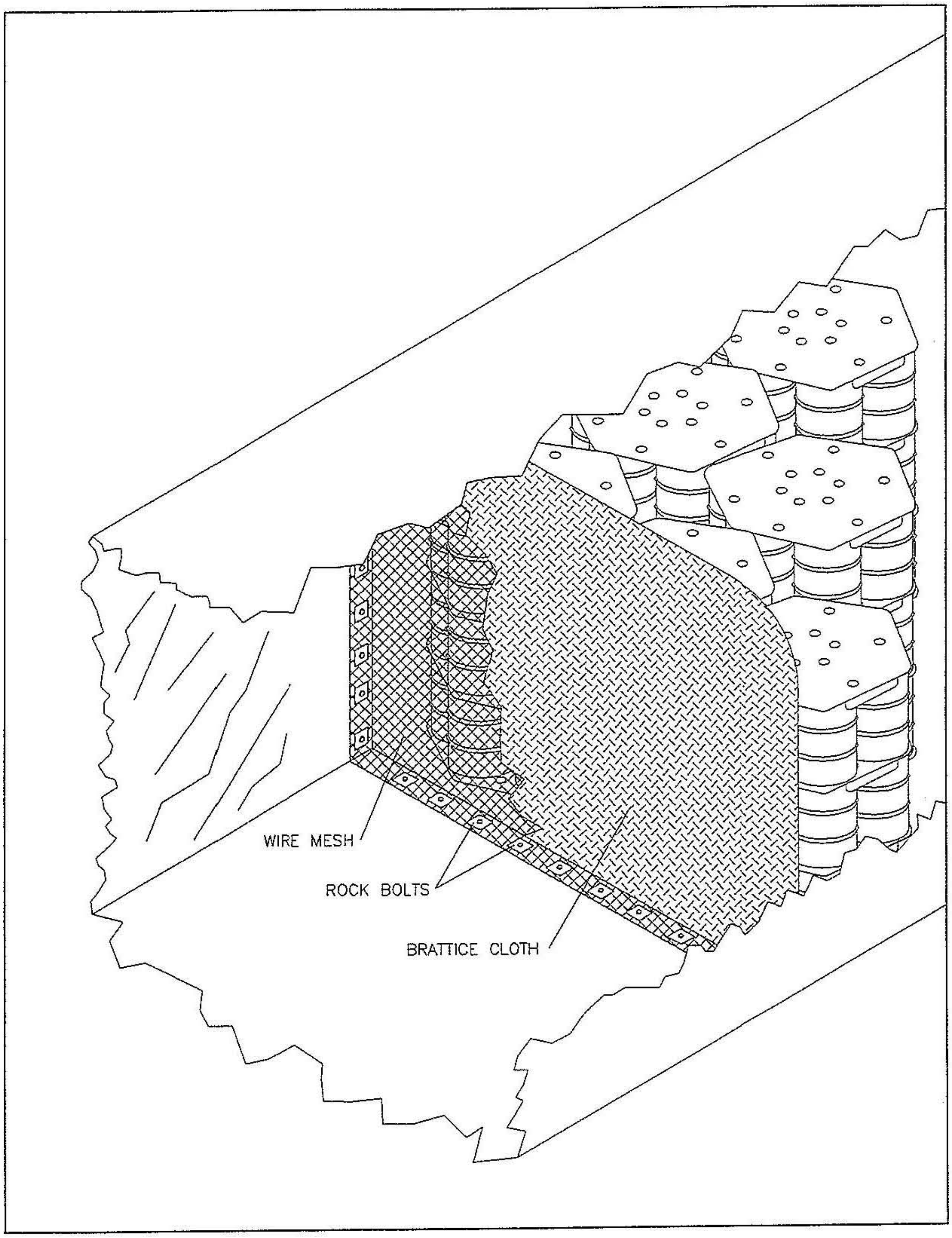


Figure M2-11
Typical Room Barricade

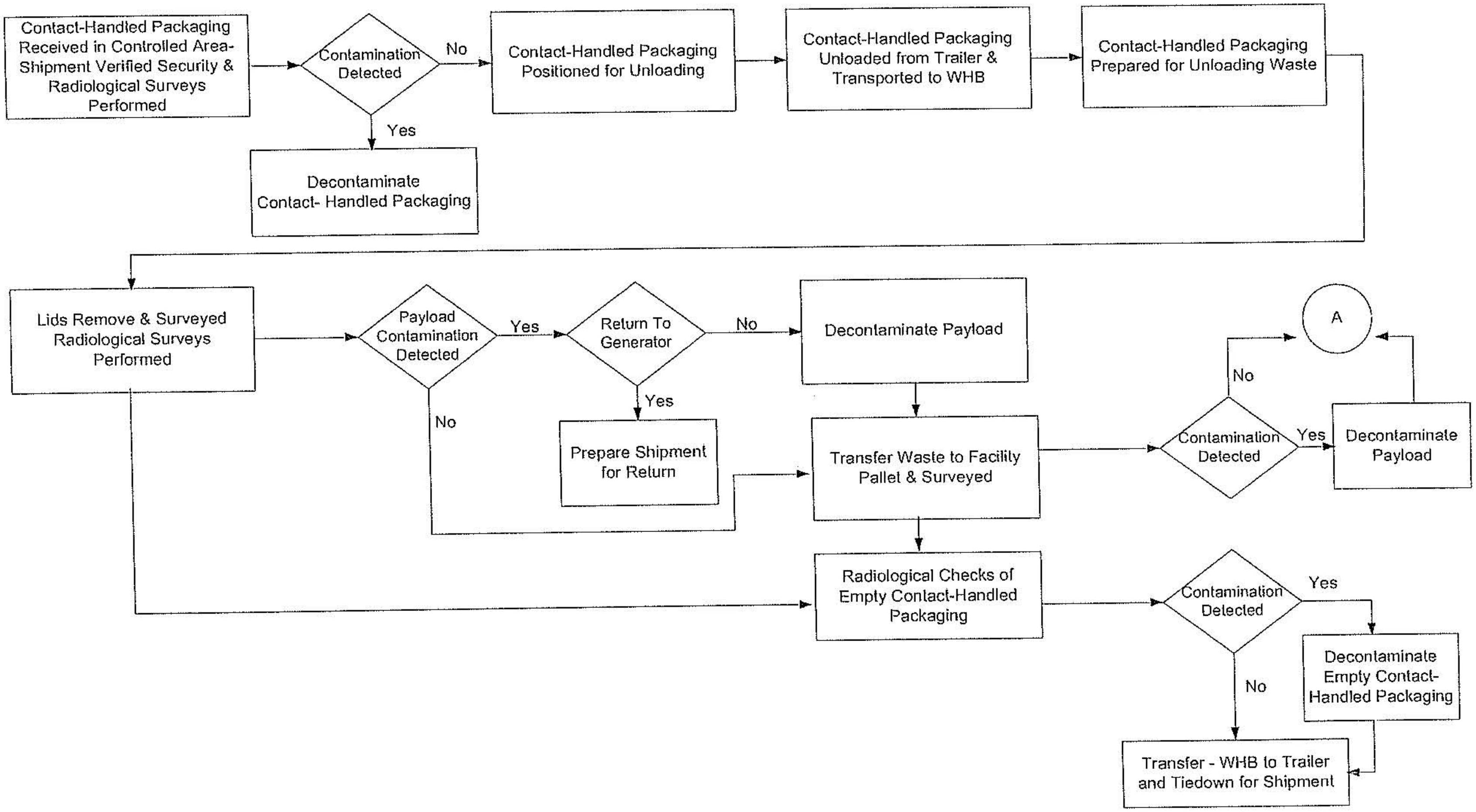


Figure M2-12
WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram

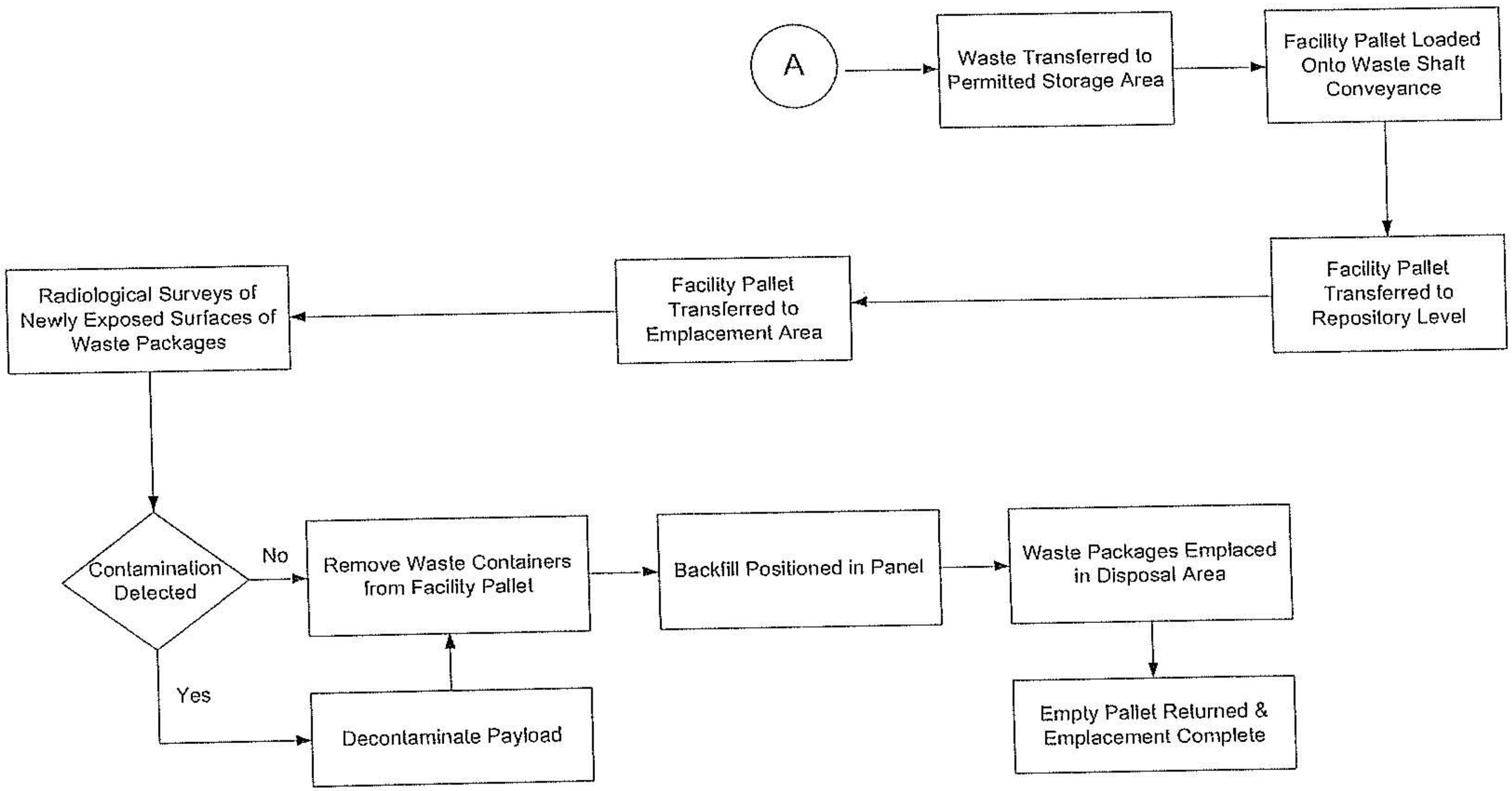


Figure M2-12
WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram (Continued)

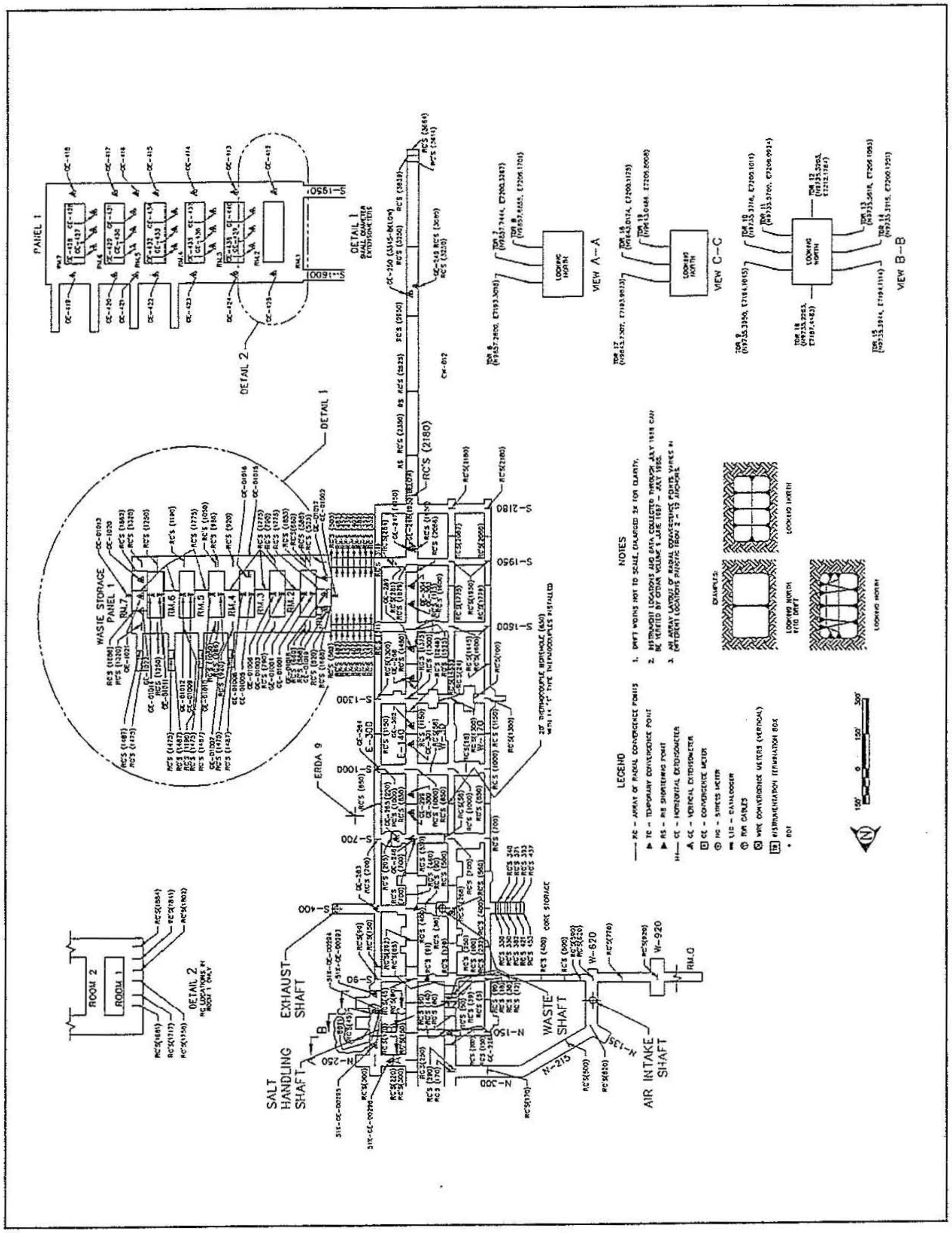


Figure M2-13
Layout and Instrumentation - As of 1/96

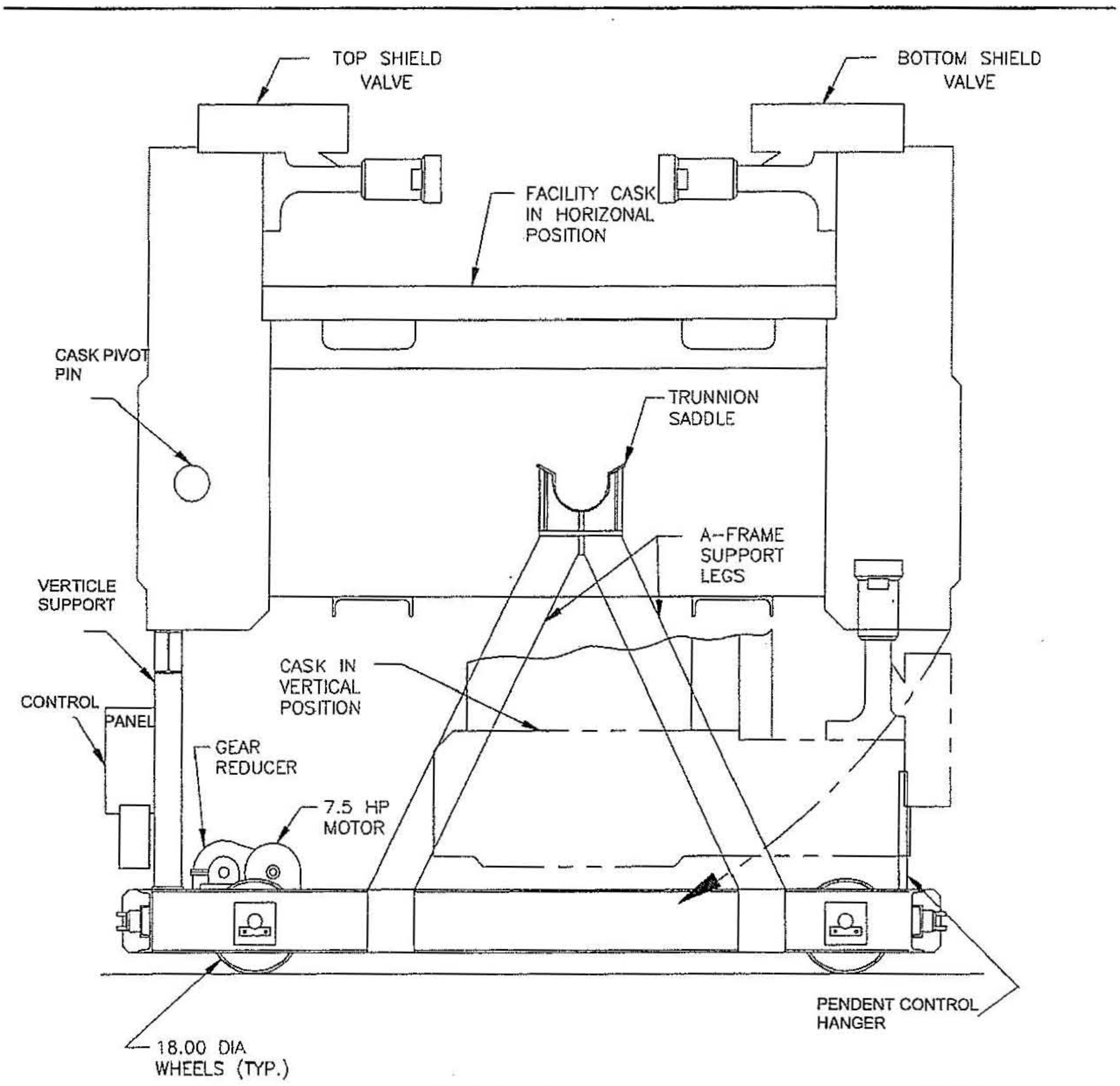


Figure M2-14
Facility Cask Transfer Car (Side View)

