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

Appendix DATA-2026
Monitoring Data and Reports

United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

Compliance Recertification Application 2026
Appendix DATA-2026

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ACRONYMS AND ABBREVIATIONS

CAP–88	Clean Air Act Assessment Package – 1988
CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CH-TRU	contact-handled transuranic
CMP	Compliance Monitoring Program
COMP	Compliance Monitoring Parameter
CRA	Compliance Recertification Application
DBDSP	Delaware Basin Drilling Surveillance Program
DOE	U.S. Department of Energy
EDTA	ethylenediaminetetraacetic acid
EPA	U.S. Environmental Protection Agency
GMP	Geotechnical Monitoring Program
GWMP	Groundwater Monitoring Program
PA	Performance Assessment
PABC	Performance Assessment Baseline Calculation
PAIR	Performance Assessment Inventory Report
PPR	Parameter Problem Report
RH-TRU	remote-handled transuranic
SMP	Subsidence Monitoring Program
SNL	Sandia National Laboratories
TIC	Total Inorganic Carbon
TP	Test Plan
WDS	Waste Data System
WIPP	Waste Isolation Pilot Plant

DATA-1.0 INTRODUCTION

Appendix DATA-2026 provides references to the data used to develop the Compliance Recertification Application (CRA) of 2026 (CRA-2026). Interpretation and analysis of those data are provided in the appropriate sections of the CRA-2026.

Title 40 Code of Federal Regulations (CFR), Part 194 (40 CFR 194) Section 194.15(a)(1), (2), (3), and (5) Content of Recertification Applications (U.S. EPA 1996), require that the U.S. Department of Energy (DOE) provide all additional geologic, geophysical, geochemical, hydrologic, and meteorologic information obtained since the most recent CRA. Monitoring results and laboratory investigation findings completed after the CRA-2019 (U.S. DOE 2019a) data cutoff must also be included, as well as information on the waste emplaced in the disposal system.

Various monitoring and surveillance programs are used to capture and analyze relevant information. These programs are discussed in the appropriate sections of this appendix. Details on how these programs are implemented are provided in Appendix MON-2026.

DATA-2.0 COMPLIANCE MONITORING PARAMETERS

In the initial U.S. Environmental Protection Agency (EPA) certification of compliance for the Waste Isolation Pilot Plant (WIPP) (U.S. EPA 1998), the EPA agreed that at a minimum, 10 compliance monitoring parameters (COMPs) would be monitored during the operational period of the project. The observed ranges and trends of these parameters support validation of disposal system performance predictions. Deviations from the expected ranges could signal abnormal conditions or potential degradation in disposal system performance. The locations of the data for the COMPs in this appendix are listed in Table DATA-1:

Table DATA-1. Location of COMPs in Appendix DATA-2026

COMP	Location in Appendix DATA-2026
Drilling frequency	Appendix DATA-3.0 – Delaware Basin Drilling Surveillance Program Section DATA-11.0 – Compliance Monitoring Program
Probability of encountering a Castile brine reservoir	Appendix DATA-3.0 – Delaware Basin Drilling Surveillance Program Section DATA-11.0 – Compliance Monitoring Program
Waste activity	Appendix DATA-8.0 – Waste Information Appendix DATA-11.0 – Compliance Monitoring Program
Subsidence	Appendix DATA-4.0 – Subsidence Monitoring Program Appendix DATA-11.0 – Compliance Monitoring Program
Culebra groundwater flow direction	Appendix DATA-6.0 – Groundwater Monitoring Program Appendix DATA-11.0 – Compliance Monitoring Program Appendix DATA-12.0 – Hydrological Investigation

COMP	Location in Appendix DATA-2026
Culebra groundwater composition	Appendix DATA-6.0 – Groundwater Monitoring Program Appendix DATA-11.0 – Compliance Monitoring Program Appendix DATA-12.0 – Hydrological Investigation
Creep closure and stresses	Appendix DATA-5.0 – Geotechnical Monitoring Program Appendix DATA-11.0 – Compliance Monitoring Program
Extent of brittle deformation	Appendix DATA-5.0 – Geotechnical Monitoring Program Appendix DATA-10.0 – Repository Investigations Program Appendix DATA-11.0 – Compliance Monitoring Program
Initiation of brittle deformation	Appendix DATA-5.0 – Geotechnical Monitoring Program Appendix DATA-11.0 – Compliance Monitoring Program
Displacement of deformation features	Appendix DATA-5.0 – Geotechnical Monitoring Program Appendix DATA-11.0 – Compliance Monitoring Program

DATA-3.0 DELAWARE BASIN DRILLING SURVEILLANCE PROGRAM

The Delaware Basin Drilling Surveillance Program (DBDSP) monitors drilling activities in the Delaware Basin. This section provides a brief discussion of the program and identifies the relevant data reports.

DATA-3.1 Program Overview

The EPA requires the DOE to demonstrate the expected long-term performance of the repository system using the Performance Assessment (PA). The PA documented in the CRA-2019 demonstrated that the DOE continues to comply with the EPA's containment standards for both undisturbed and disturbed performance scenarios. Disturbed scenarios include inadvertent human intrusion by drilling for resources.

The criteria in 40 CFR 194.33 (U.S. EPA 1996) require the use of historical drilling information up to the time the CRA is prepared to derive the frequency of deep drilling for PA human-intrusion scenarios. The DBDSP continues to monitor drilling-related activities and provide data that support assumptions, scenarios, and parameters used in PA.

DATA-3.2 Reported Drilling Data

The two COMPs monitored by the DBDSP are the frequency of deep drilling and the probability of encountering a Castile brine reservoir. These COMPs are discussed in the program's annual report and in the COMP assessments presented in Appendix DATA-11.0. Additional information collected by this program includes drilling-related data, mining information, and seismic information.

Relevant data generated through the Delaware Basin Monitoring Program are provided in the following reports published since the CRA-2019 data cutoff:

- Delaware Basin Monitoring Annual Report, DOE/WIPP-18-2308, Revision 3, June 2021 (U.S. DOE 2018a).
- Delaware Basin Monitoring Annual Report, DOE/WIPP-19-2308, Revision 2, June 2021 (U.S. DOE 2019b).
- Delaware Basin Monitoring Annual Report, DOE/WIPP-20-2308, Revision 2, June 2021 (U.S. DOE 2020a).
- Delaware Basin Monitoring Annual Report, DOE/WIPP-21-2308, September 2021 (U.S. DOE 2021a).
- Delaware Basin Monitoring Annual Report, DOE/WIPP-22-2308, December 2022 (U.S. DOE 2022a).
- Delaware Basin Monitoring Annual Report, DOE/WIPP-23-2308, January 2024 (U.S. DOE 2024a).
- Delaware Basin Monitoring Annual Report, DOE/WIPP-24-2308, February 2025 (U.S. DOE 2025a).

DATA-4.0 SUBSIDENCE MONITORING PROGRAM

Subsidence monitoring measures the vertical movement of the land surface relative to a reference location. This section provides a brief discussion of the Subsidence Monitoring Program (SMP) and identifies the relevant data reports.

DATA-4.1 Program Overview

The SMP uses a leveling survey to measure the relative vertical height differences between benchmarks. A leveling survey consists of using one benchmark's elevation as a constant to determine the relative elevation of all other benchmarks (WIPP 2025). Comparison between leveling surveys allows vertical movement patterns to be established over time.

DATA-4.2 Reported Subsidence Data

Each year, approximately 23 miles of precision digital leveling surveys are completed utilizing 14 vertical control loops comprising 77 subsidence monuments. Since the CRA-2019, 5 additional loops and 29 new monuments have been installed. The survey network also incorporates 14 National Geodetic Survey vertical control points (U.S. DOE 2025b). Data generated through the SMP are provided in the following reports published since the CRA-2019 data cutoff:

- WIPP Subsidence Monument Leveling Survey 2018, DOE/WIPP-18-3604, December 2018 (U.S. DOE 2018b).

- WIPP Subsidence Monument Leveling Survey 2019, DOE/WIPP-19-3613, January 2020 (U.S. DOE 2020b).
- WIPP Subsidence Monument Leveling Survey 2020, DOE/WIPP-20-3613, January 2021 (U.S. DOE 2021b).
- WIPP Subsidence Monument Leveling Survey 2021, DOE/WIPP-22-3613, February 2022 (U.S. DOE 2022b).
- WIPP Subsidence Monument Leveling Survey 2022, DOE/WIPP-22-3697, April 2023 (U.S. DOE 2023a).
- WIPP Subsidence Monument Leveling Survey 2023, DOE/WIPP-23-3697, February 2025 (U.S. DOE 2025b).

