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

Consideration of Protected Individual and Exposure Pathways (40 CFR §§ 194.51 and 194.52)

United States Department of Energy
Waste Isolation Pilot Plant

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Carlsbad, New Mexico

Compliance Recertification Application 2014
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(40 CFR §§ 194.51 and 194.52)

Table of Contents

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Acronyms and Abbreviations

CARD	Compliance Application Review Document
CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CRA	Compliance Recertification Application
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
mrem	millirem
PA	performance assessment
pCi/L	picocuries per liter
USDW	underground source of drinking water
WIPP	Waste Isolation Pilot Plant

Elements and Chemical Compounds

Ra	radium

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51.0 Consideration of Protected Individual and Exposure Pathways (40 CFR §§ 194.51 and 194.52)

51.1 Requirements

> §194.51 Consideration of Protected Individual and Exposure Pathways
> Compliance assessments that analyze compliance with §191.15 of this chapter shall assume that an individual resides at the single geographic point on the surface of the accessible environment where that individual would be expected to receive the highest dose from radionuclide releases from the disposal system.
>
> §194.52 Consideration of Protected Individual and Exposure Pathways
> In compliance assessments that analyze compliance with §191.15 of this chapter, all potential exposure pathways from the disposal system to individuals shall be considered. Compliance assessments with part 191, subpart C and §191.15 of this chapter shall assume that individuals consume 2 liters per day of drinking water from any underground source of drinking water in the accessible environment.

51.2 Background

40 CFR §§ 194.51 and 194.52 (U.S. EPA 1996) of the Waste Isolation Pilot Plant (WIPP) certification criteria implement the individual protection requirements of 40 CFR § 191.15 and the groundwater protection standards of 40 CFR Part 191 Subpart C (U.S. EPA 1993). Section 194.51 requires the U.S. Department of Energy (DOE) to assume in its compliance assessments that an individual resides at the point where the dose from radionuclide releases from the WIPP would be greatest. Section 194.52 requires the DOE to consider in its compliance assessments all the potential exposure pathways for radioactive contaminants from the WIPP. Compliance with sections 194.51 and 194.52 is addressed in this single section because the criteria are closely related.

Assessment of the likelihood that the WIPP will meet the individual dose limits and radionuclide concentration limits for groundwater is conducted through a process known as compliance assessment. Compliance assessment uses methods similar to those of the performance assessment (PA) for the containment requirements, but is required to address only undisturbed performance of the disposal system. That is, compliance assessment does not include human intrusion scenarios (i.e., drilling or mining for resources). Compliance assessment can be considered a “subset” of PA.

The U.S. Environmental Protection Agency (EPA) incorporated requirements in 40 CFR Part 191 for the protection of individuals and 40 CFR 141 for the protection of groundwater. The individual protection requirements of Part 191 limit annual committed effective doses of radiation to members of the public to no more than 15 millirem (mrem). This requirement is concerned with human exposure to radionuclides from disposal systems for 10,000 years. These criteria address the definition of a protected individual, the consideration of exposure pathways, the consideration of underground sources of drinking water (USDWs), the scope of compliance assessments, and the basis for determining compliance with the Individual Protection Standards (U.S. EPA 1996).

51.3 1998 Certification Decision

To obtain the EPA's 1998 certification decision, the DOE was required to demonstrate a reasonable expectation that the potential releases from the undisturbed repository will result in radiation doses lower than the dose limit of 15 mrem per year, as established by section 191.15. This demonstration incorporated the provisions of sections 194.51 and 194.52, which require the DOE to identify the location of maximum potential exposure for an individual on the surface, consider all potential exposure pathways, and assume that drinking water from any contaminated underground source is consumed at the rate of two liters per day.

To demonstrate a reasonable expectation that the undisturbed performance of the WIPP will not exceed 15 mrem per year, the DOE showed that even a highly improbable, conservative case will meet the regulatory requirements, thereby suggesting that any more probable case must also be in compliance. The DOE referred to this approach as a "bounding" dose calculation because it identified an upper bound to possible exposures. The DOE's analysis is presented in the Compliance Certification Application (CCA) (U.S. DOE 1996), Chapter 8.0, Section 8.1.2.2. Supplemental analyses were also performed and are described in U.S. DOE 1997.

In the DOE's analysis, an individual receives the highest dose if one assumes that the individual consumes drinking water directly from a well in the Salado Formation located at the WIPP Land Withdrawal Boundary. The DOE assumed that an individual would receive the maximum estimated dose regardless of location on the surface and calculated the resultant doses accordingly. The EPA found this approach to be conservative and found the DOE in compliance with section 194.51.

