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Subparts B and C
Compliance Recertification
Application
for the
Waste Isolation Pilot Plant

Appendix MON-2009
WIPP Monitoring Programs

United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

Appendix MON-2009
WIPP Monitoring Programs

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Acronyms and Abbreviations

CARD	Compliance Application Review Document
CBFO	Carlsbad Field Office
CCA	Compliance Certification Application
cm	centimeter
CMP	Compliance Monitoring Program
CRA	Compliance Recertification Application
DBDSP	Delaware Basin Drilling Surveillance Program
DOE	U.S. Department of Energy
DRZ	disturbed rock zone
EPA	U.S. Environmental Protection Agency
FEP	feature, event, or process
ft	feet
GMP	Groundwater Monitoring Program
GWMPP	Groundwater Monitoring Program Plan
kg	kilogram
km	kilometer
m	meter
M&OC	Management and Operating Contractor
mi	mile
PA	performance assessment
QA	quality assurance
QAPD	Quality Assurance Program Document
SMP	Subsidence Monitoring Program
WIPP	Waste Isolation Pilot Plant
WQSP	Water Quality Sampling Program
WWIS	WIPP Waste Information System

Elements and Chemical Compounds

Am	americium
Pu	plutonium
U	uranium

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MON-1.0 Introduction

This appendix to the 2009 Compliance Recertification Application (CRA-2009) describes a specific monitoring program that was developed to meet commitments contained in the U.S. Department of Energy's (DOE's) application to the U.S. Environmental Protection Agency (EPA), which demonstrated compliance with radioactive waste disposal regulations 40 CFR Part 191 Subparts B and C and the certification criteria in 40 CFR Part 194. This appendix does not address monitoring activities intended to demonstrate compliance with 40 CFR Part 191 Subpart A.

The monitoring activities described are performed as assurance measures to detect substantial and detrimental deviations from expected disposal system performance. This program consists of a preclosure and postclosure monitoring program using monitoring techniques that do not jeopardize the isolation of the waste. The program must be conducted until the DOE and EPA agree there are no significant concerns to be addressed by further monitoring. The long-term performance expectations for the disposal system are derived from conceptual models, scenarios, and assumptions developed for the Waste Isolation Pilot Plant (WIPP) performance assessment (PA).

On January 3, 2002, the DOE Carlsbad Field Office (CBFO) submitted a letter to the EPA (Triay 2002). This letter requested Appendix MON be rewritten to incorporate the portions of Appendices EMP, GWMP, GTMP, SMP, and DMP required to demonstrate compliance with 40 CFR § 191.14(b) (U.S. Environmental Protection Agency 1993) in accordance with the criteria established by 40 CFR § 194.42 (U.S. Environmental Protection Agency 1996). The EPA approved the request in a letter to CBFO on March 15, 2002 (Marcinowski 2002).

The activities performed for the overall monitoring programs at WIPP comprehensively address the range of regulatory requirements at departmental, state, and federal levels. This appendix addresses activities relevant to monitoring the disposal system. This document provides an overview of the Compliance Monitoring Program (CMP) and specifically describes how

- The 10 compliance monitoring parameters are derived from the data.
- Information and data are extracted from the various WIPP monitoring and sampling programs.
- The assessments are made against repository performance expectations.
- The results are reported to the EPA.

The descriptions provided in this appendix are specific to the CMP and, thus, the requirements of section 191.14(b) and section 194.42.

MON-1.1 Compliance Monitoring Program

This appendix describes the CMP for the WIPP. Compliance monitoring concentrates on the following areas:

- The Geotechnical Engineering Program
- The Groundwater Monitoring Program (GMP)
- The Delaware Basin Drilling Surveillance Program (DBDSP)
- The Subsidence Monitoring Program (SMP)
- WIPP Waste Tracking and Control

The data and information collected since the 2004 Compliance Recertification Application (CRA-2004) (U.S. Department of Energy 2004a) for the above-listed programs are recorded or referenced in Appendix DATA-2009.

MON-1.2 Preclosure and Postclosure Monitoring

The requirements of 40 CFR § 191.14, section 194.42, the initial EPA certification (U.S. Environmental Protection Agency 1998a), and the CRA-2004 serve as the regulatory basis for preclosure and postclosure monitoring. These requirements specify that disposal systems must be monitored to detect substantial and detrimental deviation from expected disposal system performance.