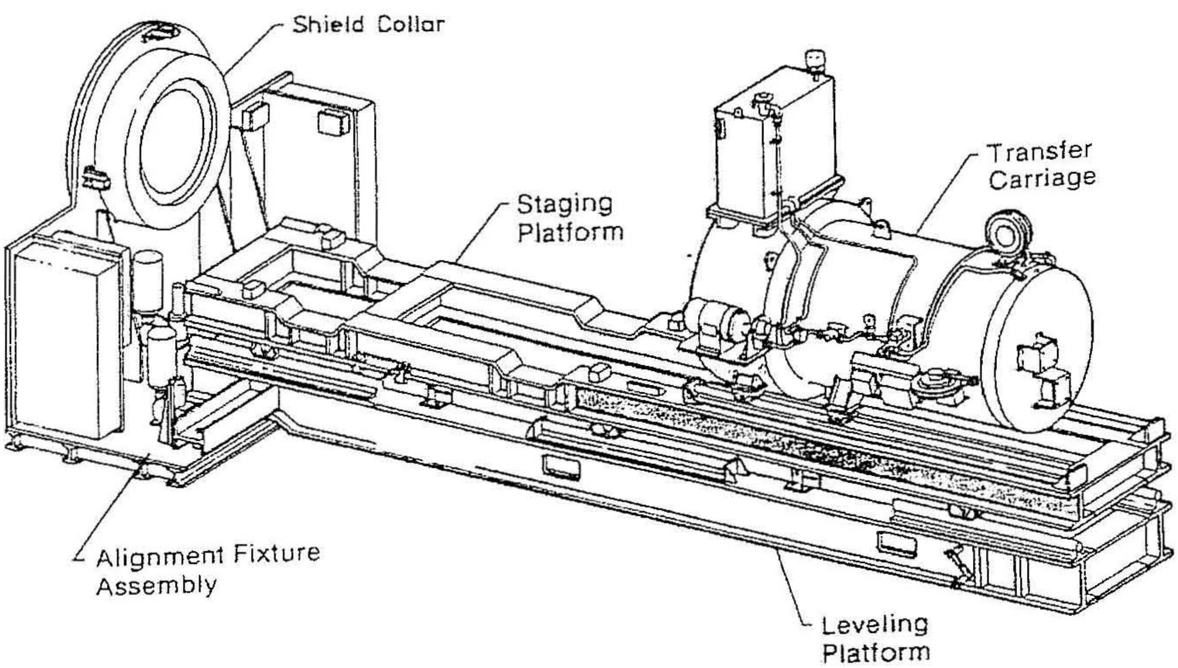


Figure M2-15
Horizontal Emplacement and Retrieval Equipment

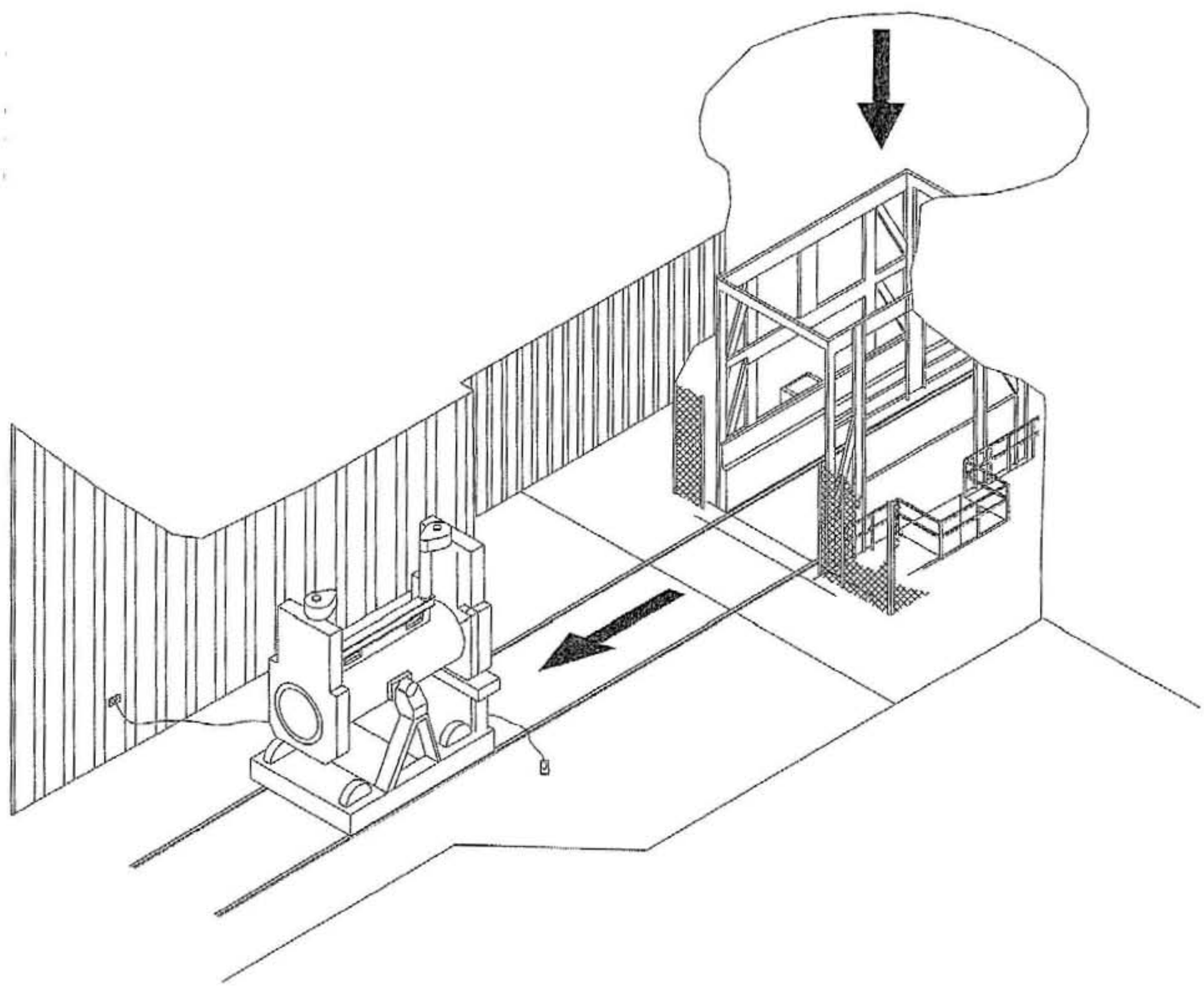


Figure M2-16
RH TRU Waste Facility Cask Unloading from Waste Shaft Conveyance

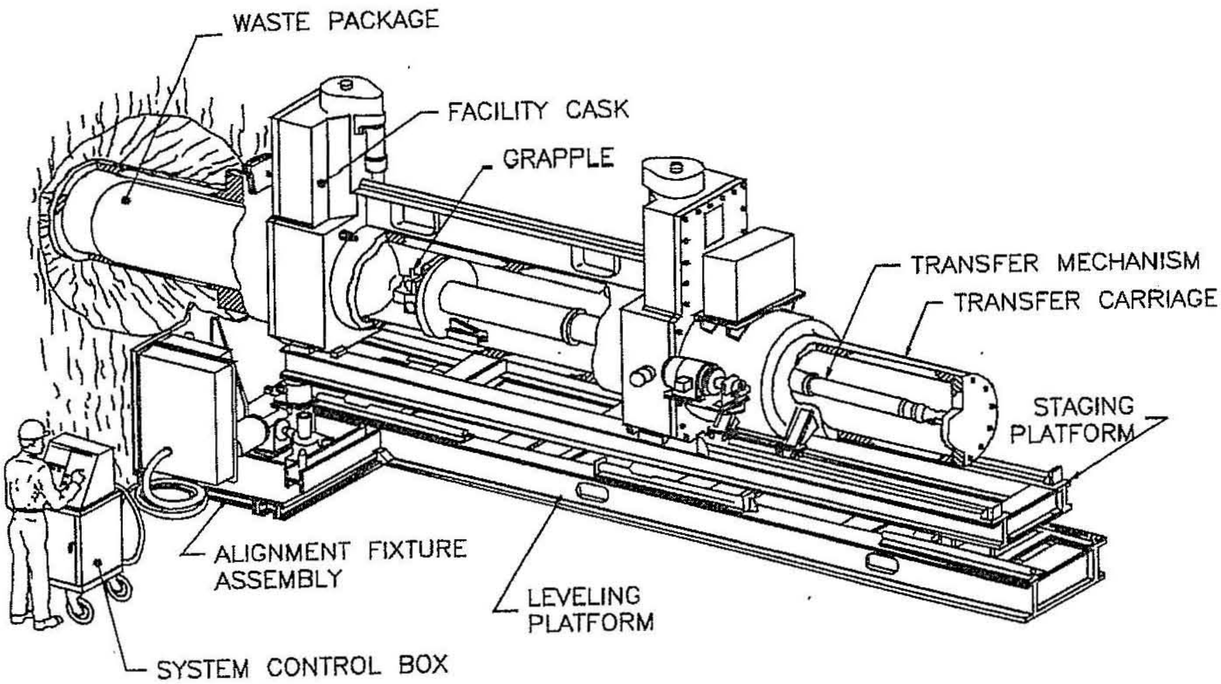


Figure M2-17
Facility Cask Installed on the Horizontal Emplacement and Retrieval Equipment

FACILITY CASK AGAINST SHIELD COLLAR, TRANSFER CARRIAGE RETRACTED,
SHIELD PLUG CARRIAGE ON STAGING PLATFORM, SHIELD PLUG BEING INSTALLED

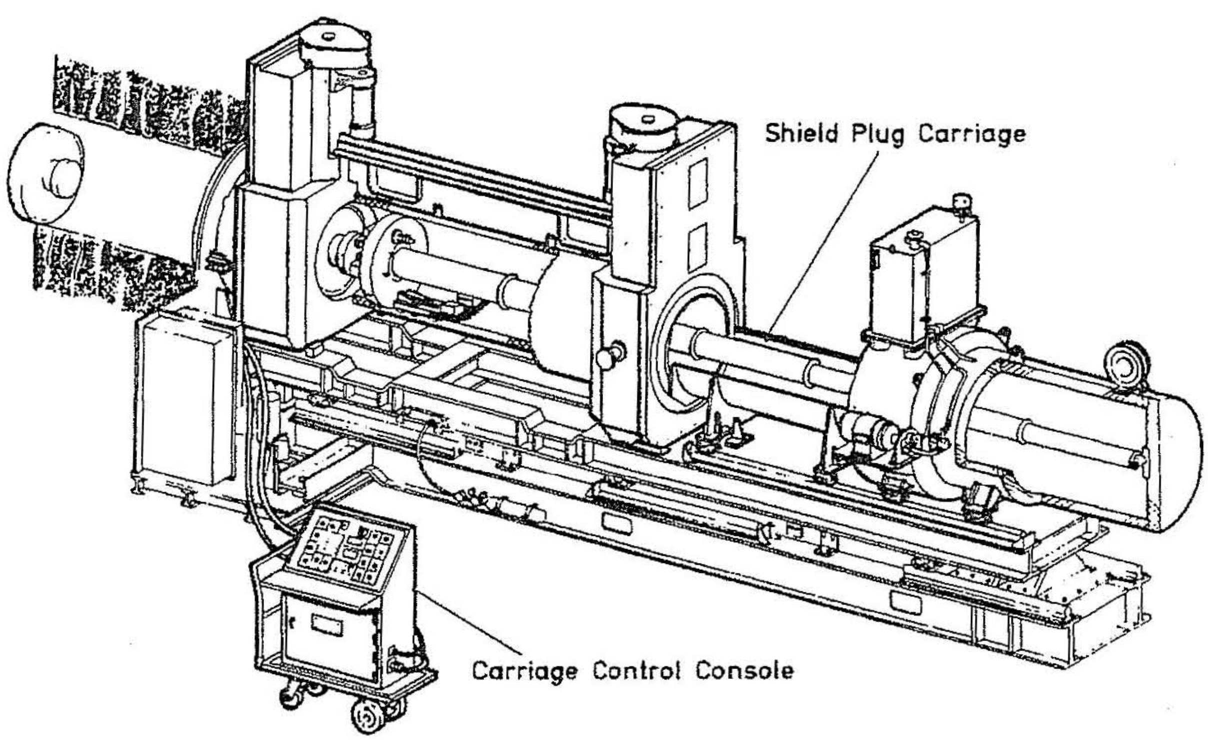
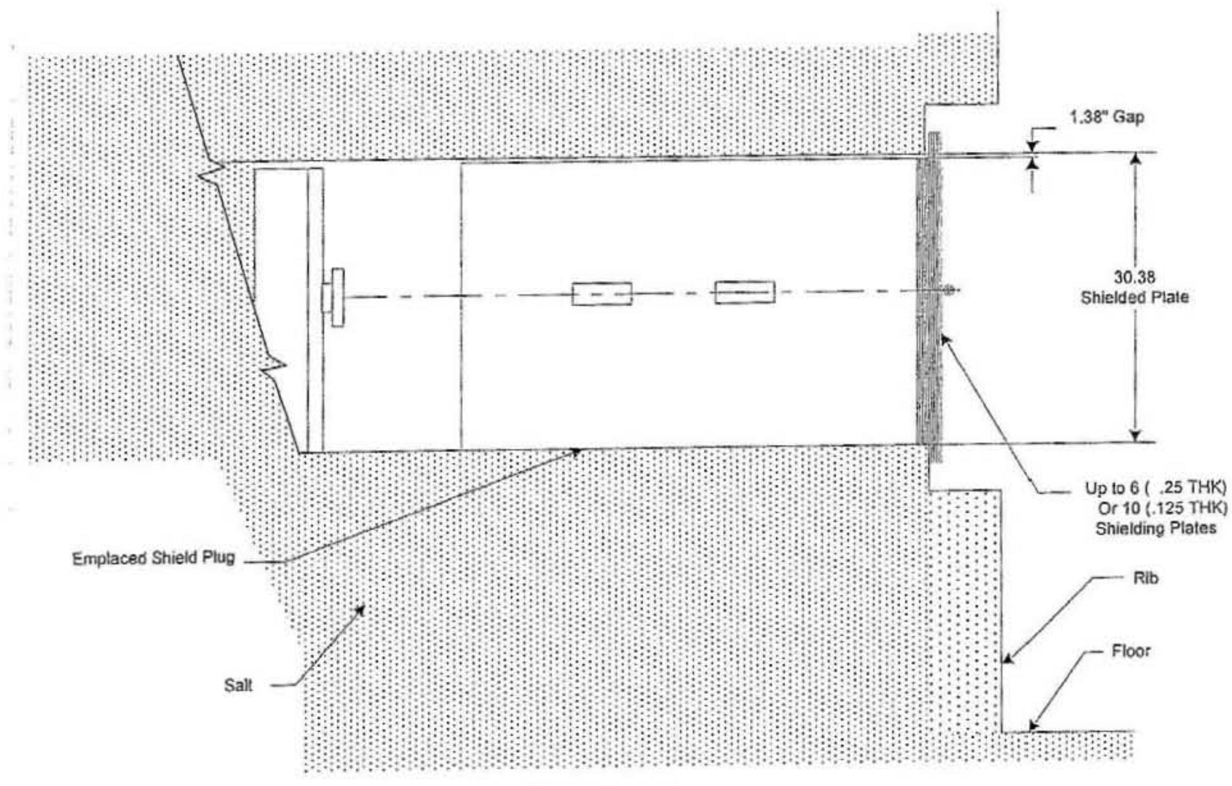


Figure M2-18
Installing Shield Plug



1

2 Figure M2-19
3 Shield Plug Supplemental Shielding Plate(s)

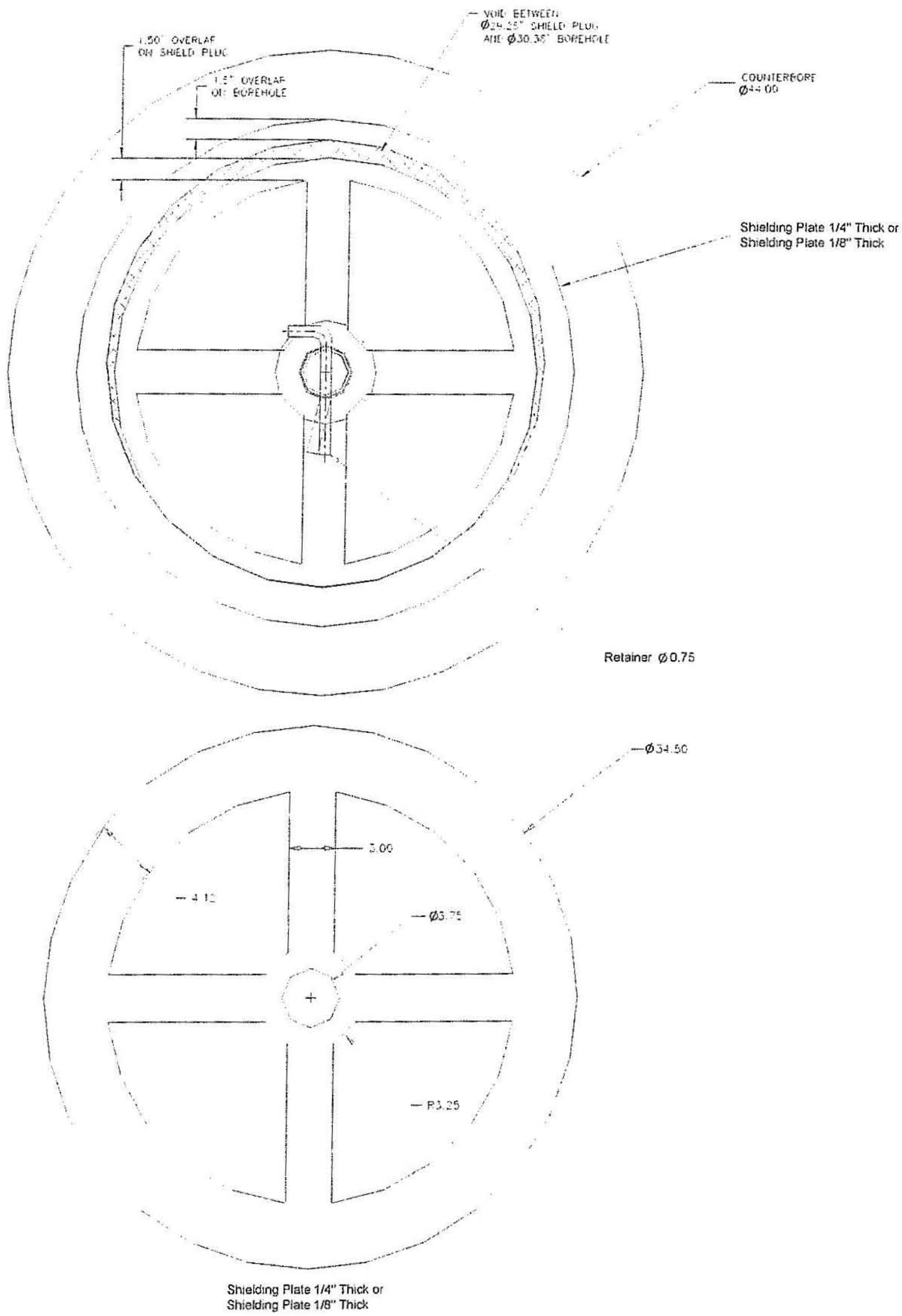
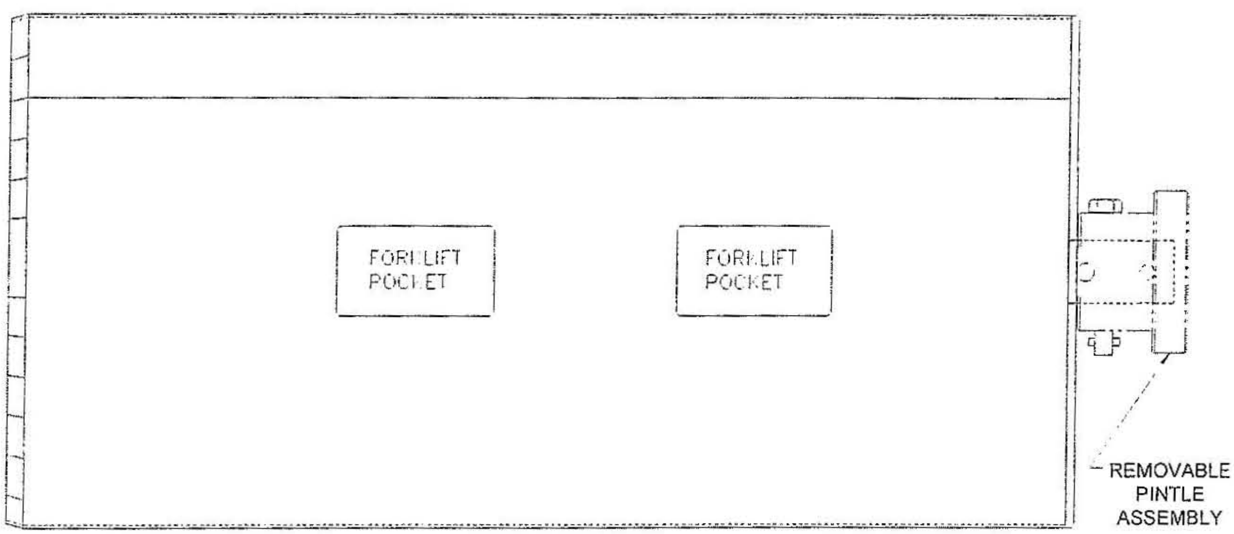


Figure M2-20
Shielding Layers to Supplement RH Borehole Shield Plugs



TYPICAL DIMENSION: APPROXIMATELY 29 INCHES DIAMETER X 61 INCHES SHIELDING LENGTH

Composition: Cylindrical steel shell filled with concrete
Weight: Approximately 3750 pounds

Figure M2-21
Shield Plug Configuration

APPENDIX M3

DRAWING NUMBER 51-W-214W
UNDERGROUND FACILITIES TYPICAL DISPOSAL PANEL

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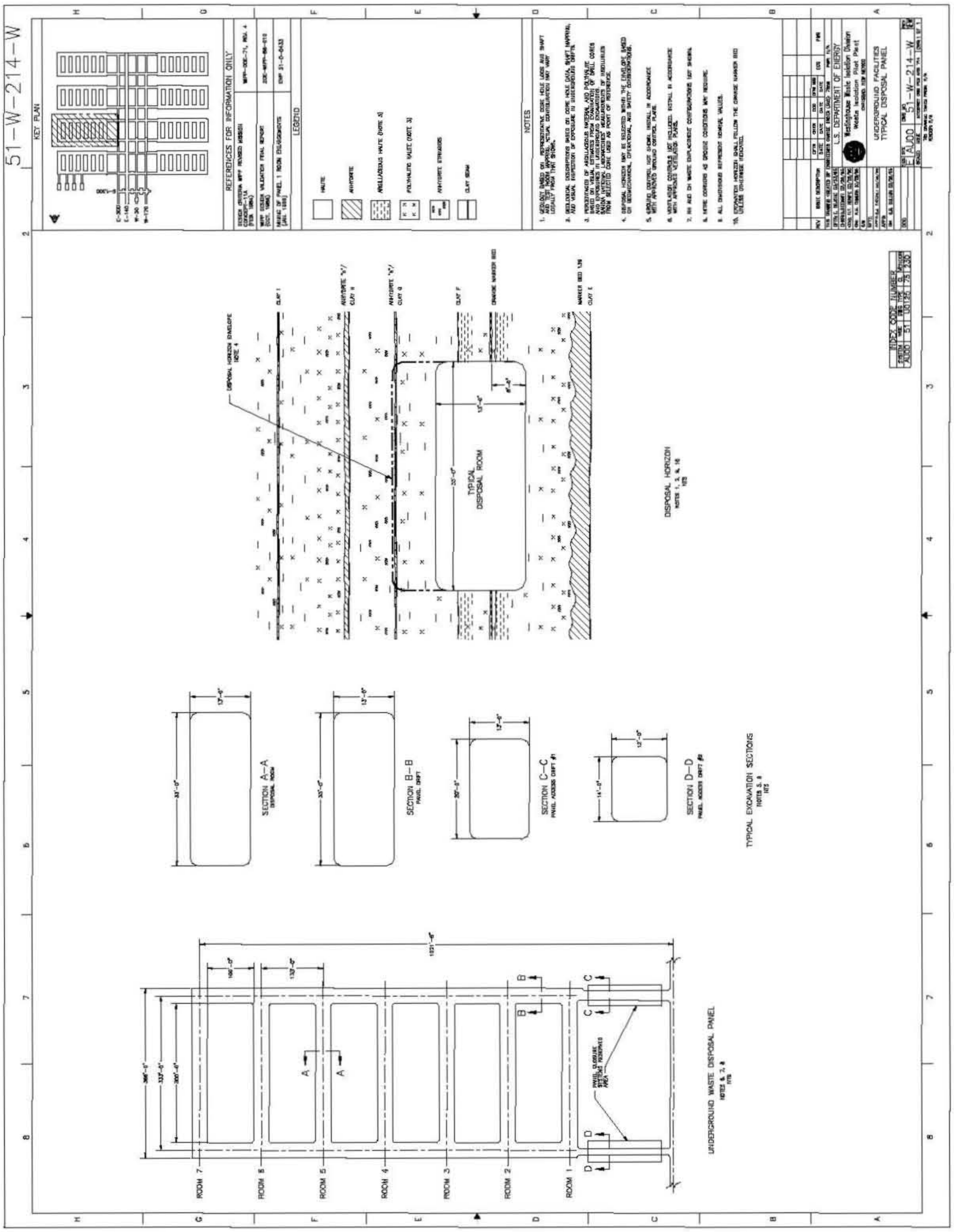

Drawing 51-W-214-W Underground Facilities Typical Disposal Panel

CHAPTER N

VOLATILE ORGANIC COMPOUND MONITORING PLAN

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CHAPTER N

VOLATILE ORGANIC COMPOUND MONITORING PLAN

TABLE OF CONTENTS

List of Tables

List of Figures

Acronyms and Abbreviations

BS/BSD	blank spike/blank spike duplicate
CH	Contact-handled
CLP	Contract Laboratory Program
COC	concentration of concern
CRQL	contract-required quantitation limit
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	feet
GC/MS	gas chromatography/mass spectrometry
HWDU	Hazardous Waste Disposal Unit
LCS	laboratory control sample
m	meter
MDL	method detection limit
MOC	Management and Operating Contractor (Permit Condition I.D.3)
MRL	method reporting limit
NIST	National Institute of Standards and Testing
ppbv	parts per billion by volume
QA	quality assurance
QAPD	Quality Assurance Program Description
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
SOP	standard operating procedure
TIC	tentatively identified compound
TRU	Transuranic
VOC	volatile organic compound
WIPP	Waste Isolation Pilot Plant

CHAPTER N

VOLATILE ORGANIC COMPOUND MONITORING PLAN

N-1 Introduction

This Permit Attachment describes the monitoring plan for volatile organic compound (**VOC**) emissions from mixed waste that may be entrained in the exhaust air from the U.S. Department of Energy (**DOE**) Waste Isolation Pilot Plant (**WIPP**) Underground Hazardous Waste Disposal Units (**HWDUs**) during the disposal phase at the facility. The purpose of VOC monitoring is to ensure compliance with the VOC limits specified in Permit Module IV. This VOC monitoring plan consists of two programs as follows; (1) Repository VOC Monitoring, which assesses compliance with the environmental performance standards in Table IV.F.2.c; and (2) Disposal Room VOC Monitoring, which assesses compliance with the disposal room performance standards in Table IV.F.3.b. This plan includes the monitoring design, a description of sampling and analysis procedures, quality assurance (**QA**) objectives, and reporting activities.

