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date: *April 7, 2025*

to: *WIPP Records Center*

from: *Sarah Brunell, 8881*

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Date: 2025.04.07 14:12:46 -06'00'

subject: *Update to CRA-2026 PA Input Parameters Due to Revised WIPP Repository Dimensions*

SUMMARY

The purpose of this memo is to provide updated values related to the Waste Isolation Pilot Plant (WIPP) repository dimensions for the 2026 Compliance Recertification Application (CRA-2026) performance assessment (PA). This includes revisions to the PA input parameters that define the area of contact-handled (CH) waste (REFCON:AREA_CH), the excavated storage volume of the repository (REFCON:VREPOS), the fraction of the repository volume occupied by CH waste (REFCON:FVW), the area of the berm placed over the waste panels (REFCON:ABERM), and the minimum volume of brine in the repository required for a direct brine release (DBR) to occur (GLOBAL:DBRMINBV). Additionally, an updated disturbed rock zone (DRZ) volume for the interim state repository is calculated for use in actinide solubility assessments. This memo fulfills Task 4 and Task 5 as outlined in the Analysis Plan for the 2026 WIPP Compliance Recertification Performance Assessment (AP-214) (Hansen et al., 2025). A Microsoft Excel spreadsheet, "CRA26_RepositoryParameters.xlsx", which is archived at /data/cvs/CVSLIB/WIPP_EXTERNAL/ap214, provides details of the calculations.

UPDATED REPOSITORY DIMENSIONS

The WIPP was initially certified as a repository consisting of 10 panels, which were excavated for the placement and long-term storage of waste. In March 2024, the Department of Energy (DOE) submitted the Replacement Panels Planned Change Request (RPPCR) to seek Environmental Protection Agency (EPA) approval for waste emplacement in two new panels, referred to as replacement panels, located to the west of the existing operations area (Bollinger, 2024). The 12-panel repository design is illustrated in Figure 1. It is anticipated that the EPA will approve the RPPCR prior to the submission of CRA-2026, establishing the 12-panel repository design as the basis for recertification in the CRA-2026 PA (EPA, 2025).

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However, the addition of two replacement panels is not expected to provide sufficient capacity for the disposal of the allowable waste volume designated for WIPP under the Land Withdrawal Act (LWA). Therefore, the 12-panel representation is considered an interim state of the repository. The DOE may seek approval for waste disposal in up to seven additional panels to accommodate the entire allowable volume of waste. This 19-panel representation, depicted in Figure 2, is regarded as the anticipated final state of the repository. PA calculations for the final state repository will be submitted as a separate analysis for the CRA-2026 PA.

Parameter updates related to the 19-panel repository were initially defined in Brunell (2020), with further refinements made in subsequent analyses. Most recently, the dimensions for the final state repository have been updated in Day (2025) based on as-mined data, necessitating additional updates to values related to repository dimensions. A summary of the revised parameter values concerning repository dimensions is provided in Table 1.

In WIPP PA, the available storage area for CH waste is represented by the parameter REFCON:AREA_CH (AREA_CH). For each repository configuration, the floor area for each panel calculated in Day (2025) is summed to determine the total storage area. For the 12-panel repository, **AREA_CH = 141,511 m^2**. For the 19-panel repository, **AREA_CH = 228,582 m^2**.

The excavated storage volume of the repository, REFCON:VREPOS (VREPOS), is determined as the product of the storage area of the repository and the height of the repository. The storage area is equivalent to the value of AREA_CH, and the height of the repository is presented in Day (2025) as 3.9624 m. The volume for the interim state repository is then **VREPOS = 560,722.29 m^2**, and the volume of the final state repository is **VREPOS = 905,734.49 m^2**.

REFCON:FVW (FVW) is defined as the fraction of the repository volume occupied by CH waste. The maximum CH waste volume, 168,500 m^3, is defined by the Land Withdrawal Act and is recorded as the parameter REFCON:VOLCHW. The value of FVW for each repository configuration was calculated by dividing REFCON:VOLCHW by the volume of the repository. For the final state repository, the updated value of **FVW = 0.186**.