MON-1.3 Monitoring Assessment

The DOE was required by 40 CFR § 194.42(a) to perform an analysis that would determine the effects of various parameters on the performance of the disposal system, and to use the results in preclosure and postclosure monitoring plans. The disposal system performance identified 10 monitoring parameters, listed in Section MON-2.1, to be monitored and assessed within the CMP. The discussion of preclosure monitoring activities for these 10 parameters includes the following:

- Identifying activities required to comply with the monitoring requirements of the EPA's certification and recertification of compliance with Part 191 Subparts B and C during the preclosure phase of the project
- Identifying organizations that generate the monitoring data, organizations that convert the data to monitoring parameters and assess the results against expected results, and the organization that reports the results of the assessments to the EPA
- Identifying the compliance monitoring schedule
- Providing an overview of quality assurance (QA) requirements applicable to the CMP

MON-1.4 Appendix Summary

Section MON-2.0 identifies the monitoring requirements of Part 191 Subparts B and C in keeping with the criteria of Part 194. Section MON-3.0 describes the preclosure monitoring

program associated with each monitoring parameter, the monitoring schedules, and program outputs. Section MON-4.0 describes the planned postclosure monitoring. Section MON-5.0 describes the QA requirements applicable to the CMP. Section MON-6.0 describes the process of communicating and reporting CMP results and evaluations.

MON-2.0 Compliance Monitoring Program Requirements

The DOE's preclosure and postclosure CMP assesses the performance of specific aspects of the disposal system. The relevant monitoring requirements are identified in

- Section 191.14(b)
- Section 194.42
- The May 18, 1998, 40 CFR Part 194 Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision, Section VIII.D.4 Monitoring (U.S. Environmental Protection Agency 1998a)
- The CRA-2004, Chapter 7.0, Section 7.2

MON-2.1 Compliance Certification/Recertification

The original approach used to develop the CMP was based on the results of the parameter analysis documented in the CCA, Chapter 7.0, and Appendix MON, Attachment MONPAR. The EPA documented its approval of the DOE monitoring approach in the compliance certification decision (U.S. Environmental Protection Agency 1998a) and Compliance Application Review Document (CARD) 42 (U.S. Environmental Protection Agency 1998b). In the CRA-2004, Appendix MON 2004 was rewritten to incorporate portions of Appendices EMP, GWMP, GTMP, SMP, and DMP that were not revised from the CRA-2004. The DOE reassessed the CCA, Appendix MON, Attachment MONPAR, for the CRA-2004 and determined the original conclusions and monitoring parameters identified in MONPAR remain valid and unchanged (Kirkes and Wagner 2003). For the CRA-2009, the DOE once again assessed the original MONPAR analysis used to determine which monitoring parameters should be included in the CMP. Based on the review of operational activities, conditions, monitoring data, PA, and experimental programs that occurred since the CRA-2004, the reassessment states, "the conclusions of the MONPAR analysis remain valid and its conclusions continue to be adequate for inclusion in the CRA-2009*"* (Wagner 2008). The EPA-approved monitoring approach recognizes that the DOE will monitor 10 parameters. These parameters are

1. Creep closure and stresses
2. Extent of brittle deformation
3. Initiation of brittle deformation
4. Displacement of deformation features
5. The Culebra Dolomite Member of the Rustler Formation (hereafter referred to as Culebra) groundwater composition
6. Change in Culebra groundwater flow
7. Drilling rate

8. Probability of encountering a Castile brine reservoir
9. Subsidence
10. Waste activity

All of the above parameters are being monitored during the preclosure period.

The CRA-2004, Appendix MON 2004, Attachment A, describes DOE's plans for postclosure monitoring. The DOE will revisit this plan for postclosure monitoring before the end of facility operations.

The monitoring parameters that have related PA parameters include

- Drilling rate
- Probability of encountering Castile brine
- Change in Culebra groundwater flow
- Culebra groundwater composition
- Waste activity

The other monitoring parameters are related to screening decisions for repository features, events, or processes (FEPs). Table MON-1 describes the related PA parameters and the major FEPs screening decisions.

The data used to determine the 10 monitoring parameters of the CMP are generated by 5 separate monitoring programs (described in Section MON-3.1, Section MON-3.2, Section MON-3.3, Section MON-3.4, and Section MON-3.5). Each monitoring program focuses on the collection of direct field measurements. The programs that generate or evaluate the data are described in Section MON-6.0. Results from each monitoring program are documented individually in annual reports (see Appendix DATA-2009), while the assessment results of the 10 parameters are documented and reported in a compliance monitoring parameter assessment report (Sandia National Laboratories 2004, 2005a, 2005b, 2006, and 2008).