N-1a Background

The Underground HWDUs are located 2,150 feet (ft) (655 meters [m]) below ground surface, in the WIPP underground. As defined for this Permit, an Underground HWDU is a single excavated panel consisting of seven rooms and two access drifts designated for disposal of contact-handled (**CH**) and remote-handled (**RH**) transuranic (**TRU**) mixed waste. Each room is approximately 300 ft (91 m) long, 33 ft (10 m) wide, and 13 ft (4 m) high. Access drifts connect the rooms and have the same cross section. The Permittees shall dispose of TRU mixed waste in Underground HWDUs designated as Panels 1 through ~~7~~8.

This plan addresses the following elements:

1. Rationale for the design of the VOC monitoring programs, based on:
    - Possible pathways from WIPP during the active life of the facility
    - Demonstrating compliance with the disposal room performance standards by monitoring VOCs in underground disposal rooms
    - VOC sampling operations at WIPP
    - Optimum location of the ambient mine air monitoring stations
2. Descriptions of the specific elements of the VOC monitoring programs, including:
    - The type of monitoring conducted
    - The location of the monitoring stations
    - The monitoring interval
    - The specific hazardous constituents monitored
    - The implementation schedule for the VOC monitoring programs
    - The equipment used at the monitoring stations

- Sampling and analytical techniques used
- Data recording/reporting procedures
- Action levels for remedial action if limits are approached

The results of baseline VOC monitoring at WIPP were used, in part, to define the VOC monitoring programs. The baseline VOC monitoring results were presented in Appendix D21 of the WIPP Resource Conservation Recovery Act (**RCRA**) Part B Permit Application (DOE, 1997). These data represent the anticipated background levels of VOCs during operations at WIPP. The technical basis for Disposal Room VOC Monitoring is discussed in detail in the Technical Evaluation Report for Room-Based VOC Monitoring (WRES, 2003).

N-1b Objectives of the Volatile Organic Compound Monitoring Plan

The CH and RH TRU mixed waste disposed in the WIPP Underground HWDUs contain VOCs which could be released from WIPP during the disposal phase of the project. This plan describes how:

- VOCs released from waste panels will be monitored to confirm that the annual average concentration of VOCs in the air emissions from the Underground HWDUs do not exceed the VOC concentrations of concern (**COC**) identified in Permit Module IV, Table IV.F.2.c. Appropriate remedial action, as specified in Permit Condition IV.F.2.d, will be taken if the limits in Permit Module IV, Table IV.F.2.c are reached.

- VOCs released from waste containers in disposal rooms will be monitored to confirm that the concentration of VOCs in the air of closed and active rooms in active panels do not exceed the VOC disposal room limits identified in Permit Module IV, Table IV.D.1. Appropriate remedial action, as specified in Permit Condition IV.F.3.c, will be taken if the Action Levels in Permit Module IV, Table IV.F.3.b are reached.

N-2 Target Volatile Organic Compounds

The target VOCs for repository monitoring (Station VOC-A and VOC-B) and disposal room monitoring presented in Table N-1.

These target VOCs were selected because together they represent approximately 99 percent of the risk due to air emissions.

N-3 Monitoring Design

Detailed design features of this plan are presented in this section. This plan uses available sampling and analysis techniques to measure VOC concentrations in air. Sampling equipment includes the WIPP VOC canister samplers both the Repository and Disposal Room VOC Monitoring Programs.

N-3a Sampling Locations

Air samples will be collected in the underground to quantify airborne VOC concentrations as described in the following sections.

N-3a(1) Sampling Locations for Repository VOC Monitoring

The initial configuration for the repository VOC monitoring stations is shown in Figure N-1. All mine ventilation air which could potentially be impacted by VOC emissions from the Underground HWDUs identified as Panels 1 through ~~7~~8 will pass monitoring Station VOC-A, located in the E-300 drift as it flows to the exhaust shaft. Air samples will be collected at two locations in the facility to quantify airborne VOC concentrations. VOC concentrations attributable to VOC emissions from open and closed panels containing CH TRU mixed waste will be measured by placing one VOC monitoring station just downstream from Panel 1 at VOC-A. The location of Station VOC-A will remain the same throughout the term of this Permit. The second station (Station VOC-B) will always be located upstream from the open panel being filled with waste (starting with Panel 1 at monitoring Station VOC-B (Figure N-1). In this configuration, Station VOC-B will measure VOC concentrations attributable to releases from the upstream sources and other background sources of VOCs, but not releases attributable to open or closed panels. The location of Station VOC-B will change when disposal activities begin in the next panel. Station VOC-B will be relocated to ensure that it is always upstream of the open panel that is receiving TRU mixed waste. Station VOC-A will also measure upstream VOC concentrations measured at Station VOC-B, plus any additional VOC concentrations resulting from releases from the closed and open panels. A sample will be collected from each monitoring station on designated sample days. For each quantified target VOC, the concentration measured at Station VOC-B will be subtracted from the concentration measured at Station VOC-A to assess the magnitude of VOC releases from closed and open panels.

The sampling locations were selected based on operational considerations. There are several different potential sources of release for VOCs into the WIPP mine ventilation air. These sources include incoming air from above ground and facility support operations, as well as open and closed waste panels. In addition, because of the ventilation requirements of the underground facility and atmospheric dispersion characteristics, any VOCs that are released open or closed panels may be difficult to detect and differentiate from other sources of VOCs at any underground or above ground location further downstream of Panel 1. By measuring VOC concentrations close to the potential source of release (i.e., at Station VOC-A), it will be possible to differentiate potential releases from background levels (measured at Station VOC-B).

N-3a(2) Sampling Locations for Disposal Room VOC Monitoring

For purposes of compliance with Section 310 of Public Law 108-447, the VOC monitoring of airborne VOCs in underground disposal rooms in which waste has been emplaced will be performed as follows:

1. A sample head will be installed inside the disposal room behind the exhaust drift bulkhead and at the inlet side of the disposal room.
2. TRU mixed waste will be emplaced in the active disposal room.
3. When the active disposal room is filled, another sample head will be installed to the inlet of the filled active disposal room. (Figure N-3 and N-4)
4. The exhaust drift bulkhead will be removed and re-installed in the next disposal room so disposal activities may proceed.
5. A ventilation barrier will be installed where the bulkhead was located in the active disposal room's exhaust drift. Another ventilation barrier will be installed in the active disposal room's air inlet drift, thereby closing that active disposal room.
6. Monitoring of VOCs will continue in the now closed disposal room. Monitoring of VOCs will occur in the active disposal room and all closed disposal rooms in which waste has been emplaced until commencement of panel closure activities (i.e., completion of ventilation barriers in Room 1).

This sequence for installing sample locations will proceed in the remaining disposal rooms until the inlet air ventilation barrier is installed in disposal room one. An inlet sampler will not be installed in disposal room one because disposal room sampling proceeds to the next panel.

N-3a(3) Ongoing Disposal Room VOC Monitoring in Panels 3 through 7

The Permittees shall continue VOC monitoring in Room 1 of Panels 3 through 7 after completion of waste emplacement until final panel closure unless an explosion-isolation wall is installed in the panel.

N-3b Analytes to Be Monitored

The nine VOCs that have been identified for repository and disposal room monitoring are listed in Table N-1. The analysis will focus on routine detection and quantification of these compounds in collected samples. As part of the analytical evaluations, the presence of other compounds will be investigated. The analytical laboratory will be directed to classify and report all of these compounds as Tentatively Identified Compounds (**TICs**).

TICs detected in 10% or more of any VOC monitoring samples (exclusive of those collected from Station VOC-B) that are VOCs listed in Appendix VIII of 20.4.1.200 NMAC (incorporating 40 CFR §261), collected over a running twelve-month timeframe, will be added to the target analyte lists for both the repository and disposal room VOC monitoring programs, unless the Permittees can justify the exclusion from the target analyte list(s).

TICs detected in the repository and disposal room VOC monitoring programs will be placed in the WIPP Operating Record and reported to NMED in the Semi-Annual VOC Monitoring Report as specified in Permit Condition IV.F.2.b.

N-3c Sampling and Analysis Methods

The VOC monitoring programs include a comprehensive VOC monitoring program established at the facility; equipment, training, and documentation for VOC measurements are already in place.

The method used for VOC sampling is based on the concept of pressurized sample collection contained in the U.S. Environmental Protection Agency (**EPA**) Compendium Method TO-15 (EPA, 1999). The TO-15 sampling concept uses 6-liter SUMMA® passivated (or equivalent) stainless-steel canisters to collect integrated air samples at each sample location. This conceptual method will be used as a reference for collecting the samples at WIPP. The samples will be analyzed using gas chromatography/mass spectrometry (**GC/MS**) under an established QA/quality control (**QC**) program. Laboratory analytical procedures have been developed based on the concepts contained in both TO-15 and 8260B. Section N-5 contains additional QA/QC information for this project.

The TO-15 method is an EPA-recognized sampling concept for VOC sampling and speciation. It can be used to provide integrated samples, or grab samples, and compound quantitation for a broad range of concentrations. The sampling system can be operated unattended but requires detailed operator training. This sampling technique is viable for use while analyzing the sample using other EPA methods such as 8260B.

The field sampling systems will be operated in the pressurized mode. In this mode, air is drawn through the inlet and sampling system with a pump. The air is pumped into an initially evacuated SUMMA® passivated (or equivalent) canister by the sampler, which regulates the rate and duration of sampling. The treatment of tubing and canisters used for VOC sampling effectively seals the inner walls and prevents compounds from being retained on the surfaces of the equipment. By the end of each sampling period, the canisters will be pressurized to about two atmospheres absolute. In the event of shortened sampling periods or other sampling conditions, the final pressure in the canister may be less than two atmospheres absolute. Sampling duration will be approximately six hours, so that a complete sample can be collected during a single work shift.

The canister sampling system and GC/MS analytical method are particularly appropriate for the VOC Monitoring Programs because a relatively large sample volume is collected, and multiple dilutions and reanalyses can occur to ensure identification and quantification of target VOCs within the working range of the method. The contract-required quantitation limits (**CRQL**) are 5 parts per billion by volume (**ppbv**) or less for the nine target compounds. Consequently, low concentrations can be measured. CRQLs are the EPA-specified levels of quantitation proposed for EPA contract laboratories that analyze canister samples by GC/MS. For the purpose of this plan, the CRQLs will be defined as the method reporting limits (**MRL**). The MRL is a function of instrument performance, sample preparation, sample dilution, and all steps involved in the sample analysis process.

Disposal room VOC monitoring system in open panels will employ the same canister sampling method as used in the repository VOC monitoring. Passivated or equivalent sampling lines will be installed in the disposal room as described in Section N-3a(2) and maintained once the room is closed until the panel associated with the room is closed. The independent lines will run from the sample inlet point to the individual sampler located in the access drift to the disposal panel. The air will pass through dual particulate filters to prevent sample and equipment contamination.

N-3d Sampling Schedule

The Permittees will evaluate whether the monitoring systems and analytical methods are functioning properly. The assessment period will be determined by the Permittees.

N-3d(1) Sampling Schedule for Repository VOC Monitoring

Repository VOC sampling at Stations VOC-A and VOC-B will begin with initial waste emplacement in Panel 1. Sampling will continue until the certified closure of the last Underground HWDU. Routine sampling will be conducted two times per week.

N-3d(2) Sampling Schedule for Disposal Room VOC Monitoring

The disposal room sampling in open panels will occur once every two weeks, unless the need to increase the frequency to weekly occurs in accordance with Permit Condition IV.F.3.c.

Beginning with Panel 3, disposal room sampling in filled panels will occur monthly until final panel closure unless an explosion-isolation wall is installed. The Permittees will sample VOCs in Room 1 of each filled panel.

N-3e Data Evaluation and Reporting

N-3e(1) Data Evaluation and Reporting for Repository VOC Monitoring

When the Permittees receive laboratory analytical data from an air sampling event, the data will be validated as specified in Section N-5d. After obtaining validated data from an air sampling event, the data will be evaluated to determine whether the VOC emissions from the Underground HWDUs exceed the COCs. The COCs for each of the nine target VOCs are presented in Permit Module IV, Table IV.F.2.c. The values are presented in terms of micrograms per cubic meter ($\mu g/m^3$) and ppbv.

The COCs were calculated assuming typical operational conditions for ventilation rates in the mine. The typical operational conditions were assumed to be an overall mine ventilation rate of 425,000 standard cubic feet per minute and a flow rate through the E-300 Drift at Station VOC-A of 130,000 standard cubic feet per minute.

Since the mine ventilation rates at the time the air samples are collected may be different than the mine ventilation rates during typical operational conditions, the Permittees will measure and/or record the overall mine ventilation rate and the ventilation rate in the E-300 Drift at Station VOC-A that are in use during each sampling event. The Permittees shall also measure and record temperature and pressure conditions during the sampling event to allow all ventilation rates to be converted to standard flow rates.

If the air samples were collected under the typical mine ventilation rate conditions, then the analytical data will be used without further manipulation. The concentration of each target VOC detected at Station VOC-B will be subtracted from the concentration detected at Station VOC-A. The resulting VOC concentration represents the concentration of VOCs being emitted from the open and closed Underground HWDUs upstream of Station VOC-A (or the Underground HWDU VOC emission concentration.)

If the air samples were not collected under typical mine ventilation rate operating conditions, the air monitoring analytical results from both Station VOC-A and Station VOC-B will be normalized to the typical operating conditions. This will be accomplished using the mine ventilation rates in use during the sampling event and the following equation:

$$NVOC_{AB} = VOC_{AB} * \left(\frac{425{,}000_{scfm} / 130{,}000_{scfm}}{V_{O\ scfm} / V_{E-300\ scfm}} \right) \qquad \text{(N-1)}$$

Where:	$NVOC_{AB}$	=	Normalized target VOC concentration from Stations VOC-A or VOC-B
	VOC_{AB}	=	Concentration of the target VOC detected at Station VOC-A or VOC-B under non-typical mine ventilation rates
	scfm	=	Standard cubic feet per minute
	Vo	=	Sampling event overall mine ventilation rate (in standard cubic feet per minute)
	VE-300	=	Sampling event mine ventilation rate through the E-300 Drift (in standard cubic feet per minute)

The normalized concentration of each target VOC detected at Station VOC-B will be subtracted from the normalized concentration detected at Station VOC-A. The resulting concentration represents the Underground HWDU VOC emission concentration.

The Underground HWDU VOC emission concentration for each target VOC that is calculated for each sampling event will be compared directly to its COC listed in Permit Module IV, Table IV.F.2.c. This will establish whether any of the concentrations of VOCs in the emissions from the Underground HWDUs exceeded the COCs at the time of the sampling.

As specified in Permit Module IV, the Permittees shall notify the Secretary in writing, within seven(7) calendar days of obtaining validated analytical results, whenever the concentrations of any target VOC listed in exceeds the concentration of concern specified in Permit Module IV, Table IV.F.2.c.

The Underground HWDU VOC emission concentration for each target VOC that is calculated for each sampling event will then be averaged with the Underground HWDU VOC emission concentrations calculated for the air sampling events conducted during the previous 12 months. This will be considered the running annual average concentration for each target VOC. For the first year of air sampling, the running annual average concentration for each target VOC will be calculated using all of the previously collected data.

As specified in Permit Module IV, the Permittees shall notify the Secretary in writing, within seven (7) calendar days of obtaining validated analytical results, whenever the running annual average concentration (calculated after each sampling event) for any target VOC exceeds the concentration of concern specified in Permit Module IV, Table IV.F.2.c.

If the results obtained from an individual air sampling event do not trigger the notification requirements of Permit Module IV, then the Permittees will maintain a database with the VOC air sampling data and the results will be reported to the Secretary as specified in Permit Module IV.

N-3e(2) Data Evaluation and Reporting for Disposal Room VOC Monitoring

When the Permittees receive laboratory analytical data from an air sampling event, the data will be validated as specified in Section N-5a, within fourteen (14) calendar days of receiving the laboratory analytical data. After obtaining validated data from an air sampling event, the data will be evaluated to determine whether the VOC concentrations in the air of any closed room, the active open room, or the immediately adjacent closed room exceeded the Action Levels for Disposal Room Monitoring specified in Permit Module IV, Table IV.F.3.b.

The Permittees shall notify the Secretary in writing, within seven (7) calendar days of obtaining validated analytical results, whenever the concentration of any VOC specified in Permit Module IV, Table IV.D.1 exceeds the action levels specified in Permit Module IV, Table IV.F.3.b.

The Permittees shall submit to the Secretary the Semi-Annual VOC Monitoring Report specified in Permit Condition IV.F.2.b that also includes results from disposal room VOC monitoring.

N-4 Sampling and Analysis Procedures

This section describes the equipment and procedures that will be implemented during sample collection and analysis activities for VOCs at WIPP.

N-4a Sampling Equipment

The sampling equipment that will be used includes the following: 6-liter (L) stainless-steel SUMMA® canisters, VOC canister samplers, treated stainless steel tubing, and a dual filter housing. A discussion of each of these items is presented below.

N-4a(1) SUMMA® Canisters

Six-liter, stainless-steel canisters with SUMMA® passivated interior surfaces will be used to collect and store all ambient air and gas samples for VOC analyses collected as part of the monitoring processes. These canisters will be cleaned and certified prior to their use, in a manner similar to that described by Compendium Method TO-15. The canisters will be certified clean to below the required reporting limits for the VOC analytical method for the target VOCs (see Table N-2). The vacuum of certified clean samplers will be verified at the sampler upon initiation of a sample cycle.

N-4a(2) Volatile Organic Compound Canister Samplers

A conceptual diagram of a VOC sample collection unit is provided in Figure N-2. Such units will be used at monitoring Stations VOC-A and VOC-B and at sampling locations for disposal room measurements. The sampling unit consists of a sample pump, flow controller, sample inlet, inlet filters in series to remove particulate matter, vacuum/pressure gauge, electronic timer, inlet purge vent, two sampling ports, and sufficient collection canisters so that any delays attributed to laboratory turnaround time and canister cleaning and certification will not result in canister shortages. Knowledge of sampler flow rates and duration of sampling will allow calculation of sample volume. The set point flow rate will be verified before and after sample collection from the mass flow indication. Prior to their initial use and annually thereafter, the sample collection units will be tested and certified to demonstrate that they are free of contamination above the reporting limits of the VOC analytical method (see Section N-5). Ultra-high purity humidified zero air will be pumped through the inlet line and sampling unit and collected in previously certified canisters as sampler blanks for analysis. The cleaning and certification procedure is derived from concepts contained in the EPA Compendium Method TO-15 (EPA, 1999).

N-4a(3) Sample Tubing

Treated stainless steel tubing is used as a sample path, from the desired sample point to the sample collection unit. This tubing is treated to prevent the inner walls from absorbing contaminants when they are pulled from the sample point to the sample collection unit.

N-4b Sample Collection

Six-hour integrated samples will be collected on each sample day. Alternative sampling durations may be defined for experimental purposes. The VOC canister sampler at each location will sample ambient air on the same programmed schedule. The sample pump will be programmed to sample continuously over a six-hour period during the workday. The units will sample at a nominal flow rate of 33.3 actual milliliters per minute over a six-hour sample period. This schedule will yield a final sample volume of approximately 12 L. Flow rates and sampling duration may be modified as necessary for experimental purposes and to meet the data quality objectives.

Sample flow will be checked each sample day using an in-line mass flow controller. The flow controllers are initially factory-calibrated and specify a typical accuracy of better than 10 percent full scale. Additionally, each air flow controller is calibrated at a manufacturer-specified frequency using a National Institute of Standards and Testing (NIST) primary flow standard.

Upon initiation of waste disposal activities in Panel 1, samples will be collected twice each week (at Stations VOC-A and VOC-B). Samples collected at the panel locations should represent the same matrix type (i.e., elevated levels of salt aerosols). To verify the matrix similarity and assess field sampling precision, field duplicate samples will be collected (two canisters filled simultaneously by the same sampler) from each sampling station (Stations VOC-A and VOC-B) during the first sampling event and at an overall frequency of 5 percent thereafter (see Section N-5a).

Prior to collecting the active open disposal room and closed room samples, the sample lines are purged to ensure that the air collected is not air that has been stagnant in the tubing. This is important in regard to the disposal room sample particularly because of the long lengths of tubing associated with these samples. The repository samples do not require this action due to the short lengths of tubing required at these locations.

N-4c Sample Management

Field sampling data sheets will be used to document the sampler conditions under which each sample is collected. These data sheets have been developed specifically for VOC monitoring at the WIPP facility. The individuals assigned to collect the specific samples will be required to fill in all of the appropriate sample data and to maintain this record in sample logbooks. The program team leader will review these forms for each sampling event.

All sample containers will be marked with identification at the time of collection of the sample. A Request-for-Analysis Form will be completed to identify the sample canister number(s), sample type and type of analysis requested.