DATA-5.0 GEOTECHNICAL MONITORING PROGRAM

The Geotechnical Monitoring Program (GMP) measures in situ geotechnical parameters in the disposal system. This section provides a brief discussion of the GMP and identifies the relevant data reports.

DATA-5.1 Program Overview

The GMP provides geologic information related to geotechnical characteristics and assesses the stability and performance of the underground WIPP facility.

DATA-5.2 Reported Geotechnical Data

Data generated through the GMP are reported annually in a Geotechnical Analysis Report, which includes data for the previous year. The report contains an assessment of the geotechnical status of the WIPP based on the data which were collected throughout the year. References for reports published since the CRA-2019 data cutoff are provided below:

- WIPP Geotechnical Analysis Report for July 2016–June 2017, DOE/WIPP-18-3561, October 2018 (U.S. DOE 2018c).
- WIPP Geotechnical Analysis Report for July 2017–June 2018, DOE/WIPP-19-3610, October 2019 (U.S. DOE 2019c).
- WIPP Geotechnical Analysis Report for July 2018–June 2019, DOE/WIPP-20-3610, October 2020 (U.S. DOE 2020c).
- WIPP Geotechnical Analysis Report for July 2019–June 2020, DOE/WIPP-21-3610, October 2021 (U.S. DOE 2021c).

- WIPP Geotechnical Analysis Report for July 2020–June 2021, DOE/WIPP-22-3610, October 2022 (U.S. DOE 2022c).

- WIPP Geotechnical Analysis Report for July 2021–June 2022, DOE/WIPP-23-3610, October 2023 (U.S. DOE 2023b).

- WIPP Geotechnical Analysis Report for July 2022–June 2023, DOE/WIPP-24-3610, October 2024 (U.S. DOE 2024b).

Four COMPs are monitored relating to information collected by the GMP. These are creep closure, the extent of deformation, the initiation of brittle deformation, and the displacement of deformation features. Creep closure and displacement of deformation features are quantitative. The extent of deformation and initiation of brittle deformation are qualitative. These four parameters are discussed and analyzed in the COMPs reports listed in Section DATA-11.2.

DATA-6.0 GROUNDWATER MONITORING PROGRAM

The Groundwater Monitoring Program (GWMP) collects and analyzes water levels, water quality, and water density in the well monitoring network. Beyond fulfilling routine regulatory requirements for detection monitoring and permit compliance, the data generated by the GWMP serve as the primary empirical basis for validating the hydrological parameters used in long-term PAs. This section briefly describes the GWMP and identifies relevant reports.

DATA-6.1 Program Overview

Although the GWMP collects and analyzes data from several hydrologic units, only the data from the Culebra Dolomite Member of the Rustler Formation (hereafter, the Culebra) are relevant to 40 CFR 194.42 and the COMPs. Examples of data collected include groundwater water levels elevation and groundwater composition from numerous wells located at and near the facility. Data obtained through this program are used to generate the Culebra groundwater composition and the Culebra groundwater flow direction COMPs.

DATA-6.2 Reported Groundwater Data

The data collected by the GWMP are analyzed and discussed in the reports listed below and in the COMPs reports listed in Section DATA-11.2. These data and analyses allow for evaluation of the Culebra Conceptual site models and underlying assumption. They also serve as the foundation for parameterization in the CRA-2026 PA calculations. Appendix HYDRO-2026 and the COMPs reports provide analyses of the water levels and the fluid density in the monitoring well network used in generating the COMPs, and trigger values indicative of conditions outside of expectations. The following reports have been published since the CRA-2019 data cutoff:

- WIPP Annual Site Environmental Report for 2017, DOE/WIPP-18-3591, September 2018 (U.S. DOE 2018d).

- WIPP Annual Site Environmental Report for 2018, DOE/WIPP-19-3591, September 2019 (U.S. DOE 2019d).
- WIPP Annual Site Environmental Report for 2019, DOE/WIPP-20-3591, September 2020 (U.S. DOE 2020d).
- WIPP Annual Site Environmental Report for 2020, DOE/WIPP-21-3591, September 2021 (U.S. DOE 2021d).
- WIPP Annual Site Environmental Report for 2021, DOE/WIPP-22-3591, September 2022 (U.S. DOE 2022d).
- WIPP Annual Site Environmental Report for 2022, DOE/WIPP-23-3591, September 2023 (U.S. DOE 2023c).
- WIPP Annual Site Environmental Report for 2023, DOE/WIPP-24-3591, September 2024 (U.S. DOE 2024c).

DATA-7.0 METEOROLOGICAL MONITORING PROGRAM

The Meteorological Monitoring Program collects atmospheric data for the WIPP site. This section provides a brief description of the program and relevant reports.

DATA-7.1 Program Description

The primary WIPP meteorological station is located northeast of the Waste Handling Building. The station measures and records wind speed, wind direction, and temperature at various elevations. The station also records ground-level measurements of barometric pressure, relative humidity, precipitation, and solar radiation. These data support two regulatory functions. First, they are used as input for the Clean Air Act Assessment Package–1988 (CAP–88) model (U.S. EPA 1988) to estimate dose and risk from airborne radionuclide emissions and to demonstrate compliance with the National Emissions Standard for Hazardous Air Pollutants. Second, they support compliance with 40 CFR 194.25(b)(3) by providing baseline conditions for calibrating groundwater models used to evaluate the effects of future pluvial climate cycles on disposal system performance.

DATA-7.2 Reported Meteorological Data

The annual site environmental reports listed in Appendix DATA-6.2 provide data collected and analyzed by the Meteorological Monitoring Program. The DOE relies on paleoclimate data to understand past pluvial periods (U.S. DOE 1996). Real-time meteorological data allows the correlation of current site-specific weather patterns with regional climate indices based on historical data and uncertainty quantification for present-day conditions. Information related to recent meteorological conditions is provided in the Annual Site Environmental Reports listed in

Appendix DATA-5.2 (U.S. DOE 2018d, U.S. DOE 2019d, U.S. DOE 2020d, U.S. DOE 2021d, U.S. DOE 2022d, U.S. DOE 2023c, and U.S. DOE 2024c).

DATA-8.0 WASTE INFORMATION

Two categories of information pertaining to waste characteristics are collected: (1) information regarding waste emplaced in the underground repository, and (2) information regarding future inventory projected for emplacement in the repository over the operational life of the project. This section provides a brief description of the programs and a list of relevant reports.

DATA-8.1 Program Overview

Information concerning waste, such as waste type, container type, disposal location, etc., emplaced in the repository is tracked and recorded using the Waste Data System (WDS). Information concerning waste projected to be emplaced in the repository is developed through updates of the Annual Transuranic Waste Inventory Reports. These data were used to generate the Performance Assessment Inventory Report (PAIR) for the interim and final state repository configurations used for the CRA-2026 PA calculations. Section 24 of this application shows the changes in stored and projected waste reported by the sites since the CRA-2019 data cutoff.

DATA-8.2 Reported Waste Characterization Data

The WIPP Annual Change Report 2023/2024 (U.S. DOE 2024d) provides a detailed listing of emplaced waste in the repository up to June 30, 2024. Summary information generated by the WDS on emplaced waste and radionuclides is provided in the following reports published since the CRA-2019 data cutoff:

- Annual Change Report 2017/2018, November 2018 (U.S. DOE 2018e).
- Annual Change Report 2018/2019, October 2019 (U.S. DOE 2019e).
- WIPP Annual Change Report 2019/2020, November 2020 (U.S. DOE 2020e).
- WIPP Annual Change Report 2020/2021, November 2021 (U.S. DOE 2021e).
- WIPP Annual Change Report 2021/2022, Revision 1, November 2023 (U.S. DOE 2023d).
- WIPP Annual Change Report 2022/2023, DOE/WIPP-23-2500, November 2023 (U.S. DOE 2023e).
- WIPP Annual Change Report 2023/2024, DOE/WIPP-24-2500, December 2024 (U.S. DOE 2024d).

Information regarding current and future inventories stored and projected at generator sites is provided in the following reports published since the CRA-2019 data cutoff:

- Annual Transuranic Waste Inventory Report–2018, DOE/TRU-18-3425, November 2018 (U.S. DOE 2018f).
- Annual Transuranic Waste Inventory Report–2019, DOE/TRU-19-3425, December 2019 (U.S. DOE 2019f).
- Annual Transuranic Waste Inventory Report–2020, DOE/TRU-20-3425, November 2020 (U.S. DOE 2020f).
- Annual Transuranic Waste Inventory Report–2021, DOE/TRU-21-3425, December 2021 (U.S. DOE 2021f).
- Annual Transuranic Waste Inventory Report–2022, DOE/TRU-22-3425, December 2022 (U.S. DOE 2022e).
- Annual Transuranic Waste Inventory Report–2023, DOE/TRU-23-3425, February 2024 (U.S. DOE 2023f).
- Annual Transuranic Waste Inventory Report–2024, DOE/TRU-2024-3425.0, December 2024 (U.S. DOE 2024e).

