CARD No. 42
Monitoring

42.A.1 BACKGROUND

Assurance requirements were included in the disposal regulations to compensate in a qualitative manner for the inherent uncertainties in projecting the behavior of natural and engineered components of the WIPP for many thousands of years (50 FR 38072). Section 194.42 is one of the six assurance requirements in the Compliance Criteria. Section 194.42 specifically addresses requirements for monitoring the disposal system during pre- and post-closure operations. This requirement distinguishes between pre- and post-closure monitoring because of the differences in monitoring techniques used to access the repository during operations (pre-closure) and after the repository has been backfilled and sealed (post-closure). The purpose of monitoring is to confirm that the repository is behaving as predicted.

42.A.2 REQUIREMENT

(a) "The Department shall conduct an analysis of the effects of disposal system parameters on the containment of waste in the disposal system and shall include the results of such analysis in any compliance application. The results of the analysis shall be used in developing plans for pre-closure and post-closure monitoring required pursuant to paragraphs (c) and (d) of this section. The disposal system parameters analyzed shall include, at a minimum:

(1) Properties of backfilled material, including porosity, permeability, and degree of compaction and reconsolidation;

(2) Stresses and extent of deformation of the surrounding roof, walls, and floor of the waste disposal room;

(3) Initiation or displacement of major brittle deformation features in the roof or surrounding rock;

(4) Ground water flow and other effects of human intrusion in the vicinity of the disposal system;

(5) Brine quantity, flux, composition, and spatial distribution;

(6) Gas quantity and composition; and

(7) Temperature distribution."

42.A.3 ABSTRACT

Section 194.42(a) requires DOE to provide an analysis of disposal system parameters to determine which parameters may affect the containment of waste in the disposal system. The results of the analysis are to be used in developing pre- and post-closure monitoring plans. The analysis should address, at a minimum, the seven parameters listed in the requirement. In addition, the analysis should explain the methodology for examining the effects of the parameters on the containment of waste and state the results of the analysis.

DOE presented an analysis that encompasses the parameters identified in Section 194.42(a). In addition, DOE's analysis included a substantial number of other parameters that it identified as associated with major disposal system processes and models. DOE qualitatively considered these parameters for their impacts on the containment of waste or ability to verify predictions about future performance of the disposal system.

42.A.4 COMPLIANCE REVIEW CRITERIA

EPA expected the CCA to contain an analysis of the effects of disposal system parameters on the containment of waste. At a minimum, the parameters analyzed must include those listed in Section 194.42(a), items (1) through (7). This analysis should detail all the parameters analyzed, the methodology and assumptions used, and the results of the analysis.

42.A.5 DOE METHODOLOGY AND CONCLUSIONS

The information supporting DOE's compliance with this requirement is located in Chapter 7.2, Appendix MON, and Attachment 1 to Appendix MON (MONPAR) of the CCA. EPA requested additional explanations and documentation regarding DOE's analysis in a letter dated December 19, 1996 (Docket A-93-02, Item No. II-I-01). In response, on February 14, 1997, DOE submitted a supplemental report entitled "Analysis of the Effects of Disposal System Parameters on Waste Containment as Specified in Section 194.42" (Docket A-93-02, Item No. II-I-08, hereafter referred to as the "Supplemental Report"). The Supplemental Report included additional information regarding the methodology of the analysis conducted to support compliance with this requirement.

Attachment MONPAR.1 (p. MONPAR 1-4) and the supplemental report (p. 1-4) describe the methodology DOE used to analyze the effects and significance of disposal system parameters on the containment of waste and disposal system performance. The term parameter, in the context of 40 CFR Part 194, signifies properties and processes in the disposal system. Results of this analysis are located in tables MONPAR-1 to MONPAR-3. DOE's methodology has three steps:

- Develop criteria for parameter significance.

- Develop a list of parameters to be subjected to the significance analysis.

- Conduct a qualitative evaluation of significance for each parameter.

Develop Criteria for Parameter Significance

Section 194.42(c) states that a disposal system parameter shall be considered significant if it affects the system's ability to contain waste or the ability to verify predictions about future performance of the disposal system. DOE implemented this criterion by evaluating:

- A parameter's potential effect on compliance with the regulatory release limits.

- The assumptions used in modeling the system's performance.

According to DOE, parameters that affect compliance include those that have the potential to change the calculated probabilities of release as expressed in the complementary cumulative distribution functions (CCDFs). DOE asserted that parameters that are most likely to affect the probabilities or magnitude of releases are those that are highly variable and are sampled during the performance assessment (PA) (Supplemental Report, p. 5).

DOE indicated that assumptions used in system performance may be verified by means of: (1) measurement of physical and chemical conditions that are significant to calculated system performance to see if they remain consistent with expected conditions or within the range of conditions incorporated into the assumptions and models; and (2) measurement of physical and chemical processes that are currently modeled based on professional judgement or regulatory guidance because data are not available (Supplemental Report, p. 5).

Develop List of Parameters for Significance Analysis

To develop the initial list of parameters to be analyzed (Table 7-2), DOE considered the major processes and models described in Chapter 6.4 and the results of previous PAs. DOE used the following criteria to select parameters for analysis:

- The parameter represents one or more aspects of the process or model.

- The parameter represents subjective uncertainty (such as spatial variability in a physical property or process used in modeling results of repository performance).

- The parameter represents stochastic uncertainty (such as drilling rate for consideration of human intrusion).

- The parameter represented subjective or stochastic uncertainty in preliminary PA calculations (such as the diameter of the drill bit in the intrusion borehole).

- The parameter proved to be moderately to highly sensitive in preliminary PA calculations.

DOE used several sources to determine if the parameters met the above criteria (Supplemental Report, p. 7). For example, Appendix SA contains sensitivity calculations that were performed in conjunction with the 1996 PA. These analyses provided information on whether parameters met the above criteria.

Conduct Qualitative Evaluation of Parameter Significance

DOE evaluated the parameters that met the above criteria for significance. Each parameter was subjected to a qualitative evaluation of the extent of its effects on disposal system performance, and was evaluated within the context of its relevant scenario. The scenarios evaluated included natural features, events and processes (FEPs), waste-induced FEPs and human initiated events and processes. See **CARD 32—Scope of Performance Assessments** for a discussion of the selection and screening of FEPS. Tables MONPAR-1, MONPAR-2, and MONPAR-3 illustrate the analysis for each parameter within the relevant scenario. The work considered during the evaluation included:

- Sensitivity calculations performed in conjunction with the 1996 PA calculations (Appendix SA).

- Reasoned arguments regarding the effects of FEPs on the disposal system and its performance (Appendix SCR).

- Sensitivity analyses performed in conjunction with previous PAs that identified parameters important to compliance.