All samples will be maintained, and shipped if necessary, at ambient temperatures. Collected samples will be transported in appropriate containers. Prior to leaving the underground for analysis, sample containers may undergo radiological screening. No potentially contaminated samples or equipment will be transported to the surface. No samples will be accepted by the receiving laboratory personnel unless they are properly labeled and sealed to ensure a tamper free shipment.

An important component of the sampling program is a demonstration that collected samples were obtained from the locations stated and that they reached the laboratory without alteration. To satisfy this requirement, evidence of collection, shipment, laboratory receipt, and custody will be documented with a completed Chain-of-Custody Form. Chain-of-custody procedures will be followed closely, and additional requirements imposed by the laboratory for sample analysis will be included as necessary.

Individuals collecting samples will be responsible for the initiation of custody procedures. The chain of custody will include documentation as to the canister certification, location of sampling event, time, date, and individual handling the samples. Deviations from procedure will be considered variances. Variances must be preapproved by the program manager and recorded in the project files. Unintentional deviations, sampler malfunctions, and other problems are nonconformances. Nonconformances must be documented and recorded in the project files. All field logbooks/data sheets must be incorporated into WIPP's records management program.

N-4d Sampler Maintenance

Periodic maintenance for canister samplers and associated equipment will be performed during each cleaning cycle. This maintenance will include, but not be limited to, replacement of damaged or malfunctioning parts without compromising the integrity of the sampler, leak testing, and instrument calibration. Additionally, complete spare units will be maintained on-site to minimize downtime because of sampler malfunction. At a minimum, canister samplers will be certified for cleanliness initially and annually thereafter upon initial use, after any parts that are included in the sample flow path are replaced, or any time analytical results indicate potential contamination. All sample canisters will be certified prior to each usage.

N-4e Analytical Procedures

Analytical procedures used in the analysis of VOC samples from canisters are based on concepts contained in Compendium Method TO-15 (EPA, 1999) and in SW-846 Method 8260B (EPA, 1996).

Analysis of samples will be performed by a certified laboratory. Methods will be specified in procurement documents and will be selected to be consistent with Compendium Method TO-15 (EPA, 1999) or EPA recommended procedures in SW-846 (EPA, 1996). Additional detail on analytical techniques and methods will be given in laboratory SOPs.

The Permittees will establish the criteria for laboratory selection, including the stipulation that the laboratory follow the procedures specified in the appropriate Air Compendium or SW-846 method and that the laboratory follow EPA protocols. The selected laboratory shall demonstrate, through laboratory SOPs, that it will follow appropriate EPA SW-846 requirements and the requirements specified by the EPA Air Compendium protocols. The laboratory shall also provide documentation to the Permittees describing the sensitivity of laboratory instrumentation. This documentation will be retained in the facility operating record and will be available for review upon request by NMED.

The SOPs for the laboratory currently under contract will be maintained in the operating record by the Permittees. The Permittees will provide NMED with an initial set of applicable laboratory SOPs for information purposes, and provide NMED with any updated SOPs on an annual basis.

Data validation will be performed by the Permittees. Copies of the data validation report will be kept on file in the operating record for review upon request by NMED.

N-5 Quality Assurance

The QA activities for the VOC monitoring programs will be conducted in accordance with the documents: *EPA Guidance for Quality Assurance Project Plans QA/G-5* (EPA, 2002) and the *EPA Requirements for Preparing Quality Assurance Project Plans, QA/R-5* (EPA, 2001). The QA criteria for the VOC monitoring programs are listed in Table N-2. This section addresses the methods to be used to evaluate the components of the measurement system and how this evaluation will be used to assess data quality. The QA limits for the sampling procedures and laboratory analysis shall be in accordance with the limits set forth in the specific EPA Method referenced in standard operating procedures employed by either the Permittees or the laboratory. The Permittees standard operating procedures will be in the facility Operating Record and available for review by NMED at anytime. The laboratory standard operating procedures will also be in the facility Operating Record and will be supplied to the NMED as indicated in Section N-4e.

N-5a Quality Assurance Objectives for the Measurement of Precision, Accuracy, Sensitivity, and Completeness

QA objectives for this plan will be defined in terms of the following data quality parameters.

Precision. For the duration of this program, precision will be defined and evaluated by the RPD values calculated between field duplicate samples and between laboratory duplicate samples.

$$RPD = \left(\frac{(A - B)}{(A + B)/2} \right) * 100 \qquad \text{(N-2)}$$

where: A = Original sample result
B = Duplicate sample result

Accuracy. Analytical accuracy will be defined and evaluated through the use of analytical standards. Because recovery standards cannot reliably be added to the sampling stream, overall system accuracy will be based on analytical instrument performance evaluation criteria. These criteria will include performance verification for instrument calibrations, laboratory control samples, sample surrogate recoveries (when required by method or laboratory SOPs), and sample internal standard areas. Use of the appropriate criteria as determined by the analytical method performed, will constitute the verification of accuracy for target analyte quantitation (i.e., quantitative accuracy). Evaluation of standard ion abundance criteria for BFB will be used to evaluate the accuracy of the analytical system in the identification of targeted analytes, as well as the evaluation of unknown contaminants (i.e., qualitative accuracy).

Sensitivity. Sensitivity will be defined by the required MRLs for the program. Attainment of required MRLs will be verified by the performance of statistical method detection limit (**MDL**) studies in accordance with 40 *Code of Federal Regulations* § 136. The MDL represents the minimum concentration that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. An MDL study will be performed by the program analytical laboratory prior to sampling and analysis, and annually thereafter.

Completeness. Completeness will be defined as the percentage of the ratio of the number of valid sample results received (i.e., those which meet data quality objectives) versus the total number of samples collected. Completeness may be affected, for example, by sample loss or destruction during shipping, by laboratory sample handling errors, or by rejection of analytical data during data validation.

N-5a(1) Evaluation of Laboratory Precision

Laboratory sample duplicates and blank spike/blank spike duplicates (**BS/BSD**) will be used to evaluate laboratory precision. QA objectives for laboratory precision are listed in Table N-2, and are based on precision criteria proposed by the EPA for canister sampling programs (EPA, 1994). These values will be appropriate for the evaluation of samples with little or no matrix effects. Because of the potentially high level of salt-type aerosols in the WIPP underground environment, the analytical precision achieved for WIPP samples may vary with respect to the EPA criteria. RPDs for BS/BSD analyses will be tracked through the use of control charts. RPDs obtained for laboratory sample duplicates will be compared to those obtained for BS/BSDs to ascertain any sample matrix effects on analytical precision. BS/BSDs and laboratory sample duplicates will be analyzed at a frequency of 10 percent, or one per analytical lot, whichever is more frequent.

N-5a(2) Evaluation of Field Precision

Field duplicate samples will be collected at a frequency of 5 percent for both monitoring locations. The data quality objective for field precision is 35 percent for each set of duplicate samples.

N-5a(3) Evaluation of Laboratory Accuracy

Quantitative analytical accuracy will be evaluated through performance criteria on the basis of (1) relative response factors generated during instrument calibration, (2) analysis of laboratory control samples (**LCS**), and (3) recovery of internal standard compounds. The criteria for the initial calibration (5-point calibration) is ≤ 30 percent relative standard deviation for target analytes. After the successful completion of the 5-point calibration, it is sufficient to analyze only a midpoint standard for every 12 hours of operation. The midpoint standard will pass a 30 percent difference acceptance criterion for each target compound before sample analysis may begin.

A blank spike or LCS is an internal QC sample generated by the analytical laboratory by spiking a standard air matrix (humid zero air) with a known amount of a certified reference gas. The reference gas will contain the target VOCs at known concentrations. Percent recoveries for the target VOCs will be calculated for each LCS relative to the reference concentrations. Objectives for percent recovery are listed in Table N-2, and are based on accuracy criteria proposed by the EPA for canister sampling programs (EPA, 1994). LCSs will be analyzed at a frequency of 10 percent, or one per analytical lot, whichever is more frequent.

Internal standards will be introduced into each sample analyzed, and will be monitored as a verification of stable instrument performance. In the absence of any unusual interferences, areas should not change by more than 40 percent over a 12-hour period. Deviations larger than 40 percent are an indication of a potential instrument malfunction. If an internal standard area in a given sample changes by more than 40 percent, the sample will be reanalyzed. If the 40 percent criterion is not achieved during the reanalysis, the instrument will undergo a performance check and the midpoint standard will be reanalyzed to verify proper operation. Response and recovery of internal standards will also be compared between samples, LCSs, and calibration standards to identify any matrix effects on analytical accuracy.

N-5a(4) Evaluation of Sensitivity

The presence of aerosol salts in underground locations may affect the MDL of the samples collected in those areas. The intake manifold of the sampling systems will be protected sufficiently from the underground environment to minimize salt aerosol interference.

The MDL for each of the nine target compounds will be evaluated by the analytical laboratories before sampling begins. The initial and annual MDL evaluation will be performed in accordance with 40 *Code of Federal Regulations* §136 and with EPA/530-SW-90-021, as revised and retitled, “Quality Assurance and Quality Control” (Chapter 1 of SW-846) (1996).

N-5a(5) Completeness

The expected completeness for this program is greater than or equal to 90 percent. Data completeness will be tracked monthly.

N-5b Sample Handling and Custody Procedures

Sample packaging, shipping, and custody procedures are addressed in Section N-4c.

N-5c Calibration Procedures and Frequency

Calibration procedures and frequencies for analytical instrumentation are listed in Section N-4e.

N-5d Data Reduction, Validation, and Reporting

A dedicated logbook will be maintained by the operators. This logbook will contain documentation of all pertinent data for the sampling. Sample collection conditions, maintenance, and calibration activities will be included in this logbook. Additional data collected by other groups at WIPP, such as ventilation airflow, temperature, pressure, etc., will be obtained to document the sampling conditions.

Data validation procedures will include at a minimum, a check of all field data forms and sampling logbooks will be checked for completeness and correctness. Sample custody and analysis records will be reviewed routinely by the QA officer and the laboratory supervisor.

Electronic Data Deliverables (**EDDs**) are provided by the laboratory prior to receipt of hard copy data packages. EDDs will be evaluated within five (5) calendar days of receipt to determine if VOC concentrations are at or above action levels in Table IV.F.3.b for disposal room monitoring data or concentrations of concern in Table IV.F.2.c for repository monitoring data. If the EDD indicates that VOC concentrations are at or above these action levels or concentrations, the hard copy data package will be validated within five (5) calendar days as opposed to the fourteen (14) calendar day time frame provided by Section N-3e(2).

Data will be reported as specified in Section N-3(e) and Permit Module IV.

Acceptable data for this VOC monitoring plan will meet stated precision and accuracy criteria. The QA objectives for precision, accuracy, and completeness as shown in Table N-2 can be achieved when established methods of analyses are used as proposed in this plan and standard sample matrices are being assessed.

N-5e Performance and System Audits

System audits will initially address start-up functions for each phase of the project. These audits will consist of on-site evaluation of materials and equipment, review of canister and sampler certification, review of laboratory qualification and operation and, at the request of the QA officer, an on-site audit of the laboratory facilities. The function of the system audit is to verify that the requirements in this plan have been met prior to initiating the program. System audits will be performed at or shortly after to the initiation of the VOC monitoring programs and on an annual basis thereafter.

Performance audits will be accomplished as necessary through the evaluation of analytical QC data by performing periodic site audits throughout the duration of the project, and through the introduction of third-party audit cylinders (laboratory blinds) into the analytical sampling stream. Performance audits will also include a surveillance/review of data associated with canister and sampler certification, a project-specific technical audit of field operations, and a laboratory performance audit. Field logs, logbooks, and data sheets will be reviewed weekly. Blind-audit canisters will be introduced once during the sampling period. Details concerning scheduling, personnel, and data quality evaluation are addressed in the QAPjP.

N-5f Preventive Maintenance

Sampler maintenance is described briefly in Section N-4d Maintenance of analytical equipment will be addressed in the analytical SOP.

N-5g Corrective Actions

If the required completeness of valid data (95 percent) is not maintained, corrective action may be required. Corrective action for field sampling activities may include recertification and cleaning of samplers, reanalysis of samples, additional training of personnel, modification to field and laboratory procedures, and recalibration of test equipment.

Laboratory corrective actions may be required to maintain data quality. The laboratory continuing calibration criteria indicate the relative response factor for the midpoint standard will be less than 30 percent different from the mean relative response factor for the initial calibration. Differences greater than 30 percent will require recalibration of the instrument before samples can be analyzed. If the internal standard areas in a sample change by more than 40 percent, the sample will be reanalyzed. If the 40 percent criterion is not achieved during the reanalysis, the instrument will undergo a performance check and the midpoint standard reanalyzed to verify proper operation. Deviations larger than 40 percent are an indication of potential instrument malfunction.

The laboratory results for samples, duplicate analyses, LCSs, and blanks should routinely be within the QC limits. If results exceed control limits, the reason for the nonconformances and appropriate corrective action must be identified and implemented.

N-5h Records Management

The VOC Monitoring Programs will require administration of record files (both laboratory and field data collection files). The records control systems will provide adequate control and retention for program-related information. Records administration, including QA records, will be conducted in accordance with applicable DOE, MOC, and WIPP requirements.

Unless otherwise specified, VOC monitoring plan records will be retained as lifetime records. Temporary and permanent storage of QA records will occur in facilities that prevent damage from temperature, fire, moisture, pressure, excessive light, and electromagnetic fields. Access to stored VOC Monitoring Program QA Records will be controlled and documented to prevent unauthorized use or alteration of completed records.

Revisions to completed records (i.e., as a result of audits or data validation procedures) may be made only with the approval of the responsible program manager and in accordance with applicable QA procedures. Original and duplicate or backup records of project activities will be maintained at the WIPP site. Documentation will be available for inspection by internal and external auditors.

N-6 Sampling and Analysis Procedures for Disposal Room VOC Monitoring in Filled Panels

Disposal room VOC samples in filled panels will be collected using the subatmospheric pressure grab sampling technique described in Compendium Method TO-15 (EPA, 1999). This method uses an evacuated SUMMA® passivated canister (or equivalent) that is under vacuum (0.05 mm Hg) to draw the air sample from the sample lines into the canister. The sample lines will be purged prior to sampling to ensure that a representative sample is collected. The passivation of tubing and canisters used for VOC sampling effectively seals the inner walls and prevents compounds from being retained on the surfaces of the equipment. By the end of each sampling period, the canisters will be near atmospheric pressure.

The analytical procedures for disposal room VOC monitoring in filled panels are the same as specified in Section N-4e.

N-7 References

U.S. Department of Energy. 1997. *Resource Conservation and Recovery Act Part B Permit Application, Waste Isolation Pilot Plant (WIPP)*, Carlsbad New Mexico, Re. 6.4, 1997

U.S. Environmental Protection Agency. 1996. SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. 3rd Edition. Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency. 1999 *Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) In Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mas Spectrometry*, EPA 625/R-96/010b. Center for Environmental Research Information, Office of Research and Development, Cincinnati, OH, January 1999.

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U.S. Environmental Protection Agency. 2002. *EPA Requirements for Preparing Quality Assurance Project Plans,* QA/R-5, EPA 240/R-01/009, December 2002, Washington, D.C.

Washington Regulatory and Environmental Services, 2004. *Technical Evaluation Report for WIPP Room-Based VOC Monitoring*.

TABLES

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TABLE N-1
TARGET ANALYTES AND METHODS FOR REPOSITORY VOC (STATION VOC-A AND VOC-B) MONITORING AND DISPOSAL ROOM MONITORING

Target Analyte	EPA Standard Analytical Method
Carbon tetrachloride	EPA TO-15[a] EPA 8260B[b]
Chlorobenzene	
Chloroform	
1,1-Dichloroethylene	
1,2-Dichloroethane	
Methylene chloride	
1,1,2,2 -Tetrachloroethane	
Toluene	
1,1,1- Trichloroethane	

[a] U.S. Environmental Protection Agency, 1999, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air- Second Edition, http://www.epa.gov/ttn/amtic/airtox.html

[b] U.S. Environmental Protection Agency, SW-846 Test Methods for Evaluation Solid Wastes, Chemical and Physical Methods, http://www.epa.gov/epaoswer/hazwaste/test/main.htm

TABLE N-2
QUALITY ASSURANCE OBJECTIVES FOR ACCURACY, PRECISION, SENSITIVITY, AND COMPLETENESS

Compound	Accuracy (Percent Recovery)	Precision (RPD) Laboratory	Field	Required MRL (ppbv)	Completeness (Percent)
Carbon tetrachloride	60 to 140	25	35	2	95
Chlorobenzene	60 to 140	25	35	2	95
Chloroform	60 to 140	25	35	2	95
1,1-Dichloroethylene	60 to 140	25	35	5	95
1,2-Dichloroethane	60 to 140	25	35	2	95
Methylene chloride	60 to 140	25	35	5	95
1,1,2,2-Tetrachloroethane	60 to 140	25	35	2	95
Toluene	60 to 140	25	35	5	95
1,1,1-Trichloroethane	60 to 140	25	35	5	95

MRL method reporting limit
RPD relative percent difference

FIGURES

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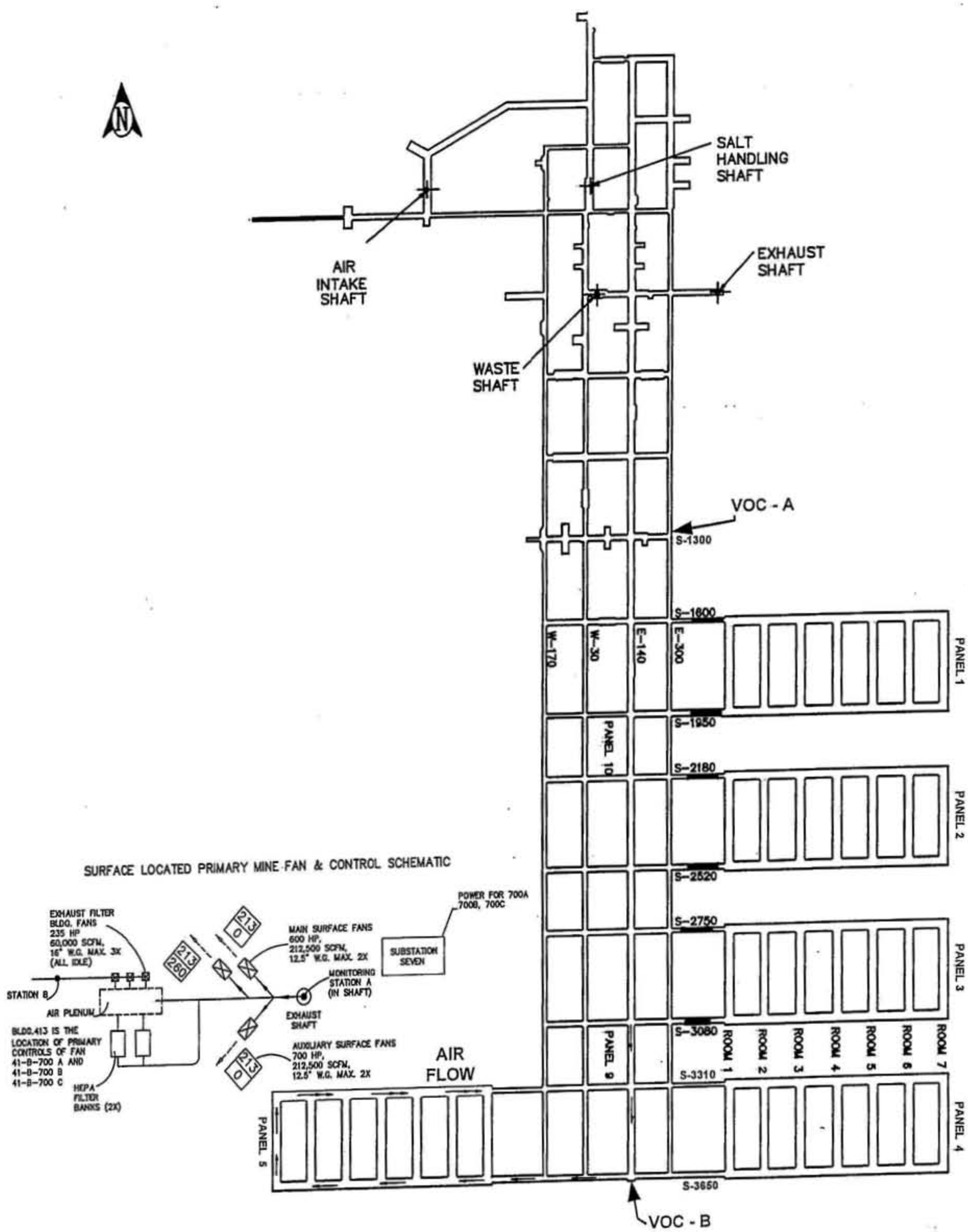