For the interim state repository, the full land withdrawal act volume of waste cannot fit in the 12 waste panels and a reduced inventory volume will be used. This inventory will have a CH waste volume of 156,247.12 m^3 (Ward, 2025). This gives a value of **FVW = 0.279** for the interim state repository.

The PA parameter REFCON:ABERM (ABERM) represents the area of the berm placed over the waste panels. This value is not updated from the RPPCR for the final state repository, as this value is not expected to be impacted by the differences in repository volumes described in Day (2025). The interim state repository value for ABERM is calculated directly based on information contained in Section 5.0 of the RPPCR (Bollinger, 2024), which provides the dimensions of the berm for each section of the repository footprint. The surface area of the original 10-panel footprint is stated as being approximately 875 m by 720 m, and the surface area of the 2-panel replacement panel footprint is stated as 317 m by 369 m. The combined surface area of the interim state repository footprint is therefore **ABERM = 750,000 m^2**.

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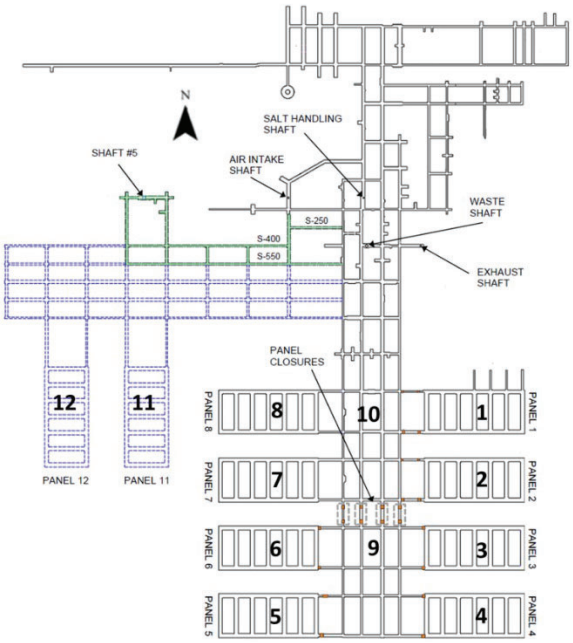

Figure adapted from Figure 1 of Bollinger (2024).

