Department of Energy
Carlsbad Field Office
P. O. Box 3090
Carlsbad, New Mexico 88221

August 21, 2024

Mr. Tom Peake, Director
Center for Waste Management and
Regulations
Radiation Protection Division
U.S. Environment Protection Agency
1200 Pennsylvania Avenue NW
Washington, D.C. 20460

Subject: Response 2 to the U.S. Environmental Protection Agency's Questions on the Replacement Panels Planned Change Request dated April 17, 2024, April 24, 2024, and May 10, 2024, from Tom Peake to Michael Gerle

Reference: 1) EPA letter from Tom Peake to Michael Gerle, dated April 17, 2024; Subject: First set of questions on the Replacement Panels Planned Change Request

2) EPA letter from Tom Peake to Michael Gerle, dated April 24, 2024; Subject: Second set of questions on the Replacement Panels Planned Change Request

3) EPA letter from Tom Peake to Michael Gerle dated May 10, 2024: Subject Third set of questions on the Replacement Panels Planned Change Request

Dear Mr. Peake:

In response to the U.S. Environmental Protection Agency's (EPA) questions on the Replacement Panels Planned Change Request (RPPCR) from the above-referenced letters dated April 17, 2024, April 24, 2024, and May 10, 2024, the U.S. Department of Energy (DOE) is responding to six of EPA's questions. The DOE will continue to submit phased responses to the EPA until all questions are addressed.

This submittal includes two enclosures:

- Enclosure 1: DOE's responses to six of EPA comments concerning the RPPCR
- Enclosure 2: Status report of DOE responses to EPA questions on the RPPCR. (The report is a table showing the status of all EPA questions received to date)

CBFO:ERCD:MG:SV:24-0422

Below are the six responses provided in Enclosure 1.

EPA Letter Date	EPA Question Number	EPA Question Description
April 17, 2024	RPPCR1-PROPMIC-1	Pu(III) PROPMIC and CAPMIC values
April 24, 2024	RPPCR2-12 Panel Analyses	12 Panel Analyses
May 10, 2024	RPPCR3-Closure-1	Closure of rooms with new design
April 17, 2024	RPPCR1-Inventory-1	Waste Characteristics
April 17, 2024	RPPCR1-DTAT0.FM6-1	Documentation for Hydromagnesite5424 Solubility
April 24, 2024	RPPCR2-DATA0.FM6-4	Omitted Pitzer interaction parameters

If you have any questions, please contact Dr. Anderson Ward at (575) 706-5291.

Sincerely,

MICHAEL GERLE

Digitally signed by MICHAEL GERLE
Date: 2024.08.21 05:26:16 -06'00'

Michael Gerle, Director
Environmental Regulatory
Compliance Division
Carlsbad Field office

Enclosures (2)

cc: w/enclosures
B. Forinash, CBFO *ED
M. Hall, CBFO ED
E. Garza, CBFO ED
G. Basabilvazo, CBFO ED
A. Ward, CBFO ED
*ED denotes electronic distribution

CBFO:ERCD:MG:SV:24-0422

Enclosure 1

Department of Energy Response 2 to EPA's Questions on the RPPCR

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RPPCR1-PROPMIC-1: Pu(III) PROPMIC and CAPMIC values

Please provide a quantitative assessment on how releases are impacted if the recommended Pu(III) values from Swanson and Lucchini (2023) are utilized for PA vectors that showed only Pu(III) releases. Lucchini and Swanson (2023) recommend a PROPMIC and CAPMIC value of 3.52 and 9.00×10^{-7} M, respectively, for Pu(III). Their recommended values for Pu(IV) are 0.3 and 1.22×10^{-9} M, respectively, and are also the values chosen for all Pu microbial colloids in the RPPCR (Table 4-20 of Brunnell et al. 2023).

The current microbial colloids approach in the PA is that colloid parameter values are element-specific. However, the values that have been recommended in Lucchini and Swanson (2023) also provide oxidation state specific Pu PROPMIC and CAPMIC parameters. Consequently, the RPPCR PA does not utilize a bounding Pu(III) microbial colloids parameter value and could be underestimating releases.

Brunnell, S., Bethune, J., Dochert, P., Kicker, D. Kim, S., King, S. Long, J. Zeitler, T. 2023. Summary Report for the 2023 Replacement Panels Planned Change Request Performance Assessment, Revision 0. Sandia National Laboratories, Carlsbad, NM. ERMS 579729.

Lucchini, J., Swanson, J. 2023. LANL ACRSP Parameter Recommendations for CRA-2024 Performance Assessment, Revision 0. Los Alamos National Laboratories, Carlsbad, NM. LCO-ACP-34.

DOE Response

The RPPCR PA used the Pu(IV) values for the element-specific Pu microbial colloid parameters as the Pu(IV) state is more likely to be realized in the RPPCR PA calculations. DOE believes these are the most realistic values to use given the element-specific parameter implementation in the PA model. King and Wilgus (2024) performed the quantitative assessment requested for the sensitivity to releases when using the Pu(III) microbial colloid parameter values for vectors that realize the low oxidation state of plutonium. The sensitivity analysis done by King and Wilgus (2024) includes one new PA calculation named PCR_MIC, based on the RPPCR PA. The only change from the RPPCR in PCR_MIC is the adjustment of plutonium microbial colloid parameter values for vectors that realize the Pu(III) oxidation state. King and Wilgus (2024) compare results from PCR_MIC to the RPPCR to demonstrate sensitivity. The results are described in detail in King and Wilgus (2024) and are summarized below.

The PCR_MIC results for Salado flow and direct release volumes are qualitatively indistinguishable from the RPPCR. Slight differences in distribution and values of mobile concentrations occur between the RPPCR and PCR_MIC with the most discernable difference being an increase of mean total mobile concentration in PCR_MIC at times past approximately 4,000 years after repository closure (Figure 1 [Figure 11 of King and Wilgus, recreated below]). Accordingly, differences in releases between PCR_MIC and the RPPCR are numerically small, demonstrating negligible sensitivity to the oxidation state-specific microbial colloid parameter values (Figure 2 and Table 1 [Figure 22 and Table 8 of King and Wilgus, recreated below]).

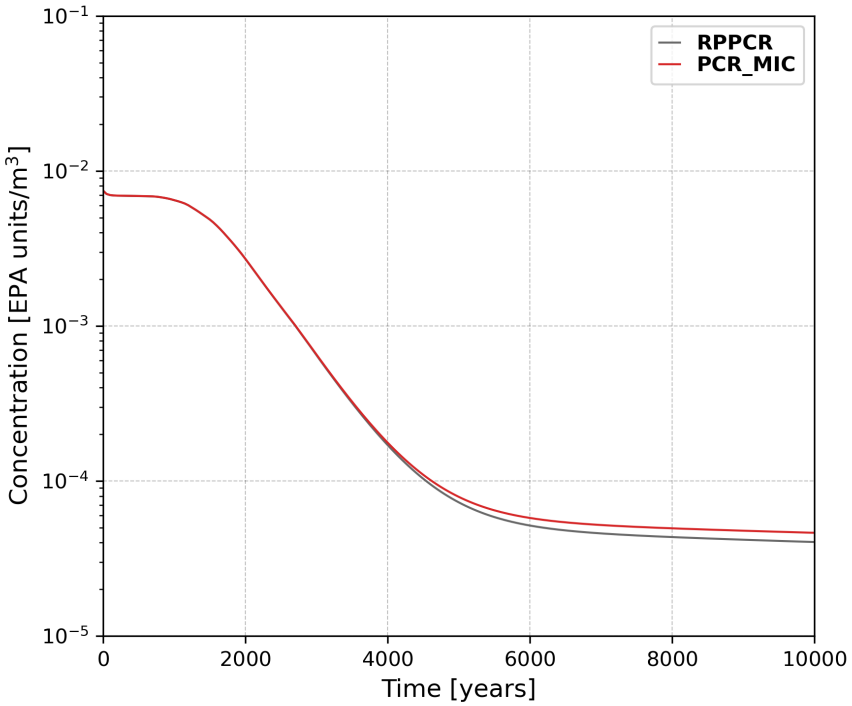

Figure 1. RPPCR1-PROPMIC-1: Mean Total Mobile Concentration Through Time
(Figure 11 from King and Wilgus, 2024. Pg 12)

