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Compliance Recertification
Application
for the
Waste Isolation Pilot Plant

Appendix MON 2004

United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

Preclosure and Postclosure Compliance Monitoring

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ATTACHMENTS

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ACRONYMS AND ABBREVIATIONS

ACR	Annual Charge Report
ASER	Annual Site Environmental Report
CARD	Compliance Application Review Document
CBFO	Carlsbad Field Office
CCA	Compliance Certification Application
CMP	Compliance Monitoring Program
COMPs	Compliance Monitoring Parameters
CRA	Compliance Recertification Application
DBDSP	Delaware Basin Drilling Surveillance Program
DOE	Department of Energy
DRZ	disturbed rock zone
EPA	Environmental Protection Agency
FEP	feature, event, or process
GWMP	Groundwater Monitoring Program
M&OC	Management and Operating Contractor
M&TE	measuring and test equipment
PA	performance assessment
QA	Quality Assurance
QAPD	Quality Assurance Program Document
SA	Scientific Advisor
SMP	Subsidence Monitoring Program
SNL	Sandia National Laboratory
WIPP	Waste Isolation Pilot Plant
WQSP	Water Quality Sampling Program
WWIS	WIPP Waste Information System

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MON-1.0 INTRODUCTION

This Appendix to the Compliance Recertification Application (CRA) is a new document and it replaces the October 1996, version submitted with the Compliance Certification Application (CCA) (DOE 1996). This appendix describes a specific monitoring program that was developed to meet commitments contained in the DOE's application to the Environmental Protection Agency (EPA) which demonstrated compliance with radioactive waste disposal regulations 40 CFR 191 Subparts B and C and 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 ensure that deviations from the expected long-term radioactive containment performance of the repository are identified at the earliest possible time. The EPA requires a monitoring program to detect substantial deviations from expected performance. This program is to consist of a preclosure and postclosure monitoring program that uses monitoring techniques that do not jeopardize the isolation of the waste and must be conducted until there are no significant concerns to be addressed by further monitoring. The long-term performance expectations for the disposal system are to be 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. This letter requested EPA approval to delete CCA Appendices BECR, LMP, and VCMP from the compliance certification because they are not needed to demonstrate compliance with 40 CFR § 191.14(b). The letter also requested CCA Appendices SER and DEL be changed to references, Appendices EMP, GWMP, GTMP, SMP, and DMP be deleted, and that Appendix MON be rewritten to incorporate the portions of those plans required to demonstrate compliance with 40 CFR § 191.14(b) in accordance with the criteria established by 40 CFR § 194.42. The EPA approved these requests in a letter to CBFO on March 15, 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 those activities relevant to long-term monitoring of the disposal system. This document provides an overview of the Compliance Monitoring Program (CMP) and specifically describes how information and data are extracted from the various WIPP monitoring and sampling programs, how the compliance monitoring parameters are derived from the data, how the assessments are made against repository performance expectations, and how the results are reported to the EPA. The descriptions provided in this appendix are specific to the CMP and thus the requirements of 191.14(b) and 194.42.

MON-1.1 Compliance Monitoring Program

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

- Geotechnical Engineering Program Plan,
- Groundwater Monitoring Program (GWMP),

- Delaware Basin Drilling Surveillance Program (DBDSP),
- Subsidence Monitoring Program (SMP), and
- WIPP Waste Tracking and Control.

The data and information collected since the issuance of the CCA for the above listed programs are recorded or referenced in Appendix DATA.

MON-1.2 Preclosure and Postclosure Monitoring

The requirements of 40 CFR § 191.14, 40 CFR § 194.42, and the initial EPA certification serve as the regulatory basis for compliance monitoring. These requirements specify that disposal systems be monitored after waste disposal to detect substantial 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 to determine effects of parameters on the performance of the disposal system and to use the results in preclosure and postclosure monitoring plans. The results identified 10 monitoring parameters, listed in Section 2.1 of this appendix, to be monitored and assessed within the CMP. The discussion of preclosure monitoring activities for these 10 parameters in this appendix includes the following:

- identifying activities required to comply with the monitoring requirements of the EPA's certification of compliance with 40 CFR Part 191 Subparts B and C during the preclosure phase of the project (more commonly referred to as the "operational" or "disposal" phase);
- identifying the organizations that generate the monitoring data, the 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; and
- providing an overview of quality assurance (QA) requirements applicable to the compliance monitoring program.