Figure 1. Representation of a 12-Panel Interim State WIPP Repository

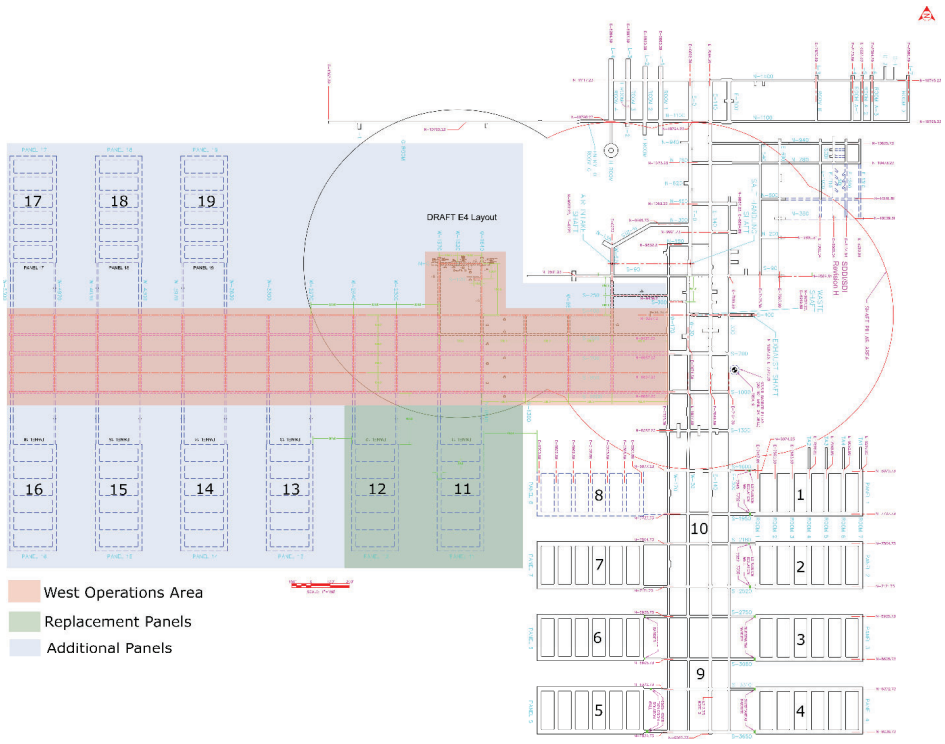

Figure derived from Sjomeling (2019).

Figure 2. Anticipated Representation of a 19-Panel Final State WIPP Repository

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MINIMUM BRINE VOLUME

Actinide solubility calculations for the WIPP PA depend on the concentration of various constituents in brine, which is influenced by the volume of brine available for dissolution. With sufficient repository pressure and brine saturation, a Direct Brine Release (DBR) may occur due to a borehole intrusion into a waste panel within the repository. The input parameter GLOBAL:DBRMINBV, referred to as DBRMINBV, represents the minimum volume of brine required in the repository for a DBR to occur. This memo presents an update to DBRMINBV based on the work of Docherty (2024), which incorporated results from updated geomechanical modeling of WIPP disposal rooms. Docherty (2024) determined the value of DBRMINBV for a 19-panel final state repository using RPPCR repository volume as DBRMINBV = 9,608 m^3.

According to Equation 4 of Docherty (2024), DBRMINBV is calculated as the product of Lagrangian porosity (ϕ_L), volume of the repository (V_{repos}), and brine saturation S_b:

$$\text{DBRMINBV} = \phi_L \cdot V_{repos} \cdot S_b$$

For a DBR to occur, the brine saturation in the intruded waste panel must exceed the residual brine saturation of the waste, which is represented by the sampled parameter in the PA named WAS_AREA:SAT_RBRN. Previous calculations have established that the median value of WAS_AREA:SAT_RBRN is an appropriate choice for brine saturation (Stein 2005; Clayton 2006, 2008; King 2021; Docherty 2024). Since there have been no updates to the WAS_AREA:SAT_RBRN parameter, the previous value of S_b = 0.276 is used again here.

The value of Lagrangian porosity was calculated in Docherty (2024) based on the updated geomechanical modeling presented in Vignes et al. (2023). Since there have been no further updates to the geomechanical model, the previously calculated value of ϕ_L = 0.040798 is used again in this calculation.

When the previously established values of Lagrangian porosity (ϕ_L = 0.040798), brine saturation (S_b = 0.276), and interim state volume are substituted into the equation for DBRMINBV, the updated 12-panel value for **DBRMINBV = 6,314 m^3**.

With the updated value of VREPOS, an updated 19-panel DBRMINBV value can be calculated as 10,199 m^3. Thermodynamic database calculations of actinide solubilities for the final state analysis have already been executed using the 9,608 m^3 DBRMINBV value from Docherty (2024). Because DBRMINBV is used to set a window where actinide solubilities are calculated and small adjustments to this window will not impact the results of the performance assessment calculation, it is recommended to use **DBRMINBV = 9,608 m^3** from Docherty (2024) for the final state analysis. The updated values are summarized in Table 1.

TOTAL DRZ VOLUME

The volume of the DRZ, which is an input into the thermodynamic model used in the calculation of actinide solubilities, is also dependent on the excavated area of the repository. An updated total DRZ volume for the interim state repository is calculated following the methodology outlined in King (2021). The vertical extent of the DRZ is maintained at 11.95 m above the repository and

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2.23 m below it. With the updated parameter REFCON:AREA_CH (Table 1), the new total DRZ volume for the interim state repository is **2,006,623 m^3**.