The PAIR documents the TRU waste inventory data needs. The information provided in this report is based on the annual inventory collected from the TRU waste sites and documented in the Annual Transuranic Waste Inventory Report.

- Performance Assessment Inventory Report–2019 for the National Environmental Policy Act Additional Panels Evaluation, LA-UR-19-32088, December 2019 (Van Soest 2019).
- Performance Assessment Inventory Report–2021 for the Replacement Panels Planned Change Request, LA-UR-22-20490, January 2022 (Van Soest 2022a).
- Performance Assessment Inventory Report–2022, INV-2212-01-01-01, December 2022 (Van Soest 2022b).
- Full Performance Assessment Inventory Report–2024, INV-2501-02-01-01, January 2025 (Van Soest 2025a).
- Interim State Performance Assessment Inventory Report–2024, LA-UR-25-24935, May 2025 (Van Soest 2025b).

DATA-9.0 WIPP MONITORING WELL NETWORK

New information regarding the WIPP monitoring well network is identified in this section.

DATA-9.1 Program Overview

Information provided in this section was reported in DOE/WIPP-95-2092, Revision 1, Waste Isolation Pilot Plant Borehole Data Report in the Compliance Certification Application (CCA), Appendix BH, Borehole Data Report (U.S. DOE 1996). Appendix BH serves as a central document providing data on the monitoring well network. The report contains a comprehensive database of wells drilled in support of site characterization and monitoring within the 16-section land withdrawal area.

DATA-9.2 Reported Well Network Data

Attachment A of Appendix DATA-2026 is a list of all monitoring wells at the WIPP, including wells installed since the CCA and those that have been plugged and abandoned.

DATA-10.0 CBFO EXPERIMENTAL AND TESTING ACTIVITIES

The DOE supports research to address knowledge gaps, validate conceptual model assumptions, and improve the conceptual models that support PA. These activities also fulfill DOE Order 435.1 requirements for continuous PA maintenance, which include ongoing evaluation of new information and assessment of its implications for disposal system performance. The program is briefly described in this section and references to relevant reports are provided.

DATA-10.1 Program Overview

The DOE supports a range of experimental and testing activities aimed at reducing conservatism and uncertainty while improving the overall understanding of the disposal system. The resulting data and analyses are compiled and included in each recertification application to reflect the most current understanding of the conditions that influence repository performance. The general areas covered under these investigations include:

- Actinide Chemistry
- Colloids
- Corrosion Chemistry
- Geochemistry
- Hydrology
- Microbiology
- Rock Mechanics

DATA-10.2 Reported Experimental and Testing Activities Data

Efforts to collect information through experimental and testing activities are documented in a variety of formats. These include test and analysis plans, technical memoranda and reports, and peer-reviewed publications issued since the CRA-2019 data cutoff.

ACTINIDE CHEMISTRY

- Total Actinide Concentrations as a function of Hydromagnesite5424 Log K (Domski 2018c).
- Prediction of Baseline Actinide Solubilities for Surplus Plutonium Disposition (Domski 2018d).
- Technical Aspects of the Baseline Solubility Model for the CRA-2019 PA (Domski 2019a).
- Th(IV), Np(V), and Am(III) Baseline Solubilities and Th(IV) and Am(III) Solubility Uncertainties for the CRA-2019 PA (Domski 2019b).
- Uncertainty Analysis of Actinide Solubilities for CRA 2019 (Domski 2019c).
- Parameter Problem Report (PPR) 2019-003 for SOLMOD5:SOLSOH (Domski 2019d).
- Spectroscopy and Solubility of U(IV) in Dilute to Concentrated NaCl Solutions in the Presence of Ethylenediaminetetraacetic Acid (EDTA) at pHm 1-11. Report LA-UR-28330 (Yalcintas et al. 2019).
- Effects of Radiolysis, Organic Complexation, and Redox Conditions on the Speciation and Oxidation State Distribution of Pu(III/IV). 2020, Test Plan LCO-ACP-25 (Beam 2020).
- Correction of the $\alpha 1$ terms of three Binary Pitzer Parameter blocks in DATA0.FM4, PPR 2019-004 through 2019-013 (Domski 2020a).
- Memorandum of Correction for Parameter Problem Reports (PPR) 2019-004 - 2019-013 (Domski 2020b).
- Interaction of Np(V) with Borate in Alkaline, Dilute-to-Concentrated, NaCl and MgCl2 Solutions (Hinz et al. 2020).
- Influence of Ethylenediaminetetraacetic Acid on the Long-Term Oxidation State Distribution of Plutonium (DiBlasi et al. 2021a).
- Impact of Ca(II) on the Aqueous Speciation, Redox Behavior, and Environmental Mobility of Pu(IV) in the Presence of EDTA (DiBlasi et al. 2021b).
- Sandia National Laboratories (SNL) WIPP Geochemistry, Actinide Uncertainty Analysis: Literature Screening Criteria Seminar, SAND2021-7665PE (Hora et al. 2021b).
- A speciated, conventional Pitzer ion-interaction model for the aqueous Nd3+–H+–Na^+–K^+–Ca^{2+}–Cl^-–OH^- system at 298 K and 0.1 MPa. (Oakes et al. 2021).
- Pu(III) and Cm(III) in the Presence of EDTA: Aqueous Speciation, Redox Behavior, and the Impact of Ca(II) (DiBlasi et al. 2022).
- Revised Literature Screening Criteria for the WIPP Actinide Solubility Uncertainty Analysis for CRA-2024 (Domski and Nemer 2022).
- Solubility of An(OH)3 (am) and An(OH)3 (cr) in the Presence of Citrate and EDTA, LCO-ACP-29 (Kutahyali Aslani 2022).

- Experimental Strategy to Challenge Actinide Solubility Predictions, Test Plan LCO-ACP-26, Revision 1 (Reed 2022).
- Plutonium Oxidation State Distribution under WIPP Relevant Conditions, LCO-ACP-31, Revision 1 (Beam 2023).
- Thermodynamic quantities for Fe^{+2} - SO_4^{-2} - H^+ - H_2O system (Revision 0) (Jang 2023a).
- Plutonium Speciation and Oxidation State Distributions in the Presence of Citrate (Comins et al. 2024).
- Solubility of Solid Phase $Am(OH)_3$ in Various Solutions at pmH 7 - 14 (Domski 2024).
- Radiolytic Degradation of Organics – Progress Report, LCO-ACP-39 (Favela Morales and Lucchini 2024).
- Effects of Borate and Organics on U(VI) Solubility in WIPP Brine, LCO-ACP-33, Revision 1 (Kutahyali Aslani 2024).
- Radiolytic Degradation of Organics – Focus on EDTA and Citrate. Test Plan LCO-ACP-35 (Lucchini 2024).
- An Alternative Conceptual Model for Radiolysis Effects on Chemical Conditions in Salt Repositories (Ward 2024).
- Plutonium Oxidation State Distribution in the Presence of WIPP-Relevant Organics and Iron Corrosion Products, LCO-ACP-38, Revision 1 (Kaplan 2025b).
- LANL ACRSP Parameter Recommendations for CRA-2026 Performance Assessment, LCO-ACP-41, Revision 1 (Kaplan et al. 2025).
- Effect of Citrate on the Solubility of Uranium(VI) in WIPP Brine, LCO-ACP-43 (Kutahyali Aslani 2025).

COLLOIDS

- Comparative Analysis of Uranium Bioassociation with Halophilic Bacteria and Archaea (Bader et al. 2018).
- Second Milestone Report on Test Plan TP 14-04, “Experimental investigation of Stability of Mineral Colloids under WIPP Conditions” (Kirkes et al. 2019).
- A summary of humic colloid parameter values to be implemented in the CRA-2019 Deferred Performance Assessment (Mariner 2019).
- Review of the Microbial Colloid Contribution to the WIPP Actinide Source Term, LCO-ACP-23 (Swanson 2019).
- Cadmium and Proton Adsorption onto a Halophilic Archaeal Species: The Role of Cell Envelope Sulfhydryl Sites (Liu et al. 2020).
- Analysis Report on Mineral Fragment Colloids under WIPP Relevant Conditions (Hora et al. 2021a).