As stated earlier, if any of the data, parameters, or observations are not consistent with expectations as defined in Section MON-6.1.1, the CMP process requires addressing concerns and developing recommendations identified by unexpected results. Results from monitoring programs will be generated on an ongoing basis throughout the operational period of the repository. Compliance monitoring data are provided to the cognizant individuals and organizations within the project and evaluated for their significance, and the evaluation results and data summaries are reported to the EPA. Section MON-6.0 describes the process of communicating and reporting CMP results and evaluations.

Table MON-1. Monitoring Parameters

Monitoring Parameter	Monitoring Program	Frequency of Data Collection and Reporting	Related PA Parameter	Related FEPs Evaluation Cycle	Evaluation of Data
Creep Closure and Stresses	Geotechnical Monitoring Program	Various data calls from weekly to monthly based on repository conditions, instrumentation, and data collection system. Data are reported annually.	Not directly related to a PA parameter. May provide a short-term (operational) observation of the geomechanical response of repository excavation. Can provide confidence in the creep closure model.	Salt creep, excavation-induced stress changes, changes in stress field, pressurization. Consolidation of waste/backfill.	Data from this monitoring program are evaluated annually and during recertification.
Extent of Brittle Deformation	Geotechnical Monitoring Program	Various data calls from weekly to monthly based on repository conditions, instrumentation, and data collection system. Data are reported annually.	Not directly related to a PA parameter. Can provide confidence in the long-term behavior of the disturbed rock zone (DRZ), as modeled. Intrinsic shaft DRZ permeability and effective shaft seal permeability is calculated from this parameter.	DRZ, roof falls, consolidation of seals.	Data are evaluated annually and during recertification.
Initiation of Brittle Deformation	Geotechnical Monitoring Program	Various data calls from weekly to monthly based on repository conditions, instrumentation, and data collection system. Data are reported annually.	Not directly related to a PA parameter. Can provide confidence in the anhydrite fracture model implemented in the BRAGFLO code. May provide related repository observation data on initiation or displacement of major brittle deformation features in the roof or surrounding rock.	Disruption due to gas effects.	Data are evaluated annually and during recertification.
Displacement of Deformation Features	Geotechnical Monitoring Program	Various data calls from weekly to monthly based on repository conditions, instrumentation, and data collection system. Data are reported annually.	Not directly related to a PA parameter. Provides related repository operational data on initiation or displacement of major brittle deformation features in the roof or surrounding rock.	Stability of open panel.	Data are evaluated annually and during recertification.

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Table MON-1. Monitoring Parameters (Continued)

Monitoring Parameter	Monitoring Program	Frequency of Data Collection and Reporting	Related PA Parameter	Related FEPs Evaluation Cycle	Evaluation of Data
Culebra Groundwater Composition	GMP	Data are collected semiannually and reported annually.	Average Culebra brines composition and matrix distribution coefficient for uranium (U) (IV, VI), plutonium (Pu) (III, IV), thorium (Th) (IV), americium (Am) (III). Matrix distribution coefficient is not a sensitive PA parameter.	Groundwater geochemistry, actinide sorption.	Data are evaluated annually and during recertification.
Change in Culebra Groundwater Flow	GMP	Data are collected monthly and reported annually.	Culebra transmissivity, fracture and matrix porosity, fracture spacing, dispersivity, and climate index. Changes in Culebra groundwater flow are moderately significant to performance and incorporated into the PA.	Groundwater flow and recharge/ discharge. Infiltration. Precipitation.	Data are evaluated annually and during recertification.
Drilling Rate	DBDSP	As well records are received (weekly and monthly basis). Data are reported annually.	Drilling rate per unit area. The number of holes is used to calculate a frequency of potential future intrusions into the repository.	Drilling.	Data are evaluated annually and during recertification.
Probability of Encountering a Castile Brine Reservoir	DBDSP	As drilling records are received. Data are reported annually.	Probability of encountering a Castile brine reservoir, reservoir pressure, and volume. These parameters are significant to long-term repository performance.	Drilling fluid flow, drilling fluid loss, blowouts, brine reservoirs.	Data are evaluated annually and during recertification.
Subsidence	SMP	Data are reported annually or as determined necessary by the DOE.	Not directly related to a PA parameter. Can provide spatial information on surface subsidence (if any) over the influence area of the underground openings during operations.	Changes to groundwater flow due to mining effects; subsidence baseline.	Data are evaluated annually or as determined necessary by the DOE.