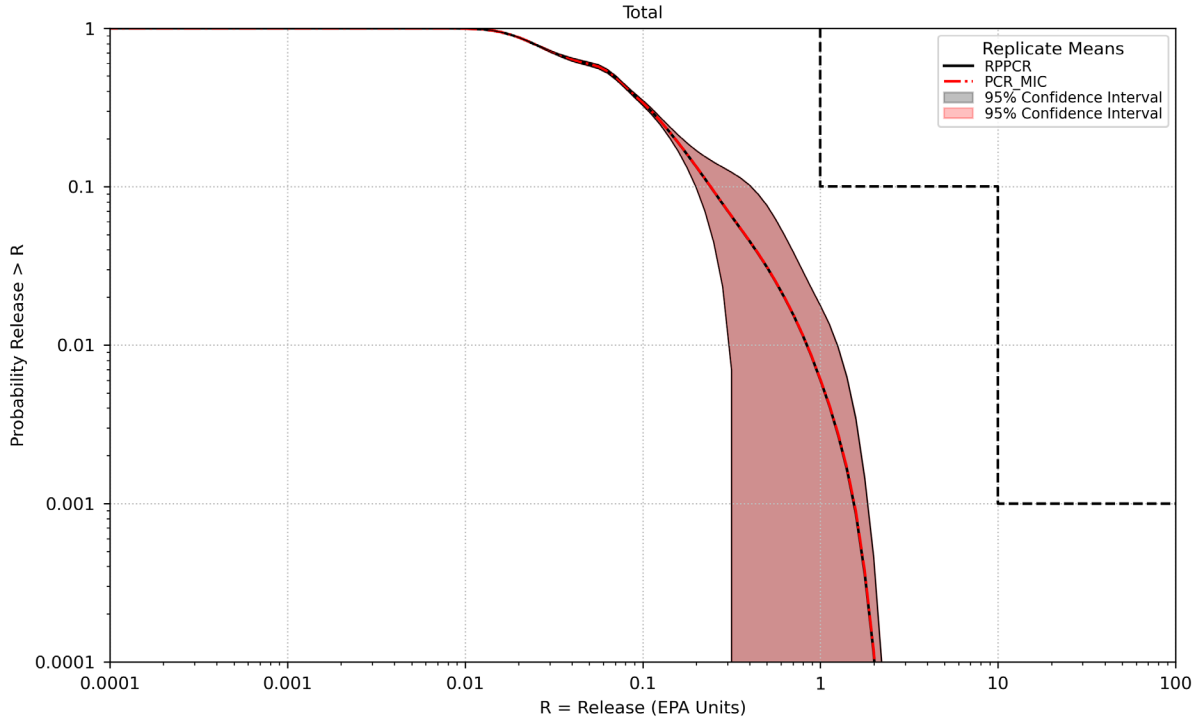

Figure 2. RPPCR1-PROPMIC-1: Total Releases (Three-Replicate Means)
(Figure 22 from King and Wilgus, 2024. Pg. 22)

Table 1. RPPCR1-PROPMIC-1: Statistics on the Mean Total Releases (Adapted from King and Wilgus, 2024)

Probability	Analysis	Mean Total Release	Lower 95% CL	Upper 95% CL	Release Limit
0.1	RPPCR	0.24	0.20	0.41	1
	PCR_MIC	0.24	0.20	0.41	
0.001	RPPCR	1.55	0.34	1.87	10
	PCR_MIC	1.56	0.34	1.88	

References RPPCR1-PROPMIC-1

King, S., and J. Wilgus. 2024. Plutonium Microbial Colloid Sensitivity Analysis. ERMS 581471. Carlsbad, NM: Sandia National Laboratories.

RPPCR2-12PanelAnalyses

EPA is interested in the possibility of using the individual panel releases shown in Figure 3 of ERMS 580656 Estimation of Releases from a 12-Panel Repository by Hansen et al. (2023) to estimate releases from a 12-panel repository. We have the following two questions:

1. Please provide a detailed explanation of how the individual panel releases shown in Figure 3 of ERMS 580656 were calculated, with accompanying conceptual descriptions and justifications.

2. Please provide an explanation of how the individual panel releases shown in Figure 3 of ERMS 580656 accumulate to yield the combined releases of all 19 panels shown in Figure 4-43 of ERMS 581044 (the RPPCR PA).

Hansen, C., Brunell, S., King, S. (2023). Estimation of Releases from a 12-Panel Repository, Revision 0. Sandia National Laboratories, Carlsbad, NM. ERMS 580656.

DOE Response

1. Figure 3 of Hansen et al. (2023a) shows per-panel releases constructed using output from the RPPCR PA (Brunell et al. 2023). When the PA code CCDFGF is simulating intrusions for a random future, it assigns each intrusion to a waste panel based on the waste panel intrusion probabilities (Table 6 of Hansen et al. 2023b). In a standard PA calculation, releases from all future intrusions into all panels are summed together. In Hansen et al. (2023a) individual panel releases are obtained by summing releases from each panel independently. Conceptually the calculation of releases from each intrusion has not been changed for the individual panel releases; only the summing of releases before creation of the CCDFs has been changed.

