40 CFR Part 191
Subparts B and C
Compliance Recertification Application 2026
for the
Waste Isolation Pilot Plant

Engineered Barriers
(40 CFR 194.44)

United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

Compliance Recertification Application 2026
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ACRONYMS AND ABBREVIATIONS

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
WIPP	Waste Isolation Pilot Plant

ELEMENTS AND CHEMICAL COMPOUNDS

MgO	magnesium oxide

44.0 ENGINEERED BARRIERS (40 CFR 194.44)

44.1 Requirements

§ 194.44 Engineered Barriers

(a) Disposal systems shall incorporate engineered barrier(s) designed to prevent or substantially delay the movement of water or radionuclides toward the accessible environment.

(b) In selecting any engineered barrier(s) for the disposal system, the Department shall evaluate the benefit and detriment of engineered barrier alternatives, including but not limited to: Cementation, shredding, supercompaction, incineration, vitrification, improved waste canisters, grout and bentonite backfill, melting of metals, alternative configurations of waste placements in the disposal system, and alternative disposal system dimensions. The results of this evaluation shall be included in any compliance application and shall be used to justify the selection and rejection of each engineered barrier evaluated.

(c) (1) In conducting the evaluation of engineered barrier alternatives, the following shall be considered, to the extent practicable:

(i) The ability of the engineered barrier to prevent or substantially delay the movement of water or waste toward the accessible environment;

(ii) The impact on worker exposure to radiation both during and after incorporation of engineered barriers;

(iii) The increased ease or difficulty of removing the waste from the disposal system;

(iv) The increased or reduced risk of transporting the waste to the disposal system;

(v) The increased or reduced uncertainty in compliance assessment;

(vi) Public comments requesting specific engineered barriers;

(vii) The increased or reduced total system costs;

(viii) The impact, if any, on other waste disposal programs from the incorporation of engineered barriers (e.g., the extent to which the incorporation of engineered barriers affects the volume of waste);

(ix) The effects on mitigating the consequences of human intrusion.

(2) If, after consideration of one or more of the factors in paragraph (c)(1) of this section, the Department concludes that an engineered barrier considered within the scope of the evaluation should be rejected without evaluating the remaining factors in paragraph (c)(1) of this section, then any compliance application shall provide a justification for this rejection explaining why the evaluation of the remaining factors would not alter the conclusion.

(d) In considering the ability of engineered barriers to prevent or substantially delay the movement of water or radionuclides toward the accessible environment, the benefit and detriment of engineered barriers for existing waste already packaged, existing waste not yet packaged, existing waste in need of re-packaging, and to-be-generated waste shall be considered separately and described.

(e) The evaluation described in paragraphs (b), (c) and (d) of this section shall consider engineered barriers alone and in combination.

44.2 Background

Title 40 Code of Federal Regulations (CFR) 194.44 (U.S. EPA 1996) implements the assurance requirement of 40 CFR 191.14(d) (U.S. EPA 1993) by requiring the Waste Isolation Pilot Plant

(WIPP) design to include one or more engineered barriers. To meet this requirement, the U.S. Department of Energy (DOE) performed an Engineered Alternatives Cost/Benefit Study to examine the benefits and detriments associated with an array of engineered barrier alternatives (Compliance Certification Application [CCA] Appendix EBS; (U.S. DOE 1996). Based on the results of these studies, the DOE proposed four engineered barriers in the CCA: shaft seals, panel closures, magnesium oxide (MgO), and borehole plugs. The U.S. Environmental Protection Agency (EPA) specified MgO as the only engineered barrier because it considered panel closures, shaft seals, and borehole plugs to be part of the disposal-system design. The WIPP continues to rely on MgO as its sole engineered barrier.

The 2019 Compliance Recertification Application (CRA-2019) (U.S. DOE 2019) reflects the EPA's determination that only MgO backfill meets the requirements for an engineered barrier. The EPA did not receive any public comments on the DOE's continued compliance with the requirements of section 194.44. Based on a review and evaluation of the CRA-2019 documentation, the EPA concluded that the DOE continued to comply with the requirements of 40 CFR 194.44 (U.S. EPA 2022).

Information and data from previous compliance certification and recertification applications, which form the basis of past DOE compliance positions, are found in the CRA-2019 (U.S. DOE 2019).

44.3 Changes or New Information since the CRA-2019

The DOE has not changed the implementation of MgO as an engineered barrier in the WIPP repository since the CRA-2019. The DOE continues to maintain the MgO excess factor at 1.2, where, on average, 1.2 moles of MgO are emplaced for every mole of organic carbon present in the waste disposed in the WIPP. Any information relating to the emplacement of MgO, hydration tests, and related experimental studies that have occurred since the CRA-2019 is found in Appendix MgO-2026. Additionally, the CCA analysis, which evaluated the benefits and detriments of engineered barrier alternatives, continues to demonstrate compliance with the requirements of 40 CFR 194.44.

44.4 References

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

U.S. Department of Energy (U.S. DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant (October). Carlsbad, NM: Carlsbad Area Office. DOE/CAO-1994-2184.

U.S. DOE. 2019. Title 40 CFR Part 191 Subparts B and C Compliance Recertification Application for the Waste Isolation Pilot Plant, Carlsbad, NM: Carlsbad Field Office. DOE/WIPP-2019-3609.*

U.S. Environmental Protection Agency (U.S. 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): 66398–66416.

U.S. 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): 5223–5245.

U.S. EPA. 2022. Section 44 Engineered Barriers. 2019 Compliance Recertification Application Review Document (CARD) (April) (p. 66). Washington, DC: Office of Radiation and Indoor Air.*