MON-1.4 Appendix Summary

Section 2.0 of this Appendix identifies the monitoring requirements of 40 CFR 191 Subparts B and C and 40 CFR 194. Section 3.0 describes the preclosure monitoring program associated with each monitoring parameter, the monitoring schedules, and program outputs. Section 4.0 describes the planned postclosure monitoring. Section 5.0 describes the QA requirements applicable to the Compliance Monitoring Program.

MON-2.0 COMPLIANCE MONITORING PROGRAM REQUIREMENTS

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

- 40 CFR § 191.14(b),
- 40 CFR § 194.42, and
- the EPA's initial certification of the WIPP (EPA 1998).

MON-2.1 Compliance Certification

The original approach used to develop the CMP was based on the results of the parameter analysis documented in CCA Chapter 7, and Appendix MON, Attachment MONPAR. The EPA documented its approval of the DOE monitoring approach in the compliance certification (EPA 1998) and Certification Application Review Document (CARD) Number 42 (EPA 1998a). The current CMP description is contained in Chapter 7, and this Appendix. Sandia National Laboratory (SNL) conducted an assessment of the CCA Attachment MONPAR and determined the original conclusions and monitoring parameters identified in MONPAR remain valid and unchanged (Wagner and Kirkes 2003). The EPA-approved monitoring approach recognizes that 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. Culebra groundwater composition,
6. change in Culebra groundwater flow,
7. drilling rate,
8. probability of encountering a Castile brine reservoir,
9. subsidence, and
10. waste activity.

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

The CCA describes DOE's plans for postclosure monitoring and this description has been brought forward as Attachment A. DOE will revisit this plan for postclosure monitoring before the end of facility operations, expected some 35 years in the future.

The 10 parameters listed are called "compliance monitoring parameters (COMPs)." As discussed previously, the DOE determined that during the WIPP certification activities, these parameters met regulatory requirements.

The data used to generate the 10 separate monitoring parameters of the CMP are generated by five separate monitoring programs (described in Sections 3.1 through 3.5). Each of the monitoring programs focuses on the collection of direct field measurements related to CCA requirements and other information relating to the site. Each program that generates or evaluates the data is described in Section 6.0. Results from each monitoring program are documented individually in annual reports (see Appendix DATA) while the results of the assessment of the 10 parameters are documented and reported annually in a compliance monitoring parameter assessment report which is provided annually to the EPA in the Annual Change Report (ACR). The monitoring parameters which have related PA parameters include:

- drilling rate,
- probability of encountering Castile brine,
- Culebra water-level,
- Culebra groundwater composition, and
- waste activity.

The other monitoring parameters are related to screening decisions for repository features, events or processes (FEPs). Table MON-1 provides a description of the related PA parameters and the major FEP screening decisions. The 10 monitoring parameters will be evaluated to determine if there is an impact on the PA-related parameters, conceptual models, or FEP screening decisions. All Scientific Advisor (SA) processes and procedures used in the parameter analysis and reporting are governed by their QA and document control procedures.

As stated earlier, if any of the data, parameters, or observations are not consistent with the CCA PA expectations, the SA again will report its evaluations and recommendations to the DOE. If needed, the CMP process will be modified to address concerns or 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, evaluated for their significance, and evaluation results and data summaries are reported to the EPA on an annual basis. Section 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 Performance Assessment 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 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 permeabilities 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 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 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.
Culebra Groundwater Composition	Groundwater Monitoring Program	Data are collected semiannually and reported annually.	Average Culebra brines composition and matrix distribution coefficient for U(IV, VI), Pu(III, IV), Th(IV), Am(III). Matrix distribution coefficient is not a sensitive PA parameter.	Groundwater geochemistry, actinide sorption.	Data are evaluated annually and during recertification.

Table MON-1. Monitoring Parameters — Continued

Monitoring Parameter	Monitoring Program	Frequency of Data Collection and Reporting	Related Performance Assessment Parameter	Related FEPs Evaluation Cycle	Evaluation of Data
Change in Culebra Groundwater Flow (Water Level)	Groundwater Monitoring Program	Data 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	Delaware Basin Drilling Surveillance Program	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	Delaware Basin Drilling Surveillance Program	As drilling records are received. Data are reported annually.	Probability of encountering a Castile brine reservoir, reservoir pressure, and volume. The probability of encountering a brine reservoir is significant to long-term repository performance.	Drilling fluid flow, drilling fluid loss, blowouts, brine reservoirs.	Data are evaluated annually and during recertification.
Subsidence	Subsidence Monitoring Program	Annually or as determined necessary by the DOE. 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.
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.	Waste radiological characteristics.	Data are evaluated annually and during recertification.