- Analyses, calculations, and scientific judgement of investigators in developing parameters, conceptual models, and mathematical models of disposal system behavior, documented in memos, parameter data packages, and analysis packages.

- Scientific judgement of investigators incorporating the effects of human intrusion into models of the repository.

DOE evaluated each of the parameters listed in Table 7-2 and assigned a high, medium, or low significance value. A high rating indicates that the FEP represented by the parameter may significantly affect the probability or magnitude of a release, or may be important for predicting system performance. For example, DOE stated that direct releases associated with the act of drilling into the repository dominate the CCDF. Therefore, parameters that strongly affect the probability or magnitude of direct releases are considered to be highly significant. These

parameters include drilling rate, time between intrusions, borehole location, waste activity, and properties of the Castile brine reservoir encountered during intrusion (Supplemental Report, p. 8).

A medium rating indicates that the FEP represented by the parameter may influence a release, but does not significantly affect its probability or magnitude. The parameter may also be moderately important for predicting system performance. DOE stated, for example, that several parameters associated with flow in the Culebra and the effects of mining potash in the Salado (expressed as changes in the hydrological properties of the Culebra) may influence, but would not strongly affect, the magnitude of a long-term release (Supplemental Report, p. 8).

A low rating indicates that the FEP represented by the parameter has little effect on the probability or magnitude of a release; therefore, the uncertainty in the parameter is not important to predicted system performance. For example, DOE stated that the natural geological thermal gradients are not large enough to cause a release or affect system performance (Supplemental Report, p. 8).

Based on this methodology and further screening conditions (discussed herein under the requirements for Section 194.42 (b)), DOE developed a list of parameters for pre- and post-closure monitoring. These parameters are presented in Table 7-7.

42.A.6 EPA Compliance Review

In conducting its compliance review for this requirement, EPA evaluated Chapter 7.2, Attachment MONPAR to Appendix MON, and the Supplemental Report. Table 7-2 and Tables MONPAR-1, MONPAR-2, and MONPAR-3 list the specific disposal system parameters that were evaluated during the analysis and provide a summary of the results of the analyses. The list includes all of the parameters required by Section 194.42(a) as well as many additional parameters. Chapter 7.2.2.1 of the CCA and Chapter 2.3.3 of the Supplemental Report define the ranking terms (high, medium, and low) used to describe the significance of the effects on the containment of waste of the parameters evaluated. The methodology used by DOE to conduct the analysis of the effects of disposal system parameters on the containment of waste is logical and sufficiently detailed. Attachment MONPAR provides the outcome of the significance evaluation for each parameter.

Appendix SA and the 12/23/96 update to Appendix SA (provided by DOE to supplement the information provided in the CCA in October 1996) (Docket Number II-G-07) describe the sensitivity analysis DOE conducted to establish the significance on the PA of a number of disposal system parameters, such as waste particle diameter, borehole permeability, effective shear resistance to erosion, Salado anhydrite permeability, inundated steel corrosion rate without CO_2, and halite porosity. Additional information regarding the significance of several of the Table 7-2 disposal system parameters was contained in Appendix SCR. Disposal system parameters discussed include creep closure, initiation of brittle deformation, disturbed rock zone characteristics, backfill properties, seal physical properties, temperature distribution, and natural temperature distribution.

As a result of these analyses, DOE identified ten parameters for pre-closure monitoring, five of which are also retained for post-closure monitoring. Portions of four of the seven parameters that Section 194.42(a) required DOE to examine are part of the final monitoring plan. The parameters from this list that will be monitored are: Culebra ground water composition, Culebra change in ground water flow, probability of encountering a Castile brine reservoir, creep closure and stresses, extent of deformation, initiation of brittle deformation, and displacement of deformation features.

EPA concluded that the methodology DOE used to develop and analyze parameters for monitoring was comprehensive. EPA also concluded that the analysis undertaken to identify parameters for pre- and post-closure monitoring included the parameters stipulated in Section 194.42(a) and additional parameters identified by DOE.

42.B.1 Requirement

(b) "For all disposal system parameters analyzed pursuant to paragraph (a) of this section, any compliance application shall document and substantiate the decision not to monitor a particular disposal system parameter because that parameter is considered to be insignificant to the containment of waste in the disposal system or to the verification of predictions about the future performance of the disposal system."

42.B.2 Abstract

DOE was required to document and substantiate any decision not to monitor a parameter analyzed under Section 194.42(a) on the basis of significance. DOE developed and presented criteria on which to base these decisions. EPA reviewed the criteria and their application to determine if they were adequate for compliance.

42.B.3 Compliance Review Criteria

EPA required information supporting DOE's decision not to monitor any one of the parameters identified in accordance with 40 CFR 194.42(a).

42.B.4 DOE Methodology and Conclusions

The information supporting DOE's compliance with this requirement was found in Chapter 7.2, Appendix MON, and Attachment MONPAR of the CCA. The methodology that DOE used to document the decision not to monitor a particular parameter was based on five screening criteria. These criteria are described in Chapter 7.2.2:

- ♦ Will monitoring address significant disposal system parameters?

- ♦ Will monitoring address important disposal system concerns?

- ♦ Will monitoring obtain meaningful data in a short period of time or provide data related to a measurable property of the disposal system?

- ♦ Will monitoring preserve disposal system integrity?

- ♦ Will monitoring be complementary with RCRA programs?

DOE derived four of these criteria (the first two and last two) from 40 CFR 194.14(b) and 194.42(d). DOE derived the criterion "will monitoring obtain meaningful data in a short period of time or related to a measurable property of the disposal system?" from the preamble to 40 CFR Part 191 (50 FR 38081).

Significant Disposal System Parameters

DOE identified parameters that are significant to the containment of waste using the methodology described within the portion of the CARD for Section 194.42(a). The results of the evaluation provided in Attachment MONPAR identified only a fraction of the total list of parameters (Table 7-2) as having a high significance to containment or a high significance to verification (Table 7-3).

Important Disposal System Concerns

This criterion is closely tied to significant disposal system parameters in that most parameters that are significant to the containment of waste are also related to important disposal system concerns. However, DOE included important disposal system concerns as a separate criterion to identify other parameters that, while not necessarily significant to the results of the PA, do describe important disposal system features. For example, the creep properties of the Salado can be considered an important feature of the disposal system, although the parameter analysis identified them as having a minor effect on the outcome of the PA. Thus, for example, creep properties of the Salado are considered significant because they can provide information that will allow DOE to evaluate its conceptual model of Salado creep closure. To assist in evaluating the parameters by this criterion, DOE divided the list of parameters in Table 7-2 into five major components:

- ♦ Salado and repository physical properties.

- ♦ Salado and repository hydrological properties.

- ♦ Non-Salado hydrological properties.

- ♦ Waste properties.

- ♦ Engineered barrier properties.

