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**Title 40 CFR Part 191  
Subparts B and C  
Compliance Recertification Application 2019  
for the  
Waste Isolation Pilot Plant**

**Results of Performance Assessments  
(40 CFR 194.34)**



**United States Department of Energy  
Waste Isolation Pilot Plant**

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**Compliance Recertification Application 2019**  
**Results of Performance Assessments**  
**(40 CFR 194.34)**

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### **Acronyms and Abbreviations**

CARD	Compliance Application Review Document
CCA	Compliance Certification Application
CCDF	complementary cumulative distribution function
CFR	Code of Federal Regulations
CRA	Compliance Recertification Application
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
LHS	Latin hypercube sampling
PA	performance assessment
WIPP	Waste Isolation Pilot Plant

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## 34.0 Results of Performance Assessments (40 CFR 194.34)

### 34.1 Requirements

#### § 194.34 Results of Performance Assessments

- (a) The results of performance assessments shall be assembled into complementary, cumulative distribution functions (CCDFs) that represent the probability of exceeding various levels of cumulative release caused by all significant processes and events.
- (b) Probability distributions for uncertain disposal system parameter values used in performance assessments shall be developed and documented in any compliance application.
- (c) Computational techniques, which draw random samples from across the entire range of the probability distributions developed pursuant to paragraph (b) of this section, shall be used in generating CCDFs and shall be documented in any compliance application.
- (d) The number of CCDFs generated shall be large enough such that, at cumulative releases of 1 and 10, the maximum CCDF generated exceeds the 99th percentile of the population of CCDFs with at least a 0.95 probability. Values of cumulative release shall be calculated according to Note 6 of Table 1, Appendix A of Part 191 of this chapter.
- (e) Any compliance application shall display the full range of CCDFs generated.
- (f) Any compliance application shall provide information which demonstrates that there is at least a 95 percent level of statistical confidence that the mean of the population of CCDFs meets the containment requirements of 40 CFR 191.13.

### 34.2 40 CFR 194.34(a)

#### 34.2.1 Background

The radioactive waste disposal regulations of 40 CFR Part 191 Subparts B and C ([U.S. EPA 1993](#)) include containment requirements for radionuclides. The containment requirements of 40 CFR 191.13 specify that releases from a disposal system to the accessible environment must not exceed the release limits set forth in Part 191 Appendix A, Table 1. Assessment of the likelihood that the Waste Isolation Pilot Plant (WIPP) will meet the release limits is conducted through a process known as a performance assessment (PA). The WIPP PA consists of a series of computer simulations that model the physical attributes of the repository (site, geology, waste forms and quantities, engineered features) in a manner that captures the expected behaviors and interactions among its various components over the 10,000-year regulatory time frame.

The PA must consider all significant processes and events that may affect the disposal system (see Section 32 of this application), and it must be structured and conducted in a way that (1) demonstrates an adequate understanding of the physical conditions at the disposal system and its surroundings, and (2) shows that the future performance of the system can be predicted with reasonable assurance. In addition, it must include simulations for both undisturbed conditions and human intrusion scenarios. The results of the PA are used to demonstrate compliance with the containment requirements of 40 CFR 191.13.

The containment requirements place limits on the likelihood of radionuclide releases from a disposal system. A radionuclide release to the accessible environment is defined in terms of the location of the release and its magnitude. Any release of radionuclides to the ground surface, atmosphere, or surface water is considered a release to the accessible environment. In addition, any subsurface transport of radionuclides beyond the boundary of the WIPP controlled area is also considered a release to the accessible environment.

The results of the WIPP PA are required to be expressed as complementary cumulative distribution functions (CCDFs). A CCDF indicates the probability of exceeding various levels of cumulative release. The CCDFs must be generated using random sampling techniques that draw upon the full range of values established for each uncertain parameter.

For the Compliance Certification Application (CCA) ([U.S. DOE 1996](#)) and each subsequent CRA (Compliance Recertification Application), the U.S. Environmental Protection Agency (EPA) has reviewed the information provided and has determined that the U.S. Department of Energy (DOE) continues to comply with the criteria of 40 CFR 194.34(a). During the CRA-2014 review, the EPA identified technical concerns that were subsequently evaluated in a set of sensitivity studies (Compliance Application Review Document [CARD] 34) ([U.S. EPA 2017](#)). Information and data from previous compliance certification and recertification applications that form the basis of past DOE compliance positions and past EPA decision documents are found in the CRA-2014 ([U.S. DOE 2014](#)).