MON-3.0 PRECLOSURE COMPLIANCE MONITORING

This section provides a general description of 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. WIPP Waste Tracking and Control is listed as a monitoring program because waste-related data are extracted from reports it generates.

MON-3.1 Geotechnical Engineering Program Plan

The WIPP Geotechnical Engineering Program Plan (WIPP 2002) defines the field programs and investigations carried out by the Geotechnical Engineering group within the M&OC (Management and Operating Contractor). The geotechnical engineering activities are designed to provide geologic information related to geotechnical characteristics and to assess the stability and performance of the underground facility. The activities within this plan that collect data related to PA parameters are Geomechanical Monitoring and Geosciences.

MON-3.1.1 Geomechanical Monitoring Activities

The purpose of the geomechanical monitoring activities is to determine the geomechanical performance of the underground by monitoring the geomechanical response of the underground openings after excavation. It also monitors geotechnical instruments installed in the shafts and drifts of the WIPP facility. This activity generates data related to the four following parameters:

1. creep closure and stresses,
2. extent of brittle deformation,
3. initiation of brittle deformation, and
4. displacement of deformation features.

MON-3.1.1.1 Scope

The instrumentation system for geomechanical monitoring activities provides data on the WIPP design for routine evaluation of safety and stability of excavations, and for collecting data on 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.

Geomechanical instruments installation and monitoring are governed by approved procedures. Instruments in the underground 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, as a minimum.

MON-3.1.1.4 Data Analysis and Dissemination

The frequency of data analysis on geomechanical data is based upon the requirements established in the WIPP Safety Analysis Report (DOE 1995). Data analysis is performed on an annual basis and published. The results of the analyses are published annually in the Geotechnical Analysis Report (DOE 2002).

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 operations, engineering, and safety managers.

MON-3.1.2 Geosciences Activities

The purpose of the Geosciences activities is to document existing geologic conditions and characteristics and to monitor for changes resulting from the excavations. This activity generates data related to the following four parameters:

- creep closure and stresses,
- extent of brittle deformation,
- initiation of brittle deformation, and
- 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 consists of monitoring using 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 monthly (remotely read instruments) or quarterly (manually read instruments) as a minimum;

- 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; and

- 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 be ongoing throughout the operations period.

MON-3.2 Groundwater Monitoring Program

The purpose of the Groundwater Monitoring Program (GWMP) is to collect groundwater data from numerous wells located near the facility. Groundwater monitoring at the WIPP is carried out under the WIPP GWMP (WIPP 2003).

The Culebra Dolomite Member remains the focus of the GWMP. 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 this program 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 GWMP (WIPP 2003) and Strategic Plan for Groundwater Monitoring at the Waste Isolation Pilot Plant (DOE 2003).

MON-3.2.1 Scope

The GWMP 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 GWMP (see Figure 2-2 in Chapter 2). They are as follows: six wells, WQSP-1 through WQSP-6, completed to the Culebra Member of the Rustler Formation, and one other well, 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 the analysis of the following:

- Ca^{2+},

- Cl^-,
- HCO_3^{2-},
- K^+,
- Mg^{2+},
- Na^+, and
- SO_4^{2-}.

Water level data are collected to assess changes in Culebra groundwater flow. Water level measurements are tracked over time using Water Quality Sampling Program (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 or water levels 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 in accordance with approved procedures maintained by M&OC: 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 the borehole effects are minimized so 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 be performed to meet state and federal requirements. The final samples are submitted to laboratories for chemical analysis. Section 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. The primary consideration for storage or transportation is that samples must be analyzed within the prescribed holding times for the parameters of interest. Procedures for sample tracking and preservation are generated, approved, and maintained by the M&OC.

MON-3.2.1.2 Sampling and Reporting for Water Level Fluctuations

Water level measurements are taken in the seven groundwater monitoring wells (WQSP-1 through WQSP-6a) and other available WIPP wells in the monitoring network (see Figure 2-2 in Chapter 2). The objective of water level monitoring is to identify water level fluctuations.

In addition to the water level measurements, pressure density surveys are conducted to determine the specific gravity of the water in the wells. These surveys allow the water level measurements to be converted to equivalent freshwater heads that can be used to develop potentiometric surface maps. Specific procedures regarding water level monitoring activities are generated, approved, and maintained by the M&OC.

