

---

**Title 40 CFR Part 191  
Subparts B and C  
Compliance Recertification  
Application  
for the  
Waste Isolation Pilot Plant  
Future States Assumptions  
(40 CFR § 194.25)**



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

**Carlsbad Field Office  
Carlsbad, New Mexico**

---

**Future States Assumptions  
(40 CFR § 194.25)**

**Table of Contents**

25.0 Future States Assumptions (40 CFR § 194.25) ..... 25-1  
    25.1 Requirements ..... 25-1  
    25.2 Background ..... 25-1  
    25.3 1998 Certification Decision ..... 25-1  
    25.4 Changes in the CRA-2004 ..... 25-2  
    25.5 EPA’s Evaluation of Compliance for the 2004 Recertification..... 25-2  
        25.5.1 40 CFR § 194.25(a)..... 25-3  
        25.5.2 40 CFR § 194.25(b)(1) ..... 25-3  
        25.5.3 40 CFR § 194.25(b)(2) ..... 25-3  
        25.5.4 40 CFR § 194.25(b)(3)..... 25-3  
        25.5.5 The 2006 Recertification Decision..... 25-3  
    25.6 Changes or New Information Since the 2004 Recertification ..... 25-4  
        25.6.1 40 CFR § 194.25(a)..... 25-4  
        25.6.2 40 CFR § 194.25(b)..... 25-4  
    25.7 References..... 25-7

**List of Tables**

Table 25-1. FEPs Screened Out Using the 40 CFR § 194.25(a) Criterion ..... 25-5  
Table 25-2. FEPs Screened In According to 40 CFR § 194.25(b) ..... 25-5

This page intentionally left blank.

### **Acronyms and Abbreviations**

CCA	Compliance Certification Application
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FEPs	feature, event, and process
PA	performance assessment
SO-C	screened out consequence
SO-R	screened out regulatory
T field	transmissivity field
UP	undisturbed performance
WIPP	Waste Isolation Pilot Plant

This page intentionally left blank.

1 **25.0 Future States Assumptions (40 CFR § 194.25)**

2 **25.1 Requirements**

§ 194.25 Future States Assumptions

(a) Unless otherwise specified in this part or in the disposal regulations, performance assessments and compliance assessments conducted pursuant to the provisions of this part to demonstrate compliance with § 191.13, § 191.15 and part 191, subpart C shall assume that characteristics of the future remain what they are at the time the compliance application is prepared, provided that such characteristics are not related to hydrogeologic, geologic or climatic conditions.

(b) In considering future states pursuant to this section, the Department shall document in any compliance application, to the extent practicable, effects of potential future hydrogeologic, geologic and climatic conditions on the disposal system over the regulatory time frame. Such documentation shall be part of the activities undertaken pursuant to § 194.14, Content of compliance certification application; § 194.32, Scope of performance assessments; and § 194.54, Scope of compliance assessments.

(1) In considering the effects of hydrogeologic conditions on the disposal system, the Department shall document in any compliance application, to the extent practicable, the effects of potential changes to hydrogeologic conditions.

(2) In considering the effects of geologic conditions on the disposal system, the Department shall document in any compliance application, to the extent practicable, the effects of potential changes to geologic conditions, including, but not limited to: Dissolution; near surface geomorphic features and processes; and related subsidence in the geologic units of the disposal system.

(3) In considering the effects of climatic conditions on the disposal system, the Department shall document in any compliance application, to the extent practicable, the effects of potential changes to future climate cycles of increased precipitation (as compared to the present conditions).

3

4 **25.2 Background**

5 The U.S. Environmental Protection Agency's (EPA's) purpose in issuing the Compliance  
6 Criteria at 40 CFR § 194.25 (U.S. Environmental Protection Agency 1996) was to minimize the  
7 impact of inherently conjectural specifications of future states on the compliance application.  
8 The EPA has found no acceptable methodology to predict the future state of society, science,  
9 languages, or other characteristics of mankind. However, the EPA does believe that established  
10 scientific methods can make plausible predictions regarding the future state of geologic,  
11 hydrogeologic, and climatic conditions. Therefore, section 194.25 stipulates that the future  
12 state will resemble present conditions except for those relating to hydrogeologic, geologic, and  
13 climatic conditions. For example, the population density and land ownership patterns in the  
14 Waste Isolation Pilot Plant's (WIPP's) surrounding regions are assumed to remain consistent  
15 with today's conditions for the next 10,000 years. However, section 194.25 requires that  
16 performance and compliance assessments include dynamic analyses of changes in the geology,  
17 hydrology, and climatic conditions during the regulatory time frame.