### **34.2.2 Changes or New Information Since the CRA-2014**

The DOE has deferred submittal of the CRA-2019 PA until after submission of the CRA-2019 (see Executive Summary 2019, Section 1.3). As such, the CRA-2014 PA continues to be the baseline calculation for the CRA-2019. As directed in 40 CFR 194.15(b), where information remains valid and has been submitted in previous recertification applications, such information may be summarized and referenced. The results of the deferred PA will be described in a second submission that will also include revisions, when appropriate, to the information submitted in March, 2019.

## **34.3 40 CFR 194.34(b)**

### **34.3.1 Background**

There is uncertainty associated with many of the parameters used in PA. 40 CFR 194.34(b) addresses the need for the uncertain parameters to be sampled from a probability distribution (e.g., uniform, normal, etc.) that has been appropriately documented and justified.

For the CCA ([U.S. DOE 1996](#)) and each subsequent CRA, the EPA has reviewed the information provided and has determined that the DOE continues to comply with the criteria of 40 CFR 194.34(b). During the CRA-2014 review, the EPA identified issues with parameters and approaches used by the DOE in PA calculations which were subsequently evaluated in a set of sensitivity studies (CARD 34) ([U.S. EPA 2017](#)). Information and data from previous compliance certification and recertification applications that form the basis of past DOE compliance positions and past EPA decision documents are found in the CRA-2014 ([U.S. DOE 2014](#)).



### **34.3.2 Changes or New Information Since the CRA-2014**

The DOE has deferred submittal of the CRA-2019 PA until after submission of the CRA-2019 (see Executive Summary 2019, Section 1.3). As such, the CRA-2014 PA continues to be the baseline calculation for the CRA-2019. As directed in 40 CFR 194.15(b), where information remains valid and has been submitted in previous recertification applications, such information may be summarized and referenced. The results of the deferred PA will be described in a second submission that will also include revisions, when appropriate, to the information submitted in March, 2019.

## **34.4 40 CFR 194.34(c)**

### **34.4.1 Background**

The intent of 40 CFR 194.34(c) is to ensure that the sampled parameters were appropriately selected for use in PA.

The EPA determined during the CCA review that the Latin hypercube sampling (LHS) method ensures parameter values will be selected from the entire range of the probability distributions because LHS stratifies the probability distributions into a number (100, in this case) of equal-probability regions and then samples one value from each region. The EPA noted that the LHS method is appropriate for generating random samples (CARD 34, Section 34.C.5) ([U.S. EPA 1998](#)). The DOE has continued to use the same approach in all CRAs.

For the CCA ([U.S. DOE 1996](#)) and each subsequent CRA, the EPA has reviewed the information provided and has determined that the DOE continues to comply with the criteria of 40 CFR 194.34(c). Information and data from previous compliance certification and recertification applications that form the basis of past DOE compliance positions and past EPA decision documents are found in the CRA-2014 ([U.S. DOE 2014](#)).

### **34.4.2 Changes or New Information Since the CRA-2014**

The DOE has deferred submittal of the CRA-2019 PA until after submission of the CRA-2019 (see Executive Summary 2019, Section 1.3). As such, the CRA-2014 PA continues to be the baseline calculation for the CRA-2019. As directed in 40 CFR 194.15(b), where information remains valid and has been submitted in previous recertification applications, such information may be summarized and referenced. The results of the deferred PA will be described in a second submission that will also include revisions, when appropriate, to the information submitted in March, 2019.

## **34.5 40 CFR 194.34(d)**

### **34.5.1 Background**

The intent of 40 CFR 194.34(d) is to ensure that PA modeling appropriately samples uncertain parameters and that future scenarios are appropriately used in PA. Also, it ensures that an appropriate number of CCDFs are generated.

The EPA found the analysis presented in the CCA, Chapter 8.0, sufficient to show that 298 CCDF curves would satisfy the statistical criterion. The EPA's independent analysis also verified that the 300 CCDF curves computed and presented in the CCA were sufficient (CARD 34, Section 34.D.5) ([U.S. EPA 1998](#)). The EPA found that the DOE correctly interpreted the definition of the 99<sup>th</sup> percentile value, and applied standard mathematical expressions for deriving the probability of an outcome of multiple events (i.e., the generation of multiple CCDF curves). The probabilistic analysis was found to be appropriate for sampling with the LHS method, which achieves better coverage than nonstratified random sampling of parameter ranges. The DOE has generated three sets of 100 CCDFs each and discussed the statistical confidence levels for the set of CCDFs in each CRA.