   Mechanically, this calculation is done with CCDFGF's option of writing to a text-based, structured diagnostic output file (Brunell 2022). This text file can be very large; the diagnostic file for Replicate 1 of the RPPCR is approximately 133 GB. The diagnostic file contains information for each intrusion in a future, including the intrusion time, the intruded panel number, intrusion type (i.e., whether a brine pocket was encountered), and releases resulting from each direct release mechanism (e.g., cuttings and cavings, spallings, or direct brine release). Figure 3 below shows an example of the data recorded for three randomly selected intrusions, intrusion numbers 60, 61, and 62, in Replicate 1, Vector 1, Future 1 of the RPPCR.

```
OBS    1, FUTURE      1, DRILL INTRUSION  60, TIME(YR)=4.012E+03,  PANEL 13 (OTHER )
     PLUG PATTERN 3, DRILL DIAM(M)=(3.111E-01)
     NONEXCAVATED, NO BRINE POCKET HAS
     NO CUTTINGS, SPALLINGS, OR DBR RELEASES

OBS    1, FUTURE      1, DRILL INTRUSION  61, TIME(YR)=4.057E+03,  PANEL  1 (UPPER )
     PLUG PATTERN 3, DRILL DIAM(M)=(3.111E-01)
     EXCAVATED    , NO BRINE POCKET HAS
          CUTTINGS RELEASE
     CH WASTE, A(M2)=7.604E-02, HT(M)=3.960E+00, VOL(M3)=3.011E-01, VOL FRAC=1.970E-01, FINAL VOL(M3)=5.932E-02
     WASTE STREAM  211, INTERP TIMES(YR)=(3.000E+03,5.000E+03), RELEASES(EPA/M3)=(7.415E-05,6.797E-05), RELEASE(EPA/M3)=7.088E-05
     WASTE STREAM  121, INTERP TIMES(YR)=(3.000E+03,5.000E+03), RELEASES(EPA/M3)=(1.389E-02,1.275E-02), RELEASE(EPA/M3)=1.329E-02
     WASTE STREAM  369, INTERP TIMES(YR)=(3.000E+03,5.000E+03), RELEASES(EPA/M3)=(2.955E-03,2.683E-03), RELEASE(EPA/M3)=2.811E-03
     WASTE STREAM(S) AVGD=  3, AVG CONC(EPA/M3)=1.062E-03, RELEASE(EPA)=3.197E-04
          SPALLINGS RELEASE
     PREVIOUS E1 INTRUSION IN DIFFERENT(NonAdjacent) PANEL AT TIME(YR)=9.777E+02, DTE1=4.057E+03-9.777E+02=3.079E+03
     INTERP TIMES(YR)=(2.000E+03-3.500E+02,3.500E+02-1.650E+03)=(3.650E+03,0.000E+00), VOLS(M3)=(0.000E+00,0.000E+00), VOLUME(M3)=
     INTERP TIMES(YR)=(3.000E+03-1.000E+03,1.000E+03-2.000E+03)=(4.000E+03,0.000E+00), VOLS(M3)=(0.000E+00,0.000E+00), VOLUME(M3)=
     FINAL INTERP TIMES(YR)=(3.500E+02,1.000E+03), VOLS(M3)=(0.000E+00,0.000E+00), VOL(M3)=0.000E+00
     INTERP TIMES(YR)=(3.000E+03,5.000E+03), CONCS(EPA/M3)=(2.657E-02,2.425E-02), CONC(EPA/M3)=4.993E-03, SPALLINGS RELEASE(EPA)=0.000E+00
          DBR RELEASE
     PREVIOUS E1 INTRUSION IN NonAdjacent PANEL (16) AT TIME(YR)=9.777E+02, DTE1=4.057E+03-9.777E+02=3.079E+03
     INTERP TIMES(YR)=(2.000E+03-3.500E+02,4.000E+03-3.500E+02)=(1.650E+03,3.650E+03), VOLS(M3)=(0.000E+00,0.000E+00), VOLUME(M3)=0.000E+00
          PVOLS =(2.851E+01,2.799E+01), PVOLUME=2.814E+01
     INTERP TIMES(YR)=(2.000E+03-3.500E+02,4.000E+03-3.500E+02)=(1.650E+03,3.650E+03), VOLS(M3)=(0.000E+00,0.000E+00), VOLUME(M3)=0.000E+00
          PVOLS =(2.851E+01,2.799E+01), PVOLUME=2.798E+01
     FINAL INTERP TIMES(YR)=(3.500E+02,1.000E+03), VOLS(M3)=(0.000E+00,0.000E+00), VOL(M3)=0.000E+00
     FINAL INTERP PANEL VOLUMES=(2.814E+01,2.798E+01),            PANEL VOLUME=2.799E+01
     INTERP TIMES(YR)=(3.000E+03,5.000E+03), CONCS(EPA/M3)=(6.318E-04,5.557E-05), CONC(EPA/M3)=3.273E-04, DBR RELEASE(EPA)=0.000E+00
     Am241 CONCS(Ci/M3)=(2.986E-04,2.491E-05), CONC(Ci/M3)=1.540E-04, DBR RELEASE(Ci)=0.000E+00
     Pu239 CONCS(Ci/M3)=(3.097E-06,3.034E-06), CONC(Ci/M3)=3.064E-06, DBR RELEASE(Ci)=0.000E+00
     U234  CONCS(Ci/M3)=(2.007E-06,1.986E-06), CONC(Ci/M3)=1.996E-06, DBR RELEASE(Ci)=0.000E+00
     Th230 CONCS(Ci/M3)=(4.196E-07,6.355E-07), CONC(Ci/M3)=5.337E-07, DBR RELEASE(Ci)=0.000E+00
          CUMULATIVE RELEASES (EPA):  CUTTINGS=7.478E-03, SPALLINGS=2.928E-04, BLOWOUTS=6.857E-04, TOTAL=8.457E-03
          CUMULATIVE VOLUME RELEASES (M3):  CUTTINGS=3.312E+00, SPALLINGS=4.687E-02, BLOWOUTS=1.033E-01

OBS    1, FUTURE      1, DRILL INTRUSION  62, TIME(YR)=4.146E+03,  PANEL 18 (OTHER )
     PLUG PATTERN 3, DRILL DIAM(M)=(3.111E-01)
     NONEXCAVATED, NO BRINE POCKET HAS
     NO CUTTINGS, SPALLINGS, OR DBR RELEASES
```

Figure 3. RPPCR2-12 PanelAnalyses: Example Diagnostic Output for Replicate 1 of the RPPCR

For the analysis in Hansen et al. (2023a), CCDFGF was run using the same inputs as the official RPPCR analysis and was instructed to output diagnostic data for all futures of all vectors in Replicate 1. To calculate per-panel releases as shown in Figure 3 of Hansen et al. (2023a), the diagnostic file produced by CCDFGF is processed using a Python script created for this purpose. Intrusions are separated by panel, and releases for each panel are summed over intrusions in each future by the release mechanism. For each panel and release mechanism, a CCDF of releases for a vector is constructed from the summed releases of all futures. The mean CCDFs are then found by calculating the average of probabilities, at each release level, for the 100 vectors in Replicate 1. Note that the releases from an individual panel in Figure 3 of Hansen et al. (2023a) represent those releases when the panel is part of the 19-panel repository modeled in the RPPCR.

2. Figure 4 below (Figure 3 of Hansen et al., 2023a) shows the mean CCDFs of total releases attributable to individual panels. Figure 5 below (Figure 4-43 of Brunell et al., 2023) shows CCDFs for each realization of total releases from the repository. A total release from the repository is the sum of releases attributable to each panel, but the CCDFs in Figure 4 below cannot be added in a manner to obtain the mean CCDF in Figure 5 below.

   In the PA calculation, random futures are simulated. Each random future comprises a sequence of intrusion events (and possibly a mining event); releases from each intrusion can be attributed to the intruded panel. The releases attributed to one panel can be summed to a total release for that future and panel. The total releases can be sorted in increasing order to form a CCDF and a mean CCDF computed over all realizations. This process produces the mean CCDFs in Figure 4 below.

A total release from the repository is computed by summing, for one future, all releases from intrusions into any panel. At this point, the total release is a sum of releases attributable to individual panels. However, after the panel releases (or the total releases) are sorted to form a CCDF, the identification of a release with a future is lost. As a consequence, at a given probability, the releases from different panels, and the total release, may be from different futures. Thus, the per-panel CCDFs cannot be "added" to obtain the CCDF of total releases.

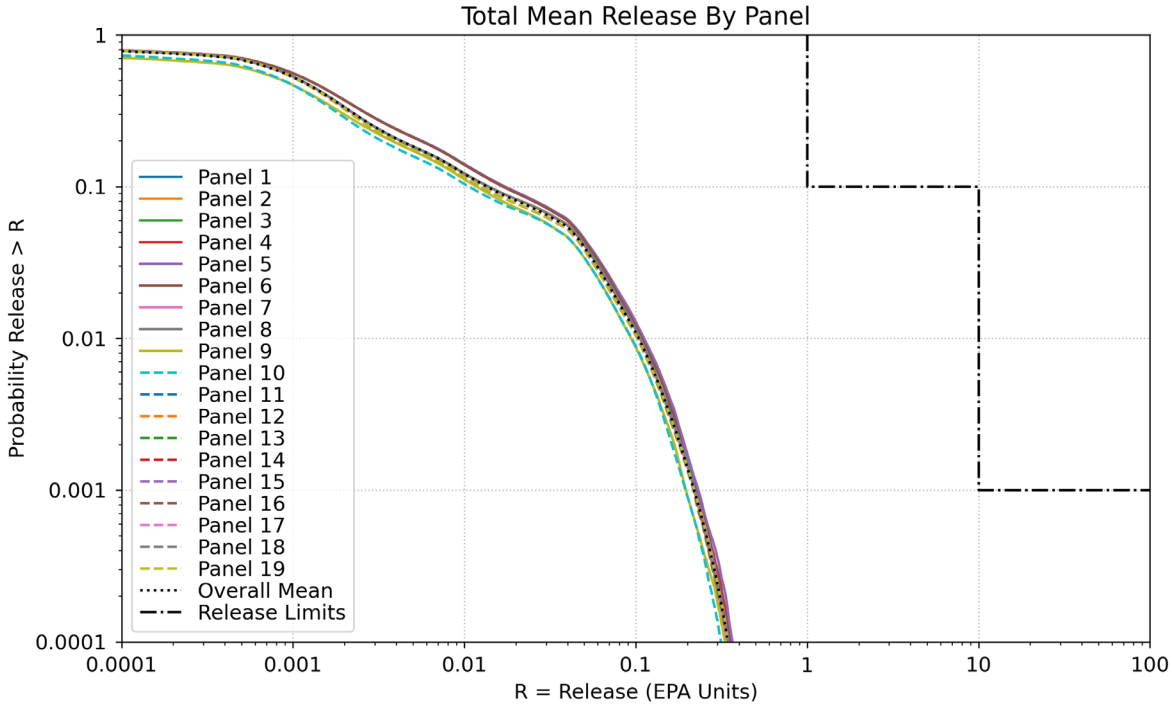

Figure 4. RPPCR2-12PanelAnalyses: Total Mean Releases by Panel for Replicate 1 of the RPPCR (Figure 3 of Hansen et al. 2023a)