18 **25.3 1998 Certification Decision**

19 Future state assumptions that are relevant to 40 CFR § 194.25(a) and may affect the containment  
20 of waste were identified by the U.S. Department of Energy (DOE) in the Compliance  
21 Certification Application (CCA), Chapter 6.0, Section 6.2 and Appendices SCR and MASS (U.S.  
22 Department of Energy 1996). Many of these future state assumptions were derived from the

1 development of features, events, and processes (FEPs) that are potentially relevant to the  
 2 performance of the waste disposal system, and can be found in the CCA, Appendix SCR (e.g.,  
 3 solution mining and anthropogenic climate changes). FEPs are screened using specific criteria to  
 4 determine what phenomena and components of the disposal system can and should be dealt with  
 5 in PA calculations.

6 In its certification decision, the EPA first determined whether all FEPs and appropriate future  
 7 state assumptions were identified and developed by the DOE. The EPA then evaluated the  
 8 DOE's criteria to eliminate (screen out) inapplicable or irrelevant FEPs and associated  
 9 assumptions. The EPA also analyzed whether there were potential variations in the DOE's  
 10 assumed characteristics and determined whether the future state assumptions were in compliance  
 11 with section 194.25(a).

12 The EPA's CCA review found no potentially significant omissions in the lists of FEPs, and no  
 13 major inadequacies in the CCA's descriptions of FEPs and related future state assumptions. The  
 14 EPA concluded that the DOE adequately described all the future state assumptions applicable  
 15 under section 194.25(a) (U.S. Environmental Protection Agency 1998a).

16 To comply with 40 CFR §§ 194.25(b)(1), (b)(2), and (b)(3), the DOE identified and described  
 17 the hydrogeologic FEPs and related future state assumptions retained for further evaluation and  
 18 inclusion in performance assessment (PA) calculations in the CCA, Chapter 6.0, Section 6.3.  
 19 The DOE describes the effects of potential changes to hydrogeologic conditions on the disposal  
 20 system in the CCA, Chapter 6.0, Sections 6.4.6 and 6.4.9 and Appendices SCR, TFIELD, and  
 21 MASS. The DOE describes the effects of potential changes to geologic conditions on the  
 22 disposal system in the CCA, Chapter 6.0, Sections 6.2, 6.4.6, 6.5.4, and Appendices SCR and  
 23 MASS. The DOE identifies and describes the effects of potential changes to future climate  
 24 cycles of increased precipitation on the repository in the CCA, Chapter 6.0, Section 6.4.9.

25 The EPA concluded that the DOE adequately addressed the impacts of potential hydrogeologic,  
 26 geologic, and climate changes to the disposal system (U.S. Environmental Protection Agency  
 27 1998a). The EPA further stated that the CCA included all relevant elements of the PA and  
 28 compliance assessments and was consistent with the requirements of section 194.25.

## 29 **25.4 Changes in the CRA-2004**

30 For the CRA-2004, the DOE reevaluated all WIPP FEPs and made improvements and  
 31 clarifications to several FEP descriptions, arguments, and screening decisions. The results of the  
 32 FEPs reassessment were presented in the 2004 Compliance Recertification Application (CRA-  
 33 2004), Appendix PA, Attachment SCR (U.S. Department of Energy 2004). The CRA-2004,  
 34 Appendix PA, Attachment SCR, Table SCR-1 summarizes these changes.

## 35 **25.5 EPA's Evaluation of Compliance for the 2004 Recertification**

36 To evaluate compliance with section 194.25 requirements, the EPA reviewed the CRA-2004  
 37 documentation, including Chapters 2.0, 6.0, 7.0, and 9.0; Appendix PA, Attachment SCR;  
 38 Attachment TFIELD; and Attachment MASS. As in the 1998 Certification Decision (U.S.  
 39 Environmental Protection Agency 1998b), the EPA first determined whether all FEPs and



1 appropriate future state assumptions were identified and developed by the DOE. The EPA then  
2 evaluated the DOE's criteria to eliminate (screen out) inapplicable or irrelevant FEPs and  
3 associated assumptions. The EPA also analyzed whether there were potential variations in the  
4 DOE's assumed characteristics and determined whether the future state assumptions were in  
5 compliance with section 194.25(a).

