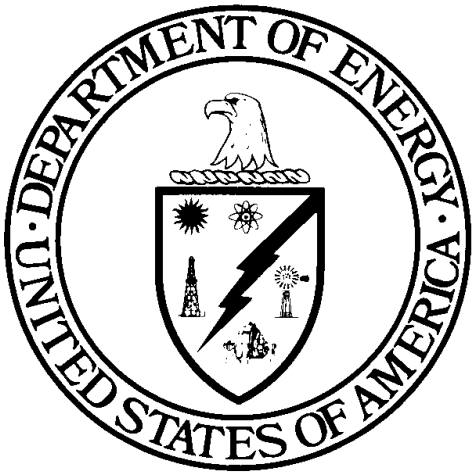
Title 40 CFR Part 191
Subparts B and C
Compliance Recertification Application 2014
for the
Waste Isolation Pilot Plant

Content of Compliance
Recertification Application(s)
(40 CFR § 194.15)



United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

Compliance Recertification Application 2014
Content of Compliance Recertification Application(s) (40 CFR § 194.15)

Table of Contents

15.0 Content of Compliance Recertification Application(s) (40 CFR § 194.15) 15-1
15.1 Requirements 15-1
15.2 Background 15-1
15.3 1998 Certification Decision 15-2
15.4 Changes in the CRA-2004 15-2
15.5 EPA's Evaluation of Compliance for the 2004 Recertification 15-2
15.6 Changes or New Information Between the CRA-2004 and the CRA-2009 (Previously: Changes or New Information Since the 2004 Recertification) 15-2
15.7 EPA's Evaluation of Compliance for the 2009 Recertification 15-3
15.8 Changes or New Information Since the CRA-2009 15-3
15.8.1 40 CFR § 194.15(a)(1) 15-5
15.8.1.1 Geologic Information 15-5
15.8.1.2 Geophysical Information 15-5
15.8.1.3 Geochemical Information 15-6
15.8.1.4 Hydrologic Information 15-7
15.8.1.5 Meteorological Information 15-7
15.8.2 40 CFR § 194.15(a)(2) 15-12
15.8.3 40 CFR § 194.15(a)(3) 15-12
15.8.3.1 WIPP Repository Conditions, Chemistry, and Processes 15-13
15.8.3.2 Waste Shear Strength Experiments 15-13
15.8.3.3 MgO Studies and Characterization 15-13
15.8.3.4 Actinide Investigations 15-14
15.8.3.5 Iron and Lead Corrosion Experiments 15-14
15.8.4 40 CFR § 194.15(a)(4) 15-14
15.8.4.1 Status of Underground Excavation 15-14
15.8.4.2 Remote-Handled Transuranic Waste Emplacement 15-15
15.8.4.3 Proposed RH-TRU Waste Container Modifications 15-17
15.8.4.4 Neutrino Experiments in the WIPP Underground Repository 15-17
15.8.4.5 Planned Change Notice Submittals 15-18
15.8.4.6 Planned Change Request Submittals 15-19
15.8.5 40 CFR § 194.15(a)(5) 15-20
15.8.5.1 Status of Waste Emplacement 15-20
15.8.5.2 Waste Characteristics and Components Important to Demonstration of Compliance 15-20
15.8.6 40 CFR § 194.15(a)(6) 15-21
15.8.7 40 CFR § 194.15(a)(7) 15-21
15.8.8 40 CFR § 194.15(b) 15-21
15.8.9 Status of Compliance with 40 CFR § 194.15 15-21
15.9 References 15-21

List of Figures

Figure 15-1. Monthly Average, Maximum, and Minimum Precipitation for the WIPP Site, 1990-2011* 15-9
Figure 15-2. 2007 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site* 15-10
Figure 15-3. 2008 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site* 15-10
Figure 15-4. 2009 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site* 15-11
Figure 15-5. 2010 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site* 15-11
Figure 15-6. 2011 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site* 15-12
Figure 15-7. Status of Mining and Waste Emplacement as of December 31, 2012 15-16

List of Tables

Table 15-1. Routine Reports 15-4
Table 15-2. Seismic Events in the Delaware Basin* 15-6
Table 15-3. Annual Average, Maximum, and Minimum Temperatures* 15-8

Acronyms and Abbreviations

ASER	Annual Site Environmental Report
ATWIR	Annual Transuranic Waste Inventory Report
CARD	Compliance Application Review Document
CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CH	contact-handled
COMP	compliance monitoring parameter
CRA	Compliance Recertification Application
DM	dark matter
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EXO	Enriched Xenon Observatory
ft	foot/feet
km	kilometer
LBRE	Low Background Radiation Experiment
LWA	Land Withdrawal Act
m	meter(s)
MEGA	Multiple Element Germanium Array
mi	mile
PA	performance assessment
PCN	Planned Change Notice
PCR	Planned Change Request
RH	remote-handled
SEGA	Segmented Enriched Germanium Assembly
SDDI	Salt Defense Disposal Investigations
SDI	Salt Disposal Investigations
TPC	Time Projection Chamber
TRU	transuranic
WIPP	Waste Isolation Pilot Plant

Elements and Chemical Compounds

Am	americium
MgO	magnesium oxide
Nd	neodymium
Pu	plutonium
U	uranium

15.0 Content of Compliance Recertification Application(s) (40 CFR § 194.15)

15.1 Requirements

§ 194.15 Content of Compliance Recertification Application(s)

(a) In submitting documentation of continued compliance pursuant to section 8(f) of the WIPP LWA, the previous compliance application shall be updated to provide sufficient information for the Administrator to determine whether or not the WIPP continues to be in compliance with the disposal regulations. Updated documentation shall include:

(1) All additional geologic, geophysical, geochemical, hydrologic, and meteorological information;

(2) All additional monitoring data, analyses and results;

(3) All additional analyses and results of laboratory experiments conducted by the Department or its contractors as part of the WIPP program;

(4) An identification of any activities or assumptions that deviate from the most recent compliance application;

(5) A description of all waste emplaced in the disposal systems since the most recent compliance certification or re-certification application. Such description shall consist of a description of the waste characteristics and waste components identified in § 194.24(b)(1) and § 194.24(b)(2);

(6) Any significant information not previously included in a compliance certification or re-certification application related to whether the disposal system continues to be in compliance with the disposal regulations; and

(7) Any additional information requested by the Administrator or the Administrator's authorized representative.

(b) To the extent that information required for a re-certification of compliance remains valid and has been submitted in previous certification or re-certification applications(s), such information need not be duplicated in subsequent applications; such information may be summarized and referenced.

15.2 Background

Information documented in each Compliance Recertification Application (CRA) is prescribed in 40 CFR § 194.15 (U.S. EPA 1996). These documentation requirements parallel the requirements of 40 CFR § 194.14 (U.S. EPA 1996), which apply to the original application, the Compliance Certification Application (CCA) (U.S. DOE 1996). The focus of section 194.15 is to ensure that each CRA includes documentation regarding any changes to the disposal system that may have occurred since the previous certification or recertification. Updated information regarding relevant aspects of the waste and the disposal system is documented. However, in cases where information and assumptions have not changed, no new information needs to be documented; a CRA may reference or summarize such unchanged information.

Each CRA must identify relevant systems and program changes implemented during the preceding five-year period. Any activity or assumption that deviates from what was described in the most recent recertification application would be considered a change. Each CRA also documents changes reviewed and approved by the U.S. Environmental Protection Agency (EPA) in the preceding five-year period (through modification of the certification or other processes). Each CRA documents instances where new baseline program elements were established as a result of changes.

15.3 1998 Certification Decision

The CCA, Chapters 2.0 and 3.0 and Appendices GCR, HYDRO, and MASS, include general information about the Waste Isolation Pilot Plant (WIPP) site and disposal system design and specifically support section 194.14. Other site characteristics, design, location, and construction information is primarily provided in the CCA, Chapter 7.0 and Appendices BACK, DEL, PCS, and SEAL, which also specifically support section 194.14. All other chapters and appendices of the CCA are not specifically relevant to section 194.14. After its review, the EPA concluded that the U.S. Department of Energy (DOE) adequately addressed the geology, geophysics, hydrogeology, hydrology, meteorology, climatology, and effects of waste and geochemistry of the disposal system and its vicinity, and how these conditions are expected to change and interact over the regulatory time frame (Compliance Application Review Document [CARD] 14, U.S. EPA 1998a). The EPA reviewed the DOE's CCA and additional information submitted by the DOE and determined that the DOE complied with each of the criteria of section 194.14. A complete description of the EPA's 1998 Certification Decision for section 194.14 can be found in U.S. EPA 1998b, as well as CARD 14 (U.S. EPA 1998a).

15.4 Changes in the CRA-2004

Baseline documentation for section 194.14 was established at the time of the original EPA certification. Information on changes to section 194.14 topics that occurred since the original certification is required to be documented by section 194.15. Changes that occurred during the five-year period following the original certification are documented in the CRA-2004 (U.S. DOE 2004), which was submitted by the DOE and reviewed by the EPA under the requirements of section 194.15.