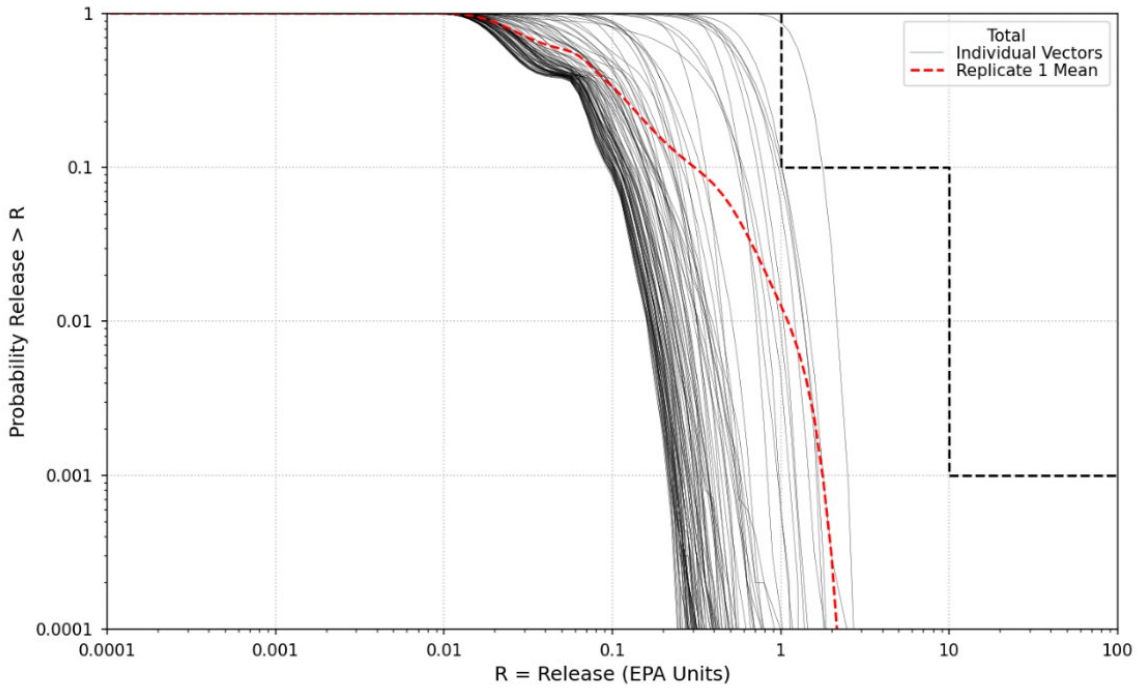

Figure 5. RPPCR2-12PanelAnalyses: Total Releases for Replicate 1 of the RPPCR (Figure 4-43 of Brunell et al. 2023)

References RPPCR2-12PanelAnalyses

Brunell, S. 2022. Design Document and User's Manual for CCDFGF Version 8.01. ERMS 577625. Carlsbad, NM: Sandia National Laboratories.

Brunell, S., J. Bethune, P. Docherty, D. Kicker, S. Kim, S. King, J. Long, and T. Zeitler. 2023. Summary Report for the Replacement Panels Planned Change Request Performance Assessment, Rev. 1. ERMS 581044. Carlsbad, NM: Sandia National Laboratories.

Hansen, C., Brunell, S., King, S. 2023a. Estimation of Releases from a 12-Panel Repository, Rev. 0. ERMS 580656. Carlsbad, NM: Sandia National Laboratories.

Hansen, C., S. King, J. Bethune, and S. Brunell. 2023b. Analysis Plan for the Performance Assessment for Replacement Panels Planned Change Request. AP-204, Rev. 1, ERMS 579449. Carlsbad, NM: Sandia National Laboratories.

RPPCR3-CLOSURE-1: Closure of Rooms with New Design

Please describe the effect of the room closure process with the new design used for RPPCR PA: the abutment pillars (between the waste rooms and the [main] access drifts) are increased from 61.0 m (200 ft) to 122.0 m (400 ft) and the isolation pillars (separating two panels) are increased from 61.0 m (200 ft) to 91.5 m (300 ft).

EPA would like to know the effect of the new design on the waste-containing areas. Would this affect the timeframe of creep closure? Should this design change have any effect on the room closure, porosity, and gas generation relationship? Would this be reflected in the updated porosity surface?

DOE Response

The proposed widening of the abutment and isolation pillars will decrease the shear stresses in the salt strata surrounding the neighboring access drifts and rooms. By reducing the shear stresses the salt should crack less, such that ground control efforts should be reduced during the operational period (U.S. DOE, 2024, Section 3.0). Reducing the shear stresses will also reduce the rate of salt creep and room closure. The reductions, however, are expected to have a small enough impact on room porosity that they can be ignored in the WIPP Performance Assessment, as discussed in the following three paragraphs.

Cracking is generally thought to have a minor influence on the porosity of waste filled rooms (Vignes et al., 2023, Section 2.1.2). Although the impact of micro- and macro-cracks around waste filled rooms is an active area of research, other factors—such as the lithostatic pressure, the resistance of the room contents, and the viscoplastic behavior of the salt—are considered more important influences on porosity. Accordingly, the effects of cracking are not included in the disposal room porosity model (Vignes et al., 2023, Section 2.1.2), and reducing cracking by widening pillars is not expected to significantly affect room closure/expansion rates.

Previous simulations of room closure by Stone and Argüello (Butcher and Mendenhall, 1993, pg. A-121 to A-134) indicate that salt creep rate reductions related to wider abutment and isolation pillars will be small compared to other variations. Several aspects of the Stone and Argüello model differ from those in the current disposal room porosity model: their model does not include salt creep behavior at low stresses (< 8 MPa), salt transient creep behavior, the anhydrite layers, the clay seams, the waste, or gas trapped within the room. Nevertheless, the trends they found should be similar to the trends that would be predicted by the current disposal room porosity model, presuming the model differences do not strongly interact with the pillar width. As shown in Figure 6 below, one of the Stone and Argüello simulations included the seven rooms that make up a panel, as well as the two neighboring main access drifts. Room 1 was at the far-right end of the panel, adjacent to a practically infinite-width pillar, while Room 7 was to the right of the 61.0 m wide abutment pillar. Another of their simulations considered a single disposal room within an infinite array of parallel rooms. The vertical closure rates from these three cases are compared by averaging the vertical closure rate from time = 0 to the time the roof touches the floor in the fastest case, which is 140 years for the infinite array of parallel rooms. The Stone and Argüello model predicted that Room 1's average vertical closure rate would be 7 % less than that of Room 7. Doubling the width of the abutment pillar should, therefore, reduce the rate of room closure by less than 7 %. To put this 7 % in perspective, Stone and Argüello also predicted that Room 1's average vertical closure rate

would be 22 % less than that of the room in the infinite array (see Figure 7 and Figure 8 below). The legacy and current disposal room porosity models already neglect this 22 % reduction in closure rates by considering an infinite array of parallel disposal rooms (Stone, 1997, pg. 14; Vignes et al., 2023, Section 2.1.4), so a 7 % reduction is small. The Stone and Argüello model did not consider the effects of the isolation pillars between each panel, but it seems reasonable to expect that increasing their width should cause similar reductions in closure rates (< 7%) to the access drifts and parts of rooms close to these isolation pillars.