#### 6 **25.5.1 40 CFR § 194.25(a)**

7 The EPA verified that all appropriate FEPs were included in the list provided by the DOE for  
8 section 194.25(a). The EPA reviewed any changes in FEPs, including all screened-in and  
9 screened-out FEPs related to future states, to verify that their selections were made correctly.  
10 The EPA's FEPs review is documented in the CRA-2004 Technical Support Document for  
11 section 194.25, 40 CFR § 194.32, and 40 CFR § 194.33 (U.S. Environmental Protection Agency  
12 2006a).

#### 13 **25.5.2 40 CFR § 194.25(b)(1)**

14 The EPA reexamined any hydrogeologic conditions that may have changed since the CCA  
15 review. The EPA determined that the DOE's review of FEPs related to hydrogeologic conditions  
16 and screening arguments was complete and that the conclusions drawn were appropriate.  
17 Changes in the hydrology at and around the WIPP site, such as water level changes in monitor  
18 wells and changes in potash mining, were appropriately included in PA modeling by updated  
19 changes in the Culebra Dolomite Member of the Rustler Formation (hereafter referred to as the  
20 Culebra) transmissivity fields (T fields). See the CRA-2004 Compliance Application Review  
21 Document 25 for more information (U.S. Environmental Protection Agency 2006b).

#### 22 **25.5.3 40 CFR § 194.25(b)(2)**

23 The EPA reexamined the DOE's characterization of future geologic conditions in the CRA-2004  
24 documents (U.S. Environmental Protection Agency 2006a). The EPA reexamined issues that  
25 were reviewed during the CCA, such as tectonics and deformation assumptions; fracture  
26 development and fault movement; ground shaking and seismic assumptions; volcanic and  
27 magmatic activity; metamorphic activity; shallow, lateral, and deep dissolution assumptions; and  
28 mineralization assumptions. The EPA also reviewed the CRA-2004 screening arguments related  
29 to geological screening decisions. The EPA determined that the DOE's geologic screening  
30 arguments are reasonable and adequate.

#### 31 **25.5.4 40 CFR § 194.25(b)(3)**

32 As in the CCA, the EPA's review of climatic condition changes focused on applicable FEPs. The  
33 EPA found that new information since the CCA does not impact FEPs or screening decisions  
34 related to climate change (U.S. Environmental Protection Agency 2006b).

#### 35 **25.5.5 The 2006 Recertification Decision**

36 Based on a review and evaluation of the CRA-2004, Chapters 2.0, 6.0, 7.0, and 9.0; Appendix  
37 PA, Attachment SCR; Attachment TFIELD; Attachment MASS; and an assessment of changes

1 since 1998, the EPA determined that the DOE continued to comply with the requirements of  
2 section 194.25 (U.S. Environmental Protection Agency 2006c).

## 3 **25.6 Changes or New Information Since the 2004 Recertification**

### 4 **25.6.1 40 CFR § 194.25(a)**

5 The DOE has reevaluated the basis of the WIPP FEPs for the CRA-2009. The results of this  
6 reevaluation are found in Appendix SCR-2009. Conclusions drawn from Appendix SCR-2009  
7 are also summarized in Section 32.

8 As described in Appendix SCR-2009, no screening decisions previously made using the future  
9 states assumption in section 194.25(a) have changed (although additional information may have  
10 been added to their descriptions); there continue to be 16 FEPs screened out based on this  
11 provision. Table 25-1 lists the 16 FEPs eliminated from PA calculations using the future states  
12 assumption.

13 Because there have been no changes to the conditions and bases for FEPs screened out using the  
14 future states assumption, the DOE continues to be in compliance with the requirements of  
15 section 194.25(a).

### 16 **25.6.2 40 CFR § 194.25(b)**

17 40 CFR § 194.25(b) requires consideration of future hydrogeologic, geologic, and climate  
18 conditions during the regulatory time frame. Table 25-2, below, lists those FEPs that are  
19 screened into PA calculations according to the criteria in section 194.25(b). There have been no  
20 changes to the screening decisions for those FEPs that represent the hydrogeologic, geologic, and  
21 climatic conditions in the future; they continue to be represented in performance calculations.

22 Section 1 of Clayton (2008) lists the changes to the PA system used for the CRA-2009  
23 calculations. None of the changes made for the CRA-2009 performance calculations affect the  
24 implementation of the FEPs screened in according to section 194.25(b).