Figure N-1
Panel Area Flow

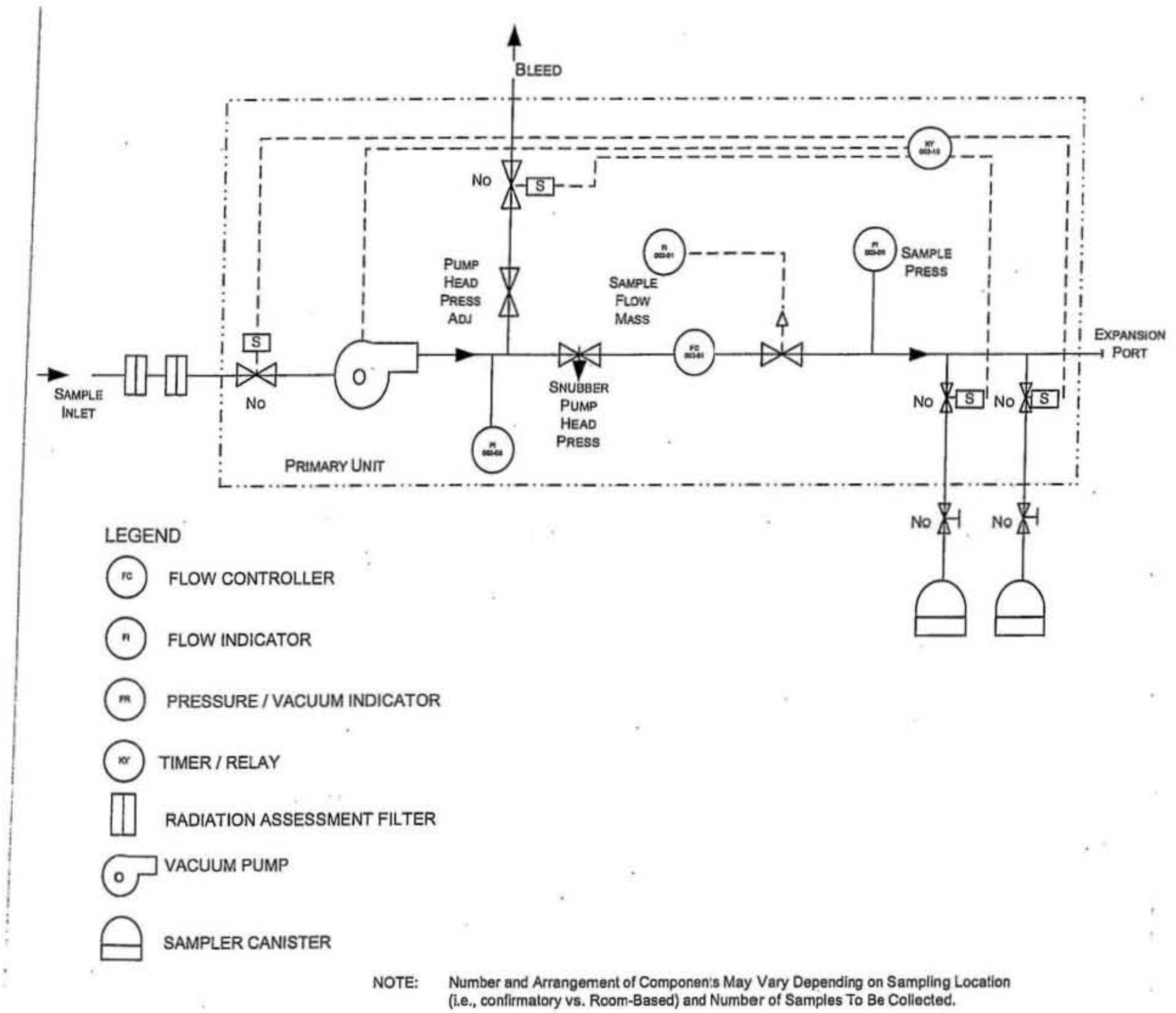

Figure N-2
VOC Monitoring System Design

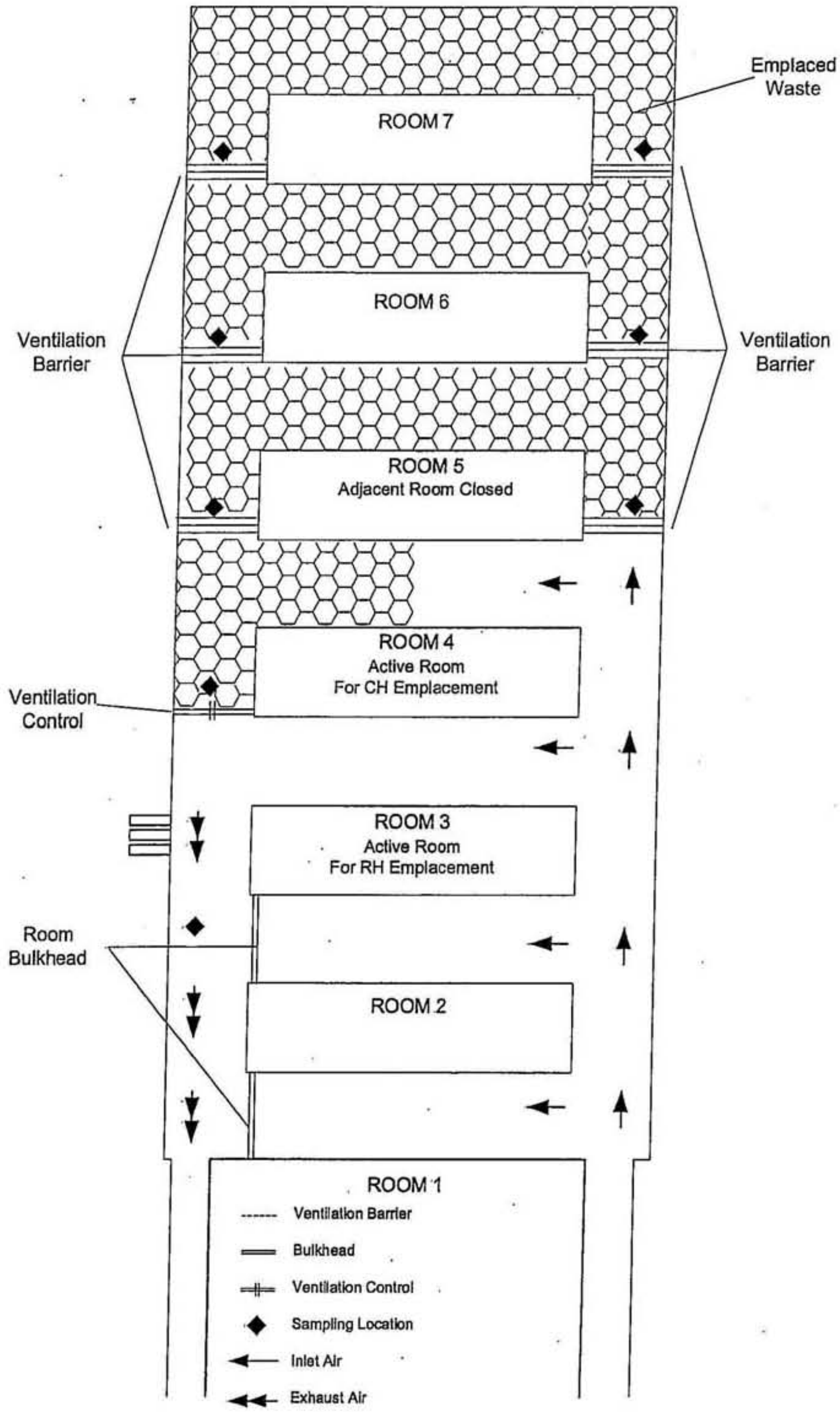

Figure N-3
Disposal Room VOC Monitoring

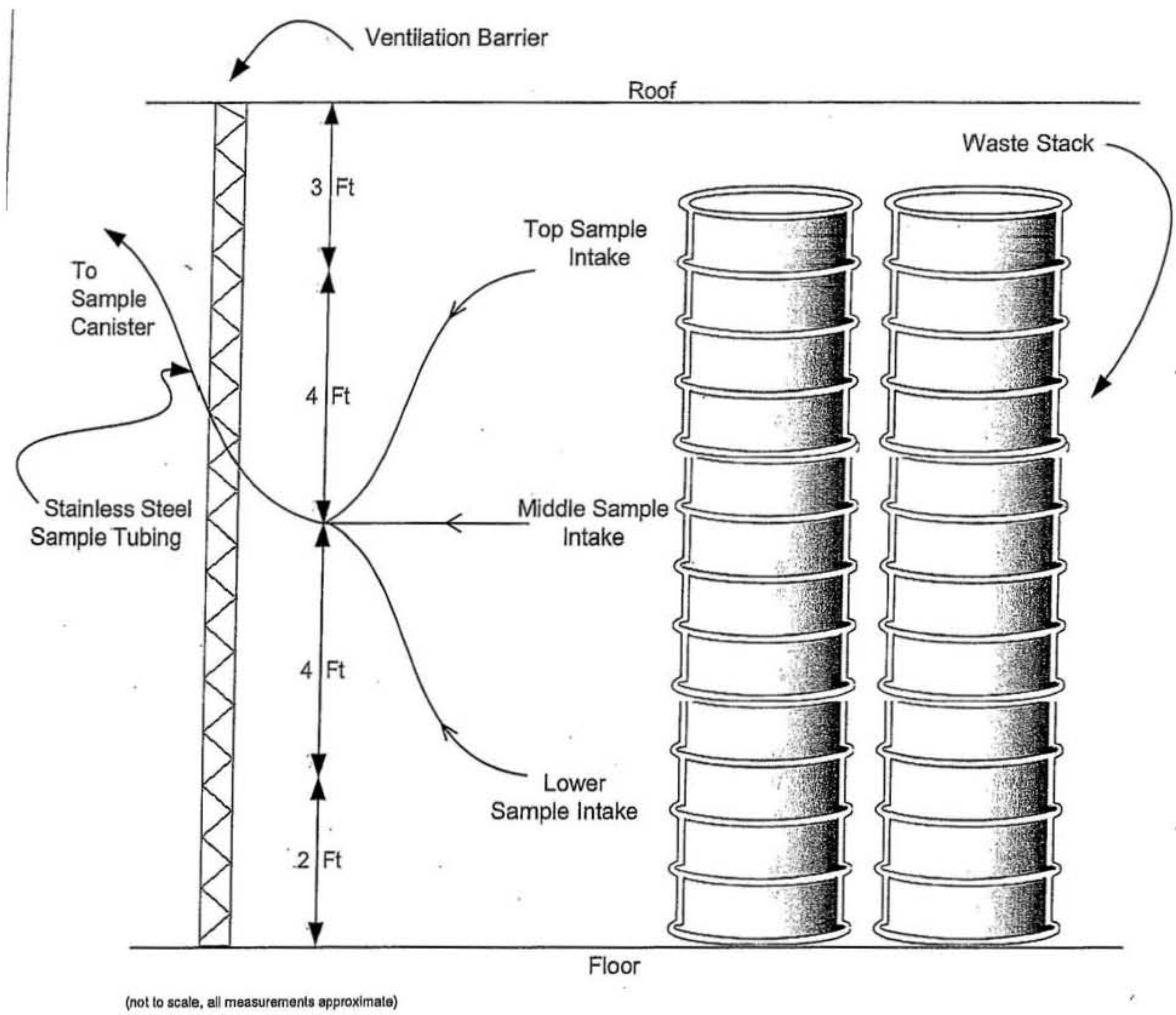

Figure N-4
VOC Sample Head Arrangement

APPENDIX N1

HYDROGEN AND METHANE MONITORING PLAN

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APPENDIX N1

HYDROGEN AND METHANE MONITORING PLAN

TABLE OF CONTENTS

List of Figures

APPENDIX N1

VOLATILE ORGANIC COMPOUND MONITORING PLAN

N1-1 Introduction

This Permit Attachment describes the monitoring plan for hydrogen and methane generated in Underground Hazardous Waste Disposal Units (**HWDUs**) 3 through 7, also referred to as Panels 3 through 7.

Monitoring for hydrogen and methane in Panels 3 through 7 until final panel closure, unless an explosion-isolation wall is installed, may be an effective way to gather data to establish realistic gas generation rates. This plan includes the monitoring design, a description of sampling and analysis procedures, quality assurance (**QA**) objectives, and reporting activities.

N1-2 Parameters to be Analyzed and Monitoring Design

The Permittees will monitor for hydrogen and methane in filled Panels 3 through 7 until final panel closure, unless an explosion-isolation wall is installed. A "filled panel" is an Underground HWDU that will no longer receive waste for emplacement.

Monitoring of a filled panel will commence after installation of the following items in each filled panel:

- substantial barriers
- bulkheads
- five additional monitoring locations.

The substantial barriers serve to protect the waste from events such as ground movement or vehicle impacts. The substantial barrier will be constructed from available non-flammable materials such as mined salt (Figure N1-1).

The bulkheads (Figure N1-2) serves to block ventilation at the intake and exhaust of the filled panel and prevent personnel access. The bulkhead is constructed as a typical WIPP bulkhead with no access doors or panels. The bulkhead will consist of a steel member frame covered with galvanized sheet metal, and will not allow personnel access. Rubber conveyor belt will be used as a gasket to attach the steel frame to the salt, thereby providing an effective yet flexible blockage to ventilation air. Over time, it is possible that the bulkhead may be damaged by creep closure around it. If the damage is such as to indicate a possible loss of functionality, then the bulkhead will be repaired or an additional bulkhead will be constructed outside of the original one.

The existing VOC monitoring lines as specified in Attachment N, Section N-3a(2), "Sampling Locations for Disposal Room VOC Monitoring", will be used for sample collection in each disposal room for Panels 3 through 7. The sample lines and their construction are shown in

Figure N1-3. In addition to the existing VOC monitoring lines, five more sampling locations will be used to monitor for hydrogen and methane. These additional locations include:

- the intake of room 1
- the waste side of the exhaust bulkhead,
- the accessible side of the exhaust bulkhead,
- the waste side of the intake bulkhead,
- the accessible side of the intake bulkhead.

These additional sampling locations (Figure N1-4) will use a single inlet sampling point placed near the back (roof) of the panel access drifts. This will maximize the sampling efficiency for these lighter compounds.

N1-3 Sampling Frequency

Sampling frequency will vary depending upon the levels of hydrogen and methane that are detected.

- If monitored concentrations are at or below Action Level 1 as specified in Table IV.F.5.b, monitoring will be conducted monthly.

- If monitored concentrations exceed Action Level 1 as specified in Table IV.F.5.b, monitoring will be conducted weekly in the affected filled panel.

N1-4 Sampling

Samples for hydrogen and methane will be collected using subatmospheric pressure grab sampling as described in Environmental Protection Agency (**EPA**) Compendium Method TO-15 (EPA, 1999). The TO-15 sampling method uses passivated stainless-steel sample canisters to collect integrated air samples at each sample location. Flow rates and sampling duration may be modified as necessary to meet data quality objectives.

Sample lines shall be purged prior to sample collection.

N1-5 Sampling Equipment

N1-5a SUMMA® Canisters

Stainless-steel canisters with passivated or equivalent interior surfaces will be used to collect and store gas samples for hydrogen and methane analyses collected as part of the monitoring processes. These canisters will be cleaned and certified prior to their use in a manner similar to that described by Compendium Method TO-15 (EPA, 1999). The vacuum of certified clean canisters will be verified upon initiation of a sample cycle. Sampling will be conducted using subatmospheric pressure grab sampling techniques as described in TO-15.

N1-5b Sample Tubing

Treated stainless steel tubing shall be used as a sample path and treatment shall prevent the inner walls from absorbing contaminants.

Any loss of the ability to purge a sample line will be evaluated. The criteria used for evaluation are shown in Figure N1-5.

The Permittees will first suspect that a line is not useable when it is purged prior to sampling. If the line cannot be purged, then it will not be used for sampling unless the line is a bulkhead line that can be easily replaced. Replacement of bulkhead lines will occur before the next scheduled sample. Non-bulkhead lines will be evaluated by first determining if adjacent sampling lines are working. If the answer is no, then the previous sample from the failed line will be examined. If the previous sample was between the first and second action levels, then the explosion-isolation wall will be installed since without the ability to monitor it is unknown whether the area is approaching the second action level or decreasing. If the previous sample was below the first action level then continued sampling is acceptable without the lost sample.

If an adjacent line is working, the prior concentrations measured in that line will be evaluated to determine if it is statistically similar to the prior measurements from the lost line. If the prior sampling results are statistically similar, the lines can be grouped. Statistical similarity will be determined using the Student's "t" test to evaluate differences.

The magnitude of *t* will be compared to the critical *t* value from SW-846, Table 9-2 (EPA, 1996), for this statistical test.

If the lost line can be grouped with an adjacent line, no further action is necessary because the unmonitored area is considered to be represented by the adjacent areas. If the lost sample line cannot be grouped with an adjacent line, the previous concentration measurement will be compared to the Action Levels. If the concentration is below Action Level 1, monitoring will continue. If the concentration is between Action Level 1 and Action Level 2, the explosion-isolation wall will be installed in the panel.

N1-6 Sample Management

Sample containers shall be sealed and uniquely marked at the time of collection of the sample. A Request-for-Analysis Form shall be completed to identify the sample canister number(s), sample type, and type of analysis requested.

N1-7 Analytical Procedures

The samples will be analyzed using gas chromatography equipped with the appropriate detector under an established QA/quality control (**QC**) program. Analysis of samples shall be performed by a laboratory that the Permittees select and approve through established QA processes.

N1-8 Data Evaluation and Notifications

Analytical data from sampling events will be evaluated to determine whether the sample concentrations of flammable gases exceed the Action Levels.

If any Action Level is exceeded, notification will be made to NMED and the notification posted to the WIPP web page and accessed through the email notification system within 7 (seven) calendar days of obtaining validated analytical data.

If any sampling line loss occurs, notification will be made to NMED and the notification posted to the WIPP web page and accessed through the email notification system within 7 (seven) calendar days of learning of a sampling line loss. After the evaluation of the impact of sampling line loss as shown in Figure N1-5, notification will be made to NMED and the notification posted to the WIPP web page and accessed through the email notification system within 7 (seven) calendar days of completing the sampling line loss evaluation.

N1-9 References

U.S. Environmental Protection Agency (EPA), 1996. SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. 3rd Edition. Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1999. *Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) In Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mas Spectrometry*, EPA 625/R-96/010b. Center for Environmental Research Information, Office of Research and Development, Cincinnati, OH, January 1999.

FIGURES

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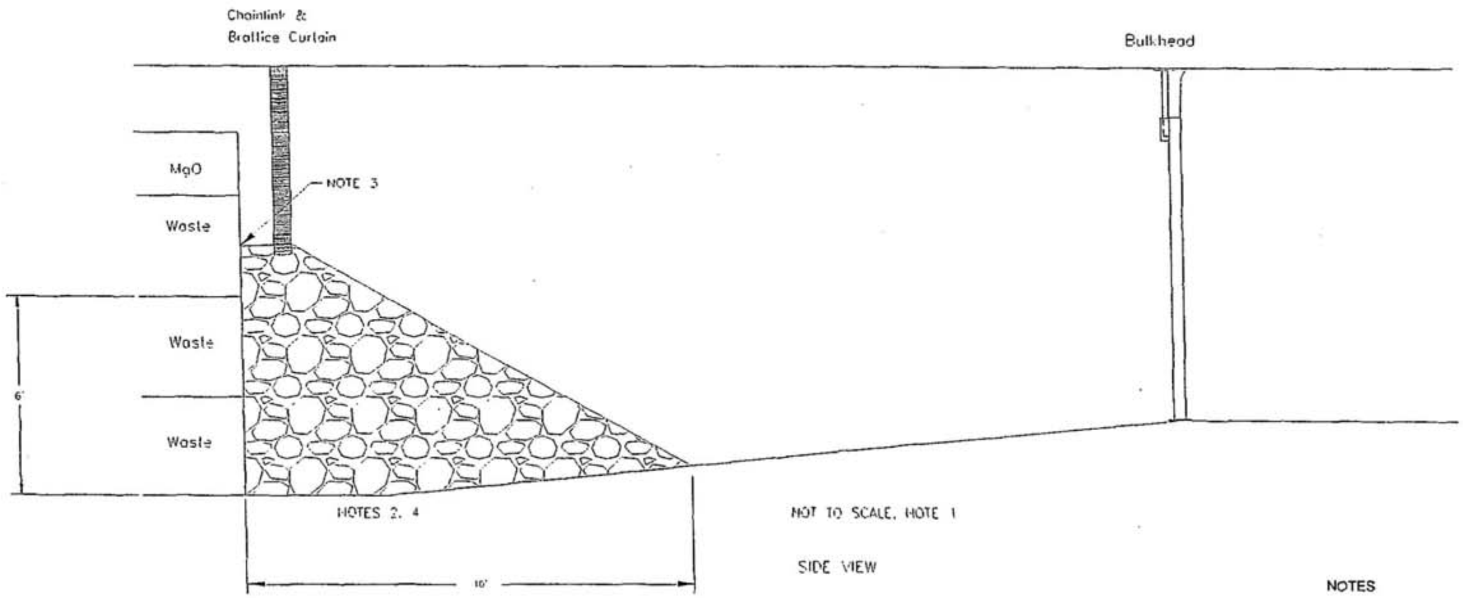


NOTES

1. CONFIGURATION AND PLACEMENT OF THE SUBSTANTIAL BARRIER AND THE BULKHEAD DICTATED BY AS-FOUND (FIELD) CONDITIONS, AS DESIGNATED BY THE COGNIZANT ENGINEER.

2. SUBSTANTIAL BARRIER MATERIAL WILL CONSIST OF RUN-OF-MINE SALT OR OTHER SUITABLE NON-FLAMMABLE MATERIAL AS DESIGNATED BY THE COGNIZANT ENGINEER.

3. SUBSTANTIAL BARRIER MATERIAL SHOULD BE AGAINST THE WASTE FACE. THE HEIGHT OF THE SUBSTANTIAL BARRIER NEAR THE WASTE WILL BE AT LEAST EQUAL TO THE HEIGHT OF THE BOTTOM OF THE TOP ROW OF WASTE.

4. DIMENSIONS INDICATED ARE MINIMUMS. THE HEIGHT OF THE SUBSTANTIAL BARRIER IS MEASURED AT THE WASTE FACE. THE LENGTH OF THE SUBSTANTIAL BARRIER IS MEASURED FROM THE BOTTOM OF THE WASTE FACE TO THE TOE OF THE SUBSTANTIAL BARRIER MATERIAL.