During public review of the CRA-2004, the EPA received comments regarding karst features, vertical fracturing, and transport through the Magenta Dolomite Member. The EPA assessed these comments and concluded that the DOE has demonstrated continued compliance. The EPA responses to comments on the CRA-2004 are documented in CARD 14/15, Appendix 15-A (U.S. EPA 2006a).

15.5 EPA's Evaluation of Compliance for the 2004 Recertification

Based on a review and evaluation of the CRA-2004 and supplemental information provided by the DOE (available for review in EPA Docket A-98-49), the EPA determined that the DOE continued to comply with the disposal standards (U.S. EPA 2006b).

15.6 Changes or New Information Between the CRA-2004 and the CRA-2009 (Previously: Changes or New Information Since the 2004 Recertification)

Baseline documentation for section 194.14 was established at the time of the original EPA certification. Information on changes to section 194.14 topics that occurred since the CCA was documented in the CRA-2004 (U.S. DOE 2004). Changes that occurred during the five-year period following the CRA-2004 were documented in Section 15 of the CRA-2009 (U.S. DOE

2009a), which was submitted by the DOE and reviewed by the EPA under the requirements of 40 CFR 194.15.

The EPA provided opportunities for public comment throughout the recertification process. Public comments received during the CRA-2009 public comment period, along with the EPA's responses, are documented in CARD 14/15, Appendix 15-C (U.S. EPA 2010a). The EPA responses to hydrologic comments are documented in CARD 14/15, Appendix 15-B (U.S. EPA 2010a).

15.7 EPA's Evaluation of Compliance for the 2009 Recertification

Based on a review and evaluation of the CRA-2009 and supplemental information provided by the DOE (available for review in Federal Document Management System Docket ID No EPA-HQ-OAR-2009-0330, Air Docket A-98-49) the EPA determined that the DOE continued to comply with the disposal standards (U.S. EPA 2010b). The EPA assessed all of the public comments received and concluded that the DOE demonstrated continued compliance.

15.8 Changes or New Information Since the CRA-2009

To document that the WIPP continues to comply with the disposal standards in each five-year recertification cycle, changes and new information and their impacts on compliance since the previous recertification must be described. Changes and new information since the CRA-2009 related to 40 CFR 194.15 are either described below, or references are provided to other sections or appendices of the CRA-2014 that provide the necessary information.

Much of the information provided in this section was obtained from routinely published reports. Table 15-1 lists these reports and summarizes the type of information contained in each report. The specific reports referenced in Table 15-1 are the latest annual or biennial versions submitted to the EPA or published for the EPA's review before this CRA's cutoff date of December 31, 2012.

Table 15-1. Routine Reports

Description	Summary	Frequency	Reference[a]
WIPP Annual Site Environmental Report (ASER)	Describes compliance status with applicable environmental laws and regulations and environmental monitoring performed during the year at the WIPP. Highlights any significant monitoring results or findings.	Annual	U.S. DOE 2012a
Geotechnical Analysis Report	Reports data related to the geotechnical performance of the various underground facility components, including the shafts, shaft stations, access drifts, and waste disposal areas. Volume 1 describes the overall program; Volume 2 provides a compilation of the collected data.	Annual	U.S. DOE 2012b
Annual Change Report	Provides information each year on any change in conditions or activities related to the disposal system, as required by 40 CFR § 194.4(b)(4)[b]. The majority of the items reported are inspections, reports, and modifications to written plans and procedures. In addition, the Annual Change Report provides updates on waste volumes of several parameters and radionuclides upon which the EPA imposes limits.	Annual	U.S. DOE 2012c
Delaware Basin Monitoring Annual Report	Lists changes in drilling including rates for shallow and deep drilling; pipeline activity; borehole plugging; injection wells; potash, sulfur, and solution mining; and any other new activity related primarily to human intrusion. This report generates data needed to demonstrate compliance with 40 CFR 194.33.	Annual	U.S. DOE 2012d
Compliance Monitoring Parameter (COMP) Assessment	The DOE uses Performance Assessment (PA) to simulate the expected long-term performance of the WIPP. COMPs are used to indicate conditions that are not within expected PA data ranges or conceptual model assumptions, and to alert the project to unexpected conditions. These assessments, in part, demonstrate compliance with 40 CFR 194.42 monitoring requirements. Examples of COMPs include waste activity, changes in groundwater conditions, and creep closure rate.	Annual	Sandia National Laboratories 2012
WIPP Subsidence Monument Leveling Survey	Includes determination of the elevation of each of the existing subsidence monuments and the WIPP baseline survey, and of the National Geodetic Survey's vertical control points.	Annual	U.S. DOE 2012e
Annual Transuranic Waste Inventory Report (ATWIR)	Documents the total inventory (stored and projected) of transuranic (TRU) waste as defined by the TRU waste sites to provide current TRU waste inventory information.	Annual	U.S. DOE 2012f
WIPP Biennial Environmental Compliance Report	As required by the WIPP Land Withdrawal Act (LWA), this document reports the status of the project's compliance with a variety of environmental protection laws and regulations.	Biennial	U.S. DOE 2012g

[a]The entry in this column is the most recent report available.
[b]U.S. EPA 1996

1

15.8.1 40 CFR § 194.15(a)(1)

40 CFR § 194.15(a)(1) requires the submittal of "all additional geologic, geophysical, geochemical, hydrologic, and meteorological information." Information related to this requirement is provided in Sections 15.8.1.1 through 15.8.1.5.

15.8.1.1 Geologic Information

Since the preparation of the CRA-2009, no new geologic mapping has been reported and no new WIPP monitoring wells have been drilled at new locations. Existing WIPP monitoring wells in deteriorated condition have been replaced and/or plugged and abandoned, as discussed in Appendix HYDRO-2014. The information collected during drilling of replacement wells did not provide new geologic information. In 2011, two exploratory potash boreholes were drilled by The Mosaic Company in township 22S range 31E sections 9 and 10 immediately north of the WIPP Land Withdrawal Boundary. The cuttings and geophysical logs collected from these boreholes (MOS-20 and MOS-21) confirmed the stratigraphy of the geologic units above the Salado Formation, as observed in nearby monitoring wells.

15.8.1.2 Geophysical Information

As described in Appendix SCR-2014, the DOE continues to screen out the impacts of all tectonic-, magmatic-, and structural-related geophysical processes on the basis of probability and/or consequence. Tectonic activity was used as the siting criterion and for the purposes of determining seismic design parameters for the facility. The intent was to avoid tectonic conditions such as faulting and igneous activity that would jeopardize waste isolation over the long term and to avoid areas where earthquake size and frequency could impact facility design and operations.

The purpose of continued monitoring of seismic activity is to maintain a database from which to trend ground motions that the WIPP repository may be subjected to in the near and distant future. The concern about seismic effects in the near future, i.e., during the operational period, pertains mainly to the design requirements for surface and underground structures for providing containment during seismic events. The concern about effects occurring over the long term, after the repository has been decommissioned and sealed, pertains more to relative motions (faulting) within the repository and possible effects of faulting on the integrity of the salt beds and/or shaft seals.

During the CRA-2014 monitoring period (October 2007 through December 2012) there were 543 seismic events recorded within approximately 300 kilometers (km) (187 miles (mi)) of the WIPP site. One notable seismic event occurred on March 18, 2012, with a magnitude of 2.4, as recorded by the WIPP's seismic array. This seismic event was associated with a potash mine roof fall that caused cracks and subsidence on the surface. This seismic event occurred 14 km (9 mi) from the WIPP site, and caused no observable damage at the WIPP.

The Delaware Basin Drilling Surveillance Program collects seismic information on areas within and outside of the Delaware Basin (defined in 40 CFR 194.2). However, only the Delaware Basin is used as the defining area for data collection and input into PAs. Recorded events that

have occurred within the Delaware Basin between 1971 and December 2012 are listed in Table 15-2, Seismic Events in the Delaware Basin.

Earthquake catalogs are usually divided into categories according to the magnitude registered for each event. Most catalogs have a section detailing seismic events with a magnitude greater than 3.0 because this is the point at which most seismic events can be felt. Below the magnitude of 3.0, most events are very seldom or barely felt. Only 62 seismic events have been reported with a magnitude greater than 3.0 within 300 km (187 mi) of the WIPP site. Of these 62 events, only four have occurred in the Delaware Basin. The closest seismic event with a magnitude of 3.2 occurred on October 19, 1997, 14 km (9 mi) from the WIPP site, and was the result of a roof fall in one of the local potash mines.