Table MON-1. Monitoring Parameters (Continued)

Monitoring Parameter	Monitoring Program	Frequency of Data Collection and Reporting	Related PA Parameter	Related FEPs Evaluation Cycle	Evaluation of Data
Waste Activity	WIPP Waste Tracking and Control	Continually updated as waste is approved for shipment to WIPP. Data are reported annually.	Radionuclide inventory. Material parameter weights. These parameters are important to PA.	Waste radiological characteristics.	Data are evaluated annually and during recertification.

The 10 parameters above are called *compliance monitoring parameters*. As discussed previously, the EPA determined during the WIPP certification and the 2004 recertification that these parameters met the regulatory monitoring requirements.

MON-3.0 Preclosure Compliance Monitoring

This section describes the preclosure CMP and the resulting data. The 10 parameters, associated monitoring program for each, frequency of data collection and reporting, related PA parameters, and related screening decisions used to support the PA are listed in Table MON-1.

MON-3.1 Geotechnical Engineering Program Plan

The WIPP Geotechnical Engineering Program Plan (Waste Isolation Pilot Plant 2006) defines the field programs and investigations carried out by the Geotechnical Engineering group within the Management and Operating Contractor (M&OC). The geotechnical engineering activities provide geologic information related to geotechnical characteristics and assess the stability and performance of the underground facility. The activities defined in the WIPP Geotechnical Engineering Program Plan that collects data related to PA parameters and make up the Geotechnical Monitoring Program described in Table MON-1 are the Geomechanical Monitoring Activities and Geosciences Activities.

MON-3.1.1 Geomechanical Monitoring Activities

Geomechanical monitoring activities provide data to validate design, track short-term and long-term geotechnical performance of underground openings, and support routine safety and stability evaluations of the excavations. Geomechanical monitoring generates data related to the following four parameters:

1. Creep closure and stresses
2. Extent of brittle deformation
3. Initiation of brittle deformation
4. Displacement of deformation features

MON-3.1.1.1 Scope

The geomechanical monitoring activities provide data on the WIPP design for evaluating the safety and stability of excavations and the behavior of underground openings. From an operational point of view, data related to identifying areas of potential instability allow corrective action to be taken in a timely manner. For underground opening behavior, in situ data are used to model long-term disposal system performance.

MON-3.1.1.2 Instrumentation

Geomechanical instruments installed in the shafts and along drifts within the WIPP facility monitor the geotechnical parameters. Instrumentation in the shafts and the underground repository presently include tape extensometer stations, convergence meters, borehole extensometers, piezometers, embedment strain gauges, stress gauges, inclinometers, load cells,

and crack meters. Instruments in the underground repository are either monitored remotely by a surface data logger or read manually.

MON-3.1.1.3 Data Acquisition

Geomechanical data are acquired either remotely by the geomechanical data logging system or manually by geotechnical engineering technicians. Manually acquired data are collected on a quarterly basis and remotely acquired data are collected on a monthly basis, at a minimum.

MON-3.1.1.4 Data Analysis and Dissemination

Data analysis is performed on an annual basis and published. The results of the analyses are published annually in the Geotechnical Analysis Report (U.S. Department of Energy 2004b, 2005a, 2006a, 2007a, and 2008).

An assessment of convergence measurements and geotechnical observations is made after each round of data collection. The results of each assessment are distributed to affected underground repository operations, engineering, and safety managers.

MON-3.1.2 Geosciences Activities

Geosciences activities document existing geologic conditions and characteristics and monitor for changes resulting from the excavations. These activities generate data related to the following four parameters:

1. Creep closure and stresses
2. Extent of brittle deformation
3. Initiation of brittle deformation
4. Displacement of deformation features

MON-3.1.2.1 Scope

Changes resulting from excavations are monitored by routine inspections of selected borehole arrays to detect and quantify the occurrences of discontinuities such as fractures and bed separations. The data collected from these inspections further the understanding of fracture development within the Salado Formation that occurs around the excavations. Geosciences activities also provide geologic and fracture mapping, geologic sampling, and seismic monitoring.