A list of parameters considered to be significant on the basis of this criterion is provided in Table 7-4 of the CCA.

Meaningful Data in a Short Period of Time/Measurable Property of the Disposal System

DOE indicated that the amount of time available to obtain data regarding important disposal system parameters is approximately 150 years. This estimate assumes a 50-year pre-closure period and 100 years of active institutional controls. However, DOE committed to continuing monitoring programs for as long as needed if meaningful data are collected or expected (p. 7-46). DOE applied this criterion by evaluating whether parameter changes were expected to occur within the first 150 years. For example, rapid changes in the brine concentration within the Salado are likely to occur initially and are not likely to be diagnostic of the steady state that will exist over the 10,000-year regulatory time period. Many parameters were screened out of the pre- and post-closure monitoring plans based on the amount of time it would take to gain meaningful data.

The second part of this criterion is that the parameters had to be amenable to measurement within the disposal system. For example, parameters such as the shape of pore spaces cannot reasonably be measured and, therefore, it is not reasonable to include these as monitorable parameters. DOE evaluated parameters that passed the first criterion to determine whether they either could be measured directly or deduced by interpreting data from the measurement of other properties of the disposal system. DOE identified ten parameters, as listed in Table 7-5, that can produce meaningful and measurable data during the monitoring period. This table also indicates whether the parameter can be measured or observed and over what time period.

Preserve Disposal System Integrity

The criterion that monitoring should not jeopardize the containment of waste in the disposal system is derived from 40 CFR 191.14(b) and 194.42(d) and applies primarily to monitoring of parameters during the post-closure time period. The integrity of the disposal system could be compromised by drill holes, conduits, and other entries that are left in place after closure to allow access to monitoring equipment. The only viable post-closure monitoring systems are those that can be operated directly, those that can transmit information without cabling (telemetry), and those that can be used to evaluate parameters using remote sensing techniques. DOE implemented this criterion primarily to distinguish which of the parameters in Table 7-5 could be monitored during both the operational and post-closure phases, and which could be monitored only during the pre-closure phase.

Nine of the ten parameters shown in Table 7-5 were identified as being measurable without violating repository integrity. These parameters are listed in Table 7-6. The only parameter excluded was Salado brine composition. According to DOE, brine composition is significant and is incorporated into PA calculations; however, based on the extensive experimental

evidence collected, there is no indication that Salado brine composition will change over the regulatory period.

Complementary with RCRA Programs

Post-closure monitoring must be complementary to that required by applicable federal hazardous waste regulations of 40 CFR Parts 264, 265, 268, and 270 (RCRA programs). The requirements of 40 CFR Parts 264, 265, 268 and 270 will likely be addressed by the State of New Mexico via conditions of a RCRA hazardous waste operating permit for the WIPP. DOE implemented this criterion by comparing the monitoring that would be required for the parameters listed in Table 7-6 with the monitoring programs that the State of New Mexico would likely require pursuant to RCRA. DOE assumed that the State of New Mexico would require geomechanical monitoring, confirmatory monitoring of Volatile Organic Compounds (VOC), and ground water surveillance monitoring during the pre-closure period, as well as ground water monitoring for the post-closure period (p. 7-51). DOE determined that monitoring of six of the nine parameters listed in Table 7-6 (creep closure, extent of deformation, initiation of brittle deformation, displacement of deformation features, Culebra ground water composition, and changes in Culebra ground water flow) will be complementary to RCRA program monitoring requirements.[1]

Documentation of Results

Each of the parameters listed in Table 7-2 was screened using the criteria described in this section. DOE provided the results of the screening process in Tables 7-3 through 7-6 and provided documentation for excluding various parameters in Appendix MON, Attachment MONPAR.

42.B.5 EPA COMPLIANCE REVIEW

EPA evaluated DOE's decision not to monitor a particular disposal system parameter by reviewing Chapter 7.2 and Attachment MONPAR to Appendix MON of the CCA. EPA determined that the methodology and screening criteria used by DOE to select or reject a parameter for monitoring comply with the requirements of 40 CFR 194.14(b) and Section 194.42.

EPA found inconsistencies between the parameters listed for monitoring in Table 7-7 and the parameters listed for monitoring in Table MONPAR-2. Table 7-7 lists waste activity as the only waste-related parameter that will be monitored during pre-closure. Table MONPAR-2 indicates that gas quantity and gas composition, which also are waste-related parameters, will be monitored during the operational phase. In fact, DOE did not retain gas quantity and composition as parameters for pre-closure monitoring because they are not likely to provide meaningful data during the monitoring period and because DOE cannot measure these parameters within the disposal system without compromising its integrity. Despite the inconsistency in the tables, EPA

[1] The requirements of 40 CFR Part 268 (Land Disposal Restrictions or LDRs) for the WIPP disposal phase were to be implemented by EPA's Office of Solid Waste. However, the WIPP was exempted from Federal LDR requirements under the 1996 amendments to the WIPP Land Withdrawal Act (Pub. Law No. 104-201).

agreed that gas quantity and composition were appropriately excluded and accepts that waste activity will be the only waste-related parameter monitored during pre-closure.

There were three parameters from Table 7-2 that DOE declined to monitor based solely on a finding of low significance to the containment of waste or prediction about future performance. These three parameters were natural temperature distribution (Attachment MONPAR.2.7), backfill properties (Attachment MONPAR.3.5), and temperature distribution (Attachment MONPAR.3.8). EPA verified the appropriateness of the significance rankings for these parameters by reviewing the documentation available in the CCA. EPA chose to verify these parameters because their exclusion for monitoring was based on only one criterion.

Natural Temperature Distribution

Attachment MONPAR.2.7 states that natural thermal gradients have been characterized and will not affect repository performance, either directly by affecting the containers and repository chemistry, or indirectly by altering fluid flow through the Salado or the Culebra. Therefore, DOE will not monitor natural thermal gradients during the operational period nor the post-closure period. Appendix SCR.1.2.2.3 states that the geothermal gradient in the region of the WIPP has been measured at about 50^{o} C per mile. Appendix SCR further states that natural convection will be too weak to have a significant effect on ground water flow and that no natural FEPs have been identified that could significantly alter the temperature distribution of the disposal system or give rise to thermal effects on ground water flow. Such effects have therefore been eliminated from PA calculations on the basis of low consequence. EPA concluded that DOE provided sufficient information in Appendix SCR to support these conclusions.