Table 15-2. Seismic Events in the Delaware Basin*

County	No. of Events	Earliest Event	Latest Event	Smallest Magnitude	Largest Magnitude
Culberson	15	10/27/1992	06/28/2007	1.1	2.4
Eddy	19	11/28/1975	03/18/2012	-1.3	3.7
Lea	1	06/23/1993	06/23/1993	2.1	2.1
Loving	3	02/04/1976	04/28/1997	1.1	1.6
Pecos	19	01/30/1975	03/10/2010	1.0	2.6
Reeves	21	02/19/1976	10/09/2012	0.6	2.4
Ward	50	09/03/1976	07/01/2009	0.3	2.8
Winkler	9	09/24/1971	10/19/2007	0.0	3.0

Key:
Magnitude
Less than 2 Very seldom felt
2.0 to 3.4 Barely felt
3.5 to 4.2 Felt as a rumble
4.3 to 4.9 Shakes furniture; objects may fall and break
5.0 to 5.9 Dislodges heavy objects; cracks walls
6.0 to 6.9 Considerable damage to buildings
7.0 to 7.3 Major damage to buildings; breaks underground pipes
7.4 to 7.9 Great damage; destroys masonry and frame buildings
Above 8.0 Complete destruction; ground moves in waves
*Source: seismic events for calendar years 1990 through 2012 compiled from (U.S. DOE 2008a; U.S. DOE 2009b; U.S. DOE 2010a; U.S. DOE 2011a; U.S. DOE 2012d).

15.8.1.3 Geochemical Information

New hydrogeochemical information has been collected and summarized since the CRA-2009. This new information is described in detail by Domski et al. (Domski et al.2011) and in Appendix HYDRO-2014. Groundwater sampling for the geochemical evaluation has been performed in replacement wells and selected older wells. The last major geochemical evaluation of the Culebra Dolomite Member groundwater was performed by Domski and Beauheim (Domski and Beauheim 2008) based on samples from 59 wells. The more recent Culebra analyses in Domski et al. (Domski et al.2011) are an update of Domski and Beauheim (Domski and Beauheim 2008). Domski et al. (Domski et al.2011) provides some updated Culebra

information, confirming the distribution of Culebra geochemical facies, and primarily contains geochemical analysis for the other hydrologic units above the Salado Formation present near the WIPP site. The spatial distribution of these facies is consistent with the locations of the Rustler Formation halite margins, the distribution of transmissivity in the Culebra, and the areas of known or suspected recharge to the Culebra.

15.8.1.4 Hydrologic Information

No new monitoring well locations have been added to the WIPP monitoring network since the CRA-2009, but several old monitoring wells have either been plugged and abandoned or plugged, abandoned and replaced. Updated hydrologic data and well construction and replacement information are provided in Appendix HYDRO-2014. Appendix HYDRO-2014 describes the new information collected since 2007; a brief summary is provided below.

The Culebra monitoring network optimization study was revised (Kuhlman 2010) to identify locations where new Culebra monitoring wells would be of greatest value and to identify wells that could be removed from the network with little loss of information. Details are provided in Appendix HYDRO-2014, Section 9.0.

The WIPP groundwater monitoring program has continued monthly water-level measurements with continuous (nominally hourly) fluid-pressure measurements using downhole pressure gauges in all Culebra wells except for the Water Quality Sampling Program wells. Continuous monitoring now also includes Magenta, Bell Canyon Formation, and Santa Rosa Formation/Dewey Lake Redbeds Formation wells. The high-frequency monitoring network continues to provide information about the temporal fluctuations of water levels in the Culebra, due to both natural and human-caused events. Details regarding the WIPP groundwater monitoring activities are described in Appendix HYDRO-2014, Section 7.0.

15.8.1.5 Meteorological Information

The Meteorological Monitoring Program measures atmospheric data for the WIPP site. This section provides a brief description of the program and updated meteorological data covering the years 2007 through 2011. No anomalous weather events or changes in climatic conditions occurred during that time period. Information related to recent meteorological conditions is provided below.

The annual average, maximum, and minimum temperatures from 1990 through 2011 are listed in Table 15-3.

1 **Table 15-3. Annual Average, Maximum, and Minimum Temperatures***

Year	Annual Average Temperature		Maximum Temperature		Minimum Temperature	
	(ºC)	(ºF)	(ºC)	(ºF)	(ºC)	(ºF)
1990	17.8	64.0	46.1	115.0	-13.9	7.0
1991	17.2	63.0	42.8	109.0	-7.8	18.0
1992	17.2	63.0	42.8	109.0	-10.0	14.0
1993	17.8	64.0	42.8	109.0	-18.9	-2.0
1994	17.8	64.0	50.0	122.0	-14.4	6.0
1995	17.0	63.0	42.0	107.0	-7.0	19.0
1996	17.0	63.0	41.0	106.0	-7.0	19.0
1997	16.3	61.4	38.6	101.5	-11.4	11.4
1998	18.3	64.9	41.6	106.9	-10.8	12.6
1999	18.1	64.6	40.9	105.6	-7.9	17.8
2000	17.4	63.3	40.2	104.4	-6.8	19.7
2001	17.5	63.5	39.5	103.2	-7.8	18.0
2002	17.2	62.3	40.8	105.5	-10.4	13.3
2003	18.1	64.6	39.2	102.7	-9.1	15.6
2004	16.8	62.2	38.6	101.5	-12.0	10.4
2005	16.8	62.2	39.8	103.6	-13.0	8.6
2006	18.3	65.0	39.6	103.3	-6.0	21.1
2007	17.0	62.7	38.8	101.9	-6.9	19.6
2008	17.7	63.8	40.6	105.0	-8.6	16.6
2009	17.7	63.8	38.1	100.6	-6.1	21.1
2010	17.3	63.2	41.3	106.3	-8.0	17.7
2011	18.9	66.0	41.7	107.0	-16.6	2.1
Average	17.5	63.5	41.2	106.2	-10.0	13.9

*Source: monthly average based on meteorological data in the WIPP Met database from the WIPP Meteorological Station, 10 meters above the ground.

2

Monthly average, maximum, and minimum precipitation data recorded at the WIPP site from 1990 through 2011 are provided in Figure 15-1. Data are from the WIPP ASERs.

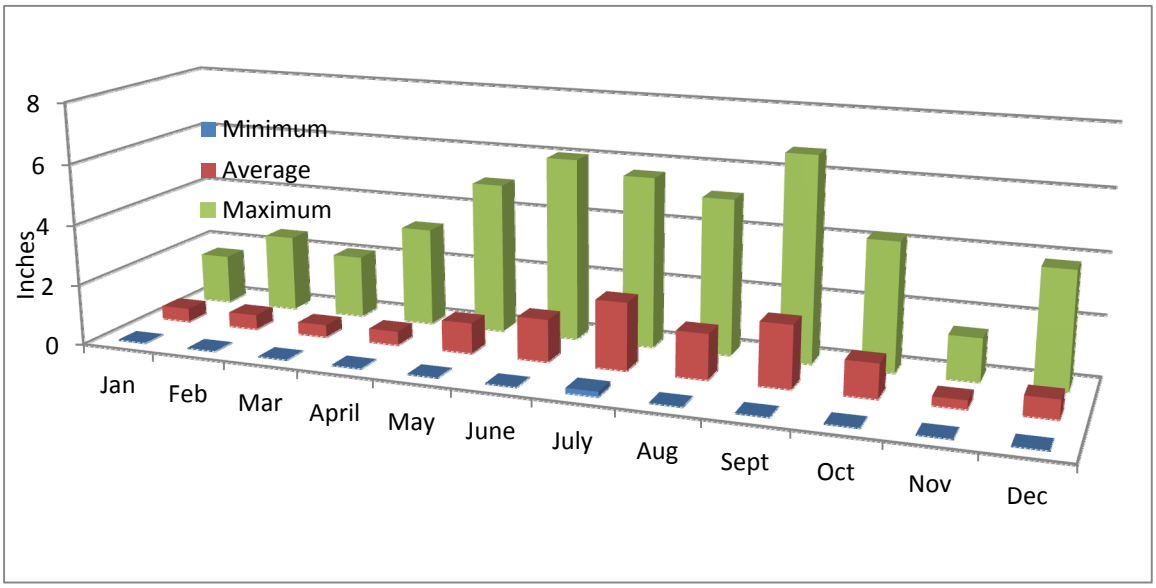


Figure 15-1. Monthly Average, Maximum, and Minimum Precipitation for the WIPP Site, 1990-2011*

*Source: precipitation data for calendar years 1990 through 2011 compiled from (U.S. DOE 2008b; U.S. DOE 2009c; U.S. DOE 2010b; U.S. DOE 2011b; U.S. DOE 2012a).

Wind rose plots at 10 meters (m) (33 feet [ft]) indicating the frequency of wind speeds and directions at the WIPP site from 2007 through 2011 are provided as Figure 15-2, Figure 15-3, Figure 15-4, Figure 15-5 and Figure 15-6. Data are from the WIPP ASERs.