MON-3.2.2 Schedule

Background water quality in both the upgradient and downgradient monitoring wells has been established for the WIPP. Therefore, the seven WQSP monitoring wells constructed for the GWMP are sampled on a semiannual basis to confirm the existing baseline water quality.

The groundwater level is measured by monitoring the wells 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 with two or more wells completed in the same interval. Groundwater level measurements are made primarily to 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 GWMP, 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. Monitoring frequencies are listed in Table MON-2.

Table MON-2. WIPP Groundwater Monitoring Program Sample Collection and Water Level Measurement Frequency

Type of Well	Frequency
Water Quality Sampling	
WQSP wells (7)	Semiannually
Other WIPP wells	On special request only
Water Level Monitoring	
WQSP wells (7)	Monthly and before sampling events
Other WIPP wells	Monthly

Note: These frequencies are subject to change as WIPP permits are modified and updated.

MON-3.2.3 Program Outputs

The groundwater samples are analyzed to quantify the following Culebra Groundwater Composition parameters and water quality parameters such as pH and density:

- Ca^{2+},
- Cl^{-},
- HCO_3^{2-},
- K^{+},
- Mg^{2+},
- Na^{+}, and
- SO_4^{2-}.

The GWMP also generates Culebra water level data. The data and results of the GWMP are summarized and published on an annual basis in the WIPP Annual Site Environmental Report (ASER) (DOE 2002a).

MON-3.3 Delaware Basin Drilling Surveillance Program

The Delaware Basin Drilling Surveillance Program (DBDSP) is described in the Delaware Basin Drilling Surveillance Plan (WIPP 1997). 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, and
2. drilling rate.

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

- borehole plugging,
- enhanced recovery,
- gas storage,
- solution mining,
- potash mining, and
- 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. They are based on actual drilling rates within the Delaware Basin over the last 100 years as required by 40 CFR § 194.33.

The results of the DBDSP continue to build on the existing database. The purpose of this program is to update these data to detect any substantial deviations from the assumptions used in the previous PA (see Table MON-3 below). The collection of 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 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 from the records of government agencies. The electronic database is updated and reviewed weekly to reflect drilling activities in the Delaware Basin.

MON-3.3.1 Schedule

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. Maps of the Delaware Basin are published on request. 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;
- determination of the fraction of plugged and abandoned boreholes that are sealed;
- well conversion activities (injection, disposal, water);
- injection well operation (disposal and secondary recovery);

- drilling activities including borehole depths, diameters, and type and amount of drilling fluid;

- identification of ownership of all state and federal minerals and hydrocarbon leases within the area; and

- 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 (DOE 2002b).

MON-3.4 Subsidence Monitoring Program

The Subsidence Monitoring Program (SMP) is described in detail in the WIPP Underground and Surface Surveying Program (WIPP 2003a). Subsidence monitoring is the measurement of 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 markers.

The activities associated with the SMP are designed to:

- provide time-related spatial information on surface subsidence within 152.4 m (500 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; and

- maintain a database of subsidence data.

With current technology, vertical elevation can be measured at a precision of 0.0305 cm (0.001 ft). Subsidence monitoring was chosen by the DOE as a long-term monitoring tool because it effectively meets the requirements in 40 CFR § 191.14(b) for long-term monitoring. Subsidence monitoring is conducted to detect substantial deviations from expected repository performance by allowing a comparison of actual subsidence to that calculated previously.

Subsidence data are currently being compiled and will be compared to subsidence predictions. In addition, monitoring subsidence 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 throughout the operations period as deemed necessary. 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 32.19 km (20 mi) of leveling loops through approximately 50 monuments. Results are reported annually in the WIPP Subsidence Monument Leveling Survey (DOE 2002c).

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 by Waste Tracking and Control to provide tabulations of key waste parameters. The waste activity parameter includes tracking the total material parameter weights and curie content of 10 radionuclides, listed in Section 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 are submitted to the WWIS database. 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 curie content of the radionuclides americium-241, plutonium-238, plutonium-239, plutonium-240, plutonium-242, uranium-233, uranium-234, uranium-238, strontium-90, and cesium-137 and the material parameter weights (cellulose, plastics and rubber (CPR) materials, free liquids, and metals) for the waste emplaced in the WIPP underground are reported in November of each year to the EPA in the annual 40 CFR § 194.4(b)(4) report (DOE 2002d).