Temperature Distribution

Attachment MONPAR.3.8 states that waste-induced and repository-induced thermal gradients will not affect repository performance, either directly by affecting the containers and repository chemistry, or indirectly by altering fluid flow through the Salado or the Culebra. Therefore, DOE will not monitor waste- and repository-induced thermal gradients during the operational period nor the post-closure period. Appendix SCR.2.2.2 states that the effects of temperature increases due to radioactive decay were eliminated from PA calculations on the basis of low consequence to the performance of the disposal system. Nuclear criticality (and the production of heat due to nuclear criticality) was eliminated from PA calculations on the basis of low probability of occurrence over 10,000 years. Appendix SCR.2.3.7 states that the effects of thermally induced stress, differing thermal expansion of components, and thermal effects on material properties in the repository were eliminated from PA calculations on the basis of low consequence to performance of the disposal system. Appendix SCR.2.5.7 states that thermal effects of exothermic reactions, including concrete hydration and backfill hydration, were eliminated from the PA calculations on the basis of low consequence to performance of the disposal system. EPA concluded that DOE provided sufficient information provided in Appendix SCR to support these conclusions.

Backfill Properties

Attachment MONPAR.3.5 states that the mechanical and hydrologic properties of the backfill are not significant to the PA results. Therefore, DOE will not monitor them during the operational or post-closure periods. The CCA states that backfill will result in an initial permeability for the disposal room lower than that of an empty cavity, so neglecting the hydrological effects of backfill is a conservative assumption with regard to brine inflow and radionuclide migration. Appendix SCR.2.3.8.1 states that backfill added to the disposal room will act to resist creep closure. However, calculations have shown that inclusion of backfill does not significantly decrease the total subsidence in the waste emplacement area or the disposal room (DOE 1994). Therefore, the mechanical effects of backfill have been eliminated from the PA on the basis of low consequence to the performance of the disposal system. EPA concluded that the information provided in Appendix SCR and associated references to support these conclusions is technically reasonable.

42.C.1 REQUIREMENT

(c) "Pre-closure monitoring. To the extent practicable, pre-closure monitoring shall be conducted of significant disposal system parameter(s) as identified by the analysis conducted pursuant to paragraph (a) of this section. A disposal system parameter shall be considered significant if it affects the system's ability to contain waste or the ability to verify predictions about the future performance of the disposal system. Such monitoring shall begin as soon as practicable; however, in no case shall waste be emplaced in the disposal system prior to the implementation of pre-closure monitoring. Pre-closure monitoring shall end at the time at which the shafts of the disposal system are backfilled and sealed."

(e) "Any compliance application shall include detailed pre-closure and post-closure monitoring plans for monitoring the performance of the disposal system. At a minimum, such plans shall:

(1) Identify the parameters that will be monitored and how baseline values will be determined;

(2) Indicate how each parameter will be used to evaluate any deviations from the expected performance of the disposal system; and

(3) Discuss the length of time over which each parameter will be monitored to detect deviations from expected performance."

42.C.2 ABSTRACT

Section 194.42(c) addresses the conduct of pre-closure monitoring of the repository, while Section 194.42(e) identifies the minimum required elements of both pre- and post-closure monitoring plans. This section of the CARD addresses only the pre-closure monitoring plan. The post-closure monitoring plan required by 194.42(e) is addressed under the discussion of Section 194.42(d) below.

EPA requires a pre-closure monitoring plan that is based on the analysis required by Section 194.42(a). The plan should identify: when monitoring will begin and end, monitoring techniques, baseline data, and how the information obtained from monitoring will be used to evaluate the containment of waste or the predictions of the PA.

Based on the analysis required by Section 194.42(a), DOE developed a list of parameters for monitoring during the pre-closure period. DOE presented monitoring plans that included monitoring techniques, baseline data and data evaluations for each parameter or group of parameters. In addition, DOE established time frames for pre-closure monitoring of each parameter or group of parameters.

EPA reviewed the list of pre-closure parameters to verify that they were derived from the analysis presented for 194.42(a). EPA also reviewed the monitoring plans for appropriateness and compliance with standard monitoring techniques.

42.C.3 Compliance Review Criteria

To fulfill the requirements of Section 194.42(c), DOE must present a plan for pre-closure monitoring of the disposal facility based on the analysis conducted for Section 194.42(a). This plan should clearly indicate which parameters will be monitored. EPA also expected the CCA to include an explanation of parameters considered significant, and substantiation of any decision not to monitor a parameter on the basis that it is not significant. Section 194.42(e) requires DOE to provide more detailed information about the pre-closure monitoring plan, including a description of when the monitoring will occur, the manner in which each parameter will be monitored, baseline data, and data evaluation methods.

42.C.4 DOE Methodology and Conclusions

The information supporting DOE's compliance with this requirement is located in Chapter 7.2.2 and 7.2.3 and Appendix MON of the CCA. Specific information regarding the pre-closure monitoring plans is located in Appendices GTMP, GWMP, VCMP, DMP, EMP, SMP and WCL. Sections 42.A.5 and 42.B.4 of this CARD describe how DOE established the disposal system parameters to be monitored during the pre-closure period.

Table 7-7 and Appendix MON, Table MON-1 list the disposal system parameters to be monitored during the pre-closure period. The parameters are divided among four monitoring elements. Listed below are the monitoring elements and the associated parameters:

- Salado Physical Parameters
  - -- Creep closure
  - -- Extent of deformation
  - -- Initiation of brittle deformation
  - -- Displacement of deformation features

♦ Waste Related Parameters

-- Waste activity

♦ Non-Salado Hydrological Properties

-- Culebra brine composition
-- Culebra well water level
-- Culebra ground water flow direction
-- Castile brine reservoir location
-- Drilling rate and drilling practices

♦ Subsidence

Chapter 7.2, and Appendices MON.4 and MON.5 of the CCA identify the individual monitoring programs for each of the parameters that advanced through the DOE screening process.

General information regarding how the monitoring results of each parameter will be used to evaluate the performance of the disposal system is provided in Chapter 7.2.2.4.1. If the results of the monitoring program identify significant deviations in expected values of the disposal system parameters from those ranges of values used in PA models, DOE will conduct an evaluation to determine whether the new information should be incorporated into the PA conducted for recertification (pp. 7-48 to 7-49). Parameter values outside of expected ranges will also prompt an evaluation of models to determine whether modifications are required for use in recertification PA activity (p. 7-49). The following sections discuss the monitoring programs for the four elements listed above.

Salado Physical Parameters: Geomechanical Monitoring

Pre-closure monitoring for the Salado Physical Parameters (creep closure, extent of deformation, initiation of brittle deformation, and displacement of deformation features) will be accomplished primarily via the geomechanical monitoring program described in Chapter 7.2.3.1, Appendix MON.4.1, and Appendix GTMP. The geomechanical monitoring program at the WIPP facility is an integral part of DOE's overall ground control program that is conducted to ensure that the underground portions of the repository are safe from unplanned roof or rib falls. Geomechanical monitoring data that are (and will be) collected from disposal rooms, drifts, and operational area excavations are used to confirm structural integrity. The Salado Physical Parameters from Table MON-1 can be measured directly with geomechanical monitoring instruments or evaluated using observations or monitoring instrument data collected during the geomechanical monitoring program.