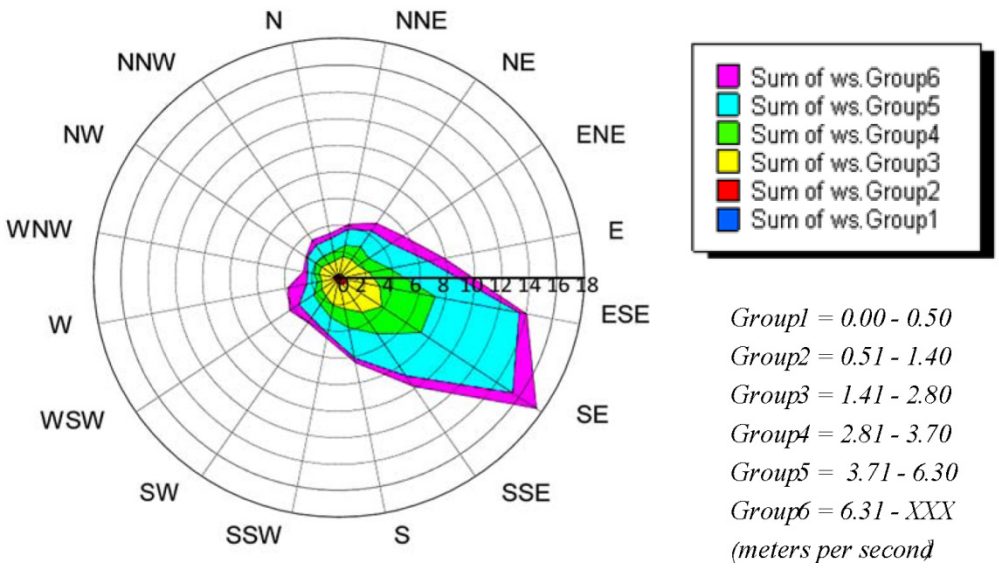


Figure 15-2. 2007 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site*

*Source: U.S. DOE 2008b

1

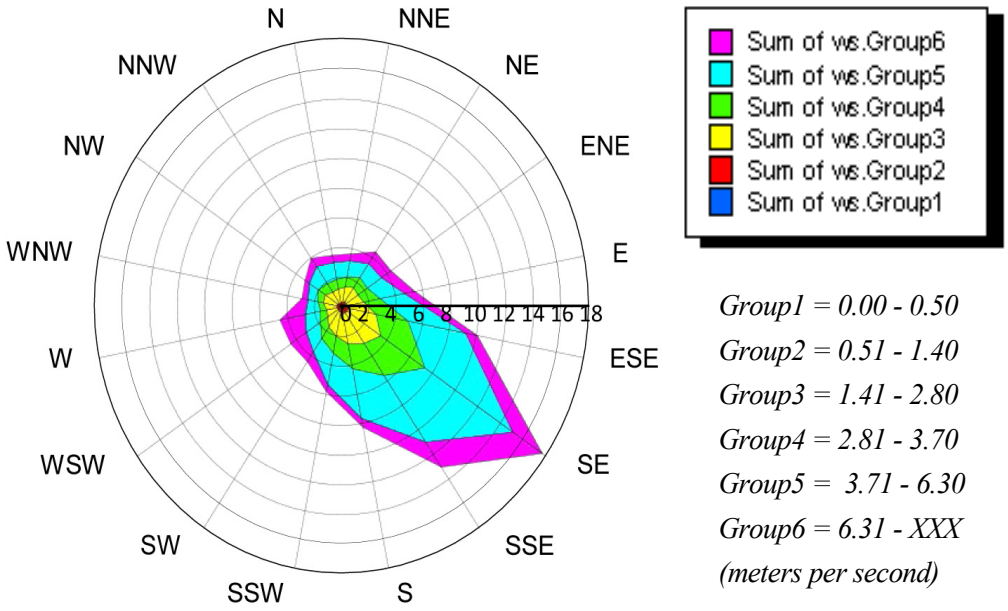


Figure 15-3. 2008 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site*

*Source: U.S. DOE 2009c

2

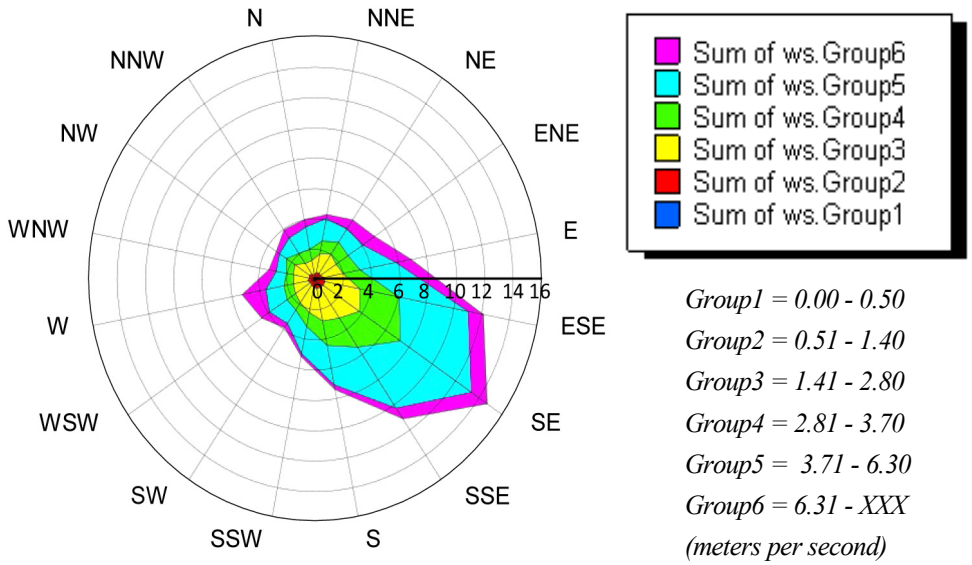


Figure 15-4. 2009 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site*

*Source: U.S. DOE 2010b

1

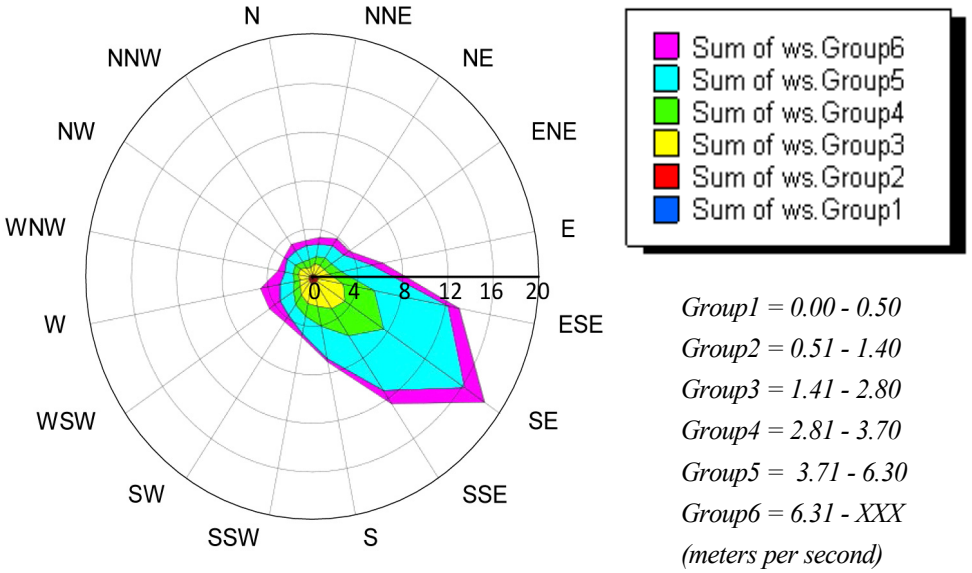


Figure 15-5. 2010 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site*

*Source: U.S. DOE 2011b

2

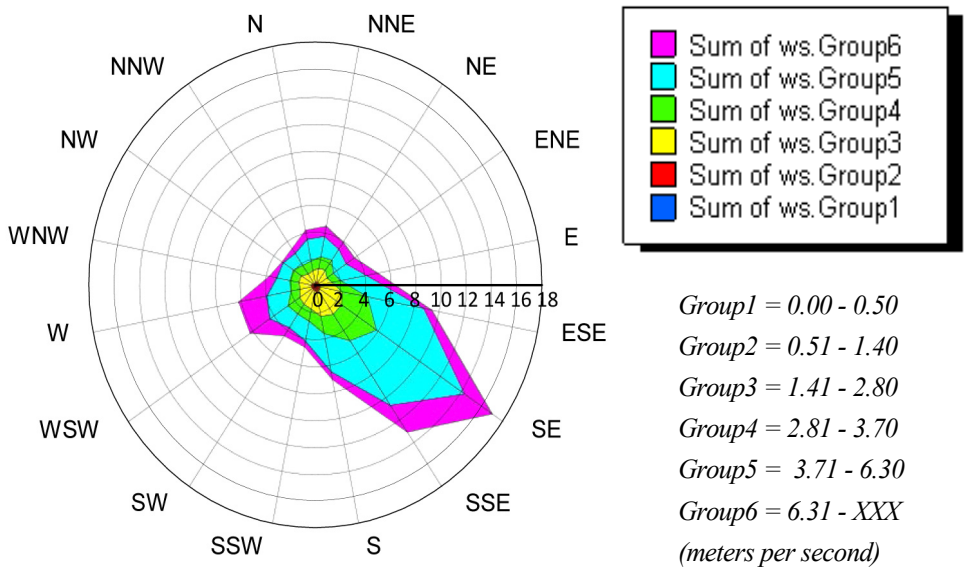


Figure 15-6. 2011 Annual Wind Rose at 10-m (33-ft) Height at the WIPP Site*

*Source: U.S. DOE 2012a

15.8.2 40 CFR § 194.15(a)(2)

40 CFR § 194.15(a)(2) requires the submittal of "all additional monitoring data, analyses, and results." Information related to this requirement is provided below.