MON-3.1.3 Schedule

The following activities are performed on the indicated schedule:

- Geomechanical Monitoring. This program uses instrumentation located in the shafts and drifts, including tape extensometer stations, convergence meters, borehole extensometers,

piezometers, embedment strain gauges, stress gauges, inclinometers, load cells, and crack meters. Instruments are read as designated in Table MON-1.

- Seismic Monitoring. Regional seismic monitoring and evaluation are conducted by the New Mexico Institute of Mining and Technology. The network is operated continuously and monitoring results are reported quarterly.

- Geologic Mapping. Geologic mapping is conducted in newly excavated areas and in other areas when deemed necessary by the cognizant engineer or Geotechnical Engineering Manager.

- At a minimum, a complete analysis of geotechnical data is performed annually. The geotechnical activities will continue throughout the operational period.

MON-3.2 GMP

The purpose of the GMP is to collect groundwater data from numerous wells located at and near the facility. Groundwater monitoring at the WIPP is carried out under the WIPP Groundwater Monitoring Program Plan (GWMPP) (Washington Regulatory Environmental Services 2007).

The Culebra remains the focus of the GMP. It has been extensively studied during past hydrologic characterization programs, and was found to be the most likely hydrologic pathway to the accessible environment or compliance point for any potential human-intrusion-caused release scenario.

Data obtained through the GMP are used to generate the Culebra groundwater composition and the Culebra groundwater flow parameters. Details on how the program is implemented are provided in the GWMPP (Washington Regulatory Environmental Services 2007).

MON-3.2.1 Scope

The GWMPP addresses requirements for sample collection, groundwater surface elevation monitoring, groundwater flow direction, data management, and reporting of groundwater monitoring data. It also identifies analytical parameters selected to assess groundwater quality.

Seven wells were drilled as part of the WIPP GMP: six Water Quality Sampling Program (WQSP) wells (WQSP-1 through WQSP-6), completed to the Culebra, and WQSP-6a, completed to the Dewey Lake Formation. Water samples are collected from these wells and analyzed for certain chemical and physical parameters. This activity generates data in support of the Culebra Groundwater Composition parameter. This parameter calls for analyzing the following ions:

Cations: Ca^{2+}, K^{+}, Na^{+}, Mg^{2+}

Anions: Cl^{-}, HCO_3^{-}, SO_4^{2-}

Water level data are collected to assess changes in Culebra groundwater flow. Water level measurements are tracked over time using WQSP wells and other wells that are widely

distributed across the WIPP area to monitor the area's potentiometric surface and groundwater flow directions. If changes in water level(s) occur, the cause is investigated, and any potential impact on the long-term performance of the repository is assessed.

MON-3.2.1.1 Sampling and Reporting for Water Quality

Sampling for water quality is performed at seven groundwater monitoring wells. The Culebra is monitored using wells WQSP-1 through WQSP-6, and the Dewey Lake is monitored using well WQSP-6a. Two types of water samples are collected: serial samples and final samples.

Serial samples are taken at regular intervals and analyzed for various physical and chemical parameters (called field indicator parameters) in a mobile field laboratory positioned at the wellhead. The serial sample data are used to determine when a representative sample of the formation water can be taken. The field indicator parameters are chloride, divalent cations, alkalinity, total iron, pH, Eh, temperature, specific conductance, and specific gravity. Interpretation of the serial sampling data determines when conditions representative of undisturbed groundwater are attained in the pumped groundwater.

When the field indicator parameters have stabilized, indicating that the sample is representative of formation groundwater, final samples are collected in the appropriate type of container for the specific analysis to meet state and federal groundwater requirements. The final samples are submitted to laboratories for chemical analysis. Section MON-3.2.1 lists the analytes needed to support the PA parameter.

The sample tracking system at WIPP uses uniquely numbered Chain of Custody forms and Request for Analysis forms. For storage or transportation, the primary consideration is that samples must be analyzed within the prescribed holding times for the parameters of interest.

MON-3.2.1.2 Sampling and Reporting for Water Level Fluctuations

Water level measurements are taken in the six groundwater monitoring wells (WQSP-1 through WQSP-6) and other available WIPP wells in the monitoring network (Appendix HYDRO-2009, Figure HYDRO-1. Location of WIPP Wells). The water level monitoring will identify water level fluctuations.