25 In summary, no changes have been made to screening decisions for those FEPs that represent the  
26 hydrologic, geologic, and climate-related conditions for the WIPP, and no changes have been  
27 made to the representation of these elements within the PA system. Therefore, the DOE remains  
28 in compliance with the requirements of sections 194.25(b)(1), (b)(2), and (b)(3).

1 **Table 25-1. FEPs Screened Out Using the 40 CFR § 194.25(a) Criterion<sup>a</sup>**

EPA FEP I.D.	FEP Name	Change Summary
H6	Archeological investigations	None
H7	Drilling associated with thermal energy production	None
H10	Liquid waste disposal	None
H11	Hydrocarbon storage	None
H14	Mining for other resources (not potash)	None
H15	Excavation activities associated with tunneling	None
H16	Construction of underground facilities	None
H40	Changes in land use	None
H47	Anthropogenic climate change – Greenhouse gas effects	None
H48	Anthropogenic climate change – Acid rain	None
H49	Anthropogenic climate change – Damage to the ozone layer	None
H53	Changes in agricultural practices – Arable farming	None
H54	Changes in agricultural practices – Ranching	None
H55	Changes in agricultural practices – Fish farming	None
H56	Demographic change, urban developments, and technological developments	None
H58	Solution mining – Potash	None

<sup>a</sup> These screening classifications are consistent with current screening arguments and classifications as presented in Appendix SCR-2009.

2

**Table 25-2. FEPs Screened In According to 40 CFR § 194.25(b)<sup>a</sup>**

EPA FEP I.D.	FEP Name	Issue	Screening Classification	Method of Representation In PA
N1	<i>Stratigraphy</i>	Disposition and properties of geological formations in control of system performance.	Included in the Undisturbed Performance (UP) scenario	BRAGFLO grid incorporates relevant stratigraphic units.
N2	<i>Brine reservoirs</i>	Pressurized brine reservoirs may be present in the Castile beneath the controlled area.	Included in the Disturbed Performance scenarios	The potential for brine pocket intrusion is represented by the parameter PBRINE in the E1 scenario.
N16	<i>Shallow Dissolution</i>	Percolation of groundwater and dissolution in the Rustler may increase transmissivity.	UP	The effects of shallow dissolution, as in Nash Draw, on the transmissivity of the Culebra are represented in the Culebra T-field generation and calibration process.

<sup>a</sup> There have been no technical changes to this information since the CRA-2004, other than the correction of errors.

3

**Table 25-2. FEPs Screened In According to 40 CFR § 194.25(b)<sup>a</sup> (Continued)**

<b>EPA FEP I.D.</b>	<b>FEP Name</b>	<b>Issue</b>	<b>Screening Classification</b>	<b>Method of Representation In PA</b>
N23	<b><i>Saturated Groundwater Flow</i></b>	Groundwater flow beneath the water table is important to disposal system performance.	UP	Groundwater flow is represented by the Culebra T fields.
N24	<b><i>Unsaturated Groundwater Flow</i></b>	The presence of air or other gas phases may influence groundwater flow.	UP	Unsaturated flow is a precursor to recharge to the Culebra, which is accounted for in the boundary conditions for the Culebra T fields.
N25	<b><i>Fracture Flow</i></b>	Groundwater may flow along fractures as well as through interconnected pore space.	UP	Fracture flow is represented by the dual-porosity Culebra transport model.
N27	<b><i>Effects of Preferential Pathways</i></b>	Groundwater flow may not be uniform, and may occur along particular pathways.	UP	Preferential pathways are accounted for in the calibration of Culebra T fields to transient hydraulic test responses.
N33	<b><i>Groundwater Geochemistry</i></b>	Groundwater geochemistry influences actinide retardation and colloid stability.	UP	Salado and Castile brine geochemistry are accounted for in actinide solubility values. Culebra brine geochemistry is accounted for in the retardation factors used in PA calculations of actinide transport.
N39	<b><i>Physiography</i></b>	The physiography of the area is a control on the surface water hydrology.	UP	Relevant aspects of the physiography are incorporated in the Culebra T fields.
N53	<b><i>Groundwater Discharge</i></b>	The amount of water leaving the groundwater system to rivers, springs, and seeps affects the groundwater hydrology.	UP	Groundwater discharge is accounted for in the boundary conditions for the Culebra T fields.
N54	<b><i>Groundwater Recharge</i></b>	The amount of water passing into the saturated zone affects the groundwater hydrology.	UP	Groundwater recharge is accounted for in the boundary conditions for the Culebra T fields.
N55	<b><i>Infiltration</i></b>	The amount of water entering the unsaturated zone controls groundwater recharge.	UP	Infiltration is accounted for in the boundary conditions for the Culebra T fields.