Table 1. Summary of Updated Repository Parameters

Material	Property	RPPCR Value	CRA26 19-Panel Value	CRA26 12-Panel Value	Units
REFCON	ABERM	1,268,303	1,268,303	750,000	m^2
REFCON	AREA_CH	216,952	228,582	141,511	m^2
REFCON	FVW	0.197	0.186	0.279	-
REFCON	VREPOS	853,284.89	905,734.49	560,722.29	m^3
GLOBAL	DBRMINBV	33,804	9,608*	6,314	m^3

* As calculated by Docherty (2024)

REFERENCES

Bollinger, M. 2024. Letter to Lee Ann B. Veal. Subject: Planned Change Request for the use of Replacement Panels 11 and 12. March 12, 2024. Carlsbad, NM: U.S. Department of Energy Waste Isolation Pilot Plant, Carlsbad Field Office.

Brunell, S. 2020. Calculation of Parameter Values for the Additional Panels Performance Assessment (APPA). ERMS 574030. Carlsbad, NM: Sandia National Laboratories.

Clayton, D. J. 2006. Update of the minimum brine volume for a direct brine release and new maximum Castile and Salado brine volumes in a waste panel. Memorandum to L. H. Bush. October 11, 2006. ERMS 544453. Carlsbad, NM: Sandia National Laboratories.

Information Only

Clayton, D. J. 2008. Update to the calculation of the minimum brine volume for a direct brine release. Memorandum to L. H. Bush. April 2, 2008. ERMS 548522. Carlsbad, NM: Sandia National Laboratories.

Day, B. 2025. Memo to WIPP Records Center. Subject: BRAGFLO Grid Development for CRA-2026. March 19, 2025. EIMS-0004447000. Carlsbad, NM: Sandia National Laboratories.

Docherty, P. 2024. Memo to WIPP Records Center. Subject: Update to WIPP PA Parameter DBRMINBV. April 30, 2024. ERMS 581499. Carlsbad, NM: Sandia National Laboratories.

EPA. 2025. Performance Assessment Calculations Needed for 2026 Waste Isolation Pilot Plant Compliance Recertification Application (CRA-2026). Washington, D.C.: U.S. Environmental Protection Agency, Office of Radiation and Indoor Air.

Hansen, C., S. Brunell, B. Day, S. King, and J. Wilgus. 2025. Analysis Plan for the 2026 WIPP Compliance Recertificaiton Application Performance Assessment. AP-214. Carlsbad, NM: Sandia National Laboratories.

King, S. 2021. Memo to WIPP Records Center. Subject: Repository Volume, DRZ Volume, and minimum brine volume for a direct brine release for a repository with new panels. December 20, 2021. ERMS 576475. Carlsbad, NM: Sandia National Laboratories.

Sjomeling, D. 2019. "2:30 Meeting Information," an email to Paul Shoemaker with the attachment "West Mains and Panels peer review info Final 091219.pdf." October 17, 2019. ERMS 572682. Carlsbad, NM: Nuclear Waste Partnership, LLC.

Stein, J.S., 2005. Estimate of Volume of Brine in Repository that Leads to a Brine Release. Memorandum to L.H. Brush. April 13, 2005. ERMS 539372. Carlsbad, NM: Sandia National Laboratories.

Vignes, C., J. Bean, and B. Reedlunn. 2023. Improved Modeling of Waste Isolation Pilot Plant Disposal Room Porosity. SAND2023-04826. Albuquerque, NM: Sandia National Laboratories.

Ward, A. 2025. Performance Assessment Inventory for Analysis of a 12-Panel Repository Configuration. Letter to Bill McInroy. March 18, 2025. CBFO:ERCD:AW:RS:25-0197. Carlsbad, NM: Department of Energy Carlsbad Field Office.

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