Figure N1-1
Typical Substantial Barrier and Bulkhead

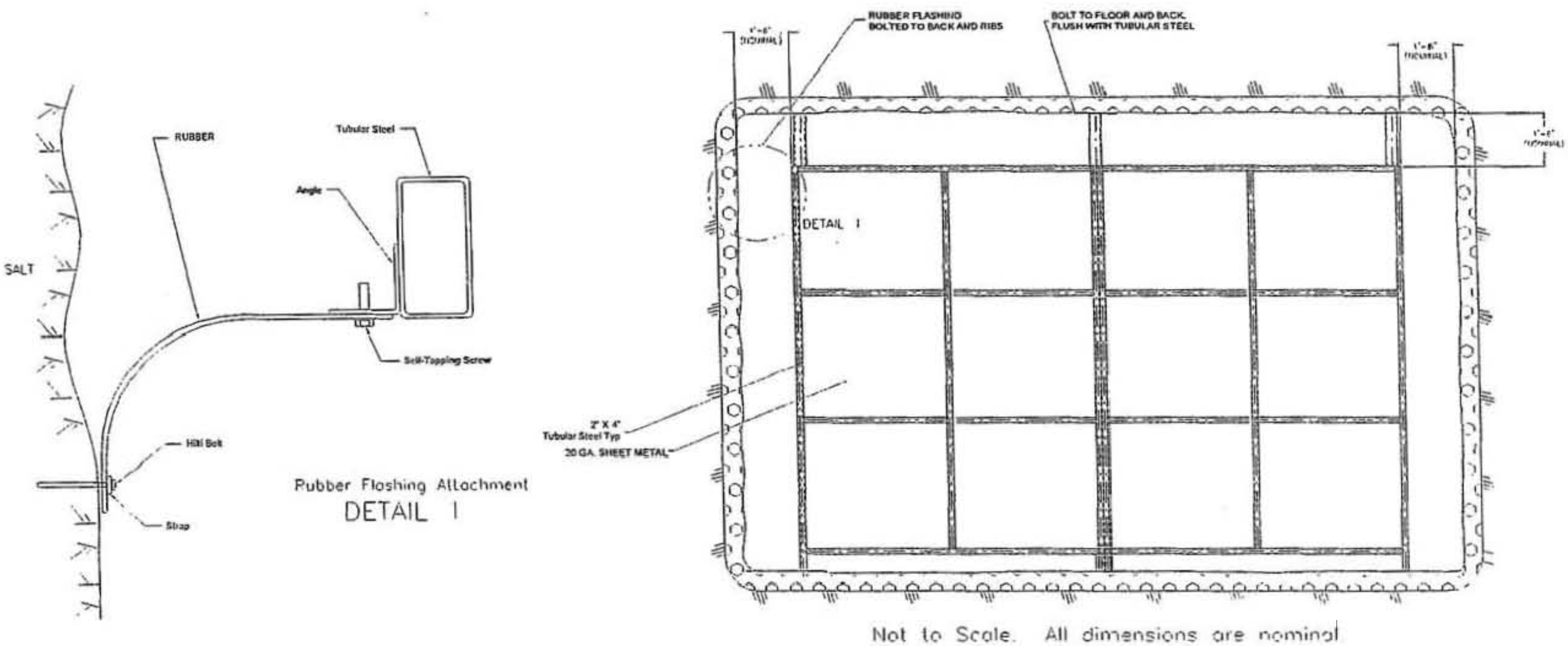


Figure N1-2
Typical Bulkhead

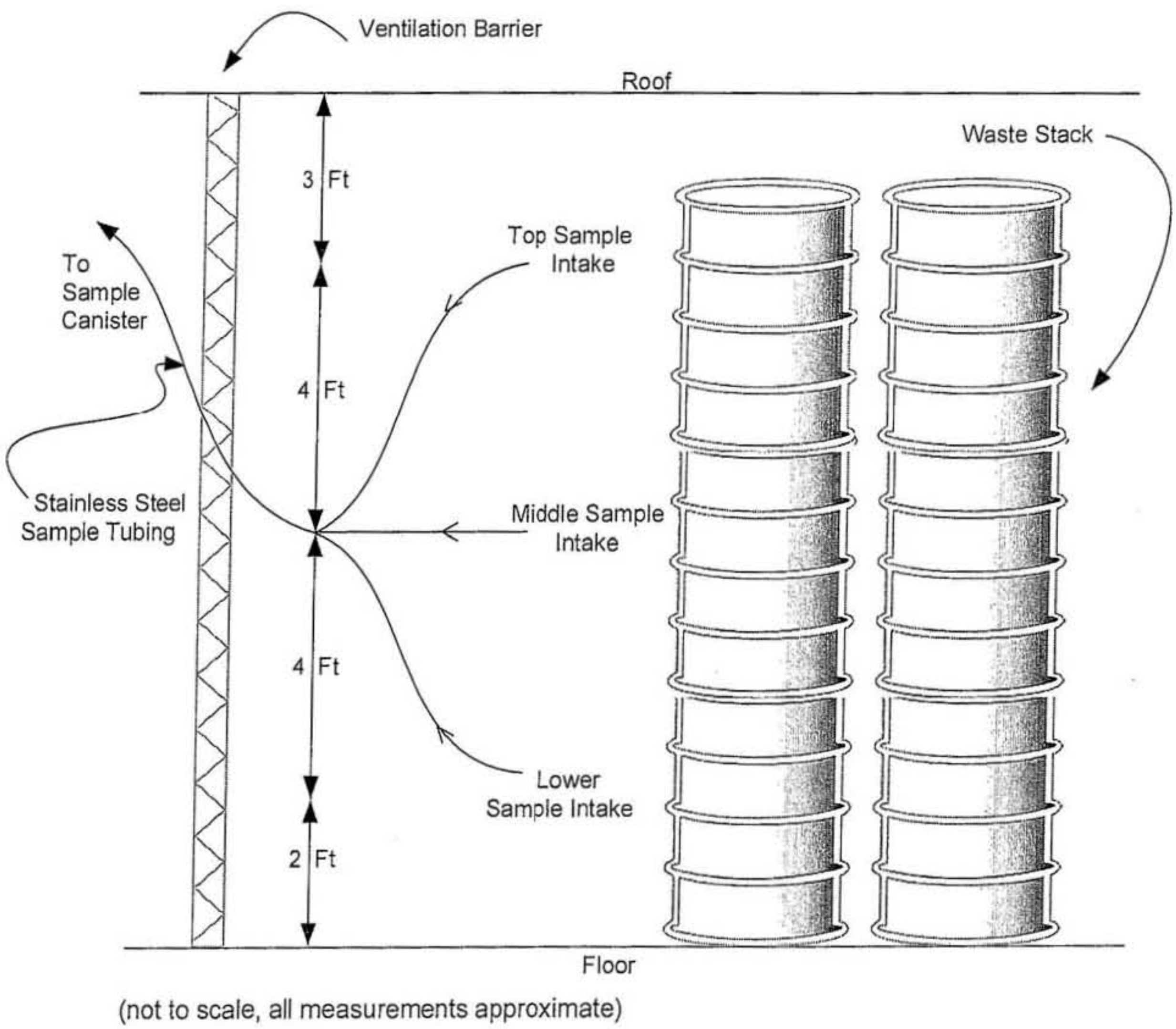


Figure N1-3
Typical Hydrogen and Methane Monitoring System

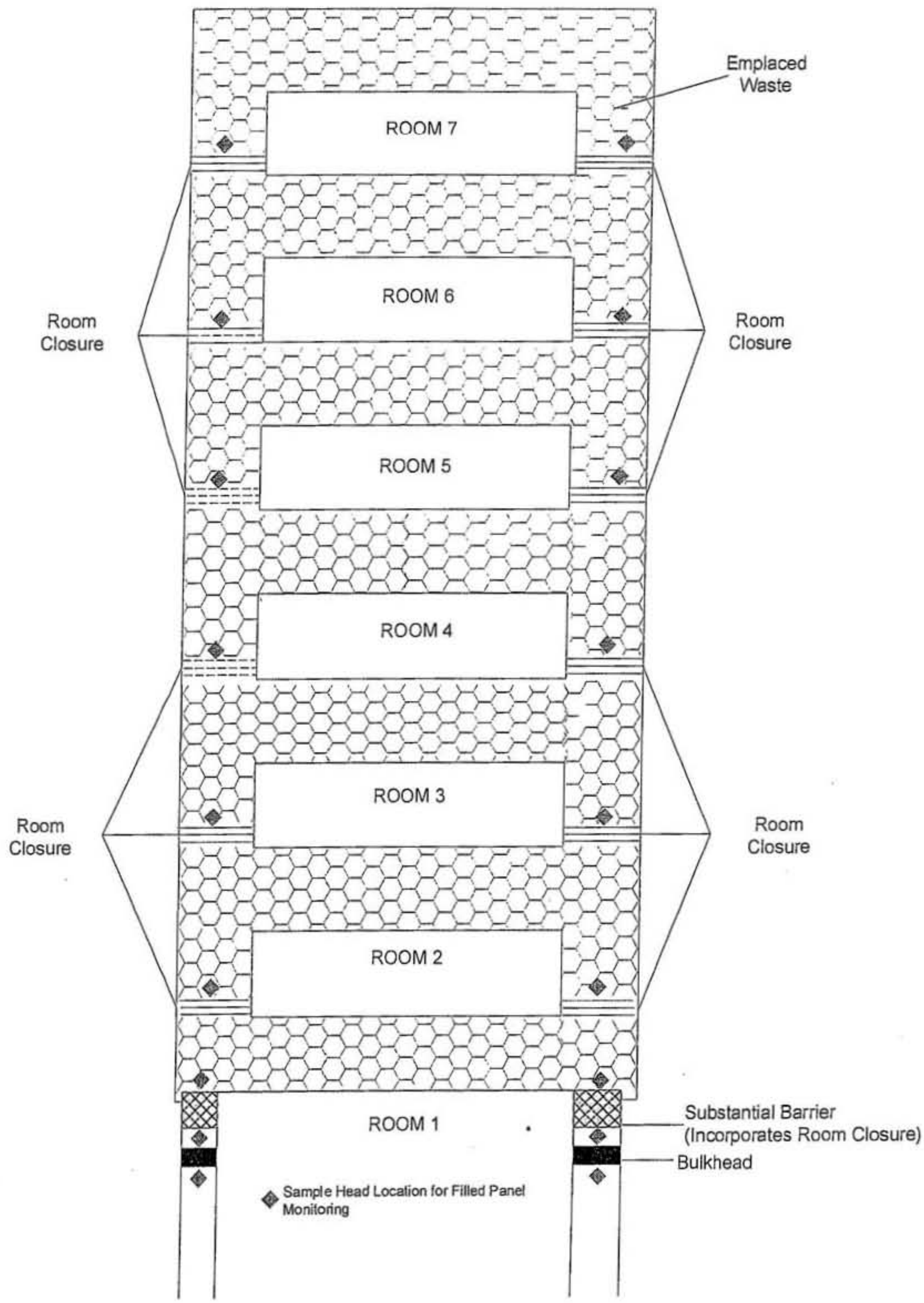
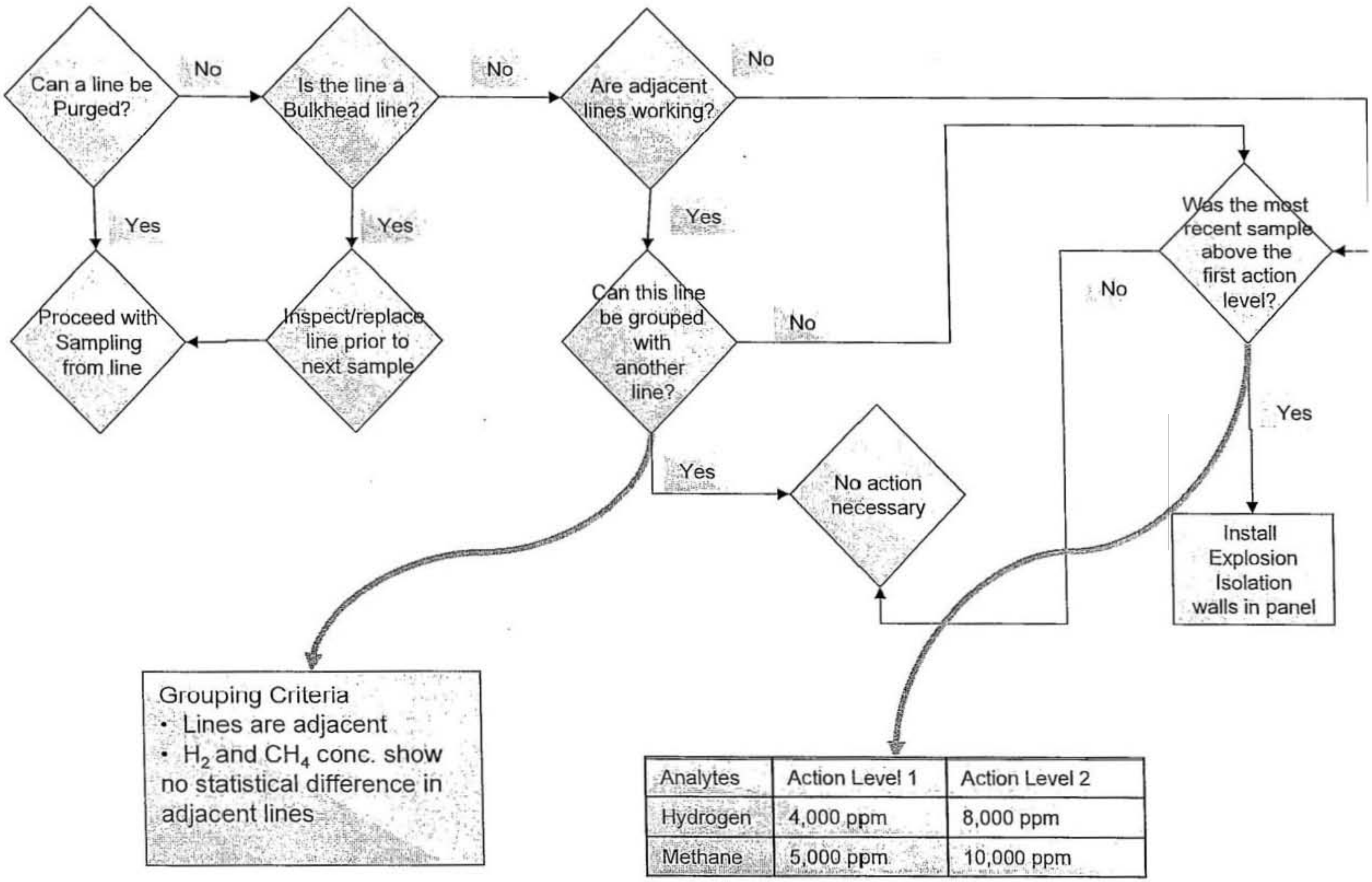


Figure N1-4
Typical Hydrogen and Methane Sampling Locations



Analytes	Action Level 1	Action Level 2
Hydrogen	4,000 ppm	8,000 ppm
Methane	5,000 ppm	10,000 ppm

Figure N1-5
Logic Diagram for Evaluating Sample Line Loss

RENEWAL APPLICATION
ADDENDUM N1

300-YEAR PERFORMANCE DEMONSTRATION RE-EVALUATION

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300-Year Performance Demonstration Re-Evaluation

The 300-year performance demonstration has been updated as part of the renewal application for the Resource Conservation and Recovery Act (**RCRA**) Part B Permit for the Waste Isolation Pilot Plant (**WIPP**). The revised performance demonstration is based on the models and parameters in the Performance Assessment Baseline Calculation (**PABC**) (Leigh et al. 2005). The PABC is the performance assessment (**PA**) baseline for the EPA's latest recertification of the WIPP. This PA baseline represents DOE's current understanding of the processes and uncertainties that could affect the movement of hazardous waste or hazardous constituents from the WIPP facility, and is the most appropriate starting point for the revised performance demonstration.

The performance demonstration uses a subset of the PABC results. First, the PABC predicts repository performance over a 10,000 year period, but the performance demonstration focuses only on the results from the PABC for the first 300 years after facility closure. Second, the PABC predicts repository performance with and without borehole intrusions, but the performance demonstration only uses the PABC predictions without intrusions. This approach is consistent with U.S. Department of Energy (**DOE**) plans and commitments in the first RCRA Part B Permit Application for the WIPP:

> *"The DOE owns all of the lands needed to protect the WIPP repository and will retain this ownership in perpetuity. In this way, the DOE will protect the WIPP from future changes in land use that may alter the surface. In addition, the DOE has planned several active and passive institutional controls to assure that no one intentionally drills into the waste while seeking resources. These plans are described in Chapter I"* (DOE 1996, Chapter D, Section D-9b(3))

The DOE plans are consistent with guidance on institutional controls from the U.S. Environmental Protection Agency (**EPA**) (EPA 2000). As the result of these institutional controls which meet the EPA's and NMED's expectations for preventing intrusion into the repository, intrusion scenarios are precluded from the performance demonstration for the closed facility.

The results of the revised performance demonstration confirm the results of the original analysis in that there is no migration of fluid or gas away from the facility (see Figure 3). Therefore, no migration of hazardous materials occurs during the first 300 years after repository closure. Although this conclusion has not changed, the PABC includes two updates relative to the original performance demonstration:

1. The PABC is based on the latest conceptual models in the PA baseline, which differ from the conceptual models for the original performance demonstration. In fact, a number of changes have occurred since the Part B permit was approved by NMED. One important change is to the conceptual model for gas generation that results from biodegradation of cellulosic, plastic and rubber materials. Full details on the model

changes with the potential to alter the performance demonstration are described in Attachment A, Technical Details of Changes for the PABC Performance Demonstration.

2. The PABC is based on the latest input parameters (DOE 2004, Appendix PA, Attachment PAR, and Leigh et al. 2006, Section 2.9), some of which differ from the input parameters for the original performance demonstration. Typical input parameters define the mechanical properties of the waste, the hydrologic properties of geologic materials surrounding the repository, and the chemical properties of radionuclides in the waste, to name a few of the important processes in the repository. The input parameters can have constant values or can be defined by distributions that represent the uncertainty in their values. For example, the input parameters for the biodegradation rate, iron corrosion rate, actinide solubilities, anhydrite permeability, and halite porosity are defined as distributions in order to represent their uncertainty in the PA. The PABC is a robust starting point for the new performance demonstration because it captures the full variability of uncertain input parameters.

   The original performance demonstration was calculated using constant values of the input parameters. These constant values are generally based on the median values for parameters with uncertainty distributions (DOE 1996, Chapter D, Tables D-2 through D-5).

As will be seen in the following discussion, there are differences between the predicted responses of the original and the revised performance demonstrations. For example, the mean pressure in the repository at 300 years for the revised performance demonstration is about a factor of 3 less than the mean pressure from the original performance demonstration, as shown in Figure 1. This reduction in pressure provides an additional margin relative to release of hazardous waste or hazardous constituents from the repository, and confirms the conclusion from the original performance demonstration that there are no releases of hazardous waste or hazardous waste constituents during the 300-year period after facility closure.

PABC Results and Comparison to the Original Performance Demonstration

The performance demonstration determines if gas or brine migrates away from the closed and sealed repository by analyzing the potential for repository gas pressure to exceed that needed for gas and fluids to migrate away from the repository. This is a reasonable approach because hazardous waste constituents can only migrate away from the repository in gas that is generated by the waste or in brine that first migrates into the repository or in water that is contained in the waste. More specifically, brine or gas may migrate away from the repository only if the repository pressure is greater than the pressure in the host rock surrounding the repository (i.e., lithostatic pressure), which is about 15 Megapascals (**MPa**) (2,200 psi) (DOE 2004, Chapter 2, Section 2.2.1.3).

The results from the PABC and original performance demonstrations for the average repository pressure, average gas generation per drum, average cumulative brine inflow into a panel, average pore volume in a panel, and average repository brine saturation are presented in Figures 1 through 5. Figures 1 through 5 contain similar information to Figures D-17B through D-17F of the original Part B permit application; although the logarithmic scales for time and pressure in the figures in the original permit application have been converted to physical values to simplify interpretation of results. The average values in Figures 1 through 5 are based on the average response of the undisturbed (or unintruded) waste panel in the 100 realizations for replicate 1 of the PABC.

Figure 1 indicates that the predicted average pressure in the waste panel increases with time. The increase in pressure is caused by gas generation from microbial degradation and corrosion and by creep closure reducing the free volume for gas. The pressure after 100 years for the PABC is about 1 MPa (145 psi), while the pressure after 100 years in the original Part B Application performance demonstration is about 5 MPa (725 psi) (Section D-9b(1)(c) and Figure D-17B). Note that the predicted pressure for the PABC at 300 years is approximately 3 MPa (435 psi), while the pressure after 300 years in the original Part B Application performance demonstration is about 10 MPa (1,450 psi).

The predicted pressure for the PABC is about a factor of 5 less than the lithostatic pressure of 15 MPa (2,200 psi). In this condition, there will be no flow of brine or gas away from the facility during the first 300 years after closure because the pressure differences driving brine and gas flows are always inward, from the rock surrounding the facility into the repository.

The PABC performance demonstration has significantly lower pressure than the original performance demonstration throughout the 300-year period for several reasons. The original analysis is based on a conservative assumption of higher than expected gas generation rates (DOE 1996, Chapter D, Section D-9b(1)(c)), while the gas generation rates for microbial degradation have been reduced for the PABC, based on 10 years of experimental data (Leigh et al. 2005 Section 2.3). These two effects reduce the mean brine-inundated gas generation rate from biodegradation by about a factor of 20 (see Attachment A), and are the likely cause of the drop in pressure for the PABC versus the original performance demonstration.

The reduction in gas generation rates is confirmed by the comparison of Figure 2. Figure 2 demonstrates that gas generation is significantly greater for the original performance demonstration than for the PABC performance demonstration throughout the 300-year period. Approximately 90 moles of gas per drum are predicted to be generated after 300 years with the PABC, while 700 moles of gas per drum are generated after 300 years in the original performance demonstration.

Brine can flow from the rock surrounding the facility into the repository whenever the gas pressure in the waste panel is less than the pore pressure in the host rock. Figure 3 presents the mean brine inflow for the first 300 years after closure. The magnitude of the cumulative brine inflow to the waste panel is about 600 m^3 during the first 50 years for the PABC performance demonstration. For the original performance demonstration, the magnitude of the cumulative brine inflow to the waste panel is 562 m^3 during the first 50 years (DOE 1996, Chapter D, Section D-9b(1)(c)). The major source of brine inflow during the first 50 years is dewatering of the halite rock directly surrounding the excavations, called the disturbed rock zone (**DRZ**). The quantity of brine from the DRZ is similar for the original and PABC performance demonstrations. The inflow for the PABC performance demonstration is slightly greater during the first 50 years than for the original performance demonstration because the reduced pressure in the waste panel for the PABC increases the inward pressure difference between the host rock and the closed facility. After the first 50 years, the cumulative brine inflow for the PABC performance demonstration increases significantly relative to the original performance demonstration because the reduced PABC pressure increases the inward pressure difference relative to the host rock, driving more brine from the host rock into the repository.

The as-emplaced waste has approximately 18% solid material and 82% free space by volume. This free space or void volume is expected to decrease as the waste is compressed by the inward movement of the rock walls due to creep of halite. This inward movement is also referred to as creep closure of the rooms. The decrease in void volume is a result of the complex interaction between creep closure, gas pressure, and brine inflow.

Figure 4 compares the void volumes for the PABC and original performance demonstrations. The total void volume decreases from 39,100 m^3 to 17,700 m^3 after 50 years for the PABC performance demonstration. The corresponding values for the original performance demonstration are from 36,900 m^3 to 16,600 m^3 during the first 50 years (DOE 1996, Chapter E, Table E1-2). All other factors being equal, the void volume in the waste for the PABC performance demonstration would be expected to be less than the volume for the original performance demonstration because there is less gas pressure retarding room closure. However, the initial void volume for the PABC performance demonstration is approximately 2,000 m^3 greater than for the original performance demonstration. The net effect of these two competing factors is that there is little difference in void volume for the first 50 years between the original performance demonstration and the PABC, as illustrated in Figure 4. After the first 50 years, the reduced repository pressure for the PABC consistently results in smaller void volumes than for the original performance demonstration.