In addition to the water level measurements, density is determined in the wells. This density is used to convert the water level measurements to equivalent freshwater heads for developing potentiometric surface maps.

MON-3.2.2 Schedule

Background water quality in both the upgradient and downgradient monitoring wells has been established for the WIPP. The seven WQSP monitoring wells constructed for the GMP are sampled on a semiannual basis to compare to the baseline water quality.

The groundwater level is measured by monitoring the wells at least on a monthly basis. Groundwater level measurements are monitored and collected for other WIPP wells, as well as for the WQSP wells. The water levels are determined in at least one accessible, completed

interval at each available well pad, and quarterly in redundant wells at well pads where two or more wells are completed in the same interval. Groundwater level measurements primarily examine changes in groundwater flow rate and direction to identify any changes pertinent to compliance. These groundwater data supplement the area water level database.

The characteristics of the GMP, such as the frequency of sampling and the location of the sampled wells, will be reevaluated if significant changes are observed in the groundwater flow direction or gradient. Reporting frequencies are listed in Table MON-2.

Table MON-2. WIPP GMP Sample Collection and Water Level Reporting Frequency

Type of Well	Frequency
Water Quality Sampling	
WQSP wells (seven)	Semiannually
Water Level Monitoring	
WQSP wells (seven)	Monthly and before sampling events
Other available WIPP wells	Monthly/quarterly

MON-3.2.3 Program Outputs

The groundwater samples are analyzed to quantify Culebra Groundwater Composition parameters and water quality parameters listed in Section MON-3.2.1.

The GMP also generates Culebra water level data. The data and results of the GMP are summarized and published on an annual basis in the WIPP Annual Site Environmental Report (U.S. Department of Energy 2003a, 2004c, 2005b, 2006b, and 2007b).

MON-3.3 Delaware Basin Drilling Surveillance Program

The DBDSP is described in the Delaware Basin Drilling Surveillance Plan (Waste Isolation Pilot Plant 2004). This plan provides for the surveillance of drilling activities within the Delaware Basin, with specific emphasis on the nine-township area surrounding the WIPP site. The DBDSP collects information related to the following two parameters:

1. Probability of encountering a Castile brine reservoir
2. Drilling rate

In addition to the parameters listed above, the DBDSP collects information on the following activities:

- Borehole plugging
- Enhanced recovery
- Natural gas storage

- Solution mining
- Potash mining
- Seismic events

The WIPP PA includes the impacts of drilling on the performance of the repository. The number of deep boreholes drilled per square kilometer is a parameter used in PA calculations for WIPP inadvertent intrusion scenarios. This parameter is based on actual drilling rates within the Delaware Basin over the last 100 years, as required by 40 CFR § 194.33 (U.S. Environmental Protection Agency 1996).

The results of the DBDSP continue to expand the existing database. This program updates these data to detect any substantial deviations from the assumptions used in the previous PA (see Section MON-3.3.1, Table MON-3). Collecting additional information about resource exploration and exploitation activities and practices in the Delaware Basin provides information to determine whether the drilling scenarios, assumptions, and probabilities used in the PA will continue to be valid for each five-year recertification of the WIPP.

Drilling information for the study area is obtained through commercially available electronic databases and the records of government agencies. The electronic database is updated and reviewed weekly to reflect drilling activities in the Delaware Basin. Records of government agencies are updated as they become available.

MON-3.3.1 Schedule

Table MON-3 shows the frequency of DBDSP data collection.

Table MON-3. DBDSP Data Collection Schedule

Information Collected	Frequency
Borehole plugging	Weekly
Enhanced recovery	Monthly
Gas storage	Annually
Solution mining	Annually
Potash mining	Annually
Seismic events	Quarterly
Drilling-related	Weekly
Probability of encountering a Castile brine reservoir	Weekly
Drilling rate calculations	Quarterly

MON-3.3.2 Program Outputs

The DBDSP updates and maintains a database of drilling activities and related practices in the Delaware Basin. For the nine-township area surrounding the WIPP, the DBDSP updates and maintains a database containing the following information:

- Plugging and abandonment activities, including descriptions of plugging configurations
- The fraction of plugged and abandoned boreholes that are sealed
- Well conversion activities (injection, disposal, water)
- Injection well operations (disposal and secondary recovery)
- Drilling activities, including borehole depths, diameters, and type and amount of drilling fluid
- Ownership of all state and federal minerals and hydrocarbon leases within the area
- Occurrences of pressurized brine within the Castile

Data collected and recorded by the DBDSP are reported annually in the Delaware Basin Monitoring Annual Program Report (U.S. Department of Energy 2003b, 2004d, 2005c, 2006c, and 2007c).