To demonstrate compliance with section 194.52, the DOE had to assume that an individual consumes two liters per day of drinking water from any USDW from the Salado outside the WIPP controlled area. The DOE considered three ingestion pathways and one inhalation pathway:

- An individual consumes drinking water directly from the Salado.
- An individual ingests plants irrigated with contaminated water.
- An individual ingests milk and beef from cattle that consumed water from a stock pond that contained contaminated water from the Salado.
- An individual inhales dust from soil irrigated with contaminated water from the Salado.

Intended to result in the maximum dose, the DOE's assumption that water is ingested directly from the Salado is conservative, because Salado water is highly saline and would have to be greatly diluted to function as drinking or irrigation water.

The EPA determined that the DOE complied with section 194.52 because the DOE considered all potential exposure pathways and assumed that an individual consumes two liters of Salado water per day, following dilution to make the water usable (U.S. EPA 1998a).

A complete description of the EPA's 1998 Certification Decision for sections 194.51 and 194.52 is provided in the EPA's final certification decision (U.S. EPA 1998a) and in U.S. EPA Compliance Application Review Document (CARD) 51/52 (U.S. EPA 1998b).

51.4 Changes in the CRA-2004

In its 2004 Compliance Recertification Application (CRA-2004) (U.S. DOE 2004), the DOE did not report any significant changes to the information on which the EPA based its 1998 certification decision of compliance with the requirements of sections 194.51 and 194.52.

The compliance assessment combines the results of the PA (for the undisturbed case) with the dose calculation. The DOE did not modify the CCA dose-bounding calculations for the compliance assessment in the CRA-2004. Releases predicted by the CRA-2004 PAs are less than or similar to those predicted by the CCA PA results; therefore, the EPA concurred that the CCA dose bounding calculations did not need to be reexecuted for the CRA-2004 compliance assessment.

51.5 EPA's Evaluation of Compliance for the 2004 Recertification

Based on the EPA's review of the activities and conditions in and around the WIPP site, the EPA did not identify any significant changes in the consideration of the protected individual and exposure pathways (see the CRA-2004, Chapter 8.0). The EPA concluded that the CRA-2004 adequately describes the location of the protected individual and the potential exposure pathways (CARD 51/52, U.S. EPA 2006a).

During its review of the CRA-2004, the EPA received no public comments on the DOE's continued compliance with the certification criteria of sections 194.51 and 194.52.

Based on a review and evaluation of the CRA-2004 and supplemental information provided by the DOE, the EPA determined that the DOE continued to comply with the requirements of sections 194.51 and 194.52 (U.S. EPA 2006a and U.S. EPA 2006b).

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

In support of the CRA-2009 (U.S. DOE 2009), the DOE reviewed and updated information provided in the CCA and the CRA-2004, Chapter 8.0, Individual and Groundwater Protection Requirements. The updated material was provided as Appendix IGP-2009. Changes or new information pertaining to the update are listed below.

1. The CRA-2009 evaluation showed that with undisturbed performance, only 1 of the 300 modeling system realizations resulted in radionuclide concentrations greater than zero reaching the accessible environment through the anhydrite interbeds in the Salado. The remaining 299 realizations showed no radionuclides reaching the accessible environment during the 10,000-year period (Appendix PA-2009, Section PA-7.2). In the case of the single realization showing releases to the accessible environment, the resulting calculated dose was an order of magnitude less than the value reported in the CCA (Appendix IGP-2009, Section

IGP-2.1). Accordingly, the CCA calculations bound the CRA-2009 results and demonstrated continued compliance with the 40 CFR § 191.15(a) individual protection standard (see Appendix IGP-2009, Section IGP-1.0).

2. To update the evaluation of the presence of any USDW at or near the WIPP, information pertaining to several new boreholes was presented in Appendix IGP-2009. Relevant data pertaining to total dissolved solids concentrations and water pumping rates were provided. An evaluation of the data from the new boreholes resulted in no new or changed conclusions regarding the presence of USDWs in the WIPP vicinity (see Appendix IGP-2009, Section IGP 3.2).

3. An updated evaluation of maximum potential radium-226 (^{226}Ra) and ^{228}Ra concentrations was provided in Appendix IGP-2009. The results of this evaluation indicated that the maximum concentration at the accessible environment boundary would be well below the 5-picocurie-per-liter (pCi/L) regulatory limit imposed by 40 CFR 141.66(b); therefore, continued compliance with the 40 CFR § 191 Subpart C groundwater protection standard was demonstrated (see Appendix IGP-2009, Section IGP-3.3.2).

4. For the CRA-2009 evaluation, the gross alpha particle activity, including ^{226}Ra and excluding radon and uranium at the boundary of the accessible environment, was expected to be essentially 0.07 pCi/L (equivalent to the concentration calculated for the CRA-2004). This compared with the standard imposed by 40 CFR 141.66(c) of 15 pCi/L. Continued compliance with the 40 CFR 191 Subpart C groundwater protection standard was demonstrated (see Appendix IGP-2009, Section IGP-3.3.3).