Geomechanical monitoring is initiated immediately after an excavation of a disposal room or access drift and continues as long as access to the excavated area is required. For access drifts and other portions of the repository that will remain open throughout the operational period, a wide variety of monitoring instruments is used to collect data. DOE stated that monitoring will

continue throughout the pre-closure period. For the Panel 1 disposal rooms (which have already been excavated), geomechanics have been monitored since 1978. For the remaining disposal panels that have not yet been excavated, geomechanical monitoring will consist of a minimum of one borehole extensometer installed in the roof at the center of each disposal room. Geomechanical monitoring of the disposal rooms can occur in open areas of the repository (Table 7-6, p. 7-48).

DOE has already established the baseline for the Salado Physical Parameters for the repository using geomechanical data collected since the initial repository excavation (Chapter 7.2.3.1).

The information regarding how the geomechanical monitoring results for each Salado Physical Parameter would be used to evaluate deviations from the expected performance of the disposal system is located in Chapters 7.2.2.4.1 and 7.2.3.1 of the CCA. Chapter 7.2.2.4.1 states that the Salado Physical Parameters all reflect on the geomechanical nature of the repository. Evaluation of these parameters will influence the operational aspects of safe operation of the repository. However, should any of these parameters exhibit properties that are significantly outside the experience and expectations of the information baselines developed to date, DOE will evaluate the impact on the design of the repository and the design of the shaft seal system. Chapter 7.2.3.1 states that creep closure is included in the conceptual model of disposal system performance and is discussed in Chapter 6.4.3.1 and Appendix PORSURF. The numerical model for predicting creep closure was developed based on theoretical considerations and observations. The goal of monitoring is to detect any substantial and detrimental deviations from the expected behavior of Salado halite and determine the significance of such deviations. The data from the geomechanical monitoring are analyzed after each round of measurements and results are distributed for use in making ground control decisions. A compilation of the data (current and previous) is published annually in DOE's Geotechnical Field Data and Analysis Report. The data compilation can be used to determine long-term trends in the behavior of underground openings and can be a diagnostic tool for determining substantial and detrimental deviations from expected performance.

Appendices MON.4.1 and GTMP provide a description of the proposed geomechanical monitoring network and a justification for its design. The CCA describes the types of monitoring instruments to be used, the frequency of monitoring, and a description of how the data will be processed and evaluated to establish the stability of the underground openings and assess the effectiveness of the roof support system that is being used (if any).

Salado Physical Parameters: VOC Confirmatory Monitoring

In addition to the geomechanical monitoring, pre-closure monitoring of the creep closure parameter can be conducted indirectly via the VOC confirmatory monitoring program described in Chapter 7.2.3.2, Appendix MON.4.3, and Appendix VCMP. The primary purpose of this program is to quantify the rate and concentration of VOC emissions from the WIPP. The data will be used to demonstrate compliance with the environmental performance standards of 20 NMAC 4.1, Subpart V, Section 264.601(c), as required by the State of New Mexico via

conditions of the WIPP RCRA operating permit.[2] The rate of VOC emission is important because it is affected by two interrelated repository properties: creep closure and gas-producing processes, both of which will lead to pressurization of a waste disposal panel once the panel closure system is in place. The pressurization will become the driving force for VOC emissions through and around the panel closure system. In the WIPP RCRA Part B Permit Application, DOE provided theoretical calculations to estimate the concentrations of VOCs emanating from both closed and open waste disposal panels that were based on assumed closure rates and gas generation rates (DOE 1996).

VOC monitoring in the repository has been ongoing at the WIPP since 1991 in order to establish the background VOC concentrations in exhaust air due to mining and maintenance activities in the repository. However, this information will not provide a useful baseline for the monitoring of the creep closure parameter since no waste or panel closures have been emplaced. The actual baseline for the VOC monitoring will be derived from theoretical predictions. The CCA states that DOE will begin the VOC monitoring just prior to emplacement of waste in Panel 1, and will continue baseline monitoring until at least six months following completion of the Panel 1 closure system.

Appendix VCMP provides a description of the proposed VOC confirmatory monitoring network and the rationale for its design. Appendix VCMP also provides a description of the specific elements of the monitoring program including the type of monitoring, monitoring instruments, locations of the monitoring stations, frequency of sampling, sampling and analytical techniques, and data recording and reporting procedures.

Waste Related Parameters

Chapter 7.2.2.4.1 and Appendix MON.4.4 state that DOE will conduct pre-closure monitoring of waste activity to ensure that the waste activity values are within the range of values used in PA models. The CCA states that any significant deviation from expected values will be addressed by DOE in a timely fashion to avoid any violation of the compliance certification. Chapter 7.2.3 of the CCA states that waste activity monitoring will begin when the first waste is emplaced in the WIPP and will continue until the last waste shipment is made. Chapter 7.2 and Appendix MON defer to Appendix WCL for further detail regarding the monitoring of waste activity.

Appendices WCL.1 and WCL.9, indicate that the inventory curie content for nine important radionuclides (^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{90}Sr, ^{137}Cs) plus ^{238}U will be tracked to verify that the ratio of emplaced activities of the ten waste component radionuclides recommended for assay is similar to that assumed in the PA. If necessary, any future PA conducted for recertification purposes will use an adjusted curie content inventory that reflects significant changes in projected values.

[2] At the time of EPA's certification decision, the RCRA operating permit has not been granted by the State of New Mexico.

Non-Salado Hydrological Properties

The pre-closure monitoring for Culebra brine composition, Culebra well water level, and Culebra ground water flow direction disposal system parameters will be accomplished via the ground water surveillance program described in Chapter 7.2.3.3, Appendix MON.4.2, and Appendix GWMP. The pre-closure monitoring for the Castile brine reservoir location and the drilling rate and drilling practices disposal system parameters will be accomplished via the observation of drilling activities described in Chapter 7.2.3.4, Appendix MON.5, and Appendix DMP.

Ground Water Surveillance

DOE established the ground water surveillance program at the WIPP to address DOE Orders and commitments made in the Final Environmental Impact Statement (DOE 1980). The ground water surveillance program is also intended to address the ground water monitoring requirements of 40 CFR Part 264 Subpart F as administered by the State of New Mexico via RCRA permit conditions. The ground water surveillance program involves collecting data on three disposal system parameters: water level, flow direction, and brine composition in the Culebra. The Culebra well water level parameter can be measured directly from ground water monitoring wells using monitoring instruments. The Culebra ground water flow direction parameter can be interpreted from the water level data, while the Culebra brine composition parameter can be measured via the collection and chemical analysis of ground water samples from monitoring wells (Table MON-1, p. MON-7).