The DOE has implemented and/or continued several experimental activities designed to address specific issues and needs of the WIPP repository. In addition, other investigations were initiated to examine the impacts of planned changes.

Environmental monitoring programs and references to relevant reports are included in Appendix MON-2014 and Appendix DATA-2014. Data on parameters required for pre-closure and post-closure monitoring, including programs for geotechnical and geoscience monitoring, are described in Appendix MON-2014, which focuses on parameters that may be relevant to the long-term performance of the repository. Appendix DATA-2014, Sections DATA-2.0 and DATA-3.0, describe the data collection procedures and reference the reports related to parameters in the Delaware Basin, including drilling rates, oil and gas production activities, and subsidence monitoring. Appendix DATA-2014, Attachment A, WIPP Borehole Update, provides an updated list of boreholes in the vicinity of the WIPP.

15.8.3 40 CFR § 194.15(a)(3)

40 CFR § 194.15(a)(3) requires the submittal of "all additional analyses and results of laboratory experiments conducted by the Department or its contractors as part of the WIPP program." Sections 15.8.3.1 through 15.8.3.5 describe experimental work conducted since the CRA-2009 in

the areas of WIPP repository conditions and parameters, waste shear strength experiments, magnesium oxide (MgO) characterization and chemistry, actinide studies, and iron and lead corrosion experiments.

15.8.3.1 WIPP Repository Conditions, Chemistry, and Processes

There were no significant changes in the WIPP repository conditions, chemistry assumptions, or subsurface processes used in PA to establish compliance since the CRA-2009. Appendix DATA-2014, Section DATA-9.0 provides references that describe waste shear strength experiments, actinide chemistry experiments, and iron and lead corrosion experiments and their results with respect to the impact on PA that occurred after the CRA-2009. A detailed description of the current conditions and assumptions used in PA is provided in Appendix MASS-2014.

15.8.3.2 Waste Shear Strength Experiments

The limits of the range of values for the hydrodynamic waste shear strength have been debated since the Cuttings model was introduced in 1992 (Berglund 1992). Since the Performance Assessment Verification Test, the lower limit has been based on a literature review and the upper limit based on a waste particle size analysis, both being chosen based on a lack of experimental results on a suitable surrogate waste material. (Hansen et al. 1997) developed a surrogate material believed to represent an extreme state of degradation, far weaker than any possible future state of the waste, and used this material to develop the material parameter values used in the Spallings model. The DOE again used this material for a series of tests in a vertical flume to assess the lower limit of the waste shear strength. Based on experimental results that realistically simulate the effect of a drilling intrusion using an accepted surrogate waste material, the DOE proposed that the waste shear strength parameter values have a range of 2.22 – 77.0 Pascals and a uniform distribution (Herrick et al. 2012; Herrick and Kirchner 2013). This range and distribution type is used in CRA-2014.

15.8.3.3 MgO Studies and Characterization

On July 10, 2007, the DOE submitted a letter in response to the EPA's questions pertaining to the efficacy of the MgO supplied to the WIPP (Patterson 2007). The letter included documents which demonstrate the stability of the MgO product in terms of both the stability of the feedstock and of the statistical data on the composition of the product. On February 11, 2008, the EPA approved the DOE's Planned Change Request (PCR) to reduce the safety factor from 1.67 to 1.2 with two conditions: 1) the DOE must continue to calculate and track both the carbon disposed and the required MgO needed on a room-by-room basis; and 2) the DOE must annually verify the reactivity of MgO and ensure that it is maintained at 94% or greater as assumed in supporting documentation (Reyes 2008).

On March 16, 2009, the DOE submitted a notification to the EPA of implementation of the 1.2 excess factor for MgO emplacement and verification of 94% or greater reactivity (Patterson 2009). A description of the change in MgO emplacement is given in CRA-2014, Engineered Barriers, Section 44.8.1. The DOE continues to implement the 1.2 excess factor of MgO on a

room-by-room basis and to ensure the MgO emplaced in the WIPP has a minimum reactivity of 94%.

15.8.3.4 Actinide Investigations

Experimental investigations to establish the speciation and solubility of actinides under WIPP-related conditions were reinitiated after the CRA-2004 and have continued through the CRA-2014. These investigations initially focused on three areas: (1) the solubility of neodymium, Nd (III), as an analogue for the plutonium, Pu (III), and americium, Am (III), oxidation states, in simulated WIPP brine; (2) the reduction of higher valent Pu (V/VI) by iron to form lower-solubility Pu (III/IV) phases; and (3) the solubility of uranium, U (VI), in carbonate-free WIPP brine. Since the CRA-2009, this has expanded to include various aspects of actinide-relevant brine chemistry, microbial effects, and actinide colloid studies. The details of these experimental studies are given in Appendix SOTERM-2014, Sections SOTERM-2 and SOTERM-3. All results reported in these studies support the existing PA assumptions for geochemistry and did not lead to conceptual model changes in the CRA-2014 PA, although a number of parameters were updated.

15.8.3.5 Iron and Lead Corrosion Experiments

Since the CRA-2009, a new series of steel and lead corrosion experiments has been conducted (Roselle 2009; Roselle 2010; Roselle 2011a; Roselle 2011b; Roselle 2013). The purpose of these experiments has been to determine steel and lead corrosion rates under more WIPP-relevant conditions. The results of these experiments have led to a revised iron corrosion rate parameter (Roselle 2013). No other changes have been made as a result of these experiments. Appendix MgO-2014, Section MgO-5.3.2.1 provides a description of the effects of MgO on gas generation from anoxic corrosion of steels and other iron-based alloys, while Appendix SOTERM-2014, Section SOTERM-2.3.4 describes the iron chemistry and corrosion assumptions that are implemented in the CRA-2014 PA.

15.8.4 40 CFR § 194.15(a)(4)

40 CFR § 194.15(a)(4) requires that the DOE "identify any activities or assumptions that deviate from the most recent compliance application." Information related to this requirement is provided in Sections 15.8.4.1 through 15.8.4.6.

15.8.4.1 Status of Underground Excavation

The status of mining in the WIPP underground repository is shown in Figure 15-7. As of December 31, 2012, Panels 1 through 7 had been mined completely and Panels 1, 2, 3, 4 and 5 were completely filled with waste. Waste was being emplaced in Panel 6 and mining of Panel 7 was completed on December 28, 2012.

The geotechnical analysis reports from 2008 through 2012 show that no major ground control problems or events have occurred since the CRA-2009 (U.S. DOE 2008c ; U.S. DOE 2009d; U.S. DOE 2010c; U.S. DOE 2011c; U.S. DOE 2012b). As expected, slow deterioration of ground conditions has occurred in the WIPP underground repository as a result of aging, but this

has been mitigated by routine maintenance and the implementation of engineered systems, as needed.

15.8.4.2 Remote-Handled Transuranic Waste Emplacement

The original plans for waste emplacement included the placement of remote-handled TRU (RH-TRU) waste in horizontal boreholes in the walls of waste-emplacement rooms, followed by the emplacement of contact-handled TRU (CH-TRU) waste in containers on the floor of each room. This configuration was planned to be used in all panels in the underground repository. Because CH-TRU waste disposal was approved about six years before RH-TRU waste approval, RH-TRU waste was emplaced in Panels 4, 5, and 6, but not in Panels 1, 2, and 3 (see Figure 15-7).