- Biomass and Salt-Dependent Effects of *Bacillus* spores on Radionuclide Migration from the Waste Isolation Pilot Plant (Swanson et al. 2021b).
- Actinide (III/IV) – Silica Colloids in the WIPP, LCO-ACP-27 (Beam 2022).
- MgO Suspension in DI Water for Mineral Fragment Colloid Analysis (Foli et al. 2022a).
- Progress Report on the Mineral Fragment Colloid Study at SNL WIPP Geochemistry (Foli et al. 2022b).
- Progress Report on the MgO Hydration and Carbonation Study at SNL WIPP Geochemistry (Rhino et al. 2022).
- Microbial Influence on the Mobility of +3 Actinides from a Salt-Based Nuclear Waste Repository (Swanson et al. 2023).
- Biologically Influenced Transport of the +3 Actinide Oxidation State from the WIPP Environment, Using Neodymium as an Analog, LCO-ACP-32, Revision 1 (Swanson 2024a).
- GEOC-24-05 Milestone Report on Mineral Fragment Colloids Under TP 22-02 (Foli 2025).

CORROSION CHEMISTRY

- Analysis Report on Iron and Lead Corrosion in WIPP-Relevant Conditions (Zhang et al. 2021).

GEOCHEMISTRY

- Comparison of Hydromagnesite5424 Log K_{sp} Values (Domski 2018a).
- Recommended Ranges of pcH, Ionic Strength, Total Inorganic Carbon (TIC), and Carbon Dioxide Fugacity for WIPP Baseline Solubility Uncertainty Calculations (Domski 2018b).
- Calculation of Organic-Ligand Concentrations for the Surplus Plutonium Disposition Performance Assessment (Domski 2018e).
- Am(III)/Nd(III) Interactions with Borate: Experimental Investigations of $Nd(OH)_3$ (micro cr) Solubility in Mixtures of NaCl and $MgCl_2$ in Equilibrium with Borax, SAND2018-3288A (Xiong et al. 2018a).
- Experimental Determination of Nd(III) Solubility in Mixtures NaCl and $MgCl_2$: Applications to Nuclear Waste Management, SAND2018-0308A (Xiong et al. 2018b).
- Solubility Model for Ferrous Iron Hydroxide and Hibbingite in Sodium Chloride Solutions in the Presence of Ethylenediaminetetraacetate, SAND2019-4222J (Jang et al. 2019).
- Characterization Milestone Report on Test Plan TP 10-01, “Experimental Study of Thermodynamic Parameters of Borate in WIPP Relevant Brines at Sandia National Laboratories Carlsbad Facility” (Xiong and Kirkes 2019).
- Interaction of Np(V) with Borate in Alkaline, Dilute-to-Concentrated, NaCl and $MgCl_2$ Solutions (Hinz et al. 2020).

- Dissolved Concentration of Iron and Lead in GWB and ERDA-6 in the presence of FeS, PbS, and Organic Ligands (Jang 2020).
- Solubility of Lead Chloride in Hydrochloric Acid Solutions of Low to High Concentrations: A Pitzer Approach, SAND2020-0870A (Jang et al. 2020).
- Third Milestone Report on Test Plan TP 12-02, "Experimental Investigation of Borate Interactions with Rare Earth Elements Under the WIPP Relevant Conditions at SNL Carlsbad Facility" (Kirkes and Hora 2020).
- First End-of-year Report on Test Plan TP 20-01 Revision 0, "Solubility and Complexation of Lead in Non-Sulfidic Brines of WIPP-Relevance" (Zhang et al. 2020a).
- Modeling of the Stability of Lead Solid Phases at the WIPP Conditions, SAND2020-0803A (Zhang et al. 2020b).
- Analysis Report documenting the Assessment of the Solubility of Lead, EDTA, and other Organic Ligands in non-Sulfide systems performed under TP 08-02 and under TP 20-01, SAND2022-13720R (Jang et al. 2021a).
- 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 (Jang et al. 2021b).
- Implementation of the Neck et al. (2009) Am(III) Model (Domski 2022).
- The $PbCO_3$(s) - $NaHCO_3$ - Na_2CO_3 - H_2O Experiment (Revision 0): Addendum to Xiong (2015a,b) (Jang 2022).
- Neptunium(V) Solubility in the Presence and Absence of WIPP Relevant Ligands, LCO-ACP-30, Rev. 0 (Kaplan 2022).
- Corrections to Section 3.1.3 of the Analysis Report: An Update to the WIPP EQ3/6 Database DATA0.FM1 with the Creation of DATA0.FM6 (Domski 2023a).
- Official Release of the Qualified WIPP Pitzer Thermodynamic Database, DATA0.FM6, for EQ3/6 under AP-200 (Domski 2023b).
- On the Occurrence and Solubility of the Magnesium Hydroxy-Chloride Phases: Phase 3 and Phase 5 in the WIPP Near-Field Environment (Domski and Nemer 2023).
- The $PbSO_4$(s) - Na_2SO_4 - NaCl - H_2O Experiment (Revision 0) (Jang 2023b).
- Solubility and Complexation of Iron, Lead, Magnesium, Neodymium, Boron, and Calcium in Brines (Jang and Foli 2023).
- Alternatives to the Current Uncertainty Methodology (Nemer 2023).
- Bayesian inference applied to the Solubility of Phase-3 and Phase-5, SAND2023-01165R (Nemer and Domski 2023).
- Bayesian Inference Applied to Estimating the Uncertainty in Phase-3 and Phase-5 Log K Values (Nemer et al. 2023).

- Reproduction of log K values for $NaPb_2(CO_3)_2(OH)(s)$ (Abellaite) and $Pb(CO_3)_3^{4-}$, and Pitzer interaction parameter for species pair of Pb^{2+}/H^+ (Rhino et al. 2023).
- GEOC 24-03 Sorption and the WIPP Chemistry Conceptual Model (Brady 2024a).
- GEOC 24-09 WIPP Chemistry-related Conceptual Models Compared to Natural Analogues (Brady 2024b).
- Implementation of Geochemistry Conceptual Models (Brady et al. 2024).
- Steps involved in the initial stages of the literature screening (Nemer 2024).
- Neptunium(V) Solubility in WIPP Brine: Presence and Absence of WIPP-Relevant Organic and Inorganic Ligand, LCO-ACP-42 (Kaplan 2025a).

HYDROLOGY

- HYDRO-24-08 Progress Report for Investigation of Culebra Pore Size Distribution (Foli 2024).
- Defining Culebra Recharge through Geochemistry and Stable Isotope Analysis (Kirkes 2024).

MICROBIOLOGY

- Experimental Determination of Solubilities of Brucite [$Mg(OH)_2(cr)$] in Na_2SO_4 Solutions with Borate to High Ionic Strengths: Interactions of $MgB(OH)_4^+$ with Na_2SO_4 (Xiong et al. 2018c).
- Potential Microbial Influence on the Performance of Subsurface, Salt-Based Nuclear Waste Repositories (Swanson et al. 2021a).
- Effects of Salt Concentration, Ionic Strength, and Water Activity on the Growth of a WIPP Archaeal Isolate, *Halobacterium* sp., LCO-ACP-28 (Swanson 2022).
- Microbial Influence on Radionuclide Transport through the Culebra, LCO-ACP-37 (Swanson 2024b).

ROCK MECHANICS

- Experimental investigation of the influence of pore pressure and porosity on the deformation of granular salt (Lampe et al. 2018).
- Micromechanical processes in consolidated granular salt (Mills et al. 2018).
- Enhancements to the Munson-Dawson Model for Rock Salt, SAND2018-12601 (Reedlunn 2018).
- Simulations Of Pipe Overpack Container Compaction at the Waste Isolation Pilot Plant, SAND2019-12111 (Reedlunn and Bean 2019).
- Initial Simulations of Empty Room Collapse and Reconsolidation at the Waste Isolation Pilot Plant, SAND2019-15351 (Reedlunn et al. 2019).