The ground water surveillance program collects ground water level data from approximately 48 Culebra monitoring wells, as shown in Figures MON-2 and MON-3. Water level data will be collected on a monthly basis throughout the operational period and for at least 30 years after closure of the repository. The ground water surveillance program also collects ground water quality samples from seven monitoring wells (WQSP-1 through WQSP-6A) that are located as shown on Figures 7-11 and MON-2. DOE is in the process of collecting background samples from these wells that will include at least four semi-annual sampling events. Ground water samples will be collected on an annual basis beginning after completion of the background (pre-operational) sampling. The ground water samples will be analyzed for specific radionuclides and chemical constituents as listed in Tables 7-9 and MON-4. DOE anticipates that the ground water surveillance program will continue for at least 30 years after closure of the WIPP to comply with the WIPP RCRA Permit.

Appendices MON.4.2 and GWMP provide a description of the proposed ground water monitoring network and a justification for its design. The CCA identifies the ground water monitoring wells to be monitored and describes the monitoring well design, the frequency of monitoring, the type and number of samples to be collected, and the constituents to be analyzed. The CCA also provides a description of the sampling equipment and techniques and quality assurance protocols to be followed during collection and shipment, as well as a description of how the data will be processed and evaluated to determine whether significant changes are occurring in the Culebra ground water composition, ground water level, or ground water flow direction; see Appendices MON.4.2.2.3 to MON.4.2.3.5.

DOE has been collecting baseline data on Culebra ground water levels and composition since 1985. The baseline information is provided in a report entitled "Background Water Quality Characterization Report for the Waste Isolation Pilot Plant" (DOE 1992).

Information regarding how the ground water monitoring results for the Non-Salado Hydrological Properties parameter would be used to evaluate deviations from the expected performance of the disposal system is located in Chapters 7.2.2.4.1 and 7.2.3.3. Chapter 7.2.2.4.1 states that Culebra ground water composition and Culebra changes in ground water flow will be evaluated to verify that they remain within the range of values assumed in model development and the PA. Should there be significant change outside the assumed range of values used in PA models, DOE will evaluate and, where appropriate, modify models for incorporation into the PA for recertification. Chapter 7.2.3.3 states that significant and persistent changes in the composition of Culebra ground water will be evaluated to establish impacts to the modeling assumptions for long-term performance, as found in Chapter 6.4.6.2. Water level changes that cannot be explained based on observed trends or past experience will be assessed relative to the assumptions made in the regional ground water flow model.

Observation of Drilling Activities and Castile Brine Reservoir Location

DOE developed the Delaware Basin drilling monitoring plan (Appendix DMP) to provide for pre-closure monitoring of the Castile brine reservoir location, drilling rate, and drilling practices parameters within the Delaware Basin. The plan focuses on the nine-township area that includes the WIPP site. DOE established a baseline database of drilling activity disposal system parameters during preparation of the CCA and included the baseline as Appendix DEL. The information contained in Appendix DEL was used to develop modeling assumptions for the PA. The plan relies upon records of drilling activities in the Delaware Basin from commercial sources and governmental agencies as well as actual field checks. The baseline database will be updated quarterly with information regarding activity in the nine-township area around the WIPP, and on an annual basis for the remaining portions of the Delaware Basin. The plan will be implemented no later than the beginning of the operational phase and will continue until 100 years after closure.

Information regarding how the results of drilling monitoring will be used to evaluate deviations from the expected performance of the disposal system is located in Chapters 7.2.2.4.1 and 7.2.3.4 and Appendix DMP. Monitoring results will be reported on an annual basis and summarized every five years for input into the recertification process. Data will be reviewed annually to evaluate whether the Castile brine reservoir encounters, Castile brine reservoir pressure, and drilling rate parameters are within the range of values assumed in model development and the PA. Should there be significant deviation from the assumed ranges in the PA models, DOE will evaluate and, where appropriate, modify models for incorporation into the PA for recertification.

Subsidence

Pre-closure monitoring for subsidence will be accomplished via the subsidence monitoring program described in Chapter 7.2.3.5, and Appendices MON.5, MON.6, and SMP. While subsidence is not a disposal system parameter identified in Table 7-2, nor is it evaluated as

significant to the containment of waste in the repository in Attachment MONPAR, Appendices MON.2 and MON.5 indicate that the post-closure monitoring program for the WIPP will include subsidence monitoring to evaluate long-term performance of the repository. Appendices MON.5 and SMP.2 indicate that subsidence predictions exist for the WIPP. Appendix SMP states that subsidence monitoring is a non-intrusive technique that can be related to numerical predictions to detect substantial and detrimental deviations from expected repository performance. Periodic subsidence surveys will provide data for review and analysis against predictions. Analysis of anomalies, if they do occur, may provide information regarding the conceptual models used to predict long-term repository performance. Chapter 7.2.2.4.1 states that in the event that subsidence values fall significantly outside the range of values predicted and experienced elsewhere in the Delaware Basin, DOE will conduct additional evaluation of potential effects of such deviations. If the evaluation requires changes to the models incorporated into the PA, these changes will be made and the revised models will be incorporated into the recertification PA.

Appendix SMP.2 describes the various calculations that have been conducted to predict potential subsidence at the WIPP site and Appendix SMP.3 describes the baseline surveys that have been conducted since 1977. The pre-closure subsidence monitoring will consist of Class I leveling surveys of approximately 50 benchmarks (Figure SMP-1). An initial Class I leveling survey was conducted in 1996 and the benchmarks will be resurveyed every ten years during the operational phase. It is anticipated that decontamination and decommissioning activities may damage or eliminate some survey benchmarks. After decontamination and decommissioning, the damaged/lost benchmarks will be replaced and another Class I leveling survey will be conducted to establish a new baseline using the adjusted network.

Appendix MON.6.1 and Appendix SMP describe the procedures, equipment, and quality assurance protocols that will be used to conduct subsidence monitoring. Maintenance and calibration of equipment used for subsidence monitoring is addressed in Appendix QAPD.2.4.4. The CCA states that measurements, maintenance, and calibration are performed by the equipment vendor in accordance with national standards. The subsidence monitoring program will not involve any intrusive activities, except for the very shallow excavations required to install benchmarks, and therefore will not jeopardize the containment of waste in the disposal system.

Environmental Monitoring

In addition to monitoring the previously mentioned parameters, DOE will conduct the environmental monitoring plan described in Appendix MON, Appendices MON.3.5 and MON.5, and Appendix EMP, in order to comply with the requirements of DOE Orders and the Agreement for Consultation and Cooperation between the State of New Mexico and DOE (DOE 1981).