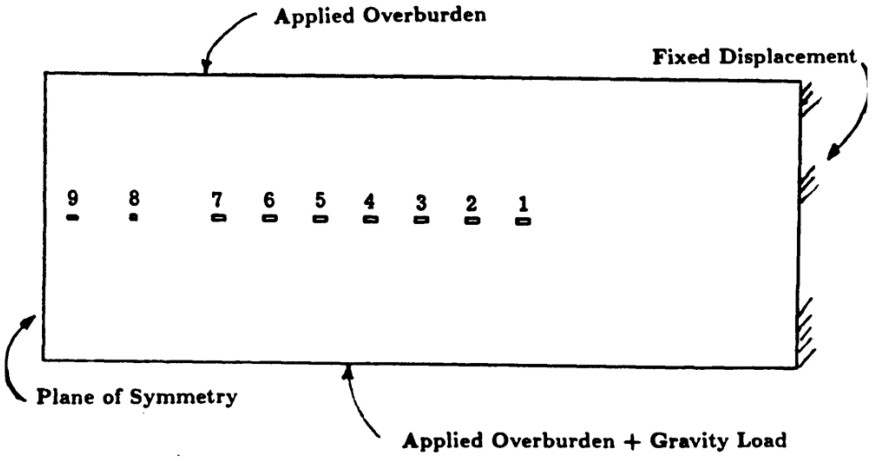

Figure 6. RPPCR3-Closure-1: Schematic of the simulation domain and boundary conditions utilized by Stone and Argüello (Butcher and Mendenhall, 1993, pg. A-130)

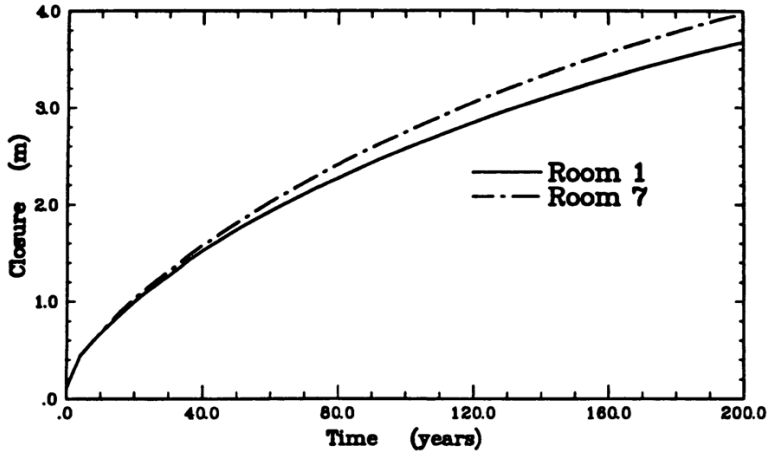

Figure 7. RPPCR3-Closure-1 Stone and Argüello's predictions of vertical closure in Rooms 1 and 7 (Butcher and Mendenhall, 1993, pg. A-132)

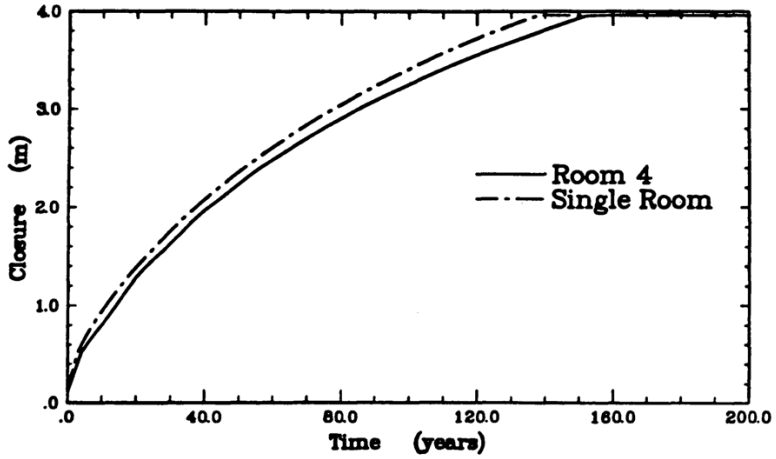

Figure 8. RPPCR3-Closure-1: Stone and Argüello's predictions of vertical closure in Room 4 and a single room within an infinite array of parallel rooms (Butcher and Mendenhall, 1993, pg. A-134)

It should be noted that the pillar width does not impact the room's "final" porosity, which is reached once the resistance of the room contents balances the lithostatic pressure. Pillar width is only relevant while the room porosity is evolving. Room porosity evolves quickly if the lithostatic pressure exceeds the room contents' pressure by a large amount. In the Stone and Argüello model simulations of empty rooms and access drifts, the pressure difference was 14.8 MPa and each room reached 100 % vertical closure in 140 to 240 years, which is a small fraction of the 10,000-year regulatory period. Room porosity evolves more slowly, on the other hand, if the room contents supply a back pressure close to the lithostatic pressure, which occurs once the waste is compacted and fluids (gas or brine) cannot easily escape the room. Brown and Weatherby (Butcher and Mendenhall, 1993, pg. A-5 to A-25) included crushed salt, waste, and trapped gas in each room of their infinite array model and they predicted the room would approach its final porosity in the order of thousands of years. Regardless of the time required to reach the final porosity, doubling the pillar widths is still expected to reduce this time by less than 7 %.

References RPPCR3-CLOSURE-1

Butcher, B. M. and Mendenhall, F. T. 1993. A Summary of the Models Used for the Mechanical Response of Disposal Rooms in the Waste Isolation Pilot Plant with Regard to Compliance with 40 CFR 191, Subpart B. SAND92–0427. Sandia National Laboratories.

Stone, C. M. 1997. Final Disposal Room Structural Response Calculations. SAND97-0795. Sandia National Laboratories.

U.S. Department of Energy (DOE). 2024. Planned Change Request for the Use of Replacement Panels 11 and 12. United States Department of Energy, Carlsbad Field Office. Carlsbad, NM, USA.

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

RPPCR1-Inventory-1: Waste Characteristics

Please provide updated tables that identify and assess waste characteristics for their impact on disposal system performance, with an analysis substantiating all decisions to exclude consideration of a waste characteristic or component.

DOE is required to identify and assess all waste characteristics for their impact on disposal system performance, and to submit an analysis substantiating decision to exclude consideration of a waste characteristic or component [40 CFR 194.24(b)]. EPA noted during their review of the CRA-2019 that the tables identifying the impacts of waste characteristics have not been updated since CRA-2004 and contained entries inconsistent with the CRA-2019 DPA (see Issue #18). EPA and DOE agreed during an October 2022 Technical Exchange meeting that DOE would provide an updated listing of all waste characteristics and components that are included or excluded from consideration along with substantiating analyses for the RPPCR.

DOE Response

The requirements of 40 CFR 194.24(b) were first met in Appendix WCA of the Compliance Certification Application (U.S. DOE, 1996) and as later amended in the CRA-2004 in Appendix TRUWASTE (U.S. DOE, 2004). The following tables provide updated information on the following:

- A list of the waste characteristics and components expected to have a significant effect on disposal system performance (included in PA),
- a list of the waste characteristics and components expected to have negligible effect on disposal system performance,
- a list of waste characteristics and components that were considered and excluded from performance assessment (PA), and
- references that support the determination of effects on performance.

Table 2. RPPCR1-Inventory-1: Waste Characteristics and Components Used in PA: Characteristics Expected to Have a Significant Effect on Disposal System Performance

Characteristic	Component	Effect on Performance	Reference
Radioactivity of Each Isotope	Radionuclides	Used in Calculating Normalized Releases	Kicker 2023; Appendix SCR-2019, Section SCR-6.1.2.1 (W2 and W3)
TRU Radioactivity at Closure	α-Emitting TRU Radionuclides, half-life > 20 Years	Determines Waste Unit Factor (WUF)	Kicker 2023; Appendix SCR-2019, Section SCR-6.1.2.1 (W2 and W3)
Solubility	Radionuclides	Actinide Mobility	Appendix SCR-2019, Section SCR-6.5.2.1 (W56)