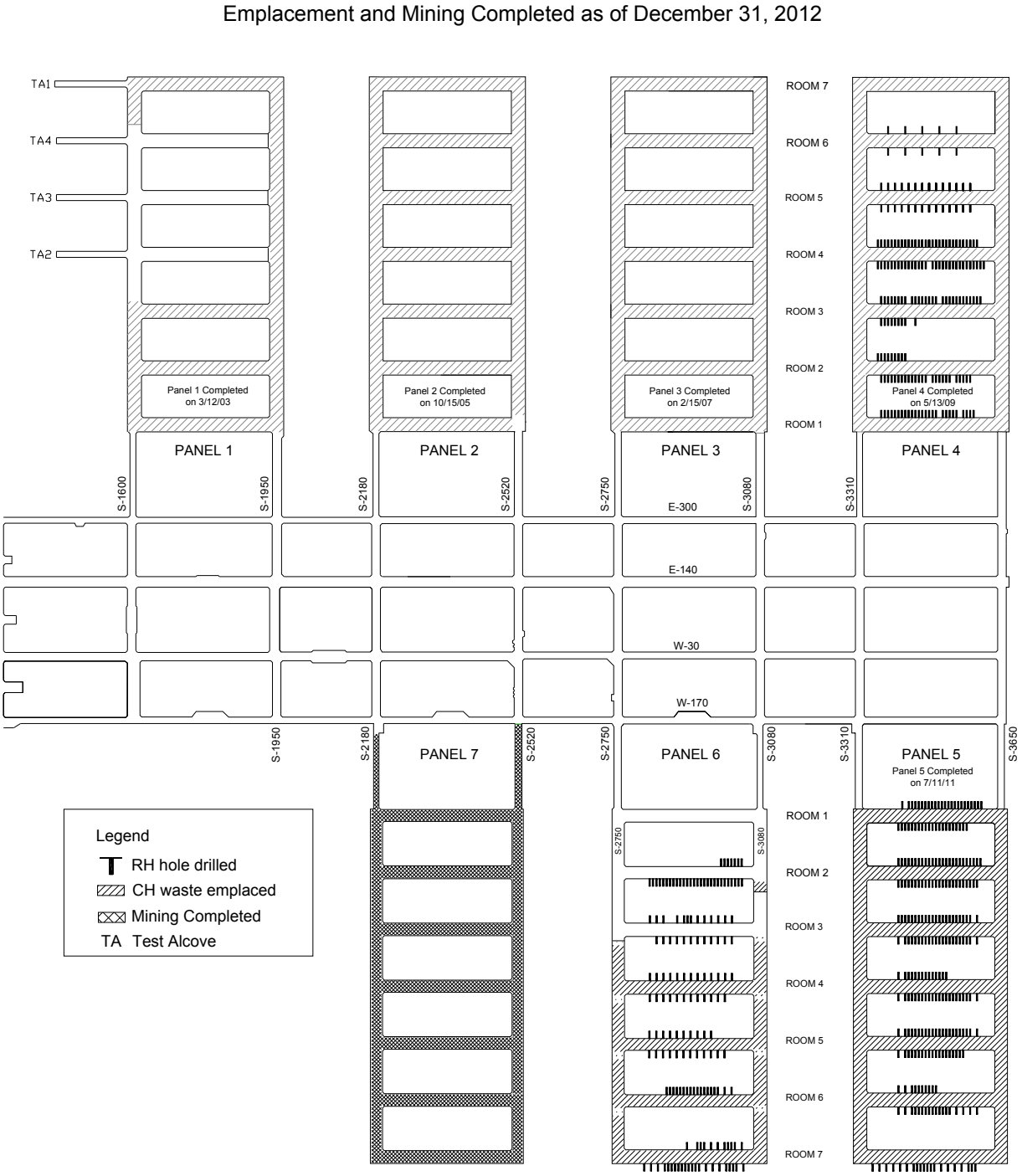


Figure 15-7. Status of Mining and Waste Emplacement as of December 31, 2012

15.8.4.3 Proposed RH-TRU Waste Container Modifications

On November 15, 2007, the DOE submitted a PCR to the EPA for approval to emplace a portion of the RH-TRU waste in shielded containers in the WIPP (Moody 2007). The shielded container has approximately the same exterior dimensions as a 55-gallon drum. It has 1-inch thick lead shielding placed between a double-walled steel shell. The external steel wall is 1/8-inch thick, and the internal steel wall is 3/16-inch thick. The lid and the bottom of the containers are made of carbon steel and are 3 inches thick. The containers are designed to hold a 30-gallon container filled with RH-TRU waste, and would be shipped to the WIPP in HalfPACT transportation containers. The shielded container would be handled and emplaced like CH-TRU waste containers because the surface dose rate for a shielded container would be no higher than 200 millirem/hour. Even though the RH-TRU waste in shielded containers will be handled as if it were CH-TRU waste, these containers will still be recorded as RH-TRU waste in the WIPP Waste Data System, and the volume of the waste will be counted against the limit of 250,000 cubic feet (7,080 cubic meters) of RH-TRU waste, as set by the Consultation and Cooperation Agreement between the DOE and the State of New Mexico.

On December 7, 2007, the EPA sent the DOE its first letter with the results of a preliminary review and comments on the shielded container PCR and requested additional documentation (Reyes 2007). The DOE submitted supplemental information on April 30, 2008, and October 29, 2008, in response to the EPA's request (Moody 2008a and Moody 2008b).

On March 25, 2011, the EPA determined that the DOE had fulfilled all documentation requirements set forth by the EPA and had demonstrated that the use of shielded containers in the repository would not affect facility compliance with either 40 CFR Part 191or 40 CFR Part 194 (Edwards 2011a). The EPA proposed the approval of the shielded container assembly for use at the WIPP, pending the solicitation and resolution of public comments.

The EPA opened an informal 60-day comment period, which was later extended to 90 days at the request of the stakeholders and closed on June 24, 2011. The EPA considered all comments submitted and found that no new technical issues had been raised.

On August 8, 2011, the EPA issued its technical approval of the DOE's PCR for the emplacement of RH-TRU waste in shielded containers with one condition (Edwards 2011b): prior to shipping shielded containers to the WIPP, the DOE will demonstrate a consistent complex-wide procedure to ensure that shielded containers containing RH-TRU waste remain below the WIPP LWA surface dose rate limit for CH-TRU waste of 200 millirem per hour.

15.8.4.4 Neutrino Experiments in the WIPP Underground Repository

Several new research projects have been initiated at the WIPP. Although these projects are not related to the expected performance of the repository, they are described here because they are being performed in the WIPP underground facility. The WIPP underground repository is a desirable location for these experiments because it provides an environment shielded from cosmic radiation that would otherwise interfere with the experiments. Equipment used during these experiments will be removed before closure of the repository.

The Segmented Enriched Germanium Assembly (SEGA) and the Multiple Element Germanium Array (MEGA) projects are being performed to investigate double-beta decay, a rare type of nuclear decay that provides information on the mass of the neutrino. The SEGA and MEGA projects are being performed by a collaboration of several universities, with Stanford University serving as the lead. The SEGA and MEGA experiments have been ongoing since 2008.

Los Alamos National Laboratory is leading the Enriched Xenon Observatory (EXO) project, also in the WIPP underground repository. This project is investigating neutrinoless double-beta decay. The first two clean room modules for the EXO project were successfully placed in the WIPP underground in 2007. The detector for the EXO project, called the Time Projection Chamber (TPC), was installed in January 2010. Data-taking mode began when the EXO detector was filled with xenon containing 80% xenon-136. Construction of the EXO is approximately 90% complete. Experimental modules continue to be assembled, outfitted, tested and emplaced in the WIPP underground.

On May 28, 2009, the DOE submitted to the EPA the notification of intent to emplace the Dark Matter (DM) TPC in the northern part of the North Experimental Area in the WIPP underground (Moody 2009a). The EPA approved the DM-TPC on July 23, 2009 (Edwards 2009a). The experiment was assembled in the WIPP underground in 2010. The DM-TPC continues to operate safely and reliably.

On January 8, 2009, the DOE submitted to the EPA the notification of intent to begin the Low Background Radiation Experiment (LBRE) (Moody 2009b). The LBRE is designed to examine the effects of very low background radiation on bacteria. The EPA approved the intent to begin the LBRE on January 28, 2009 (Edwards 2009b). Experimental protocols were developed and incubators were emplaced above ground and underground. Experiments have been ongoing in the WIPP underground since 2009.

15.8.4.5 Planned Change Notice Submittals

A Planned Change Notice (PCN) is a formal submittal of information to the EPA that describes minor, insignificant changes to activities and conditions at the WIPP that are different from those described in the compliance baseline. A summary of the PCNs submitted since the CRA-2009 is provided below.

Planned Change Notice for Salt Disposal Investigations

On August 11, 2011, the DOE submitted to the EPA a PCN to initiate mining activities for the Salt Disposal Investigations (SDI) project in the WIPP underground (Ziemianski 2011a). The objective of the SDI experiment is to investigate thermal and hydro-geochemical responses to temperature sources in excess of 160º Celsius located in bedded salt.

On November 17, 2011, the EPA agreed that the DOE may conduct the initial preparatory phase of the SDI program and found that the mining phase of the SDI activities will not adversely impact the WIPP's waste handling activities, air monitoring, disposal operations, or long-term repository performance (Edwards 2011c). The initial preparatory phase of the mining project began on December 1, 2011.

On June 20, 2012, the DOE notified the EPA (Franco 2012a) that an additional component, and possible alternative to the SDI project, had been developed entitled the Salt Defense Disposal Investigations (SDDI). The SDDI project would test an in-drift emplacement concept with thermal loads more closely aligned with the DOE defense high-level waste canisters.

Planned Change Notice for RH-72B Neutron Shielded Canister

On May 21, 2010, the DOE submitted to the EPA a PCN to employ a polyethylene liner inside some standard RH-TRU waste canisters to shield neutron-emitting waste destined for disposal at the WIPP (Moody 2010).