- Reconstruction of the Room D, B, G, and Q Closure Histories at the Waste Isolation Pilot Plant, SAND2021-6904 (Reedlunn and Williams. 2021).
- Report on Permeability Changes of Damaged Rock Salt Adjacent to Inclusions of Different Stiffness (Anwar and Stormont 2022).
- Permeability And Porosity of Loose Mixtures of Salt, SAND2022-16010C (Babcock et al. 2022).
- WEIMOS: Creep of rock salt at low deviatoric stresses (Lüdeling et al. 2022).
- A New Rock Salt Constitutive Model with Back Stress and Drag Stress Hardening, SAND2022-2298C (Reedlunn 2022a).
- A New Constitutive Model for Rock Salt Viscoplasticity: Formulation, Implementation, and Demonstrations (Reedlunn 2022b).
- A Reinvestigation into Munson's Model for Room Closure in Bedded Rock Salt (Reedlunn et al. 2022c).
- WEIMOS: Shear Behaviors of Bedded Salt Clay Seams and their Impact on Disposal Room Porosity, SAND2022-2303C (Sobolik et al. 2022).
- Improved Compaction Experiments and Modeling of Waste Isolation Pilot Plant Standard, Non-Degraded, Waste Containers, SAND2023-04823 (Jensen et al. 2023).
- Improved Modeling of Waste Isolation Pilot Plant Disposal Room Porosity, SAND2023-04826 (Vignes et al. 2023).
- Status Of Efforts to Model the Geomechanics of Empty Room Collapse and Reconsolidation at the Waste Isolation Pilot Plant, SAND2024-16297CTF (Reedlunn et al. 2024).

DATA-11.0 COMPLIANCE MONITORING PROGRAM

Annually, the Compliance Monitoring Program (CMP) extracts data from the five monitoring programs described above (DBDSP, SMP, GMP, GWMP, and WDS). The data are used to derive values for the 10 COMPs described in Appendix DATA-2.0 and to identify any data values that are not within expected values. The CMP activities are briefly described in this section. Data generated under the CMP are also identified.

DATA-11.1 Program Overview

The objective of the CMP is to provide assurance that any deviations from the expected long-term performance of the repository are identified at the earliest possible time. The CMP is implemented in accordance with DOE/WIPP-99-3119, Compliance Monitoring Implementation Plan for 40 CFR 191.14(b), Assurance Requirement (U.S. DOE 2023g). Annual evaluations of the compliance parameters follow the requirements found in Sandia National Laboratories SP 9-8, Monitoring Parameter Assessment Per 40 CFR 194.42 (Kicker 2020).

DATA-11.2 Reported Compliance Monitoring Data

Data and results from the CMP are provided in the following reports published since the CRA-2019 data cutoff:

- Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2018, January 2019 (Wagner and Hayes 2019).
- Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2019, January 2020 (Wagner and Hayes 2020).
- Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2020, January 2021 (Kicker et al. 2021).
- Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2021, March 2022 (Kicker et al. 2022).
- Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2022, January 2023 (Kicker et al. 2023).
- Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2023, February 2024 (Kicker and Jackson 2024).
- Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2024, March 2025 (Kicker and Jackson 2025).

DATA-12.0 HYDROLOGICAL MONITORING

The Hydrologic Monitoring Program has been initiated by DOE for the Culebra to record water levels and continues to investigate water level fluctuations that may impact the long-term performance of the WIPP. The results of these investigations are discussed in Appendix HYDRO-2009, Appendix HYDRO-2014, Appendix HYDRO-2019, and Appendix HYDRO-2026.

Since the CRA-2019, minor anthropogenic events were identified but these events would then rebound to the natural attenuation of the aquifer after a brief time. It was discovered that an illegal well completed in the Culebra and operated by a local ranch south of the WIPP site was being used as a water source for commercial purposes for several years. Water extraction from this well created notable drawdown in 15 wells in the Culebra monitoring network. A detailed discussion of the observed drawdown and how compliance monitoring was affected is presented in Appendix HYDRO-6.1.

DATA-12.1 Reported Hydrological Monitoring Data

Data acquired from hydrologic monitoring are provided in the reports listed below for Culebra water-level monitoring.

DATA-12.1.1 Culebra Water-Level Monitoring

The following reports are related to Culebra water-level monitoring:

- Letter to Records Center (Subject: 2018 Calculated Densities), April 2019 (Johnson 2018).
- Letter to Records Center (Subject: 2019 Calculated Densities), March 2020 (Johnson 2019).
- Letter to Records Center (Subject: 2020 Calculated Densities), March 2021 (Farinacci and Johnson 2020).
- Letter to Records Center (Subject: 2021 Calculated Densities), March 2022 (Farinacci 2021).
- Letter to Records Center (Subject: 2022 Calculated Densities), February 2023 (Farinacci 2022).
- Letter to Records Center (Subject: 2023 Calculated Densities), February 2024 (Reyna and Johnson 2023).
- Letter to Records Center (Subject: 2024 Calculated Densities), January 2025 (Reyna and Johnson 2024).

The following reports are related to Culebra water-level fluctuations in WIPP monitoring wells:

- CY19 Fluctuations in the WIPP Monitoring Well Network. ERMS 573306. (Bowman and Hayes 2020).
- CY20 Fluctuations in the WIPP Monitoring Well Network. ERMS 575174. (Bowman 2021).
- CY21 Fluctuations in the WIPP Monitoring Well Network. ERMS 577608. (Bowman 2022).
- CY22 Fluctuations in the WIPP Monitoring Well Network. ERMS 579861. (Bowman and Kirkes 2023).
- CY23 Fluctuations in the WIPP Monitoring Well Network. ERMS 581799. (Kirkes and Bowman 2024).
- CY24 Fluctuations in the WIPP Monitoring Well Network. EIMS-0004825959. (Kirkes and Bowman 2025).

DATA-13.0 WASTE CONTAINERS AND EMPLACEMENT

Information regarding WIPP waste emplacement containers and underground waste emplacement layouts is provided in this section. Approved containers that are inside other containers, such as pipe overpacks, are not discussed.

DATA-13.1 Program Overview

Information provided in this section was compiled from several sources to serve as a central document describing both waste-emplacement containers and waste-emplacement layouts. Both contact-handled transuranic (CH-TRU) and remote-handled transuranic (RH-TRU) waste containers are described along with CH-TRU and RH-TRU waste-emplacement layouts in a typical panel in the repository. Only containers approved for disposal in the repository are discussed.

DATA-13.2 Reported Waste Containers and Emplacement Data

Attachment B to this appendix provides detailed information on the various waste containers and their emplacement in the underground repository.

DATA-14.0 REFERENCES

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

Anwar, I., and J.C. Stormont. 2022. Report on Permeability Changes of Damaged Rock Salt Adjacent to Inclusions of Different Stiffness. Carlsbad, NM: Sandia National Laboratories. EIMS-0005020833.*

Babcock, E., J.C. Stormont, M.M. Mills, and E.N. Matteo. 2022. Permeability and Porosity of Loose Mixtures of Salt. Carlsbad, NM: Sandia National Laboratories. SAND2022-16010C.*

Bader, M., K. Müller, H. Foerstendorf, M. Schmidt, K. Simmons, J. Swanson, D. Reed, T. Stumpf, and A. Cherkouk. 2018. Comparative Analysis of Uranium Bioassociation with Halophilic Bacteria and Archaea. *Plos One.* DOI: 10.1371/journal.pone.0190953*

Beam, J.C. 2020. Effects of Radiolysis, Organic Complexation, and Redox Conditions on the Speciation and Oxidation State Distribution of Pu(III/IV). 2020. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-25, Rev. 0.*

Beam, J.C. 2022. Actinide (III/IV) – Silica Colloids in the WIPP. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-27, Rev. 0.*

Beam, J.C. 2023. Plutonium Oxidation State Distribution under WIPP Relevant Conditions. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-31, Rev. 1.*

Bowman, D., and A. Hayes. 2020. Milestone HYDRO 20-02: Progress Report that Documents CY19 Fluctuations in the WIPP Monitoring Well Network. Carlsbad, NM: Sandia National Laboratories. ERMS 573306.*

Bowman, D. 2021. Milestone HYDRO 21-02: Progress Report that Documents CY20 Fluctuations in the WIPP Monitoring Well Network. Carlsbad, NM: Sandia National Laboratories. ERMS 575174.*

Bowman, D. 2022. Milestone HYDRO 22-02: Progress Report that Documents CY21 Fluctuations in the WIPP Monitoring Well Network. Carlsbad, NM: Sandia National Laboratories. ERMS 577608.*

Bowman, D., and J. Kirkes. 2023. Milestone HYDRO 23-02: Progress Report that Documents CY22 Fluctuations in the WIPP Monitoring Well Network. Carlsbad, NM: Sandia National Laboratories. ERMS 579861.*

Brady, P. 2024a. GEOC 24-03 Sorption and the WIPP Chemistry Conceptual Model. Carlsbad, NM: Sandia National Laboratories. ERMS 581507.*

Brady, P. 2024b. GEOC 24-09 WIPP Chemistry-related Conceptual Models Compared to Natural Analogues. Carlsbad, NM: Sandia National Laboratories. ERMS 582410.*

Brady, P. V., P. Domski, I. Foli, J. Jang, A. Pavitt, and T. Platte. 2024. GEOC-23-10 Milestone Report, Implementation of Geochemistry Conceptual Models. Carlsbad, NM: Sandia National Laboratories. ERMS 581445.*