MON-3.4 SMP

The SMP is described in detail in the WIPP Underground and Surface Surveying Program (Waste Isolation Pilot Plant 2009). Subsidence monitoring measures vertical movement of the land surface relative to a reference location using state-of-the-art leveling equipment. The technique used to monitor subsidence measures the vertical height difference between two or more markers placed on a surface a known distance away from each other using a leveling survey. A reference benchmark is used as the standard and the relative movement of the other benchmark(s) is measured to detect vertical movement over time. Subsidence measurements are relative because the reference is fixed only with respect to the subsidence marker(s).

The activities associated with the SMP are designed to

- Provide time-related spatial information on surface subsidence within 152.4 meters (m) (500 feet (ft)) surrounding the waste shaft during the operational phase of the repository
- Provide time-related spatial information on surface subsidence over the influence area of the underground openings for comparison with subsidence predictions
- Maintain a database of subsidence data

With current technology, vertical elevation can be measured at a precision of 0.0305 centimeters (cm) (0.001 ft). Subsidence monitoring was chosen by the DOE as a long-term monitoring tool

because it effectively meets the requirements in section 191.14(b) for long-term monitoring. Subsidence monitoring is conducted to detect substantial and detrimental deviations from expected repository performance by comparing actual subsidence to predicted subsidence.

Subsidence data currently being compiled will be compared to subsidence predictions. In addition, subsidence monitoring during the operational phase generates data to establish a baseline against which long-term subsidence data and information may be evaluated.

MON-3.4.1 Schedule

Subsidence surveys are performed annually throughout the operations period. After closure of the repository, subsidence surveys will be performed at 10-year intervals for at least 100 years or until no further useful information may be obtained through continued monitoring.

MON-3.4.2 Program Outputs

The SMP generates annual surface subsidence data for 24.14 kilometers (km) (15 miles (mi)) of leveling loops through approximately 50 monuments. Results are reported annually in the WIPP Subsidence Monument Leveling Survey (U.S. Department of Energy 2003c, 2004e, 2005d, 2006d, and 2007d).

MON-3.5 WIPP Waste Information System

Information on the waste activity parameter is measured or estimated by generator sites through waste characterization activities. Sites are required to report certain information in the WIPP Waste Information System (WWIS). Reports are generated to tabulate key waste parameters. The waste activity parameter includes tracking the total material parameter weights and curie content of 10 radionuclides listed in Section MON-3.5.2.

MON-3.5.1 Schedule

Radionuclide inventory data and material parameter weights for every container of waste placed in the WIPP underground repository are submitted to the WWIS database at the time waste is certified for shipment to WIPP. A current collection of radionuclide inventory data and material parameter weights for the WIPP is maintained within the WWIS.

MON-3.5.2 Program Outputs

The data collected for the waste activity parameter is tracked by the WWIS. The WWIS annually generates a Waste Emplacement Summary Report that is submitted each November to the EPA in the annual 40 CFR § 194.4(b)(4) report (Triay 2003 and U.S. Department of Energy 2004f, 2005e, 2006e, and 2007e). The waste activity parameters being tracked and reported include radiological activity (in curies) that were emplaced during the 40 CFR § 194.4(b)(4) (U.S. Environmental Protection Agency 1996) reporting period and the cumulative activity since waste was first emplaced in the repository. The radionuclides being tracked (in curies) include

- ^{241}Am

- ^{238}Pu
- ^{239}Pu
- ^{240}Pu
- ^{242}Pu
- ^{233}U
- ^{234}U
- ^{238}U
- ^{90}Sr
- ^{137}Cs

The WWIS tracks other waste-related components that are annually reported in the section 194.4(b)(4) report. These waste components include

- Emplaced magnesium oxide (kg per room and per panel)
- Emplaced cellulose, plastic and rubber materials (kg per room and per panel)
- Emplaced container volume (m^3)
- Emplaced ferrous metals (kg)
- Emplaced non ferrous metals (kg)

MON-4.0 Postclosure (Long-Term) Monitoring

The final Postclosure Monitoring Plan will be developed prior to final facility closure (sealing of the shafts), but will not be implemented until after facility closure. This plan will include a review of the CRA-2004, Appendix MON 2004, Attachment A. When the final Postclosure Monitoring Plan is written, any proposed changes to the commitments made in Attachment A must be approved by the appropriate regulatory authorities.