For the CCA ([U.S. DOE 1996](#)) and each subsequent CRA, the EPA has reviewed the information provided and has determined that the DOE continues to comply with the criteria of 40 CFR 194.34(d). Information and data from previous compliance certification and recertification applications that form the basis of past DOE compliance positions and past EPA decision documents are found in the CRA-2014 ([U.S. DOE 2014](#)).

### **34.5.2 Changes or New Information Since the CRA-2014**

The DOE has deferred submittal of the CRA-2019 PA until after submission of the CRA-2019 (see Executive Summary 2019, Section 1.3). As such, the CRA-2014 PA continues to be the baseline calculation for the CRA-2019. As directed in 40 CFR 194.15(b), where information remains valid and has been submitted in previous recertification applications, such information may be summarized and referenced. The results of the deferred PA will be described in a second submission that will also include revisions, when appropriate, to the information submitted in March, 2019.

## **34.6 40 CFR 194.34(e)**

### **34.6.1 Background**

The intent of 40 CFR 194.34(e) is to show the full range of CCDFs in order to provide an indication of the nature of the releases.

The DOE has displayed the full range of 300 CCDFs generated from PA calculations in each CRA.

For the CCA ([U.S. DOE 1996](#)) and each subsequent CRA, the EPA has reviewed the information provided and has determined that the DOE continues to comply with the criteria of 40 CFR 194.34(e). Information and data from previous compliance certification and recertification applications that form the basis of past DOE compliance positions and past EPA decision documents are found in the CRA-2014 ([U.S. DOE 2014](#)).

### **34.6.2 Changes or New Information Since the CRA-2014**

The DOE has deferred submittal of the CRA-2019 PA until after submission of the CRA-2019 (see Executive Summary 2019, Section 1.3). As such, the CRA-2014 PA continues to be the

baseline calculation for the CRA-2019. As directed in 40 CFR 194.15(b), where information remains valid and has been submitted in previous recertification applications, such information may be summarized and referenced. The results of the deferred PA will be described in a second submission that will also include revisions, when appropriate, to the information submitted in March, 2019.

## **34.7 40 CFR 194.34(f)**

### **34.7.1 Background**

Because of the unique nature of the WIPP disposal system, the EPA wanted to ensure that the PA results could be used to adequately support a certification decision. To this end, the EPA required the DOE to demonstrate compliance with a high statistical confidence. For 40 CFR 194.34(f), the DOE must show, in effect, that the mean of its 300 CCDF curves, and the 95<sup>th</sup> percentile upper confidence limit of the population mean, meet the containment requirements of 40 CFR 191.13 for the cumulative releases at 1 and 10 times the quantities in Part 191 Appendix A, Table 1. In the CCA and all subsequent CRAs, the DOE has used the same general approach for calculating the statistical confidence for release limits.

For the CCA ([U.S. DOE 1996](#)) and each subsequent CRA, the EPA has reviewed the information provided and has determined that the DOE continues to comply with the criteria of 40 CFR 194.34(f). Information and data from previous compliance certification and recertification applications that form the basis of past DOE compliance positions and past EPA decision documents are found in the CRA-2014 ([U.S. DOE 2014](#)).

### **34.7.2 Changes or New Information Since the CRA-2014**

The DOE has deferred submittal of the CRA-2019 PA until after submission of the CRA-2019 (see Executive Summary 2019, Section 1.3). As such, the CRA-2014 PA continues to be the baseline calculation for the CRA-2019. As directed in 40 CFR 194.15(b), where information remains valid and has been submitted in previous recertification applications, such information may be summarized and referenced. Information and data from previous compliance certification and recertification applications that form the basis of past DOE compliance positions and past EPA decision documents are found in the CRA-2014 ([U.S. DOE 2014](#)). The results of the deferred PA will be described in a second submission that will also include revisions, when appropriate, to the information submitted in March, 2019.

## **34.8 References**

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

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

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U.S. Environmental Protection Agency (EPA). 1993. 40 CFR Part 191: Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Final Rule. *Federal Register*, vol. 58 (December 20, 1993): 66398–416.

U.S. Environmental Protection Agency (EPA). 1998. CARD No. 34: Results of Performance Assessments. 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 (May) (pp. 34-1 through 34-29). Washington, DC: Office of Radiation and Indoor Air.

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