Brine saturation is the fraction of the void volume that is filled with brine. In other words, brine saturation is equal to brine volume in the waste divided by the total void volume in the waste. Brine saturation varies between 0 for dry waste to 1 for waste that is completely saturated with brine. Figure 5 demonstrates that brine saturation in the waste panel increases slowly in the PABC performance demonstration to a maximum value of 0.16 at 300 years after closure. This increase is caused by brine inflow from the rock (see Figure 3) and by creep closure decreasing the void volume in the waste (see Figure 4).

The original performance demonstration reaches a maximum brine saturation of about 0.05 at about 50 years and decreases thereafter because brine inflow becomes almost constant after 50 years (see Figure 3), because there is less room closure than for the PABC (see Figure 4), and because brine is consumed by steel corrosion. For comparison, the brine saturation in the PABC performance demonstration is 0.075 at 50 years and increases throughout the 300-year period. Lower gas generation rates for the PABC performance demonstration maintain lower pressure (see Figure 1), resulting in more brine inflow (see Figure 3) and less pore volume (see Figure 4) for the PABC. The increased brine inflow for the PABC appears to be great enough to exceed the consumption of brine by iron corrosion, resulting in continuously increasing brine saturation throughout the 300-year period.

The original Part B Permit Application for the WIPP (DOE 1996) provided extensive discussion of waste management practices and demonstrated that, under normal operating conditions, there was no potential for release of hazardous waste from surface operations. Likewise, normal operations for emplacing waste in the underground repository minimized the potential for release via soils and groundwater. The results from the PABC performance demonstration, particularly the facility pressure and the cumulative inflow of brine during the 300-year period after closure (see Figure 3), confirm the conclusions in the original RCRA 300-year performance demonstration that there is no outward migration of hazardous waste or hazardous waste constituents along surface water, soil, groundwater, or air/gas pathways during the first 300 years after repository closure.

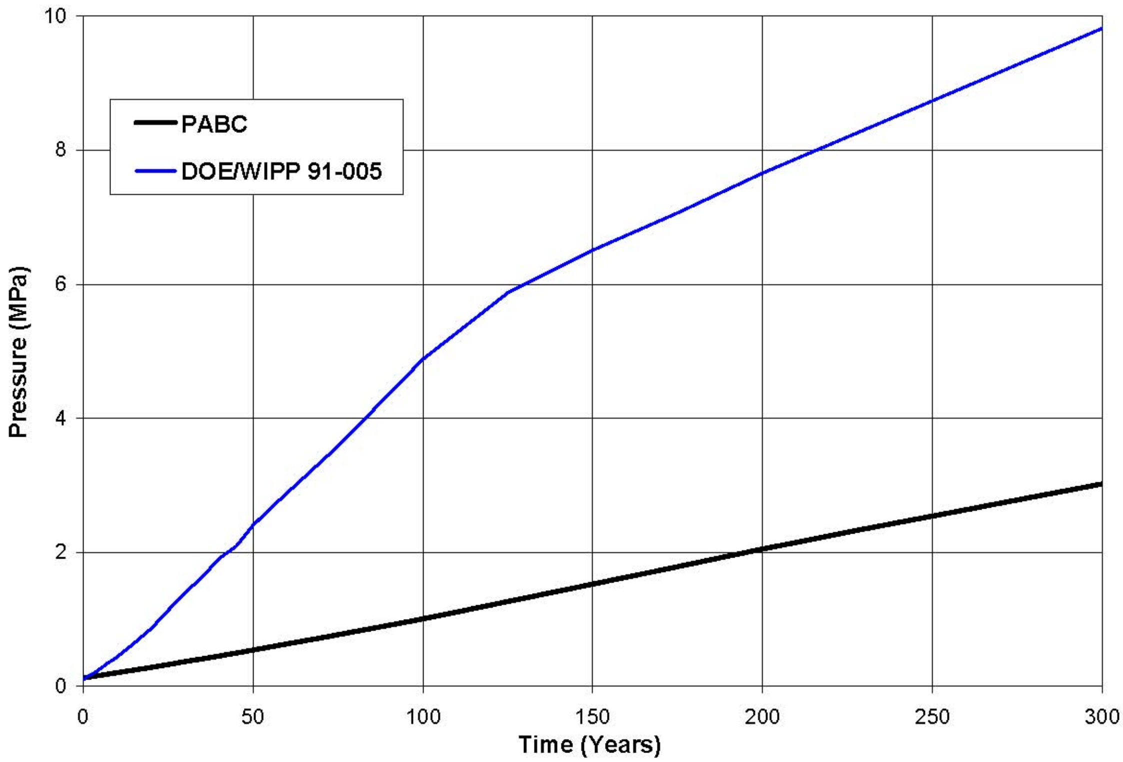

Figure 1. Predicted Change in Repository Pressure Following Closure for the PABC and Original Performance Demonstrations

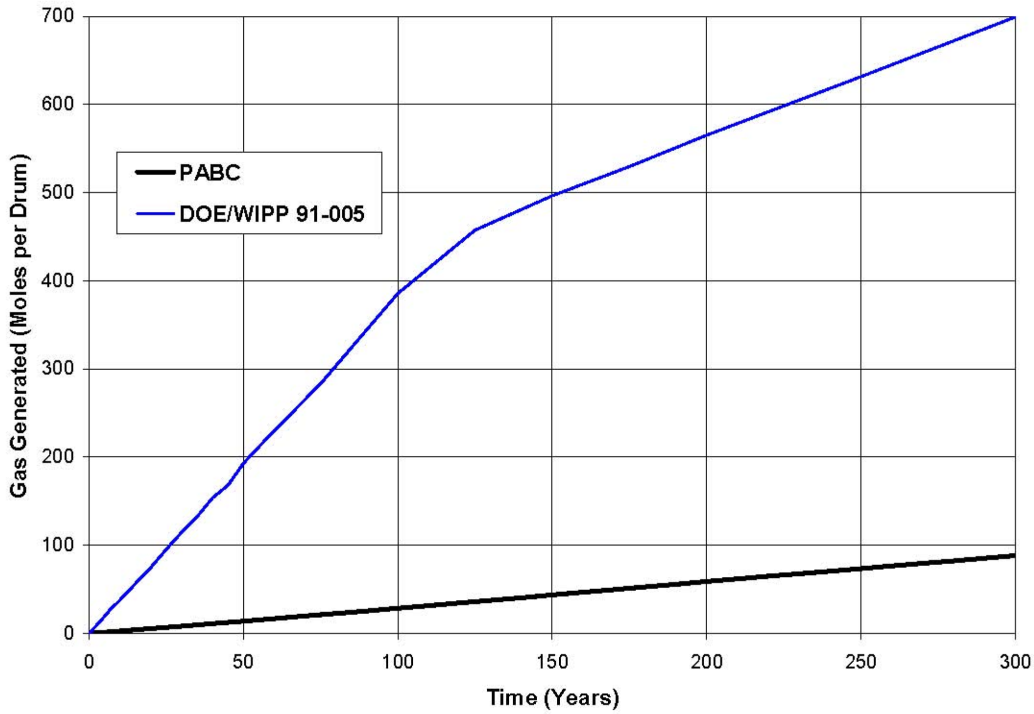

Figure 2. Predicted Cumulative Moles of Gas Generated Per Drum of Waste for the PABC and Original Performance Demonstrations

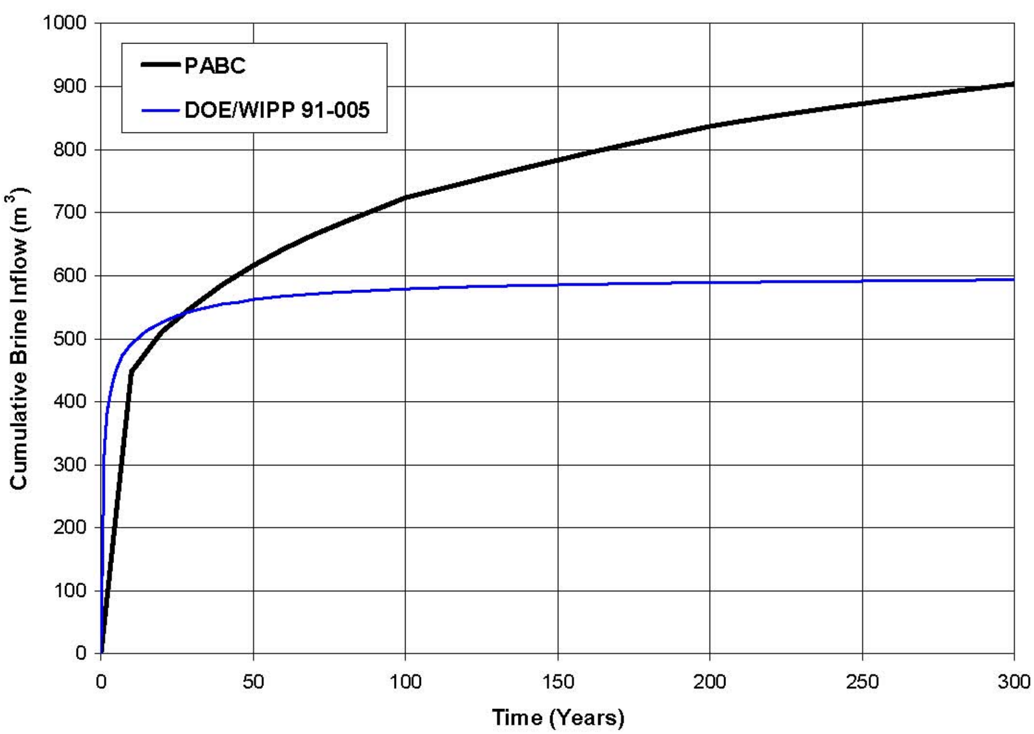

Figure 3. Predicted Cumulative Brine Inflow into a Closed Waste Panel for the PABC and Original Performance Demonstrations

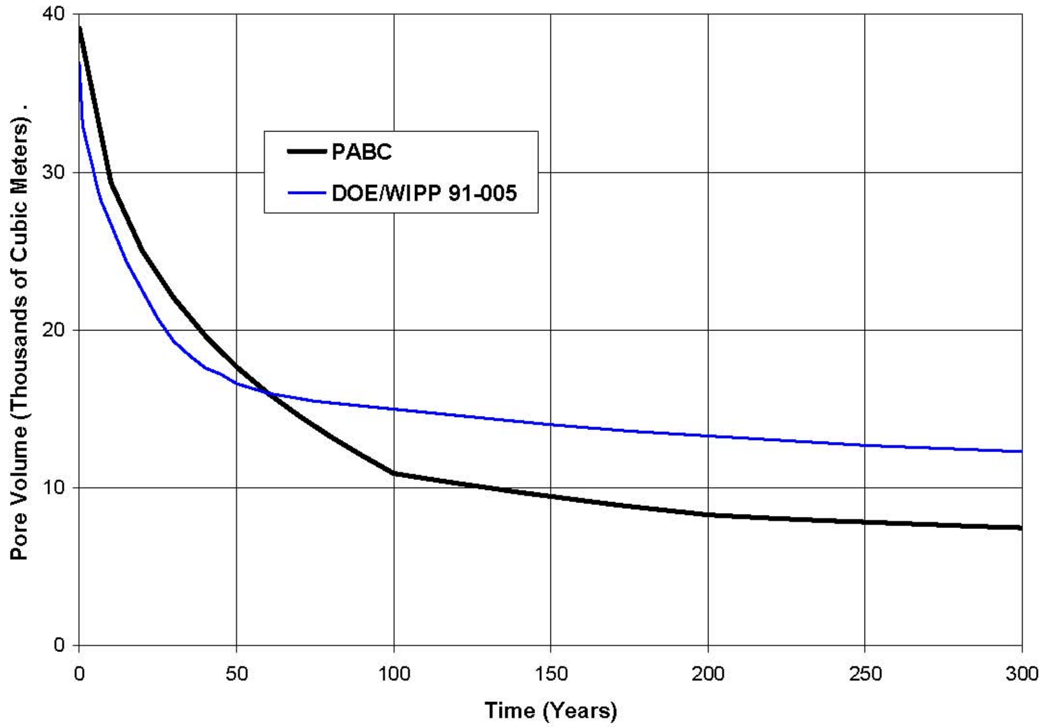

Figure 4. Predicted Change in Panel Pore Volume Due to Creep Closure for the PABC and Original Performance Demonstrations

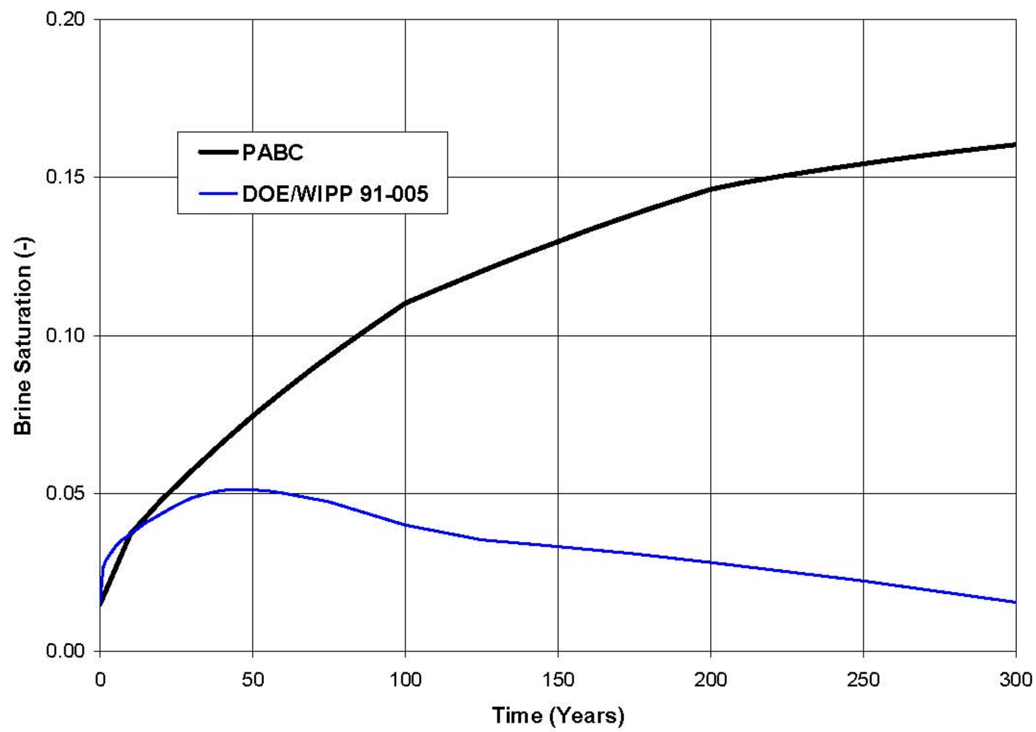

Figure 5. Predicted Average Brine Saturation in the Panel for the PABC and Original Performance Demonstrations

Attachment A

Technical Details of Changes for the PABC Performance Demonstration

The 300-year performance demonstration has been updated as part of the renewal application for the Part B Permit. The revised performance demonstration is based on a similar approach to that used in the original Part B application, but includes the latest conceptual models, codes, and parameters used in the Performance Assessment Baseline Calculation (**PABC**) (Leigh et al. 2005). The PABC is the performance assessment (**PA**) baseline for the EPA's latest recertification of the WIPP[1]. This PA baseline represents DOE's current understanding of the processes and uncertainties that could affect the migration of hazardous waste or of hazardous constituents from the WIPP facility, and is the most appropriate starting point for the revised performance demonstration.

Since the original RCRA 300-year performance demonstration was prepared in 1996 for the WIPP Part B Application, there have been many changes to the conceptual models and parameters used by performance assessment (**PA**) to represent long-term performance of the repository. The individual changes that are relevant to the PABC performance demonstration are described here, with a qualitative estimate of the significance of the change for the performance demonstration. Given the number of changes to conceptual models and the potential for complex interactions between brine inflow, gas generation, room closure, and the DRZ, it is appropriate to use the results of the PABC to predict the quantitative response of the WIPP facility for the 300-year performance demonstration.

The following changes for the PABC are directly relevant to the new demonstration analysis:

(1) Parameter uncertainties are addressed in the PABC by sampling distributions with a range of values, as opposed to the use of median values for the input parameters in the original performance demonstration (DOE 1996, Chapter D, Tables D-2 through D-5). For example, the PABC uses a sampled distribution for the biodegradation rate of cellulose, plastic, and rubber materials (Leigh et al. 2005, Section 2.3), while the original performance demonstration uses a constant biodegradation rate (DOE 1996, Chapter D, Table D-2). Two more examples are: (1) the PABC uses distributions for the porosity and permeability of halite (DOE 2004, Appendix PA, Attachment PAR.7, parameter names S_HALITE/POROSITY and S_HALITE/PRMX_LOG), while the original performance demonstration uses constant values for halite porosity and permeability (DOE 1996, Chapter D, Table D-3); and (2) the PABC uses distributions for the permeability and compressibility of anhydrite (DOE 2004, Appendix PA, Attachment PAR.7, parameter names S_MB139/PRMX_LOG and S_MB139/COMP_RCK), while the original performance demonstration uses constant values for halite permeability and halite porosity (DOE 1996, Chapter D, Table D-4).

[1] Demonstration of compliance with the disposal standard 40 CFR 191 and its criteria, 40 CFR 194.

(2) The original performance demonstration assumed that gas generation from biodegradation always occurred at the fixed inundated rate, and that all cellulose, plastic, and rubber materials are available for consumption (DOE 1996, Chapter D, Section D-9b(1)(a)). The PABC demonstration uses both inundated and humid rates. The PABC demonstration allows cellulose materials to degrade in 100% of the realizations, but only allows the plastic and rubber materials to degrade in 25% of the realizations (Leigh et al. 2005, Sections 2.2 and 2.3).

(3) Microbial gas generation rates are revised for the PABC. The repository is pre-charged at T=0 to represent initial gas production in the new multi-rate gas generation model, and the long-term gas generation rate is reduced, based on 10 years of experimental data (Leigh et al. 2005, Section 2.3).

(4) Microbial degradation occurs through denitrification and sulfidization for the PABC. The multi-step biodegradation reactions are not allowed to progress to methanogenesis (Leigh et al. 2005, Section 2.4).

(5) The logarithm of the disturbed rock zone (**DRZ**) permeability was changed from a constant value of −15 (permeability units of m^2) to a uniform distribution ranging from −19.4 to −12.5 (permeability units of m^2), with a median value of −16 m^2 (DOE 2004, Chapter 6, Table 6-19). On average, this change makes little difference. However, the low and high ends of the distribution will result in less and more brine inflow, respectively, for the same pressure differential between the waste panel and the rock surrounding the repository.

(6) The inundated corrosion rate for iron-based materials without carbon dioxide was changed from a constant value of 7.94×10^{-15} m/s (DOE 1996, Chapter D, Table D-2) to a uniform distribution with a range of 0 to 3.17×10^{-14} m/s (DOE 2004, Chapter 6, Table 6-12). This change increases the gas generation from iron corrosion, all other factors (such as brine saturation) being equal.

(7) The waste permeability was changed from a constant value of 1.7×10^{-13} m^2 to a constant value of 2.4×10^{-13} m^2 (DOE 2004, Chapter 6, Section 6.4.3.2 and Table 6-10). This change has an insignificant effect on Salado flow because the waste permeability is orders of magnitude greater than the permeabilities of the surrounding halite and anhydrite (DOE 2004, Chapter 6, Tables 6-16 and 6-17).

(8) The modeling of the four shafts connecting the repository to the surface has been simplified (DOE 2004, Chapter 6, Section 6.4.4 and Appendix PA, Section PA-4.2.7). The planned design of the shaft seals involves numerous materials including earth, crushed salt, clay, asphalt, and Salado Mass Concrete. For the original compliance demonstration, each material in the shaft seal design was represented in the BRAGFLO grid (DOE 1996, Chapter D, Section D-9b(1)(b)(ii) and Table D-5). The simplified shaft model for the PABC divides the shaft into three sections: an upper section (shaft seal above the Salado), a lower section (within the Salado), and a concrete monolith

section within the repository horizon. This simplification is reasonable because no significant flow of gas or brine occurs within the shaft seal system over the 10,000 year regulatory period (DOE 2004, Appendix PA, Section PA-4.2.7).

(9) The grid geometry and repository layout were changed in the BRAGFLO model, including revised radial flaring in the BRAGFLO grid (DOE 2004, Appendix PA, Attachment MASS, Section MASS-4.2). This had an insignificant effect on Salado flow (Stein and Zelinski 2003).

(10) Representation of panel closures was changed from a generic design to the Option D panel closure design. This change also included a fracture model for the DRZ above the closures. This change affected pressures and saturations in the waste emplacement areas and operations/experimental areas of the repository (DOE 2004, Chapter 6, Section 6.4.3).

(11) The molecular weight of cellulose was decreased from 30.026 g/mol to 27.023 g/mol, resulting in a slight increase of long-term pressure.

(12) The waste inventory was changed for the PABC. The amounts of cellulosic, plastic, and rubber materials have changed and include emplacement materials. The new values for radionuclide inventory and waste material parameters for the PABC are defined in Leigh, Trone, and Fox (2005).

(13) The residual saturation and rock compressibility parameters for MB 138/139 and Anhydrite A&B have changed for the PABC (Leigh et al. 2005, Table 2-1).

References

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Leigh, C. D., J. F. Kanney, L. H. Brush, J. W. Garner, G. R. Kirkes, T. Lowry, M. B. Nemer, J. S. Stein, E. D. Vugrin, S. Wagner, and T. B. Kirchner. 2005. *2004 Compliance Recertification Application Performance Assessment Baseline Calculation*, (Revision 0). ERMS 541521. Carlsbad, NM: Sandia National Laboratories.

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CHAPTER O

RESERVED

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CHAPTER O

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CHAPTER P

WIPP TECHNICAL PROCEDURE SUMMARIES REFERENCED IN OTHER ATTACHMENTS

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CHAPTER P

WIPP TECHNICAL PROCEDURE SUMMARIES REFERENCED IN OTHER ATTACHMENTS

TABLE OF CONTENTS

The most current revision of the complete document or procedure is maintained within the WIPP Operating Record.

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WP 02-EM1002

The procedure following this page has been removed in its entirety and replaced with a Procedure Summary. The complete and current procedure is retained within the WIPP Operating Record.

Procedure Summary

WP 02-EM1002 is a technical procedure that provides step-by-step instructions for acquiring ground-water samples using electric submersible pumps (**ESPs**). The procedure addresses the equipment in general, lists precautions and limitations which assure that only qualified individuals operate the equipment, prerequisite actions which assure the correct installation and operation. The procedure details how to install the various subsystems such as the surface discharge and pressure monitoring system and the pressure monitoring bubbler and how to start up and shut down the ESP.