MON-5.0 Monitoring Programs Quality Assurance Requirements

The quality of the work performed under the DOE CMP is accomplished per the criteria of 40 CFR § 194.22(a)(2)(ii) (U.S. Environmental Protection Agency 1996) and controlled by the application of the CBFO Quality Assurance Program Document (QAPD) (U.S. Department of Energy 2007f). Waste information is controlled by implementing the QAPD at generator sites.

In addition to the management requirements, such as document and record control established in the QAPD, requirements related to sampling and monitoring activities are specified. In particular, the following two sections of the QAPD are directly related to the performance of monitoring work and the control of samples:

- Section 2.4 – Inspection and Testing
  - Qualification of personnel
  - Inspection
  - Test requirements
  - Monitoring, measuring, testing, and data collection
  - Use and control of measuring and test equipment
  - Calibration
- Section 4.0 – Sample Control Requirements
  - Sample control
  - Sample identification
  - Handling, storing, and shipping samples
  - Disposition of nonconforming samples

WIPP monitoring programs are subject to EPA inspections in accordance with 40 CFR § 194.21 (U.S. Environmental Protection Agency 1996).

The CMP relies on the individual monitoring plan's QA program to ensure compliance with DOE WIPP requirements for data quality assessments, objectives, and analyses. Each sampling and monitoring program is implemented through individual implementation plans, which include the QA descriptions, objectives, and references to the applicable governing QA documents.

MON-6.0 Reporting And Assessment

Information flow is controlled to ensure important monitoring results are communicated to the appropriate individuals and groups.

MON-6.1 Monitoring Data Reporting

The monitoring programs that generate data used in the CMP are implemented by the M&OC. Reporting the data for the 10 compliance monitoring parameters is coordinated through the M&OC.

MON-6.1.1 CMP Assessment Report

The results of the CMP are reported in the compliance assessment report (Sandia National Laboratories 2004, 2005a, 2005b, 2006, and 2008).

The CMP results may indicate two general cases: normal or expected conditions, in which results are generally consistent with existing data, parameter values, and conceptual models; and anomalous conditions, in which results are inconsistent with existing data, parameter values, or conceptual models. DOE determines whether these results are consistent with expected conditions modeled in the PA or screening decisions used to support the compliance determination. The report also recommends if the CMP should be modified based on results of the monitoring programs.

This report is sent to the EPA as part of the annual reporting requirement of 40 CFR § 194.4(b)(4).

MON-6.1.2 External Reporting

The DOE reviews the recommendations of the M&OC and the scientific advisor to evaluate their significance. Significance is determined based on consideration of the following criteria:

- Containment requirements established pursuant to 40 CFR § 191.13 (U.S. Environmental Protection Agency 1993) are, or are expected to be, exceeded.

- Releases from previously emplaced waste that lead to committed effective doses that are, or are expected to be, in excess of those established pursuant to 40 CFR § 191.15 (U.S. Environmental Protection Agency 1993) (not including emissions from operations covered pursuant to Part 191 Subpart A).

- Releases that have caused, or are expected to cause, concentrations of radionuclides (or estimated doses due to radionuclides in underground sources of drinking water in the accessible environment) to exceed the limits established pursuant to Part 191 Subpart C.

If monitoring results meet any of these criteria, the results are considered significant. Significant monitoring results are promptly reported to the EPA. The report is accompanied by a recommended course of action, including the appropriate external reporting. If the monitoring

results exceed or possibly exceed containment requirements or release limits as specified in 40 CFR § 194.4(b)(3)(ii), the CBFO will immediately cease emplacement of waste in the WIPP and notify the EPA within 24 hours.

If the DOE discovers a condition or activity that differs significantly from what is indicated in the most recent compliance application, but does not involve conditions or activities listed in section 194.4(b)(3)(ii), then the difference shall be reported in writing to the EPA within 10 calendar days of discovery.

For normal conditions where monitoring results are within expectations, the CMP assessment documents this condition (Sandia National Laboratories 2004, 2005a, 2005b, 2006, and 2008). As stated previously, this report is sent to the EPA as part of the annual reporting requirement of section 194.4(b)(4).

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