5. For the CRA-2009 evaluation, the maximum radionuclide concentration in the accessible environment was one order of magnitude less than the maximum bounding CCA value (Appendix IGP-2009, Section IGP-2.1). As such, resulting doses for the CRA-2009 case would be correspondingly lower and continued compliance with the 40 CFR § 191.15(a) annual dose equivalent standard was demonstrated (see Appendix IGP-2009, Section IGP-3.3.4).

6. The CCA compliance assessments assumed that an individual resides at the single geographic point on the surface of the accessible environment where that individual would be expected to receive the highest dose of radionuclide releases from the disposal system. Potential releases calculated for the CRA-2009 compliance assessment are less than those calculated for the CCA. Therefore the CCA dose calculation is bounding, and a new dose calculation was unnecessary for the CRA-2009 (see Appendix IGP-2009, Section IGP 4.0).

7. The CCA and CRA-2009 compliance assessments evaluated all potential exposure pathways from the disposal system to individuals. The assessments also included an assumption that individuals consume two liters per day of drinking water from any USDW in the accessible environment (see Appendix IGP-2009, Section IGP-2.2.2).

The DOE continued to comply with the provisions of sections 194.51 and 194.52 (see Appendix IGP-2009, Section IGP-4.0).

51.7 EPA's Evaluation of Compliance for the 2009 Recertification

Based on the EPA's review of the CRA-2009 and activities and conditions in and around the WIPP site, the EPA did not identify any significant changes in the consideration of the protected individual and exposure pathways. The EPA concluded that the CRA-2009 adequately describes the location of the protected individual and the potential exposure pathways (CARD 51/52, U.S. EPA 2010a).

During its review of the CRA-2009, the EPA received no public comments on the DOE's continued compliance with the certification criteria of sections 194.51 and 194.52.

Based on a review and evaluation of the CRA-2009 and supplemental information provided by the DOE, the EPA determined that the DOE continued to comply with the requirements of sections 194.51 and 195.52 (U.S. EPA 2010a and U.S. EPA 2010b).

51.8 Changes or New Information Since the CRA-2009

In support of the CRA-2014, the DOE reviewed and updated information provided in the CCA and previous CRA's sections relating to Individual and Groundwater Protection Requirements. The updated material is provided in Appendix IGP-2014. Changes or new information pertaining to the update are listed below.

1. The CRA-2014 evaluation showed that for the undisturbed performance scenario, none of the 300 modeling system realizations resulted in radionuclide concentrations greater than zero reaching the accessible environment through the anhydrite interbeds in the Salado Formation over the 10,000-year compliance period (Appendix PA-2014, Section PA-7.2). As with all previous CRAs, the CCA calculations bound the CRA-2014 results and are used to demonstrate continued compliance with the 40 CFR § 191.15(a) individual protection standard (see Appendix IGP-2014, Section IGP-1.0).

2. Because there were no realizations with concentrations greater than zero reaching the accessible environment, an updated evaluation of maximum potential ^{226}Ra and ^{228}Ra concentrations was unnecessary and was not provided in Appendix IGP-2014. Therefore, the PA results demonstrate continued compliance with the 40 CFR § 141.66(b) groundwater protection standard because they are below the 5-pCi/L regulatory limit (see Appendix IGP-2014, Section IGP-3.3.2).

3. For the CRA-2014 evaluation, the gross alpha particle activity, including ^{226}Ra and excluding radon and uranium at the boundary of the accessible environment, was zero. Continued compliance with the groundwater protection standard limit defined in 40 CFR § 141.66(c) of 15 pCi/L was demonstrated (see Appendix IGP-2014, Section IGP-3.3.3).

4. The bounding CCA compliance assessments assumed that an individual resides at the single geographic point on the surface of the accessible environment where that individual would be expected to receive the highest dose of radionuclide releases from the disposal system. Potential releases calculated for the CRA-2014 compliance assessment are zero and therefore less than those calculated for the CCA. As has been done for all previous CRAs, the CCA

dose calculation is used as the bounding case and a new dose calculation is unnecessary for the CRA-2014 (see Appendix IGP-2014, Section IGP 4.0).

5. The bounding CCA compliance assessments evaluate all potential exposure pathways from the disposal system to individuals. The assessments also included an assumption that individuals consume two liters per day of drinking water from any USDW in the accessible environment (see Appendix IGP-2009, Section IGP-2.2.2).

The DOE believes the information provided in this section demonstrates continued compliance with the requirements of 40 CFR 194.51 and 194.52 (see Appendix IGP-2014, Section IGP-4.0).

51.9 References

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

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