Comins, M.B., U. Kaplan, J. Beam, A. Navarrette, and A. Hixon. 2024. Plutonium Speciation and Oxidation State Distributions in the Presence of Citrate. *Environmental Science & Technology*. Vol. 58, pp. 15766 – 15778.*

DiBlasi, N., E. Yalcintas, F. Stanley, D. Reed, and A. Hixon. 2021a. Influence of Ethylenediaminetetraacetic Acid on the Long-Term Oxidation State Distribution of Plutonium. *Chemosphere,* 274 (2021) 129741.*

DiBlasi, N., A. Tasi, X. Gaona, D. Fellhauer, K. Dardenne, J. Rothe, D. Reed, A. Hixon, and M. Altmaier. 2021b. Impact of Ca(II) on the Aqueous Speciation, Redox Behavior, and Environmental Mobility of Pu(IV) in the Presence of EDTA, *Science of the Total Environment*, 783 (2021) 146993.*

DiBlasi, N., A.G. Tasi, M. Trumm, A. Schnurr, X. Gaona, D. Fellhauer, K. Dardenne, J. Rothe, D. Reed, A. Hixon, and M. Atlmaier. 2022. Pu(III) and Cm(III) in the Presence of EDTA: Aqueous Speciation, Redox Behavior, and the Impact of Ca(II). *Royal Society of Chemistry, RSC Advances.* Vol. 12, pp. 9478 – 9493.*

Domski, P. S. 2018a. Comparison of Hydromagnesite5424 Log K_{sp} Values. Carlsbad, NM: Sandia National Laboratories. ERMS 570188.*

Domski, P. S. 2018b. Recommended Ranges of pcH, Ionic Strength, Total Inorganic Carbon (TIC), and Carbon Dioxide Fugacity for WIPP Baseline Solubility Uncertainty Calculations. Carlsbad, NM: Sandia National Laboratories. ERMS 570102.*

Domski, P. S. 2018c. Total Actinide Concentrations as a function of Hydromagnesite5424 Log K. Carlsbad, NM: Sandia National Laboratories. ERMS 570027.*

Domski, P. S. 2018d. Prediction of Baseline Actinide Solubilities for Surplus Plutonium Disposition. Carlsbad, NM: Sandia National Laboratories. ERMS 570602.*

Domski, P. S. 2018e. Calculation of Organic-Ligand Concentrations for the Surplus Plutonium Disposition Performance Assessment. Carlsbad, NM: Sandia National Laboratories. ERMS 570586.*

Domski, P. S. 2019a. Technical Aspects of the Baseline Solubility Model for the CRA-2019 PA. Carlsbad, NM: Sandia National Laboratories. ERMS 571535.*

Domski, P. S. 2019b. Th(IV), Np(V), and Am(III) Baseline Solubilities and Th(IV) and Am(III) Solubility Uncertainties for the CRA-2019 PA. Carlsbad, NM: Sandia National Laboratories. ERMS 571169.*

Domski, P. S. 2019c. Uncertainty Analysis of Actinide Solubilities for CRA 2019. Carlsbad, NM: Sandia National Laboratories. ERMS 571179.*

Domski, P. S. 2019d. Parameter problem report (PPR) 2019-003 for SOLMOD5:SOLSOH. Carlsbad, NM: Sandia National Laboratories. ERMS 572265.*

Domski, P. S. 2020a. Correction of the $\alpha 1$ terms of three Binary Pitzer Parameter blocks in DATA0.FM4, PPR 2019-004 through 2019-013. Carlsbad, NM: Sandia National Laboratories. ERMS 572559.*

Domski, P. S. 2020b. Memorandum of Correction for Parameter Problem Reports (PPR) 2019-004 - 2019-013. Carlsbad, NM: Sandia National Laboratories. ERMS 574281.*

Domski, P. S. 2022. Implementation of the Neck et al. (2009) Am(III) Model. Carlsbad, NM: Sandia National Laboratories. ERMS 577677.*

Domski, P. S. 2023a. Corrections to Section 3.1.3 of the Analysis Report: An Update to the WIPP EQ3/6 Database DATA0.FM1 with the Creation of DATA0.FM6. Carlsbad, NM: Sandia National Laboratories. ERMS 579803.*

Domski, P. S. 2023b. Official Release of the Qualified WIPP Pitzer Thermodynamic Database, DATA0.FM6, for EQ3/6 under AP-200. Carlsbad, NM: Sandia National Laboratories. ERMS 579375.*

Domski, P. S. 2024. Solubility of Solid Phase $Am(OH)_3$ in Various Solutions at pmH 7 - 14. Carlsbad, NM: Sandia National Laboratories. ERMS 582409.*

Domski, P. S., and M. B. Nemer. 2022. Revised Literature Screening Criteria for the WIPP Actinide Solubility Uncertainty Analysis for CRA-2024. Carlsbad, NM: Sandia National Laboratories. ERMS 577493.*

Domski, P. S., and M. B. Nemer. 2023. On the Occurrence and Solubility of the Magnesium Hydroxy-Chloride Phases: Phase 3 and Phase 5 in the WIPP Near-Field Environment. Carlsbad, NM: Sandia National Laboratories. ERMS 580461.*

Farinacci, M. 2021. 2021 Calculated Densities. Carlsbad, NM: Sandia National Laboratories. ERMS 577068.*

Farinacci, M. 2022. 2022 Calculated Densities. Carlsbad, NM: Sandia National Laboratories. ERMS 581035.*

Farinacci, M., and P. Johnson. 2020. 2020 Calculated Densities. Carlsbad, NM: Sandia National Laboratories. ERMS 575042.*

Favela Morales, D., and J. Lucchini. 2024. Radiolytic Degradation of Organics – Progress Report. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-39, Rev. 0.*

Foli, I. 2024. HYDRO-24-08 Progress Report for Investigation of Culebra Pore Size Distribution. Carlsbad, NM: Sandia National Laboratories. ERMS 582420.*

Foli, I. 2025. GEOC-24-05 Milestone Report on Mineral Fragment Colloids Under TP 22-02. Carlsbad, NM: Sandia National Laboratories. ERMS 582426.*

Foli, I., K. Rhino, and J. Jang. 2022a. MgO Suspension in DI Water for Mineral Fragment Colloid Analysis. Carlsbad, NM: Sandia National Laboratories. ERMS 578498.*

Foli, I., K. Rhino, and J. Jang. 2022b. Progress Report on the Mineral Fragment Colloid Study at SNL WIPP Geochemistry. Revision 0. Carlsbad, NM: Sandia National Laboratories. ERMS 578424.*

Hinz, K., D. Fellhauer, X. Gaona, M. Vespa, K. Dardenne, D. Schild, T. Yokosawa., M.A. Silver, D.T. Reed, T.E. Albrecht-Schmitt, M. Altmaier, and H. Geckeis. 2020. Interaction of Np(V) with Borate in Alkaline, Dilute-to-Concentrated, NaCl and $MgCl_2$ Solutions. *Royal Society of Chemistry, Dalton Transactions*, Vol. 49, pp. 1570-1581.*

Hora, P., C. Miller, J. Jang, L. Zhang, and L. Kirkes. 2021a. Analysis Report on Mineral Fragment Colloids under WIPP Relevant Conditions. Carlsbad, NM: Sandia National Laboratories. ERMS 576110.*

Hora, P., C. Miller, L. Kirkes, J. Jang, L. Zhang, P. Domski, and M. Nemer. 2021b. SNL WIPP Geochemistry, Actinide Uncertainty Analysis: Literature Screening Criteria Seminar. Carlsbad, NM: Sandia National Laboratories. SAND2021-7665PE.*

Jang, J. Je-Hun (J-H). 2020. Dissolved Concentration of Iron and Lead in GWB and ERDA-6 in the presence of FeS, PbS, and Organic Ligands. Carlsbad, NM: Sandia National Laboratories. ERMS 574160.*

Jang, J. J-H. 2022. The $PbCO_3$(s) - $NaHCO_3$ - Na_2CO_3 - H_2O Experiment. Revision 0: Addendum to Xiong (2015a,b). Carlsbad, NM: Sandia National Laboratories. ERMS 578642.*

Jang, J. J-H. 2023a. Thermodynamic quantities for Fe^{+2} - SO_4^{-2} - H^+ - H_2O system. Revision 0. Carlsbad, NM: Sandia National Laboratories. ERMS 578717.*

Jang, J. J-H. 2023b. The $PbSO_4$(s) - Na_2SO_4 - NaCl - H_2O Experiment. Revision 0. Carlsbad, NM: Sandia National Laboratories. ERMS 578721.*