<sup>a</sup> There have been no technical changes to this information since the CRA-2004, other than the correction of errors.

1

**Table 25-2. FEPs Screened In According to 40 CFR § 194.25(b)<sup>a</sup> (Continued)**

EPA FEP I.D.	FEP Name	Issue	Screening Classification	Method of Representation In PA
N56	<b><i>Changes in Groundwater Recharge and Discharge</i></b>	Changes in climate and drainage pattern may affect the amount of water entering and leaving the groundwater system.	UP	Changes in groundwater recharge and discharge are accounted for in the Climate Index factor.
N59	<b><i>Precipitation (e.g., Rainfall)</i></b>	Rainfall is the source of water for infiltration and stream flow.	UP	Future variations in precipitation are accounted for in the Climate Index factor.
N60	<b><i>Temperature</i></b>	The temperature influences how much precipitation evaporates before it reaches streams or enters the ground.	UP	Future variations in temperature are accounted for in the Climate Index factor.
N61	<b><i>Climate Change</i></b>	Temperature and precipitation will vary as natural changes in the climate take place.	UP	Future climate change is accounted for in the Climate Index factor.

<sup>a</sup> There have been no technical changes to this information since the CRA-2004, other than the correction of errors.

2

3 **25.7 References**

4 Clayton, D.J. 2008. *Analysis Plan for the Performance Assessment for the 2009 Compliance*  
 5 *Recertification Application* (Revision 1). AP-137. ERMS 547905. Carlsbad, NM: Sandia  
 6 National Laboratories.

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

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

13 U.S. Environmental Protection Agency (EPA). 1996. “40 CFR Part 194: Criteria for the  
 14 Certification and Recertification of the Waste Isolation Pilot Plant’s Compliance with the 40  
 15 CFR Part 191 Disposal Regulations; Final Rule.” *Federal Register*, vol. 61 (February 9, 1996):  
 16 5223–45.

17 U.S. Environmental Protection Agency (EPA). 1998a. “CARD No. 25: Future State  
 18 Assumptions.” *Compliance Application Review Documents for the Criteria for the Certification*  
 19 *and Recertification of the Waste Isolation Pilot Plant’s Compliance with the 40 CFR Part 191*

- 1 *Disposal Regulations: Final Certification Decision* (May) (pp. 25-1 through 25-14).  
2 Washington, DC: Office of Radiation and Indoor Air.
- 3 U.S. Environmental Protection Agency (EPA). 1998b. “40 CFR Part 194: Criteria for the  
4 Certification and Recertification of the Waste Isolation Pilot Plant’s Compliance with the 40  
5 CFR Part 191 Disposal Regulations: Certification Decision; Final Rule.” *Federal Register*, vol.  
6 63 (May 18, 1998): 27353–406.
- 7 U.S. Environmental Protection Agency (EPA). 2006a. *Technical Support Documents for*  
8 *Sections 194.25, 194.32, and 194.33: Compliance Recertification Application Review of*  
9 *Features, Events, and Processes* (March). Washington, DC: Office of Radiation and Indoor Air.
- 10 U.S. Environmental Protection Agency (EPA). 2006b. “Recertification CARD No. 25: Future  
11 State Assumptions.” *Compliance Application Review Documents for the Criteria for the*  
12 *Certification and Recertification of the Waste Isolation Pilot Plant’s Compliance with the 40 CFR*  
13 *191 Disposal Regulations: Final Recertification Decision* (March) (pp. 25-1 through 25-5).  
14 Washington, DC: Office of Radiation and Indoor Air.
- 15 U.S. Environmental Protection Agency (EPA). 2006c. “40 CFR Part 194: Criteria for the  
16 Certification and Recertification of the Waste Isolation Pilot Plant’s Compliance with the 40  
17 CFR Part 191 Disposal Regulations: Recertification Decision” (Final Notice). *Federal Register*,  
18 vol. 71 (April 10, 2006): 18010-021.