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 CCA Appendix MON, sections MON.6 through MON.7, which are brought forward as Attachment A of this Appendix. Attachment A is as written in the CCA and any references in Attachment A are to the CCA. When the final Postclosure Monitoring Plan is written, any proposed changes to the commitments made in Attachment A will only be made after review and approval by the appropriate regulatory authorities.

MON-5.0 MONITORING PROGRAMS QUALITY ASSURANCE REQUIREMENTS

The quality of the work performed under the DOE CMP is controlled by the application of the CBFO Quality Assurance Program Document (QAPD) (DOE 2003a) and existing QA procedures employed by the CBFO. Waste information is controlled by implementation of 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 (M&TE), and
  - calibration.
- **Section 4.0 – Sample Control Requirements**
  - sample control,
  - sample identification,
  - handling, storing, and shipping samples, and
  - disposition of nonconforming samples.

Sampling and monitoring activities follow properly documented and implemented quality assurance/quality control procedures. WIPP monitoring programs are subject to EPA inspections in accordance with 40 CFR § 194.21.

The CMP relies on the individual monitoring plans' QA programs 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 the data used in the CMP are implemented by the M&OC. The reporting of the data for the 10 compliance monitoring parameters is coordinated through the M&OC.

It is the responsibility of the M&OC to ensure that the DOE is fully informed regarding any occurrence of anomalous CMP results and evaluations. The M&OC communicates important monitoring results to the SA. The SA communicate to the M&OC, via the DOE, any information generated that may impact the M&OC monitoring activities during their assessment.

MON-6.1.1 Assessing Compliance Monitoring Parameters

The SA is responsible for assessing compliance monitoring parameters against PA expectations and will report results through an annual compliance assessment report to the DOE.

It is the responsibility of the SA to ensure that the DOE is fully informed in the event that the SA's activities generate information that changes current understanding of data, parameter values, or conceptual models that are important to the assessment of the performance of the repository. In this role, the SA integrates the information generated through the various SA activities and presents a single position to the DOE. When unexpected or anomalous results are generated, the SA recommends to the DOE actions appropriate to mitigate or respond to the unexpected result. The SA also serves the information-exchange function described above by communicating to the M&OC any results that may impact the M&OC monitoring activities. The SA develops the compliance monitoring parameter assessment annually. 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 Reporting and Assessment Point of Contact

In its role as the centralized point of contact for monitoring activities, the DOE is responsible for the following activities:

- Review monitoring results – CMP results may indicate two general cases:

  (1) normal or expected conditions in which results are generally consistent with existing data, parameter values, and conceptual models; or

  (2) anomalous conditions that are inconsistent with existing data, parameter values, or conceptual models. It is the responsibility of the DOE to review recommendations provided by the M&OC and the SA generated through the monitoring programs to determine whether these results are consistent or inconsistent with expected

conditions modeled in PA or screening decisions used to support the compliance determination.

- Definition of responsive actions or changes – Anomalous results may warrant changes in the monitoring programs, research activities, PA assumptions, or some other aspect of the overall compliance program. In addition, occasions may arise when it is appropriate to modify existing monitoring programs for modifications that may be required by regulators or are initiated from within the project.

MON-6.1.3 External Reporting

The DOE will review the recommendations of the M&OC and the SA to evaluate their significance. Significance will be determined based on consideration of the following criteria:

- containment requirements established pursuant to 40 CFR § 191.13 are, or are expected to be, exceeded;

- releases from waste already emplaced lead to committed effective doses that are, or are expected to be, in excess of those established pursuant to 40 CFR § 191.15 (not including emissions from operations covered pursuant to Subpart A of 40 CFR Part 191); or

- releases 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 40 CFR 191, Subpart C.

If monitoring results meet any of these criteria, the results will be considered to be significant. Monitoring results determined by the CBFO to be significant will be promptly reported to the EPA. The report will be accompanied by a recommended course of action, including the appropriate external reporting. If the monitoring results indicate an exceedance or possible exceedance of containment requirements or release 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 monitoring results are significant but do not indicate an immediate or imminent exceedance or release as described in 40 CFR § 194.4(b)(3)(ii), the CBFO will prepare a written report of its findings. The CBFO Manager provides this report to the EPA within 10 days.

For normal conditions where monitoring results are within expectations, the compliance monitoring parameter assessment will document this condition annually. As stated previously, this report is sent to the EPA as part of the annual reporting requirement of 40 CFR § 194.4(b)(4).

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