The goal of the environmental monitoring program is to determine if the local ecosystem has been affected during the pre-disposal and disposal phases of the WIPP, primarily due to activities that occur at the ground surface. If a local ecosystem has been affected, the objective is to evaluate the severity, geographic extent, and environmental significance of the impacts. The radiological portion of the environmental monitoring plan includes environmental radiation analysis of liquid effluent and air emissions from the WIPP and sampling of surface water, ground water, sediments, soils, and biotics (vegetation, cattle/deer, quail, rabbits and fish). The non-

radiological environmental monitoring consists of meteorological monitoring, VOC monitoring, ground water surveillance, ecological monitoring plot selection, aerial photography, and wildlife ecology evaluation.

The environmental monitoring described in Appendix EMP will be conducted throughout the entire pre-closure period. The radiological portion of the environmental monitoring program will continue for a minimum of two years after decontamination and decommissioning is complete. The environmental monitoring program is not described further since the data collected will not provide information that can be related to specific disposal system parameters.

42.C.5 EPA COMPLIANCE REVIEW

EPA evaluated the information regarding pre-closure monitoring plans in Chapters 7.2.2 and 7.2.3 and various appendices for:

- ♦ A description of the parameters to be monitored and discussion of when monitoring will begin and end.
- ♦ A description of how the monitoring results will be used to evaluate performance of the disposal system.
- ♦ A detailed pre-closure monitoring plan.

Description of Parameters to be Monitored and When Monitoring Will Begin and End

The CCA describes the disposal system parameters to be monitored and identifies the corresponding time frames for monitoring. The CCA also describes monitoring to be conducted in accordance with applicable RCRA hazardous waste regulations and explains how monitoring techniques will not jeopardize the containment of waste in the disposal system.

The CCA identifies two mechanisms for obtaining data for creep closure: the geomechanical monitoring plan (p. 7-57) and the VOC confirmatory monitoring plan (p. 7-58). EPA noted that monitoring creep closure via the geomechanical monitoring plan is the most direct and useful way of obtaining data on creep closure. Although data on creep closure will be limited based on the amount of time the instruments remain functional in each panel, information will be available throughout the operational period as waste is emplaced in each panel. The VOC monitoring acts only as a secondary indicator of creep closure because there is not a direct relationship between VOC levels and creep closure rates. While VOC levels might indicate changes in creep closure rates, such changes would be observed earlier and would be better defined by direct geomechanical monitoring, which will be conducted throughout the operation of the WIPP. DOE stated that VOC monitoring will also provide data on gas producing processes (p. 7-58). DOE did not include gas producing processes as one of the parameters to be monitored, however, because the modeling of gas-producing processes is based on data and assumptions about long-term behavior that will not be applicable during the operational period (p. 7-36).

EPA agreed that VOC monitoring is not necessary as a secondary indicator of creep closure and is not necessary to fulfill the requirements of Section 194.42.

Description of How the Monitoring Results Will be Used to Evaluate Performance of the Disposal System

Chapters 7.2.2.4.1 and 7.2.3 and Appendix MON provide information on how the monitoring results for each parameter will be used to evaluate the performance of the disposal system. The CCA states that if the results of the monitoring programs identify significant deviations in expected values of the disposal system parameters from those ranges of values used in PA models, an evaluation will be made to determine whether the new information will be incorporated into the PA conducted for recertification. Parameter values outside of expected ranges will also prompt the evaluation of models to determine whether modifications are required for use in recertification PA activity.

The CCA states that subsidence monitoring will be conducted during the pre-closure phase and will be the primary post-closure monitoring activity. Appendix MON.5 and Appendix SMP.2 indicate that subsidence predictions exist for the WIPP and that subsidence monitoring results can be related to numerical predictions as a means of detecting substantial and detrimental deviations from expected repository performance by allowing a comparison of actual subsidence to that calculated numerically. Periodic subsidence surveys will provide data for review and analysis against predictions and will allow DOE to identify any data anomalies that might occur. Analysis of such anomalies, if they do occur, may provide information regarding the conceptual models used to predict long-term repository performance. Anomalous conditions would require further investigations by DOE to determine if the condition is detrimental to disposal system performance.

Detailed Pre-closure Monitoring Plans

Pre-closure monitoring plans are discussed in Chapter 7.2.2 and 7.2.3, Appendix MON, and Appendices GTMP, GWMP, VCMP, DMP, and SMP. Appendix MON and the CCA appendices explain the parameters to be monitored, how the baseline values will be established, the rationale for the design of the monitoring networks, and the procedures and equipment to be used to conduct the monitoring. Appendices WCL.1 and WCL.9 indicate that an inventory of curie content for the waste component radionuclides will be tracked. See the discussion of 194.24(c)(4) in **CARD 24—Waste Characterization** for more information about characterization of waste activity.

EPA did not evaluate the pre-closure environmental monitoring plan because it is not required by 40 CFR Part 194.

42.D.1 REQUIREMENT

(d) "Post-closure monitoring. The disposal system shall, to the extent practicable, be monitored as soon as practicable after the shafts of the disposal system are backfilled and sealed to detect substantial and detrimental deviations from expected performance and shall end when

the Department can demonstrate to the satisfaction of the Administrator that there are no significant concerns to be addressed by further monitoring. Post-closure monitoring shall be complementary to monitoring required pursuant to applicable federal hazardous waste regulations at Parts 264, 265, 268, and 270 of this chapter and shall be conducted with techniques that do not jeopardize the containment of waste in the disposal system."

(e) "Any compliance application shall include detailed pre-closure and post-closure monitoring plans for monitoring the performance of the disposal system. At a minimum, such plans shall:

(1) Identify the parameters that will be monitored and how baseline values will be determined;

(2) Indicate how each parameter will be used to evaluate any deviations from the expected performance of the disposal system; and

(3) Discuss the length of time over which each parameter will be monitored to detect deviations from expected performance."

42.D.2 ABSTRACT

Section 194.42(d) addresses the conduct of post-closure monitoring of the repository. Section 194.42(e) identifies the minimum required elements of both pre- and post-closure monitoring plans. This section of the CARD addresses only the details of the post-closure monitoring plan. The pre-closure monitoring plan required by 194.42(e) is addressed under the discussion of 194.42(c) above.

EPA requires a post-closure monitoring plan that is based on the analysis required by Section 194.42(a). The plan should identify: when monitoring will begin and end, monitoring techniques, baseline data, and how information obtained from monitoring will be used to evaluate the containment of waste or the predictions of the PA.

Based on the analysis required under Section 194.42(a), DOE developed a list of parameters for monitoring during the post-closure period. DOE presented monitoring plans that included monitoring techniques, baseline data, and data evaluations for each parameter or group of parameters. In addition, DOE established time frames for post-closure monitoring of each parameter or group of parameters.

EPA reviewed the list of post-closure parameters to verify that they were derived from the analysis presented for 194.42(a). EPA also reviewed the monitoring plans for appropriateness and compliance with standard monitoring techniques.