Jang, J. J-H., M. Nemer, C. Marrs, J. Knox, and H. Burton. 2019 Solubility Model for Ferrous Iron Hydroxide and Hibbingite in Sodium Chloride Solutions in the Presence of Ethylenediaminetetraacetate. Carlsbad, NM: Sandia National Laboratories. SAND2019-4222J.*

Jang, J. J-H., L. Kirkes, and L. Zhang. 2020. Solubility of Lead Chloride in Hydrochloric Acid Solutions of Low to High Concentrations: A Pitzer Approach. Carlsbad, NM: Sandia National Laboratories. SAND2020-0870A.*

Jang, J. J-H., P. Hora, L. Kirkes, C. Miller, and L. Zhang. 2021a. Analysis Report documenting the Assessment of the Solubility of Lead, EDTA and other Organic Ligands in non-Sulfide systems performed under TP 08-02 and under TP 20-01. Carlsbad, NM: Sandia National Laboratories. SAND2022-13720R.*

Jang, J. J-H., P. Hora, L. Kirkes, C. Miller, and L. Zhang. 2021b. 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, Revision 0. Carlsbad, NM: Sandia National Laboratories. SAND2022-13723R.*

Jang, J. J-H., and I. Foli. 2023. Solubility and Complexation of Iron, Lead, Magnesium, Neodymium, Boron, and Calcium in Brines. Revision 1. Carlsbad, NM: Sandia National Laboratories. ERMS 578806.*

Jensen, R.P., S. T. Broome, C. G. Herrick, and B. Reedlunn. 2023. Improved Compaction Experiments and Modeling of Waste Isolation Pilot Plant Standard, Non-Degraded, Waste Containers. Carlsbad, NM: Sandia National Laboratories. SAND2023-04823. *

Johnson, P. 2018. 2018 Calculated Densities. Carlsbad, NM: Sandia National Laboratories. ERMS 571445.*

Johnson, P. 2019. 2019 Calculated Densities. Carlsbad, NM: Sandia National Laboratories. ERMS 572937.*

Kaplan, U. 2022. Neptunium(V) Solubility in the Presence and Absence of WIPP Relevant Ligands. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-30, Rev. 0.*

Kaplan, U. 2025a. Neptunium(V) Solubility in WIPP Brine: Presence and Absence of WIPP-Relevant Organic and Inorganic Ligands. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-42, Rev. 0.*

Kaplan, U. 2025b. Plutonium Oxidation State Distribution in the Presence of WIPP-Relevant Organics and Iron Corrosion Products. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-38, Rev. 1.*

Kaplan, U., J. Swanson, and C. Kutahyali Aslani. 2025. LANL ACRSP Parameter Recommendations for CRA-2026 Performance Assessment. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-41, Rev. 1.*

Kicker, D. 2020. Sandia National Laboratories SP 9-8, Monitoring Parameter Assessment per 40 CFR 194.42, Revision 3. Carlsbad, NM: Sandia National Laboratories. ERMS 573316.*

Kicker, D., D. Bowman, and A. Hayes. 2021. Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2020 (January 2021). WBS 4.3.1. ERMS 574855. Carlsbad, NM: Sandia National Laboratories.*

Kicker, D., D. Bowman, and R. Jackson. 2022. Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2021 (March 2022). Carlsbad, NM. WBS 4.3.1. ERMS 576731. Carlsbad, NM: Sandia National Laboratories.*

Kicker, D., R. Jackson, and A. Hayes. 2023. Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2022 (January 2023). WBS 4.3.1. ERMS 578677. Carlsbad, NM: Sandia National Laboratories.*

Kicker, D., and R. Jackson. 2024. Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2023 (February 2024). WBS 4.3.1. ERMS 581299. Carlsbad, NM: Sandia National Laboratories.*

Kicker, D., and R. Jackson. 2025. Sandia National Laboratories Waste Isolation Pilot Plant Compliance Monitoring Parameter Assessment for 2024 (March 2025). WBS 4.3.1. Carlsbad, NM: Sandia National Laboratories. EIMS-0004805064.*

Kirkes, J., and D. Bowman. 2024. Milestone HYDRO 24-01: Progress Report that Documents CY23 Fluctuations in the WIPP Monitoring Well Network. Carlsbad, NM: Sandia National Laboratories. ERMS 581799.*

Kirkes, J., and D. Bowman. 2025. Milestone HYDRO 25-01: Progress Report that Documents CY24 Fluctuations in the WIPP Monitoring Well Network. Carlsbad, NM: Sandia National Laboratories. EIMS-0004825959.*

Kirkes, L., P. Mariner, and C. Sisk-Scott. 2019. Second Milestone Report on Test Plan TP 14-04, "Experimental investigation of Stability of Mineral Colloids under WIPP Conditions." Carlsbad, NM: Sandia National Laboratories. ERMS 570781.*

Kirkes, L., and P. Hora. 2020. Third Milestone Report on Test Plan TP 12-02, "Experimental Investigation of Borate Interactions with Rare Earth Elements Under the WIPP Relevant Conditions at Sandia National Laboratories Carlsbad Facility." Carlsbad, NM: Sandia National Laboratories. ERMS 574511.*

Kirkes, L. D. 2024. Defining Culebra Recharge through Geochemistry and Stable Isotope Analysis. Carlsbad, NM: Sandia National Laboratories. ERMS 582400.*

Kutahyali Aslani, C. 2022. Solubility of An(OH)3 (am) and An(OH)3 (cr) in the Presence of Citrate and EDTA. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-29, Rev. 0.*

Kutahyali Aslani, C. 2024. Effects of Borate and Organics on U(VI) Solubility in WIPP Brine. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-33, Rev. 1.*

Kutahyali Aslani, C. 2025. Effect of Citrate on the Solubility of Uranium(VI) in WIPP Brine. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-43, Rev. 0.*

Lampe, B.C., J.C. Stormont, T.D. Lynn, and S.J. Bauer. 2018. Experimental investigation of the influence of pore pressure and porosity on the deformation of granular salt. International Journal of Rock Mechanics and Mining Sciences. 110 (2018) 291-305. DOI: 10.1016/j.ijrmms.2018.07.007.*

Liu, J., Q. Yu, A.R. Showalter, B. Bunker, J. Swanson, D. Reed, X. Rong, and J. Fein. 2020. Cadmium and Proton Adsorption onto a Halophilic Archaeal Species: The Role of Cell Envelope Sulfhydryl Sites. Geochimica et Cosmochimica Acta 276 (2020) 186-197.*

Lucchini, J. 2024. Radiolytic Degradation of Organics – Focus on EDTA and Citrate. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-35, Rev. 0.*

Lüdeling, C., R.M. Günther, A. Hampel, J. Sun-Kurczinski, R. Wolters, U. Düsterloh, K.H. Lux, S. Yildirim, D. Zapf, S. Wacker, I.Epkenhans, J. Stahlmann, and B. Reedlunn. 2022. WEIMOS: Creep of rock salt at low deviatoric stresses. In: The Mechanical Behaviour of Salt X. J.H.P. de Bresser, M.R. Drury, P. A. Fokker, M. Gazzani, S.J.T. Hangx, A.R. Niemeijer, and C.J. Spiers, editors. DOI: 10.1201/9781003295808.*

Mariner, P. E. 2019. A summary of humic colloid parameter values to be implemented in the CRA-2019 Deferred Performance Assessment. Carlsbad, NM: Sandia National Laboratories. ERMS 571250.*

Mills, M.M., J.C. Stormont, and S.J. Bauer. 2018. Micromechanical processes in consolidated granular salt. Engineering Geology. DOI: 10.1016/j.enggeo.2018.03.024.*

Nemer, M. 2023. Alternatives to the Current Uncertainty Methodology. Carlsbad, NM: Sandia National Laboratories. ERMS 578712.*

Nemer, M. B. 2024. Steps involved in the initial stages of the literature screening. Carlsbad, NM: Sandia National Laboratories. ERMS 581001.*

Nemer, M. B., and P. Domski. 2023. Bayesian inference applied to the Solubility of Phase-3 and Phase-5. Carlsbad, NM: Sandia National Laboratories. SAND2023-01165R. ERMS 580369.*

Nemer, M. B., P. Domski, and H. Najm. 2023. Bayesian Inference Applied to Estimating the Uncertainty in Phase-3 and Phase-5 Log K Values. ABC-Salt VII Workshop 2023, Actinide Brine Chemistry.*

Oakes, C.S., A.L. Ward, N. Chugunov, and J. Icenhower. 2021. A speciated, conventional Pitzer ion-interaction model for the aqueous Nd3+–H+–Na^{+}–K^{+}–Ca^{2+}–Cl^{-}–OH^{-} system at 298 K and 0.1 MPa. Geochimica et Cosmochimica Acta, 297, pp.308-327.