Planned Change Notice for Placement of Magnesium Oxide

On February 14, 2012, the DOE submitted a PCN, based on operating experience and historical data, to inform the EPA that a process was being instituted to emplace MgO on every other row of waste containers, in contrast to emplacing MgO on every waste stack (Franco 2012b). Historical data showed the MgO excess factor on a per room basis to range from 1.22 to 2.85 when MgO was placed on every stack of waste. These values were higher than the excess factor of 1.2 mandated by the EPA's letter dated February 11, 2008 (Reyes 2008). The PCN also described the process that requires the Waste Handling Engineer to continue to calculate the excess factor at the end of each shift and to direct the placement of additional MgO if the excess factor dropped below 1.2. The EPA agreed to this operational change in an email from Peake to Franco dated July 13, 2012. Details regarding this change can be found in Appendix MgO, Section MgO-2.1.4.

15.8.4.6 Planned Change Request Submittals

A PCR is a formal submittal of information to the EPA that describes and requests approval for the implementation of more complex changes to activities and conditions at the WIPP that are different from those described in the compliance baseline. A summary of the PCRs submitted since the CRA-2009 is provided below.

Planned Change Request for Repository Reconfiguration

On August 30, 2011, the DOE submitted a Repository Reconfiguration PCR to the EPA to relocate Panels 9 and 10 from the main north-south access drift to south of the existing Panels 4 and 5 (Ziemianski 2011b). The DOE stated that relocating Panels 9 and 10 to south of the existing Panels 4 and 5 will enhance worker safety and reduce maintenance requirements by providing a more stable geotechnical environment for the two new waste emplacement panels in the repository.

Planned Change Request for Panel Closure Redesign

On September 28, 2011, the DOE submitted to the EPA a PCR for panel closure redesign (Ziemianski 2011c). The DOE has requested that the EPA modify Condition 1 of the Final Certification Decision for 40 CFR Part 194 by replacing the current approved panel closure design, “Option D,” with the proposed design, Run-of-Mine Panel Closure.

Condition 1 of the Final Certification Decision for 40 CFR Part 194 specifies that the panel closure system to be used in the WIPP repository be "Option D," as specified in the CCA (U.S. DOE 1996). "Option D" specified that certain components be constructed using Salado Mass Concrete. In 2007, the DOE initiated hydrogen and methane monitoring to gather data to determine more realistic accumulation rates for these gases in filled panels. More realistic accumulation rates for hydrogen and methane could be used to establish a panel closure design that would be less complex than the Option D design.

On December 22, 2011, the EPA provided a set of initial questions and comments to the DOE focusing on the justification for Run-of-Mine Panel Closure representation and its parameters in the reconfiguration PCR PA that were different from those in the 2009 Performance Assessment Baseline Calculation (Perrin 2011).

On April 17, 2012, the DOE replied to the initial set of review questions and comments related to the PCR for replacing the current "Option D" panel closure system (Franco 2012c).

In 2012, the DOE submitted a PA, Panel Closure System-2012, for the proposed panel closure redesign. The results of the PA demonstrated that the WIPP will remain in compliance with the containment requirements found in 40 CFR §191.13.

15.8.5 40 CFR § 194.15(a)(5)

40 CFR § 194.15(a)(5) requires that the CRA-2014 include "a description of all waste emplaced in the disposal system since the most recent compliance certification or recertification application. Such description shall consist of a description of the waste characteristics and waste components identified in § 194.24(b)(1) and § 194.24(b)(2)." Information related to these requirements is provided in Sections 15.8.5.1 and 15.8.5.2.

15.8.5.1 Status of Waste Emplacement

The status of waste emplacement in the WIPP underground repository is illustrated in Figure 15-7. Additional detail is provided in Section 24, Waste Characterization.

15.8.5.2 Waste Characteristics and Components Important to Demonstration of Compliance

Section 24 provides an updated waste inventory of waste anticipated to be emplaced in the WIPP and waste that has already been emplaced since the CRA-2009. Section 24 also reports an analysis of the impacts of waste inventory on the performance of the WIPP disposal system. Information about the limits imposed by the DOE on significant components or characteristics of the waste to ensure that they are consistent with assumptions made for the CRA-2014 PA is also provided in Section 24.

There have been five inventory updates (ATWIR-2008, ATWIR-2009, ATWIR-2010, ATWIR-2011 and ATWIR-2012) since the CRA-2009. The DOE used the ATWIR-2012 data for the CRA-2014 inventory, after it was scaled for PA. The scaled inventory was documented in the Performance Assessment Inventory Report - 2012 (Van Soest 2012).

15.8.6 40 CFR § 194.15(a)(6)

40 CFR § 194.15(a)(6) requires the submittal of "any significant information not previously included in a compliance certification or recertification application related to whether the disposal system continues to be in compliance with the disposal regulations."

The information required by this section of the certification criteria is provided in the sections and appendices of the CRA-2014. The DOE believes that this information demonstrates that the WIPP continues to comply with the disposal regulations.

15.8.7 40 CFR § 194.15(a)(7)

40 CFR § 194.15(a)(7) requires the submittal of "any additional information requested by the Administrator or the Administrator's authorized representative."

There currently are no outstanding requests from the EPA for additional information. As such, the DOE is in compliance with this certification criterion.

15.8.8 40 CFR § 194.15(b)

40 CFR § 194.15(b) states, "To the extent that information required for a re-certification of compliance remains valid and has been submitted in previous certification or re-certification applications(s), such information need not be duplicated in subsequent applications; such information may be summarized and referenced."

The DOE has followed this direction in the preparation of this recertification application. To the extent appropriate, information from the CCA, the CRA-2004, and the CRA-2009 that remains valid and unchanged is not repeated in this recertification application; instead, it is summarized and incorporated by reference.

15.8.9 Status of Compliance with 40 CFR § 194.15

The information in this section and in the other sections and appendices of the CRA-2014 establishes that the DOE continues to demonstrate compliance with the requirements of section 194.15.

15.9 References

(*Indicates a reference that has not been previously submitted.)

Berglund, J.W. 1992. Mechanisms Governing the Direct Removal of Wastes from the Waste Isolation Pilot Plant Repository Caused by Exploratory Drilling. SAND92-7295. Sandia National Laboratories, Albuquerque, NM.

Domski, P.S., and R.L. Beauheim. 2008. *Evaluation of Culebra Brine Chemistry*. AP-125. ERMS 549336. Sandia National Laboratories, Carlsbad, NM.*

Domski, P.S., Beauheim, R.L., and Johnson, P.B. 2011. "AP-147 Analysis Report: Evaluation of WIPP Groundwater Compositions." ERMS 556581. Sandia National Laboratories, Carlsbad, NM.*

Edwards, J. 2009a. Letter to D. Moody (Subject: *EPA's approval of DOE's Dark Matter-Time Projection Chamber (DM-TPC) experiment*). 23 July 2009. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.*

Edwards, J. 2009b. Letter to D. Moody (Subject: *U.S. EPA's approval of the DOE's Low Background Radiation Experiment in the WIPP*). 28 January 2009. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.*

Edwards, J. 2011a. Letter to E. Ziemianski (Subject: *EPA's proposed decision to approve the DOE's Planned Change Request to emplace a portion of the RH-TRU waste inventory in specially designed shielded containers at the WIPP)*. 25 March 2011. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.*

Edwards, J. 2011b. Letter to E. Ziemianski (Subject: *U.S. EPA's technical approval of the DOE's Shielded Container Planned Change Request*). 8 August 2011. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.*

Edwards, J. 2011c. Letter to E. Ziemianski (Subject: *U.S. EPA's review of DOE's Salt Disposal Investigations Proposal*). 17 November 2011. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.*

Franco, J.R. 2012a. Letter to J. Edwards (Subject: *Notification of Revisions to the Salt Disposal Investigations Testing Concepts*). 20 June 2012. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Franco, J.R. 2012b. Letter to A. Perrin (Subject: *Planned Change Notice for Placement of Magnesium Oxide Supersacks*). 14 February 2012. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Franco, J.R. 2012c. Letter to J. Edwards (Subject: *Response to EPA Letter Dated December 22, 2011*). 17 April 2012. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Hansen, F.D., M. K. Knowles, T. W. Thompson, M. Gross, J. D. McLennan, and J. F. Schatz. 1997. Description and Evaluation of a Mechanistically Based Conceptual Model for Spall. SAND97–1369. Sandia National Laboratories, Albuquerque, NM.