Characteristic	Component	Effect on Performance	Reference
Colloid Formation	Radionuclides, Soils, Cellulosic, Plastic, and Rubber (CPR) Materials	Actinide Mobility	Lucchini and Swanson (2023); Appendix SOTERM-2019, Section SOTERM-3.5
Redox State	Radionuclides	Actinide Mobility	Appendix SCR-2019, Section SCR-6.5.5.1 (W64 and W66)
Redox Potential	Ferrous Metals	Actinide Oxidation State; Actinide Mobility	Appendix SCR-2019, Section SCR-6.5.5.1 (W64 and W66)
Gas Generation	Ferrous Metals	Increase in Gas Pressure	Appendix SCR-2019, Section SCR-6.5.1.4 (W49 and W51)
Microbial Substrate	Cellulosic, Plastic, Rubber Materials	Increase in Gas Pressure	Appendix SCR-2019, Section SCR-6.5.1.1 (W44)
Particle Diameter	Solid Waste Components	Spallings Release	Appendix PA-2019, Section PA-4.7.2
Microbial Nutrients	Sulfates	Increase Gas Pressure	Nemer and Zelinksi (2005); Appendix PA-2009, Section PA-4.2.5
Microbial Nutrients	Nitrates	Increase Gas Pressure	Wang and Brush (1996); Nemer and Zelinski (2005); Appendix PA-2009, Section PA-4.2.5
Compressibility and Shear Strength	Solid Waste Components	Effect on Creep Closure, Cuttings, Cavings, Spallings	Appendix PA-2019, Section PA-1.1.6; Appendix SCR-2019, Section SCR-6.6.2.1 (W84, W85, W86)
Brine Radiolysis[a]	Radionuclides	Increase Gas Pressure	Appendix SCR-2019, Section SCR-6.5.1.6 (W52); Appendix PA-2019, Section PA-1.1.3; Day (2019)
Brine Radiolysis	Radionuclides	Actinide Oxidation State	Lucchini and Swanson (2023); Appendix SOTERM-2019, Section SOTERM-3.4
Complexation with Actinides[b]	Soil and Humic Material	Actinide Mobility	Appendix SCR-2019, Section SCR-6.5.6.2 (W70)
Complexation with Actinides[c]	Organic Ligands	Can Increase Radionuclide Solubility	Appendix SOTERM-2019, Section SOTERM-3.3.3; Appendix SCR-2019, Section SCR-6.5.6.1 (W68 and W69)

(a) Brine Radiolysis was moved from “Not Used in Performance Assessment” to “Expected to have a Significant Effect on Disposal System Performance” based on its inclusion in Performance Assessment discussed in Day (2019) Section 1.1.3.

(b) Complexation with Actinides by Soil and Humic Material was moved from “Expected to Have a Negligible Effect on Disposal System Performance” to “Expected to have a Significant Effect on Disposal System Performance” based on inclusion in Performance Assessment discussed in Appendix PA 2019 Section 4.4.1.

(c) Complexation with Actinides by Organic Ligands “Expected to Have a Negligible Effect on Disposal System Performance” to “Expected to have a Significant Effect on Disposal System Performance” based on inclusion in performance assessment discussed in Appendix SOTERM 2019.

Table 3. RPPCR1-Inventory-1: Waste Characteristics and Components Used in Performance Assessment:
Characteristics Expected to Have a Negligible Effect on Disposal System Performance

Characteristic	Component	Effect on Performance	Reference
Permeability (waste)	Solid Waste Components	Negligible Effect on Brine Movement	Vaughn et al. (1995); Butcher (1997); Appendix SCR-2019, Section SCR-6.3.5.1 (W32)
Porosity (waste)	Solid Waste Components	Negligible Effect on Brine/Gas Storage	Appendix SCR-2019, Section SCR-6.3.5.1 (W32); Brunell et al., 2023
Microbial Nutrients, CO_2 Generation	Sulfates, Nitrates	Negligible: MgO Reacts with CO_2	Appendix SCR-2019, Section SCR-6.5.1.1 (W44)
Microbial Substrate: CO_2 Generation	Cellulosic, Plastic, Rubber Materials	Negligible: MgO Reacts with CO_2	Appendix SCR-2019, Section SCR-6.5.1.1 (W44)
Gas Generation	Water in the Waste	Enhances Initial Gas Generation	Appendix TRUWASTE (U.S. DOE, 2004), Section TRUWASTE 2.5.1.
Explosivity	Other Organic Compounds (explosive)	None	Appendix SCR-2019, Section SCR-6.3.3.1 (W27)
Binding to Organic Ligands[a]	Ferrous Metals	Can Reduce Actinide Mobility	Domski, 2023 Appendix SCR-2019, Section SCR-6.5.6.1 (W69)

(a) Binding to Organic Ligands by Ferrous Metals was moved from “Not Used in Performance Assessment (Table 4)” to “Expected to Have a Negligible Effect on Disposal System Performance (Table 3)” based on calculations completed for the RPRCR (Domski, 2023) that include iron citrate complexes.

Table 4. RPPCR1-Inventory-1: Waste Characteristics and Components Not Used in Performance Assessment

Characteristic	Component	Effect on Performance	Reference
Cellulosic Materials Radiolysis	Radionuclides	Negligible Effect on Total Gas Generation	Knerr (2020); Appendix SCR-2019, Section SCR-6.5.1.7 (W53)
Galvanic Action	Nonferrous Metals	Negligible	Appendix SCR-2019, Section SCR-6.5.1.5 (W50)
Buffering Action[a]	Cement [a]	Negligible: Reacts with CO_2 and $MgCl_2$	Appendix SCR-2019, Section SCR-6.5.2.1.3.2 (W56)
Heat of Solution	Cement	Negligible	Appendix SCR-2019, Section SCR-6.3.4.1 (W73)
Ca^{2+} Binding to Organic Ligands	Cement	Negligible Compared to Other Metals	Appendix SCR-2019, Section SCR-6.1.4.2 (W8); FEP update ERMS 580214 and SCR-6.5.4.1 (W61)
Buffering Action[a]	Ferrous Metals[a]	Actinide Mobility	Appendix TRUWASTE-2004, Section TRUWASTE-2.4.1.2
Galvanic Action	Ferrous Metals	Negligible	Appendix SCR-2019, Section SCR-6.5.1.5 (W50)
Redox Reactions	Nonferrous Metals	Negligible Compared to Iron	Appendix SCR-2019, Section SCR-6.5.5.1 (W64 and W66)
Gas Generation	Al and Other Nonferrous Metals	Negligible Relative to Iron	Appendix SCR-2019, Section SCR-6.5.1.4 (W49 and W51)
Microbial Nutrients, CO_2 Generation	Phosphates	Negligible because MgO Reacts with CO_2	Appendix SCR-2019, Section SCR-6.1.5.1 (W9)
Microbial Nutrients: CH_4 Generation	Phosphates[a]	Negligible	Cotsworth (2005), and Nemer and Stein (2005)
Heat Generation	RH-TRU	Negligible	Appendix SCR-2019, Section SCR-6.2.1.2 (W13)
Electrochemical Processes	Sulfate, Nitrate, Phosphate	Negligible	Appendix SCR-2019, Sections SCR-6.7.4.1(W94), SCR-6.7.4.2 (W95), and SCR-6.7.4.3 (W96)
Binding to Organic Ligands[a]	Nonferrous Metals[a]	Can Reduce Actinide Mobility	Appendix SCR-2019, Section SCR-6.5.6.1 (W69)

(a) Waste characteristics and components that influence performance indirectly – by influencing components and characteristics listed in Table 2.

References RPPCR1-Inventory-1

Brunell, S., J. Bethune, P. Docherty, D. Kicker, S. Kim, S. King, J. Long, and T. Zeitler. 2023. Summary Report for the 2023 Replacement Panels Planned Change Request Performance Assessment. Sandia National Laboratories, Carlsbad, NM. ERMS 579729.

Butcher, B.M. 1997. Waste Isolation Pilot Plant Disposal Room Model. SAND97-0794. Albuquerque, NM: Sandia National Laboratories.

Cotsworth, E. 2005. Letter to I. Triay. Subject: EPA Letter on Conducting the Performance Assessment Baseline Change (PABC) Verification Test. 4 March 2005. U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, DC. ERMS 538858.

Day, B.A. 2019. Reassessment of Need and Parameter Justification for Modeling Gas Generation due to Radiolysis of Brine and Cellulose/Plastic/Rubber in WIPP for CRA-2019. (February 12, 2019). Carlsbad, NM: Sandia National Laboratories. ERMS 570873.

Domski, P.S. 2023. "Prediction of Baseline Actinide Solubilities for the Replacement Panels Planned Change Request (RPPCR) Performance Assessment." Carlsbad, NM: Sandia National Laboratories. ERMS 579503.

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Lucchini, J. and J. Swanson. 2023. LANL ACRSP Parameter Recommendations for CRA-2024 Performance Assessment. Report LCO-ACP-34. Los Alamos National Laboratory; Carlsbad, NM. LA-UR-23-23839.