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WP 02-EM1005

The procedure following this page has been removed in its entirety and replaced with a Procedure Summary. The complete and current procedure is retained within the WIPP Operating Record.

Procedure Summary

WP 02-EM1005 is a technical procedure that provides step-by-step instructions for on site analysis of ground water to determine ground-water stability prior to the collection of final samples for analysis. The procedure addresses the equipment in general, lists precautions and limitations which assure that only qualified individuals operate the equipment, prerequisite actions which assure data quality. The procedure addresses the field measurement of Eh, pH, temperature, specific gravity, specific conductance, alkalinity, chloride, divalent cation, and total iron as indicators of ground-water stability.

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WP 02-EM1006

The procedure following this page has been removed in its entirety and replaced with a Procedure Summary. The complete and current procedure is retained within the WIPP Operating Record.

Procedure Summary

WP 02-EM1006 is a technical procedure that provides step-by-step instructions for acquiring ground-water samples from the WQSP wells in the vicinity of WIPP. The procedure addresses the equipment in general, lists precautions and limitations which assure that only qualified individuals operate the equipment, and prerequisite actions which assure the data quality. The procedure addresses collection of samples from private wells, collection of serial ground-water samples, the collection of final samples for submittal to the laboratory, and data review by the monitoring task leader.

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WP 02 EM1014

The procedure following this page has been removed in its entirety and replaced with a Procedure Summary. The complete and current procedure is retained within the WIPP Operating Record.

Procedure Summary

WP 02-EM1014 is a technical procedure that specifies the steps followed by Environmental Monitoring (**EM**) personnel for making manual ground-water level measurements in ground-water wells in the vicinity of the WIPP facility. The procedure provides general instructions including prerequisites, safety precautions, performance frequency, quality assurance, and records. Specific instructions are included for using the water level measurement electrical conductance probe and data management.

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WP 02-EM3001

The procedure following this page has been removed in its entirety and replaced with a Procedure Summary. The complete and current procedure is retained within the WIPP Operating Record.

Procedure Summary

WP 02-EM3001 is a management control procedure to provide the administrative guidance to be used by Environmental Monitoring (**EM**) personnel to maintain quality control (**QC**) associated with EM sampling activities and to assure that data acquired under the WIPP Environmental Monitoring Program are valid. The precautions and limitations portion of this procedure assure that only qualified personnel acquire samples under the EM program, that cross contamination of sampling equipment is prevented, and that sample hold times are not exceeded. The Performance portion of the procedure provides step-by-step instructions for Quality Assurance/Quality Control (**QA/QC**) implementation, the use of data sheets and sample tracking logbooks, sample tacking from collection to submittal, and actions to take if sample results indicate the potential for exceeding a regulatory limit.

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WP 02-EM3003

The procedure following this page has been removed in its entirety and replaced with a Procedure Summary. The complete and current procedure is retained within the WIPP Operating Record.

Procedure Summary

WP 02-EM3003 is a management control procedure to provide Environmental Monitoring (**EM**) personnel instructions on performing validation and verification of laboratory data containing the analysis results of non-radiological samples. This procedure is used only on the analytical results of the non-radiological environmental surveillance sampling performed around the WIPP site.

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WP 02-RC.01

The procedure following this page has been removed in its entirety and replaced with a Procedure Summary. The complete and current procedure is retained within the WIPP Operating Record.

Procedure Summary

WP 02-RC.01 is a step-by-step procedure that defines site-generated non-radioactive hazardous waste and lists responsibilities of waste management organizations including the generator, waste handlers, sampling personnel, safety personnel, and compliance personnel. In addition, the procedure defines training requirements, container marking requirements, spill response, and lists waste disposal prohibitions. A Section of the procedure is focused on waste management practices including the management in satellite accumulation areas, the hazardous waste staging area (which includes, but is not limited to, materials awaiting analysis), the establishment of accumulation times, and hazardous waste disposal.

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WP 02-RC.04

The document following this page has been removed in its entirety and replaced with a Document Summary. The complete and current document is retained within the WIPP Operating Record.

Document Summary

WP 02-RC.04 defines the process for evaluating, tracking and maintaining the Resource Conservation and Recovery Act (**RCRA**) training requirements contained in 20.4.1.300, 500, 600, and 900 NMAC (incorporating 40 CFR §262, §264, §265, and §270). Personnel of the Waste Isolation Pilot Plant (**WIPP**) must successfully complete training consisting of classroom instruction and applicable on-the-job training. Training includes instruction in hazardous waste management procedures relevant to the position in which they are employed. The HWFP has been integrated into this plan. The WIPP Permit stipulates that within 30 days of employment, individuals working at WIPP successfully complete the General Employee Training (**GET**) class. GET provides initial RCRA training to each employee by providing instruction and information on radiation safety, emergency preparedness, spill response, safety, security, hazard communications, and a brief history and overview of the RCRA. GET also includes a policies and procedures overview and first responder awareness training in which each individual is instructed in how to initiate an emergency response sequence by notifying the Central Monitoring Room (**CMR**). Additionally, more detailed hazardous waste, emergency response and similar training may be required dependent upon the employee’s job description. Those job descriptions and their associated level of training is outlined in the HWFP. This plan also addresses the mechanism for addressing changes in the employees duties, job descriptions and position.

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WP 10-AD3029

The document following this page has been removed in its entirety and replaced with a Document Summary. The complete and current document is retained within the WIPP Operating Record.

Document Summary

WP 10-AD3029 provides the step-by-step protocols for the establishment and maintenance of a master database of monitoring and data collection (**M&DC**) equipment, the recall process for equipment needing calibration, the performance of calibrations, the management of calibration results to determine the adequacy of recall frequencies, functional testing of M&DC equipment, and reporting including out-of-tolerance reporting and expired calibration reporting. In addition, the procedure provides step-by-step process for the storage of calibrated M&DC equipment and the use of rental equipment.

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WP 12-HP1100

The document following this page has been removed in its entirety and replaced with a Document Summary. The complete and current document is retained within the WIPP Operating Record.

Document Summary

WP 12-HP1100 provides specific methods and guidance for performing surface contamination, dose rate surveys of items, equipment, and areas. Radiological surveys are to be performed: (1) routinely, as specified by Attachment 4, Radiological Survey Frequencies, and as scheduled by the Operational Health Physics(**OHP**) Manager; (2) in association with a Radiation Work Permit (**RWP**); and/or (3)upon a special request. This procedure does not cover monitoring of personnel. The limits for performing radiological receipt surveys are driven by 10 CFR 835.

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WP 13-1

The document following this page has been removed in its entirety and replaced with a Document Summary. The complete and current document is retained within the WIPP Operating Record.

Document Summary

WP 13-1 identifies federal and industry quality requirements applicable to the Management and Operating Contractor (**MOC**) quality assurance program. This document establishes the minimum quality requirements for MOC personnel and guidance for the development and implementation of quality assurance programs by all MOC departments. Requirements and guidance are based on criteria contained in applicable Federal Regulations, DOE Directives, EPA requirements documents, industry standards and the Department of Energy (**DOE**) Carlsbad Field Office Quality Assurance Program Document (**QAPD**). Source documents, which fall into one of three categories:

- Regulatory documents that define the requirements necessary for WIPP to be granted a certificate of compliance by the federal government and permit(s) by state governmental agencies to dispose of mixed transuranic (**TRU**) wastes in the WIPP repository
- Commitment documents that are imposed by DOE
- Guidance documents that provide additional information useful in developing quality assurance programs

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CHAPTER Q

WIPP MINE VENTILATION RATE MONITORING PLAN

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CHAPTER Q

WIPP MINE VENTILATION RATE MONITORING PLAN

TABLE OF CONTENTS

List of Tables

RENEWAL APPLICATION
CHAPTER Q

WIPP MINE VENTILATION RATE MONITORING PLAN

Q-1 Definitions

Consistent with their use in the Renewal Application, the following terms are defined:

Actual cubic feet per minute (**acfm**): The volume of air passing a fixed point in an excavation, normally determined as the product of the cross section of the excavation and the mean velocity of the air.

Standard cubic feet per minute (**scfm**): The actual cubic feet per minute passing a fixed point adjusted to standard conditions. In the Imperial measurement system, the standard condition for pressure is 14.7 pounds per square inch (**psi**) (sea level) and the standard condition for temperature is 492 degrees Rankine (freezing point of water or 32 degrees Fahrenheit). The greatest difference between acfm and scfm occurs in the summer when the pressure at the repository horizon is about 14.2 psi and the temperature is about 560 degrees Rankine (100 degrees Fahrenheit). Then

$$1 \text{ scfm} \times (560/492) \times (14.7/14.2) = 1.2 \text{ acfm}$$

A reasonably conservative conversion factor, therefore, is 1.2. Using this factor, 35,000 scfm is very nearly 35,000 x 1.2 or 42,000 acfm.

Restricted Access: If the required ventilation rate in an active disposal room cannot be achieved or cannot be supported due to operational needs, access is restricted by the use of barriers, signs and postings, or individuals stationed at the entrance to the active disposal room when ventilation rates are below 35,000 scfm.

Shift: Those work shifts when there is normal access to the Waste Isolation Pilot Plant (**WIPP**) underground.

Worker: Anyone who has normal access to the WIPP underground.

Q-2 Objective

The objective of this plan is to describe how the ventilation requirements in the Permit will be met. This plan achieves this objective and documents the process by which the Permittees demonstrate compliance with the ventilation requirements by:

- Maintaining an annual running average of 260,000 scfm through the underground repository

- Maintaining a minimum of 35,000 scfm of air through the active disposal rooms when workers are present in the rooms

This plan contains the following elements: Objective; Implementation and Approval; Design and Procedures; Equipment Calibration and Maintenance; Reporting and Record Keeping; Quality Assurance.

Q-3 Implementation and Approval

The Permittees have implemented this plan and it will be maintained in the facility Operating Record until closure of the WIPP facility.

Q-4 Design and Procedures

This section describes the four basic processes that make up the mine ventilation rate monitoring plan:

- Test and Balance, a periodic re-verification of the satisfactory performance of the entire underground ventilation system and associated components

- Monitoring and calculation of the Running Annual Average of the Total Mine Airflow to verify achievement of the 260,000 scfm minimum requirement

- Monitoring of active disposal room(s) to assure a minimum flow of 35,000 scfm whenever workers are present in the room

- Quarterly verification of the total mine airflow

Q-4a Test and Balance

Q-4a(1) Test and Balance Process

The WIPP ventilation system and the underground ventilation modes of operation are described in Renewal Application Appendix M2-2a(3). The Permittees verify underground ventilation system performance by conducting a periodic Test and Balance. The Test and Balance is a comprehensive series of measurements and adjustments designed to assure that the system is operating within acceptable design parameters. The Test and Balance is an appropriate method of verifying system flow because it provides consistent results based on good engineering practices. The testing of underground ventilation systems is described in McPherson, 1993. Once completed, the Test and Balance data become the baseline for underground ventilation system operation until the next Test and Balance is performed.

The “Test” portion of the process involves measuring the pressure drop and air quantity of every underground entry excluding alcoves or other dead end drifts. In addition, the tests verify resistance curves for each of the main regulators, measure shaft resistance, and measure main fan pressure and quantity. This is done at the highest achievable airflow to facilitate accurate measurements. From these measurements the frictional resistance of the system is determined.

Pressure is measured using the gage and tube method, which measures the pressure drop between two points using a calibrated pressure recording device and pitot tubes. Pressure drops across the shafts are measured by either calibrated barometers at the top and bottom of shafts or the gage and tube method. Airflow is measured using a calibrated vane anemometer to take a full entry traverse between system junctions. Fan pressure is measured using a calibrated pressure recording device and pitot tube to determine both static and velocity pressure components.

Multiple measurements are taken at each field location to assure accurate results. Consecutive field values must fall within ±5% to be acceptable. These data are verified during the testing process by checking that:

- the sum of airflows entering and leaving a junction is equal to zero; and,
- the sum of pressure drops around any closed loop is equal to zero.

Once the measurements are taken, data are used to calculate the resistance of every underground drift, as well as shafts and regulators using Atkinson’s Square Law

$$P=R \times Q^2$$

where the pressure drop of an entry (P) is equal to a resistance (R) times the square of the quantity of air flowing (Q) through the circuit.

The “Balance” portion of the process involves adjusting the settings of the system fans and regulators to achieve the desired airflow distribution in all parts of the facility for each mode of operation. Particular emphasis is given to the active disposal room(s) in the Waste Disposal Circuit to assure that a minimum airflow of 35,000 scfm is achieved. The system baseline settings for the current Balance are established from the previous Test and Balance. Adjustments are then made to account for changes in system resistance due to excavation convergence due to salt creep, approved system modifications, or operational changes.

The Permittees use a commercially available ventilation simulator to process Test and Balance field data. The simulator uses the Hardy-Cross Iteration Method (McPherson, 1993) to reduce field data into a balanced ventilation network, including the appropriate regulator settings necessary to achieve proper airflow distribution for the various operating modes. Once balanced, the same simulator is used to evaluate changes such as future repository development and potential system modification before they are implemented.

The Test and Balance process culminates in a final report which is retained on site. Following receipt of the Test and Balance Report, the Permittees revise the WIPP surface and underground ventilation system procedures to incorporate any required changes to the ventilation system configuration. The Test and Balance data are used to adjust the operating range of fan controls, waste tower pressure, auxiliary air intake tunnel regulator settings, underground regulator settings, and door configurations. The model data and procedure changes are used to establish normal configuration settings to achieve the desired airflow in the underground. These settings are then modified by operations personnel throughout the year to compensate for system fluctuations caused by seasonal changes in psychrometric properties, and to meet specific operations needs. This assures that the facility is operated at the design airflow rate for each ventilation mode.

Q-4a(2) Test and Balance Schedule

The Test and Balance is conducted on a 12- to 18-month interval, an interval sufficient to account for changes in the mine configuration since over this period the ventilated volume changes very little. The quality and maintenance of ventilation control structures (e.g., bulkheads) is excellent, so leakage is small and relatively constant. Historic test and balance results confirm that changes between test and balances fall within anticipated values. In no case will the interval between Test and Balance performance be greater than 18 months.

The Permittees select the specific time to conduct the Test and Balance based on the following operational considerations:

- Available testing windows
- Operational considerations
- Ongoing or upcoming system modification considerations
- Availability of testing personnel

Q-4b Running Annual Average of the Total Mine Airflow

Q-4b(1) Monitoring Total Mine Airflow

The Permittees use the Central Monitoring Room Operator's (**CMRO**) Log to monitor total mine airflow. Run-times for the various modes of operation are entered into the CMRO Log. For example, if the CMRO Log indicates that the ventilation system was configured for Alternate Mode (one main fan) at 8:00 am, and that this configuration was maintained until 11:30 am, a total of 3.5 hours of run-time in Alternate Mode would be recorded. Run times are recorded to the nearest quarter hour. The CMRO records each time when the ventilation system configuration is changed, including periods when there is no ventilation.

Q-4b(2) Calculation of the Running Annual Average of Total Mine Airflow

The Permittees calculate the running average flow rate on a monthly basis. The Permittees use the logged runtime data for various modes of operation (as described in Q-4b(1)) and the nominal design flow-rates for the various modes presented in Table Q-1 to calculate the average monthly flow rate for the facility.

The average monthly mine flow rate is computed monthly using the following formula:

$$\text{Monthly Average Flow Rate} = \{[\text{Normal Mode Run-time (hrs.)} \times 425{,}000 \text{ scfm}] + [\text{Alternate Mode Run-time (hrs.)} \times 260{,}000 \text{ scfm}] + [\text{Maintenance Bypass Run-time (hrs.)} \times 260{,}000 \text{ scfm}] + [\text{Reduced Mode Run-time (hrs.)} \times 120{,}000 \text{ scfm}] + [\text{Minimum Mode Run Time (hrs.)} \times 60{,}000 \text{ scfm}] + [\text{Filtration Mode Run-time (hrs.)} \times 60{,}000 \text{ scfm}]\} / 730 \text{ Hours per month.}$$

The running annual average of total mine airflow annual average flow rate is calculated using the monthly averages and the following formula:

$$\text{Annual Average Flow Rate} = \frac{\sum \text{Monthly Average for Previous 12 Months}}{12}$$

The use of an average value of 730 hours per month in the monthly average calculation is reasonable, given that all the numbers involved are very large and that the final use of the monthly average flow is in an annual calculation. The Permittees will notify NMED if the minimum running annual average mine ventilation exhaust rate of 260,000 scfm and a minimum active room ventilation rate of 35,000 scfm when workers are present in the room are not achieved.

Q-4c Active Disposal Room Minimum Airflow

Q-4c(1) Verification of Active Disposal Room Minimum Airflow

Whenever workers are present, the Permittees verify the minimum airflow through active disposal room(s) of 35,000 scfm at the start of each shift, any time there is an operational mode change, or if there is a change in the ventilation system configuration.

Q-4c(2) Measurement and Calculation of the Active Waste Disposal Room Airflow

The Permittees measure the airflow rate and use the room cross-sectional area to calculate the volume of air flowing through a disposal room. The measurement of airflow uses a calibrated anemometer and a moving traverse (McPherson, 1993). Airflow measurements are collected at an appropriate location, chosen by the operator to minimize airflow disturbances, near the entrance of each active disposal room. The excavation dimensions at the measurement location are taken and the cross-sectional area is calculated. The flow rate is the product of the air velocity and the cross-section area. The value is entered on a log sheet (see Table Q-3) and compared to the required minimum. The format and content of the log sheet may vary, but will always contain the data and information shown on Table Q-3. Working values are in acfm and the conversion to scfm is described in section Q-1 above. Measurements are collected, recorded, and verified by qualified operators.

The operator compares the recorded acfm value with the minimum acfm value provided at the top of the log sheet. The airflow is re-checked and recorded whenever there is an operational mode change or a change in ventilation system configuration. Once the ventilation rate has been recorded and verified to be at least the required minimum, personnel access to the room is unrestricted in accordance with normal underground operating procedures. If the required ventilation rate cannot be achieved, or cannot be supported due to operational needs, access to the room is restricted. Those periods when active disposal room access is restricted are documented on the log sheet for that active disposal room.

Q-4d Quarterly Verification of Total Mine Airflow

The Permittees perform a quarterly verification of the total mine airflow to ensure that rates established by the Test and Balance for various operational modes are reasonably maintained. These checks are identified in Renewal Application Chapter D, Table D-1, and are performed as indicated in Table D-1.

Q-5 Equipment Calibration and Maintenance

Equipment used for the periodic Test and Balance, quarterly flow verification checks, and daily verification of active disposal room flow rate is calibrated in accordance with appropriate WIPP calibration and data collection procedures. Work performed by subcontractors is also calibrated to an equivalent standard. Equipment is inspected before each use to assure that it is functioning properly and that the equipment calibration is current. Maintenance of equipment is completed by qualified individuals or by qualified off-site service vendors.

Equipment used to conduct the Test and Balance, Quarterly Verification of Total Mine Airflow, and to determine the airflow through the active disposal room(s) are provided in Table Q-2.

Q-6 Reporting and Record Keeping

Q-6a Reporting

The Permittees submit an annual report presenting the results of the data and analysis of the Mine Ventilation Rate Monitoring Plan. In the years that the Test and Balance is performed, the Permittees will provide a summary of the results in the Annual Report.

The Permittees calculate the running annual average mine ventilation rate on a monthly basis and evaluate compliance with the minimum active room ventilation rate specified in Q-4b(2) on a monthly basis. Whenever the evaluation of the mine ventilation monitoring program data identifies that the ventilation rates specified in Q-4b(2) have not been achieved, the Permittees will notify the Secretary in writing within seven calendar days.

Q-6b Record Keeping

The Permittees retain the following information in the Operating Record:

- The CMRO Log documenting the ventilation system operating mode.
- The underground facility running annual average mine ventilation rate on a monthly basis.
- Active disposal room ventilation flow rate readings as documented on the Active Disposal Room Ventilation Rate Log Sheet (Table Q-3).
- The quarterly flow verification check and associated documentation.

These records will be maintained in the facility Operating Record until closure of the WIPP facility.

Q-7 Quality Assurance

Quality assurance associated with the Mine Ventilation Rate Monitoring Plan complies with the requirements of the WIPP Quality Assurance Program Description (**QAPD**). The Permittees verify the qualification of personnel conducting ventilation flow measurements. The instrumentation used for monitoring both underground and active disposal is calibrated in accordance with the applicable provisions of the WIPP procedures. The software used to calculate the monthly and annual running averages and the ventilation simulation software programs are controlled in accordance with the WIPP QAPD and WIPP computer software quality assurance plans.

Data generated by this plan, as well as records, and procedures to support this plan are maintained and managed in accordance with the WIPP QAPD. Nonconformance or conditions adverse to quality as identified in performance of this plan will be addressed and corrected as necessary in accordance with applicable WIPP Quality Assurance Procedures.

References

McPherson, M. J., 1993. *Subsurface Ventilation and Environmental Engineering*, Chapman & Hall, London, First Edition.

TABLES

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TABLE Q-1
VENTILATION OPERATING MODES AND ASSOCIATED FLOW RATES

Mode of Operation	Flow Rate (scfm) Nominal Design Values
Normal (two main fans)	425,000
Alternate (one main fan)	260,000
Maintenance Bypass [parallel operation of main fan(s) and filtration Fan(s)]	260,000 to 425,000
Reduced (two filtration fans)	120,000
Minimum (one filtration fan)	60,000
Filtration (one filtration fan)	60,000

TABLE Q-2
MINE VENTILATION RATE TESTING EQUIPMENT

Equipment Used to Conduct Test	Ventilation Test Performed		
	Test and Balance	Active Disposal Room(s)	Quarterly Flow Verification Check
Calibrated Anemometer	X	X	
Calibrated Differential Pressure Sensor	X		
Pitot Tubes	X		X
Tubing	X		X
Temperature Sensing Device	X		X
Relative Humidity Sensor	X		X
Calibrated Barometers	X		X
Electronic Manometer	X		X

TABLE Q-3
ACTIVE DISPOSAL ROOM VENTILATION RATE LOG SHEET (EXAMPLE)

ROOM NUMBER ___________

NOTE: When airflow reading is below 42,000 acfm, access will be restricted.

DATE	TIME	AIRFLOW READING	WAS 42,000 ACFM ACHIEVED?		ROOM ACCESS WAS RESTRICTED?		SIGNATURE	VERIFIED BY
			YES	NO	YES	NO		