Herrick, C.G., M.D. Schuhen, D.M. Chapin, and D.C. Kicker. 2012. Determining the Hydrodynamic Shear Strength of Surrogate Degraded TRU Waste Materials as an Estimate for the Lower Limit of the Performance Assessment Parameter TAUFAIL. ERMS 558479. Sandia National Laboratories, Carlsbad, NM.*

Herrick, C.G. and T. Kirchner. 2013. Follow-up to questions concerning TAUFAIL flume testing raised during the November 14-15, 2012 technical exchange between the DOE and EPA.*

Kuhlman, K.L. 2010. "Analysis Report AP-111 Revision 1, Culebra Water Level Monitoring Network Design." ERMS 554054, Sandia National Laboratories, Carlsbad, NM.*

Moody, D.C. 2007. Letter to J. Reyes (Subject: T*ransmittal of Planned Change Request for Shielded Containers*). 15 November 2007. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Moody, D.C. 2008a. Letter to J. Reyes (7 Attachments). 30 April 2008. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Moody, D.C. 2008b. Letter to J. Reyes (8 Attachments). 29 October 2008. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Moody, D.C. 2009a. Letter to J. Edwards (Subject: *Notification of Intent to Begin the Dark Matter Time Projection Chamber Experiment*). 28 May 2009. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Moody, D.C. 2009b. Letter to J. Edwards (Subject: *Notification of Intent to Begin Low Background Radiation Experiment)*. 8 January 2009. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Moody, D.C. 2010. Letter to J. Edwards (Subject: *Planned Change Notice for the RH-72B Neutron Shielded Canister*). 21 May 2010. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Patterson, R.L. 2007. Letter to J. Reyes (Chemical Analysis of the MagChem 10 WTS 60 as supplied to the Waste Isolation Pilot Plant). 10 July 2007. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

Patterson, R.L. 2009. Letter to J. Edward (Subject: *Notification of Implementation of the Excess Factor for Magnesium Oxide Emplacement at the Waste Isolation Pilot Plant*). 16 March 2009. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Perrin, A.D. 2011. Letter to E. Ziemianski (Subject: Additional Questions and Comments to DOE related to the PCS and the Repository Reconfiguration). 22 December 2011. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.*

Reyes, J. 2007. Letter to D. Moody (Subject: *Preliminary review and comments on the Shielded Container Planned Change Request*). 7 December 2007. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.

Reyes, J. 2008. Letter to D. Moody (5 Enclosures). 11 February 2008. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.*

Roselle, G.T. 2009. *Iron and Lead Corrosion in WIPP-Relevant Conditions: Six Month Results.* Milestone report. October 7, 2009. ERMS 552218. Sandia National Laboratories, Carlsbad, NM.*

Roselle, G.T. 2010. *Iron and Lead Corrosion in WIPP-Relevant Conditions: 12 Month Results*. Milestone report. October 14, 2010. ERMS 554383. Sandia National Laboratories, Carlsbad, NM.*

Roselle, G.T. 2011a. *Iron and Lead Corrosion in WIPP-Relevant Conditions: 18 Month Results*. Milestone report. January 5, 2011. ERMS 554715. Sandia National Laboratories, Carlsbad, NM.*

Roselle, G.T. 2011b. *Iron and Lead Corrosion in WIPP-Relevant Conditions: 24 Month Results*. Milestone report. May 3, 2011. ERMS 555426. Sandia National Laboratories, Carlsbad, NM.*

Roselle, G.T. 2013. *Determination of Corrosion Rates from Iron/Lead Corrosion Experiments to be Used for Gas Generation Calculations*, Rev. 1. Analysis report. January 23, 2013. ERMS 559077. Sandia National Laboratories, Carlsbad, NM.*

Sandia National Laboratories. 2012. *Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2012, WBS 1.3.1, November 2012*. Sandia National Laboratories, Carlsbad, NM.*

U.S. Department of Energy (DOE). 1996. *Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant* (October). 21 vols. DOE/CAO 1996-2184. Carlsbad Field Office, Carlsbad, NM.

U.S. Department of Energy (DOE). 2004. *Title 40 CFR Part 191 Compliance Recertification Application for the Waste Isolation Pilot Plant* (March). 10 vols. DOE/WIPP 2004-3231. Carlsbad Field Office, Carlsbad, NM.

U.S. Department of Energy (DOE). 2008a. *Delaware Basin Monitoring Annual Report* (September). DOE/WIPP 08-2308. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2008b. *Waste Isolation Pilot Plant Annual Site Environmental Report for 2007* (September). DOE/WIPP 08-2225. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2008c. *Geotechnical Analysis Report for July 2006–June 2007*. DOE/WIPP 08-3177. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2009a. *Title 40 CFR Part 191 Compliance Recertification Application for the Waste Isolation Pilot Plant* (March). DOE/WIPP 2009-3424. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2009b. *Delaware Basin Monitoring Annual Report* (September). DOE/WIPP 09-2308. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2009c. *Waste Isolation Pilot Plant Annual Site Environmental Report for 2008* (September). DOE/WIPP 09-2225. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2009d. *Geotechnical Analysis Report for July 2007–June 2008*. DOE/WIPP 09-3177. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2010a. *Delaware Basin Monitoring Annual Report* (September). DOE/WIPP 10-2308. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2010b. *Waste Isolation Pilot Plant Annual Site Environmental Report for 2009* (September). DOE/WIPP 10-2225. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2010c. *Geotechnical Analysis Report for July 2008–June 2009*. DOE/WIPP 10-3177. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2011a. *Delaware Basin Monitoring Annual Report* (September). DOE/WIPP 11-2308. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2011b. *Waste Isolation Pilot Plant Annual Site Environmental Report for 2010* (September). DOE/WIPP 11-2225. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2011c. *Geotechnical Analysis Report for July 2009–June 2010*. DOE/WIPP 11-3177. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2012a. *Waste Isolation Pilot Plant Annual Site Environmental Report for 2011* (September). DOE/WIPP 12-3489. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2012b. *Geotechnical Analysis Report for July 2010–June 2011*. DOE/WIPP 12-3484. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2012c. *Annual Change Report 2011/2012: From July 1, 2011, to June 30, 2012* (October). DOE/WIPP 12-3496. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2012d. *Delaware Basin Monitoring Annual Report* (September). DOE/WIPP 12-2308. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2012e. *WIPP Subsidence Monument Leveling Survey 2012* (December 2012). DOE/WIPP 12-3497. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2012f. *Annual Transuranic Waste Inventory Report – 2012*. DOE/TRU-12-3425, Revision 0. Carlsbad Field Office, Carlsbad, NM.*

U.S. Department of Energy (DOE). 2012g. *Waste Isolation Pilot Plant Biennial Environmental Compliance Report*. DOE/WIPP 12-3487, Revision 0. Carlsbad Field Office, Carlsbad, NM.*

U.S. Environmental Protection Agency (EPA). 1996. "40 CFR Part 194: Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations; Final Rule." *Federal Register*, vol. 61 (February 9, 1996): 5223–45.

U.S. Environmental Protection Agency (EPA). 1998a. "CARD No. 14: Content of Compliance Certification Application." *Compliance Application Review Documents for the Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Final Certification Decision* (May) (pp. 14-1 through 14-86). Office of Radiation and Indoor Air, Washington, DC.

U.S. Environmental Protection Agency (EPA). 1998b. "40 CFR Part 194: Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision; Final Rule." *Federal Register*, vol. 63 (May 18, 1998): 27353–406.

U.S. Environmental Protection Agency (EPA). 2006a. "Recertification CARD Nos. 14/15: Content of Compliance Certification Application and Compliance Recertification Application(s)." *Compliance Application Review Documents for the Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Final Recertification Decision* (March) (pp. 14/15-1 through 14/15-34, pp. 14-A-1 through 14-A-3, and pp. 15-A-1 through 15-A-17). Office of Radiation and Indoor Air, Washington, DC.

U.S. Environmental Protection Agency (EPA). 2006b. "40 CFR Part 194: Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Recertification Decision" (Final Notice). *Federal Register*, vol. 71 (April 10, 2006): 18010–021.

U.S. Environmental Protection Agency (EPA). 2010a. "2009 Compliance Recertification Application (2009 CRA) Compliance Application Review Documents (CARD) 194.14 and 194.15: Content of Compliance Certification Application; Content of Compliance Recertification Application(s)." EPA Docket FDMS Docket ID No. EPA-HQ-OAR-2009-0330. Office of Radiation and Indoor Air, Washington, DC.*

U.S. Environmental Protection Agency (EPA). 2010b. "40 CFR Part 194 Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Recertification Decision; Final Notice." Federal Register, vol. 75. (November 18, 2010).*

Van Soest, G.D. 2012. *Performance Assessment Inventory Report – 2012,* INV-PA-12, Revision 0. Los Alamos National Laboratory-Carlsbad Operations, Carlsbad, NM.*

Ziemianski, E. 2011a. Letter to J. Edwards (Subject: *Notification of Intent to Begin the Salt Disposal Investigations*). 11 August 2011. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Ziemianski, E. 2011b. Letter to J. Edwards (Subject: *Transmittal of Planned Change Request for Repository Reconfiguration*). 30 August 2011. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*

Ziemianski, E. 2011c. Letter to J. Edwards (Subject: *Transmittal of Planned Change Request for Panel Closure Redesign*). 28 September 2011. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.*