Nemer, M.B., and J.S. Stein. 2005. Analysis Package for BRAGFLO, 2004 Compliance Recertification Application Performance Assessment Baseline Calculation (June 28). Carlsbad, NM: Sandia National Laboratories. ERMS 540527.

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

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Vaughn, P., Bean, J., Garner, J., Lord, M., MacKinnon, R., McArthur, D., Schreiber, J., and Shinta, A. 1995. FEPs Screening Analysis DR2, DR3, DR6, DR7 and S6. Sandia National Laboratories, Albuquerque, NM. ERMS 238152.

Wang, Y., and L. Brush. 1996. Memorandum to M.S. Tierney (Subject: Estimates of Gas-Generation Parameters for the Long-Term WIPP Performance Assessment). January 1996. Sandia National Laboratories. Albuquerque, NM. ERMS 231943.

RPPCR1-DATA0.FM6-1: Documentation for Hydromagnesite5424 Solubility

Please provide a short explanation of the source of the log K value for hydromagnesite5424 in the DATA0.FM6 documentation.

DOE recalculated the DATA0.FM1 hydromagnesite5424 log K value of 32.25 to a value of 31.49 for DATA0.FM4 (Sisk-Scott 2019). EPA (2022, Attachment B, Section 3.4.1) accepted the recalculated hydromagnesite5424 log K value of 31.39 during its review of DATA0.FM4, noting that the recalculated value was more internally consistent with other thermodynamic data in the database.

During development of the DATA0.FM6 database, DOE appropriately revised the hydromagnesite5424 log K value from the DATA0.FM1 value to 31.49, but this change was not included in Table IX.3.1 of Jang et al. (2021) or the discussion of database revisions related to magnesium in Domski (2023, Section 3.1.3). The revised hydromagnesite5424 data block is, however, appropriately included in a summary listing of the database revisions to create DATA0.FM6 (Domski 2023, Appendix A) and in the DATA0.FM6 database. To avoid possible confusion regarding the DATA0.FM6 log K value for hydromagnesite5424, DOE should include a short explanation of its source in the DATA0.FM6 documentation.

Domski, P.S. 2023. An Update to the WIPP EQ3/6 Database DATA0.FM1 with the Creation of DATA0.FM6. ERMS 579370, Sandia National Laboratories, Carlsbad, New Mexico.

EPA (U.S. Environmental Protection Agency). 2022. Technical Support Document for Section 194.24, Evaluation of the Compliance Recertification Application (CRA-2019) Actinide Source Term, Gas Generation, Backfill Efficacy, Water Balance, and Culebra Dolomite Distribution Coefficient Values. EPAHQ-OAR-2019-0534, Office of Radiation and Indoor Air, Washington, DC.

Jang, J., P. Hora, L. Kirkes, C. Miller, and L. Zhang, 2021. Analysis Report Documenting Solubility and Complexation of Iron, Lead, Magnesium, Neodymium, and Boron in the WIPP-Relevant Brines Under TPs 06-03, 08-02, 12-02, 14-03, 14-05, 16-02, 19-01, and 20-01. ERMS 576381, Sandia National Laboratories, Carlsbad, New Mexico.

Sisk-Scott. 2019. Analysis Plan to Update the WIPP Geochemical Thermodynamic Database (DATA0.FM1) to DATA0.FM4 for CRA-2019. AP-183, Revision 1, ERMS 571001, Sandia National Laboratories, Carlsbad, New Mexico

DOE Response

The change of the value of log K for hydromagnesite5424 from that in DATA0.FM1 (Xiong, 2011) to the value included DATA0.FM6 (Domski, 2023) was not documented in an appropriate reference for DATA0.FM6 (Domski, 2023). As noted by the EPA in their comment RPPCR1-DATA0.FM6-1 this change was documented in Section 2.1.2 of Sisk-Scott (2019). To summarize from Sisk-Scott (2019):

"…an error in transcription was discovered when the data from Robie and Hemingway (1973) was compared to that in DATA0.FM1. The error is in the FMT thermodynamic database fmt_050405.chemdat (Xiong et al. 2005) where the μ^0/RT value attributed to Robie and Hemingway (1973) does not match what was reported by Robie and Hemingway (1973)."

This transcription error was corrected for the DATA0.FM4 database as documented by Sisk-Scott (2019) and was carried over to DATA0.FM6.

To improve the traceability of the log K value presented in Sisk-Scott (2019) the calculation was reproduced and is presented in APPENDIX A.

References RPPCR1-DATA0.FM6-1

Domski, P.S. 2023. An Update to the WIPP EQ3/6 Database DATA0.FM1 with the Creation of DATA0.FM6. ERMS 579370, Sandia National Laboratories, Carlsbad, New Mexico.

Sisk-Scott. 2019. Analysis Plan to Update the WIPP Geochemical Thermodynamic Database (DATA0.FM1) to DATA0.FM4 for CRA-2019. AP-183, Revision 1, ERMS 571001, Sandia National Laboratories, Carlsbad, New Mexico.

Robie, R. A., and B. S. Hemingway. 1973. The enthalpies of formation of nesquehonite, $MgCO_3 \cdot 3H_2O$, and hydromagnesite, $5MgO \cdot 4CO_2 \cdot 5H_2O$. *Journal of Research of the U.S. Geological Survey*, 1: 543-547.

Xiong, Y.-L. 2005. “Release of FMT_050405.CHEMDAT.” E-mail to J.F. Kanney and J.J. Long, April 5, 2005. Carlsbad, NM: Sandia National Laboratories. ERMS 539304.

Xiong, Y.-L. 2011. "Release of EQ3/6 Database DATAO.FM1." E-mail to Jennifer Long, March 9, 2011. Carlsbad, NM: Sandia National Laboratories. ERMS 555152.

APPENDIX A. Calculation of logK_{sp} for Hydromagnesite5424

The reaction for the dissolution of hydromagnesite5424 is as follows:

$$Mg_5(CO_3)_4(OH)_2{\cdot}4H_2O + 6H^+ \rightleftharpoons 5Mg^{2+} + 4HCO_3^- + 6H_2O$$

Robie and Hemmingway (1973) provide the Gibbs free energy of formation for hydromagnesite5424 as -1,401,710 ± 260 cal/mol. Converting to joules (J), 4.184 J/cal, we have ΔG_f = -5864754.64 ± 1087.84 J/mol. Dividing the Gibbs energy by the product of the Ideal Gas Constant (R; 8.3145 J/K·mol) and the absolute temperature (T=298.15K), we get the standard chemical potential for hydromagnesite5424.

Where hydromagnesite5424 μ^0/RT = -2365.80 ± 0.44

Table A-1. Standard Chemical Potential values from Harvie et al. (1984). Note the authors did not provide standard error values for these chemical potential values.

Chemical Entity	μ^0/RT
H^+	0.0000
H_2O	-95.6635
HCO_3^-	-236.7510
Mg^{2+}	-183.4680

The $\log_{10}$ K for hydromagnesite5424 may be calculated via the general expression:

$$Log_{10}\,K = \frac{1}{2.303}\sum_{\square}^{\square} v_i \left(\frac{v_i^0}{RT}\right) \sum_i^n v_i \left(\frac{v_i^0}{RT}\right) \qquad \text{Equation (1)}$$

$$v_i = chemical\ potential\ of\ species\ i$$

Log_{10} K = 1/(2.303) × ([-2365.8047] + 6 × [0.0] – 5 × [-183.4680] – 4 × [-236.7510] – 6 × [-95.6635])

= 31.4895 ± 0.19[1]

This value was rounded up to 31.49 for inclusion in DATA0.FM6.

[1] The error values were based on the Gibbs free energy of formation error value (±260 cal/mol) provided by Robie and Hemmingway (1973).