42.D.3 COMPLIANCE REVIEW CRITERIA

To fulfill the requirements of Section 194.42(d), DOE must present a plan for post-closure monitoring of the disposal facility based on the analysis conducted for Section 194.42(a). This

plan should clearly state the parameters to be monitored, and document how the monitoring will be effective to detect deviations from expected performance. In addition, DOE should identify the monitoring to be conducted in accordance with hazardous waste regulations, and describe how the post-closure monitoring is complementary to the hazardous waste regulations. Section 194.42(e) requires DOE to provide more detailed information about the post-closure monitoring plan, including a description of when the post-closure monitoring will occur, the manner in which each parameter will be monitored, information on baseline data, and data evaluation methods.

42.D.4 DOE METHODOLOGY AND CONCLUSIONS

The information supporting DOE's compliance with this requirement is located in Chapters 7.2.2 and 7.2.3 and Appendix MON of the CCA. Specific information regarding post-closure monitoring plans is located in Appendices GWMP, DMP, and SMP. Sections 42.A.5 and 42.B.4 of this CARD describe how DOE established the disposal system parameters to be monitored during the post-closure period.

Table 7-7 and Appendix MON, Table MON-5 of the CCA list the disposal system parameters to be monitored during the post-closure period. These parameters are Non-Salado Hydrological Parameters and Subsidence. Chapter 7.2 and Appendices MON.4 and MON.5 of the CCA discuss the monitoring programs for each of the parameters that advanced through the DOE screening process.

General information regarding how the monitoring results of each parameter will be used to evaluate the performance of the disposal system is provided in Chapter 7.2.2.4.1. The CCA states that if the results of the monitoring programs identify significant deviations in expected values of the disposal system parameters from those ranges of values used in PA models, DOE will conduct an evaluation to determine whether the new information should be incorporated into the PA conducted for recertification. Parameter values outside of expected ranges will also prompt an evaluation of models to determine whether modifications are required for use in a PA for purposes of recertification.

Non-Salado Hydrological Properties

Post-closure monitoring for the Culebra brine composition, Culebra well water level, and Culebra ground water flow direction disposal system parameters will be accomplished via the ground water surveillance program described in Chapter 7.2.3.3, Appendix MON.4.2 and Appendix GWMP. Post-closure monitoring for the Castile brine reservoir location and the drilling rate and drilling practices disposal system parameters will be accomplished by observing drilling activities described in Chapter 7.2.3.4, Appendix MON.5, and Appendix DMP.

Ground water Surveillance

DOE established the ground water surveillance program at the WIPP to address DOE Orders and commitments contained in the Final Environmental Impact Statement to conduct ground water monitoring. See discussion under Section 194.42(c) of this CARD.

Observation of Drilling Activities and Castile Brine Reservoir Location

DOE developed the Delaware Basin drilling monitoring plan to provide for post-closure monitoring of the Castile brine reservoir location, drilling rate, and drilling practices parameters within the Delaware Basin. See the discussion of Drilling Activities and Castile Brine Reservoir Location in Section 42.C.4 of this CARD.

Subsidence

Post-closure monitoring for subsidence will be accomplished via the subsidence monitoring program described Chapter 7.2.3.5, Appendix MON.5 and MON.6, and Appendix SMP. Although subsidence is not a disposal system parameter identified in Table 7-2, nor is it evaluated as significant to the containment of waste in the repository in Attachment MONPAR, Appendices MON.2 and MON.5 of the CCA state that the post-closure monitoring program for the WIPP will include subsidence monitoring to evaluate long-term performance of the repository. See the discussion of subsidence monitoring in Section 42.C.4 of this CARD.

Post-closure Environmental Monitoring

The environmental monitoring plan described in Appendices MON.3.5 and MON.5 and Appendix EMP will be conducted to comply with the requirements of DOE Orders and the Agreement for Consultation and Cooperation between the State of New Mexico and DOE (DOE 1981).

The radiological portion of the environmental monitoring program will continue for a minimum of two years after decontamination and decommissioning is complete. In addition, post-closure environmental monitoring will include the collection of four annual surface soil and four annual surface water samples for 5 years after decontamination and decommissioning, as required by the Agreement for Consultation and Cooperation (DOE 1981).

42.D.5 EPA COMPLIANCE REVIEW

EPA evaluated the information regarding post-closure monitoring and the monitoring plans in Chapters 7.2.2 and 7.2.3 and related appendices. The CCA's descriptions of the monitoring programs were adequate to show that DOE provided the information required by 194.42 (d) and (e).

Description of Parameters to be Monitored and When Monitoring Will Begin and End

The CCA describes the disposal system parameters to be monitored and identifies the corresponding time frames for monitoring. EPA found that DOE's proposed post-closure monitoring activities are complementary to the hazardous waste regulations and will not jeopardize the containment of waste in the disposal system.

Description of How the Monitoring Results Will be Used to Evaluate Performance of the Disposal System

Chapter 7.2.2.4.1 and 7.2.3 and Appendix MON provide information on how the monitoring results of each parameter will be used to evaluate the performance of the disposal system. The CCA states that if the results of the monitoring programs identify significant deviations in expected values of the disposal system parameters from those ranges of values used in PA models, an evaluation will be made to determine whether the new information will be incorporated into the PA conducted for recertification. Parameter values outside of expected ranges will also prompt the evaluation of models to determine whether modifications are required for use in recertification PA activity.

The CCA states that subsidence monitoring will be the primary post-closure monitoring activity. Appendices MON.5 and SMP.2 state that subsidence predictions exist for the WIPP and that subsidence monitoring results can be related to numerical predictions as a means of detecting substantial and detrimental deviations from expected repository performance, by allowing a comparison of actual subsidence to that calculated numerically. Periodic subsidence surveys will provide data for review and analysis against predictions and will allow DOE to identify any data anomalies that might occur. Analysis of such anomalies, if they do occur, may provide information regarding the conceptual models used to predict long-term repository performance. Anomalous conditions would require further investigations by DOE to determine if the condition is detrimental to disposal system performance.

42.E REFERENCES

DOE 1980. U.S. Department of Energy. Final Environmental Impact Statement, Waste Isolation Pilot Plant, Vols. 1 and 2, DOE/EIS-0026. 1980. (CCA Reference #178)

DOE 1981. U.S. Department of Energy and State of New Mexico. Consultation and Cooperation Agreement. 1981. (CCA Reference #212)

DOE 1992. U.S. Department of Energy. Background Water Quality Characterization Report for the Waste Isolation Pilot Plant, DOE-WIPP 92-013. 1992. (CCA Reference #190)

DOE 1994. Westinghouse Electric Corp. Backfill Engineering Analysis Report. 1994. (CCA Reference #684)

DOE 1996. U.S. Department of Energy. RCRA Part B Permit Application, Revision 6, DOE/WIPP 91-005. April 1996.