RPPCR2-DATA0.FM6-4: Omitted Pitzer interaction parameters

The Pitzer interaction parameters from Moog et al. (2004) listed in the following table were previously included in the DATA0.FM4 database reviewed by EPA (2022). Please explain the reasons for omitting these parameters from DATA0.FM6. Please provide calculations that show whether omission of these parameters would affect predicted dissolved iron concentrations in WIPP brines under repository conditions.

i	j	k	Q_{ij}	Y_{ijk}
K^+	Fe^{2+}	--	0.0274	--
Ca^{2+}	Fe^{2+}	--	0.0811	--
Fe^{2+}	K^+	Cl^-	--	-0.0252
Fe^{2+}	Ca^{2+}	Cl^-	--	-0.016

DOE Response

The iron Pitzer parameters included in DATA0.FM6 are those selected, used, and presented in Table IX.1-2 in GEOC-21-11 (Jang et al., 2021). GEOC-21-11 contained the measurements used to parameterize the Fe-Na-(Cl) and Fe-Mg-(Cl) chemical systems, thus, the Fe parameters of Fe-Na-(Cl) and Fe-Mg-(Cl) in Moog et al. (2004) were used and reported in GEOC-21-11. GEOC-21-11 did not contain measurements regarding Fe-Ca-(Cl) and Fe-K-(Cl), therefore, the Fe Pitzer parameters of Fe-Ca-(Cl) and Fe-K-(Cl) chemical systems in Moog et al. (2004) were not selected in GEOC-21-11. Table IX.1-2 of Jang et al. (2021) provided the Fe Pitzer parameters that were to be added in DATA0.FM1 to create DATA0.FM6. The Pitzer model parameters from Moog et al. (2004) were not included in Data0.FM6 because Data0.FM4 was not used in the creation of Data0.FM6; subsequently, since these parameters were not listed in Jang et al. (2021) they were overlooked during the creation of Data0.FM6.

To test the effect of these parameters on the iron concentration at repository conditions a copy of DATA0.FM6 was made and named DATA0.PCR and the four sets of Pitzer parameters were included. This database was then used to run the RPPCR minimum volume cases of the baseline solubility model for both the GWB and ERDA-6 brine compositions. The results were compared with minimum volume case results using DATA0.FM6. A comparison of the results is tabulated in Table 5 below.

Table 5. Comparison of values at repository conditions using DATA0.FM6 (RPPCR) and DATA0.PCR (RPPCR2-DATA0.FM6-4)

Source	Brine	pcH	Ionic Strength	Fe (*m*)	Am (*m*)	Th (*m*)	Np (*m*)
RPPCR[a]	GWB	9.36	7.92	6.16E-05	3.90E-06	6.12E-08	5.67E-07
RPPCR2-DATA0.FM6-4	GWB	9.36	7.92	6.28E-05	3.90E-06	6.12E-08	5.67E-07
RPPCR[a]	ERDA-6	9.46	7.06	6.46E-05	3.99E-06	6.50E-08	2.05E-06
RPPCR2-DATA0.FM6-4	ERDA-6	9.46	7.06	6.47E-05	3.99E-06	6.50E-08	2.05E-06

(a) Domski (2023b)

Files

All files for this comment response are archived at:
"/data/cvs/CVSLIB/WIPP_EXTERNAL/RPPCR_comments"

References RPPCR2-DATA0.FM6-4

Domski, P.S. 2023a. An Update to the WIPP EQ3/6 Database DATA0.FM1 with the Creation of DATA0.FM6. ERMS 579370, Sandia National Laboratories, Carlsbad, New Mexico.

Domski, P.S. 2023b. "Prediction of Baseline Actinide Solubilities for the Replacement Panels Planned Change Request (RPPCR) Performance Assessment". Carlsbad, NM: Sandia National Laboratories. ERMS 579503.

Jang, J., P. Hora, L. Kirkes, C. Miller, and L. Zhang, 2021. Analysis Report Documenting Solubility and Complexation of Iron, Lead, Magnesium, Neodymium, and Boron in the WIPP-Relevant Brines Under TPs 06-03, 08-02, 12-02, 14-03, 14-05, 16-02, 19-01, and 20-01. ERMS 576381, Sandia National Laboratories, Carlsbad, New Mexico.

Moog, H. C., Hagemann, S., and Rumyantsev, A. V., 2004. Isopiestic investigation of the systems $FeCl_2$ - (Na, K, Mg, Ca)Cl_n-H_2O at 298.15 K. ZEITSCHRIFT FUR PHYSIKALISCHE CHEMIE-INTERNATIONAL JOURNAL OF RESEARCH IN PHYSICAL CHEMISTRY & CHEMICAL PHYSICS, 218, 1063-1087.

Enclosure 2

Department of Energy Response 2

Status Report of DOE Responses To EPA Questions on the RPPCR

Status Report of DOE Responses to EPA questions on the RPPCR			
EPA Comment Number	**EPA Request Description**	**EPA Request Letter Date**	**DOE Response**
RPPCR1-References-1	Document Request	April 17, 2024	Response 1
RPPCR2-General-1	Dimensions of replaced area and new panels	April 24, 2024	Response 1
RPPCR1-PROPMIC-1	Pu(III) PROPMIC and CAPMIC values	April 17, 2024	Response 2
RPPCR2-12 PanelAnalyses	12 Panel Analyses	April 24, 2024	Response 2
RPPCR3-Closure-1	Closure of rooms with new design	May 10, 2024	Response 2
RPPCR1-Inventory-1	Waste Characteristics	April 17, 2024	Response 2
RPPCR1-DTAT0.FM6-1	Documentation for Hydromagnesite5424 Solubility	April 17, 2024	Response 2
RPPCR2-DATA0.FM6-4	Omitted Pitzer interaction parameters	April 24, 2024	Response 2
RPPCR1-OXCUTOFF-1: a-b	Sensitivity Study Using OXCUTOFF Parameter	April 17, 2024	In progress
RPPCR-Inventory-2	Breakdown of Emplaced and Temporary Storage CH and RH Waste Volumes by Waste Generator Site	April 17, 2024	In progress
RPPCR1-DBMAR-1: a-d	Questions related to the DBMAR	April 17, 2024	In progress
RPPCR1-EM-1: a-e	Questions about the EM survey	April 17, 2024	In progress
RPPCR1-DATA0.FM6-2: a-c	XRD Examination of Post-Test Solids	April 17, 2024	In progress
RPPCR1-DATA0.FM6-3: a-b	WIPP Test Plans Cited in DATA0.FM6 Documentation	April 17, 2024	In progress
RPPCR1-DATA0.FM6-4	$FeEDTA^{2-}$ Stability Constant	April 17, 2024	In progress

Status Report of DOE Responses to EPA questions on the RPPCR			
EPA Comment Number	**EPA Request Description**	**EPA Request Letter Date**	**DOE Response**
RPPCR1-DATA0.FM6-5	$FeCitrate^-$ Stability Constant	April 17, 2024	In progress
RPPCR1-DATA0.FM6-6	Cotunnite Solubility	April 17, 2024	In progress
RPPCR1-DATA0.FM6-7	Lead-Carbonate Aqueous Speciation	April 17, 2024	In progress
RPPCR1-DATA0.FM6-8: a-b	Hydrocerussite Solubility	April 17, 2024	In progress
RPPCR1-DATA0.FM6-9	Cerussite Solubility	April 17, 2024	In progress
Enclosure 2: Ongoing uncertainties related to WIPP chemical conditions and Pu oxidation state	Questions and uncertainties on the ongoing Pu-239 Experiments (Beam 2023)	April 17, 2024	In progress
Enclosure 2: Ongoing uncertainties related to WIPP chemical conditions and Pu oxidation state	Questions and uncertainties on WIPP repository chemical conditions	April 17, 2024	In progress
Enclosure 2: Ongoing uncertainties related to WIPP chemical conditions and Pu oxidation state	DOE should also perform the following: A comprehensive literature review on Pu oxidation states A peer review of the WIPP chemical conditions	April 17, 2024	In progress
RPPCR2-DATA0.FM6-1: a-c	$Am(OH)_3(am)$ verification calculations at low ionic strength	April 24, 2024	In progress
RPPCR2-DATA0.FM6-2: a-c	$Am(OH)_3(am)$ verification calculations at high ionic strength	April 24, 2024	In progress
RPPCR2-DATA0.FM6-3	$AmOHCO_3(c)$ verification calculations	April 24, 2024	In progress
RPPCR3-Mineralogy-1	Detailed mineralogy of new panels	May 10, 2024	In progress
RPPCR3-BRAGFLO-1	Follow up on BRAGFLO convergence	May 10, 2024	In progress
End of Status Report			