Reyna, O., and P. Johnson 2023. 2023 Calculated Densities. ERMS 581106. Carlsbad, NM: Sandia National Laboratories.*

Reyna, O., and P. Johnson 2024. 2024 Calculated Densities. EIMS-0004426199. Carlsbad, NM: Sandia National Laboratories.*

Reed, D.T. 2022. Experimental Strategy to Challenge Actinide Solubility Predictions. 2022. Test Plan. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-26, Rev. 1.*

Reedlunn, B. 2018. Enhancements to the Munson-Dawson Model for Rock Salt. Carlsbad, NM: Sandia National Laboratories. SAND2018-12601.*

Reedlunn, B., and J. Bean. 2019. Simulations of Pipe Overpack Container Compaction at the Waste Isolation Pilot Plant. Carlsbad, NM: Sandia National Laboratories. SAND2019-12111.*

Reedlunn, B., G. Moutsanidis, J. Baek, T.H. Huang, J. Koester, E. Matteo, X, He, K. Taneja, H. Wei, Y. Bazilevs, J.S. Chen, C. Mitchell, R. Lander, and T. Dewers. 2019. Initial Simulations of Empty Room Collapse and Reconsolidation at the Waste Isolation Pilot Plant. Carlsbad, NM: Sandia National Laboratories. SAND2019-15351.*

Reedlunn, B., and L.A. Williams. 2021. Reconstruction of the Room D, B, G, and Q Closure Histories at the Waste Isolation Pilot Plant. Carlsbad, NM: Sandia National Laboratories. SAND2021-6904.*

Reedlunn, B. 2022a. A New Rock Salt Constitutive Model with Back Stress and Drag Stress Hardening. In: The Mechanical Behavior of Salt X. J.H.P. de Bresser, M.R. Drury, P. A. Fokker, M. Gazzani, S.J.T. Hangx, A.R. Niemeijer, and C.J. Spiers, editors. DOI: 10.1201/9781003295808. SAND2022-2298C.*

Reedlunn, B. 2022b. A New Constitutive Model for Rock Salt Viscoplasticity: Formulation, Implementation, and Demonstrations. 56th US Rock Mechanics/Geomechanics Symposium. DOI: 10.56952/ARMA-2022-0640.*

Reedlunn, B., J. G. Argüello, F.D. Hansen. 2022c. A Reinvestigation into Munson's Model for Room Closure in Bedded Rock Salt. International Journal of Rock Mechanics and Mining Sciences. DOI: 10.1016/j.ijrmms.2021.105007.*

Reedlunn, B., J.B. Coulibaly, D. O'Connor, F. Beckwith. 2024. Status of Efforts to Model the Geomechanics of Empty Room Collapse and Reconsolidation at the Waste Isolation Pilot Plant, October 2024. Carlsbad, NM: Sandia National Laboratories. SAND2024-16297CTF.*

Rhino, K. P., I. Foli, and J. Jang. 2022. Progress Report on the MgO Hydration and Carbonation Study at SNL WIPP Geochemistry. Revision 0. Carlsbad, NM: Sandia National Laboratories. ERMS 578571.*

Rhino, K. P., P. Domski, and J. Jang. 2023. Reproduction of log K values for $NaPb_2(CO_3)_2(OH)(s)$ (Abellaite) and $Pb(CO_3)_3^{4-}$, and Pitzer interaction parameter for species pair of Pb^{2+}/H^+. Carlsbad, NM: Sandia National Laboratories. ERMS 578704.*

Sobolik, S.R., C. Vignes, S. Buchholz, E. Keffeler, and B. Reedlunn. 2022. WEIMOS: Shear Behaviors of Bedded Salt Clay Seams and Their Impact on Disposal Room Porosity. Carlsbad, NM: Sandia National Laboratories. SAND2022-2303C.*

Swanson, J. 2019. Review of the Microbial Colloid Contribution to the WIPP Actinide Source Term. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-23, Rev. 0.*

Swanson, J., M. Bader, and A. Cherkouk. 2021a. Potential Microbial Influence on the Performance of Subsurface, Salt-Based Nuclear Waste Repositories. In: The Microbiology of Nuclear Waste Disposal. J.R. Lloyd and A. Cherkouk, editors. Amsterdam: Elsevier Inc. pp. 97-1 117.*

Swanson, J., A. Navarrette, C. Hazelton, M. Richmann, and F. Stanley. 2021b. Biomass and Salt-Dependent Effects of *Bacillus* spores on Radionuclide Migration from the Waste Isolation Pilot Plant. *Chemosphere,* 280 (2021) 130680.*

Swanson, J. 2022. Effects of Salt Concentration, Ionic Strength, and Water Activity on the Growth of a WIPP Archaeal Isolate, *Halobacterium* sp. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-28, Rev. 0.*

Swanson, J., A. Navarrette, J. Knox, H. Kim, and F. Stanley. 2023. Microbial Influence on the Mobility of +3 Actinides from a Salt-Based Nuclear Waste Repository. *Microorganisms*, 2023, 11, 1370.*

Swanson, J. 2024a. Biologically Influenced Transport of the +3 Actinide Oxidation State from the WIPP Environment, Using Neodymium as an Analog. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-32, Rev. 1.*

Swanson, J. 2024b. Microbial Influence on Radionuclide Transport through the Culebra. Carlsbad, NM: Los Alamos National Laboratory. LCO-ACP-37, Rev. 0.*

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

U.S. DOE. 2018a. Delaware Basin Monitoring Annual Report. June 2021. DOE/WIPP-18-2308. Revision 3. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2018b. WIPP Subsidence Monument Leveling Survey 2018. December 2018. DOE/WIPP-18-3604. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2018c. Waste Isolation Pilot Plant Geotechnical Analysis Report for July 2016– June 2017. October 2018. Volumes 1 and 2. DOE/WIPP-18-3561. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2018d. Waste Isolation Pilot Plant Annual Site Environmental Report for 2017. September 2018. DOE/WIPP-18-3591. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2018e. Annual Change Report 2017/2018. November 2018. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2018f. Annual Transuranic Waste Inventory Report–2018, Revision 0. November 2018. Carlsbad, NM: Carlsbad Field Office. DOE/TRU-18-3425.*

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

U.S. DOE. 2019b. Delaware Basin Monitoring Annual Report. June 2021. DOE/WIPP-19-2308. Revision 2. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2019c. Waste Isolation Pilot Plant Geotechnical Analysis Report for July 2017– June 2018. October 2019. Volumes 1 and 2. DOE/WIPP-19-3610. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2019d. Waste Isolation Pilot Plant Annual Site Environmental Report for 2018. September 2019. DOE/WIPP-19-3591. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2019e. Annual Change Report 2018/2019. October 2019. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2019f. Annual Transuranic Wate Inventory Report – 2019. December 2019. DOE/TRU-19-3425. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2020a. Waste Isolation Pilot Plant Delaware Basin Monitoring Annual Report. June 2021. Revision 2. DOE/WIPP-20-2308. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2020b. WIPP Subsidence Monument Leveling Survey 2019. January 2020. DOE/WIPP 19-3613. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2020c. Waste Isolation Pilot Plant Geotechnical Analysis Report for July 2018– June 2019. October 2020. Volumes 1 and 2. DOE/WIPP-20-3610. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2020d. Waste Isolation Pilot Plant Annual Site Environmental Report for 2019. September 2020. DOE/WIPP-20-3591. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2020e. Waste Isolation Pilot Plant Annual Change Report 2019/2020. July 2020. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2020f. Annual Transuranic Waste Inventory Report–2020, Revision 0. November 2020. DOE/TRU-20-3425. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2021a. Waste Isolation Pilot Plant Delaware Basin Monitoring Annual Report. September 2021. DOE/WIPP-21-2308. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2021b. WIPP Subsidence Monument Leveling Survey 2020. January 2021. DOE/WIPP 20-3613. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2021c. Waste Isolation Pilot Plant Geotechnical Analysis Report for July 2019 – June 2020. October 2021. Volumes 1 and 2. DOE/WIPP-21-3610. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2021d. Waste Isolation Pilot Plant Annual Site Environmental Report for 2020. September 2021. DOE/WIPP-21-3591. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2021e. Waste Isolation Pilot Plant Annual Change Report 2020/2021. November 2021. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2021f. Annual Transuranic Waste Inventory Report–2021, Revision 0. December 2021. DOE/TRU-21-3425. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2022a. Waste Isolation Pilot Plant Delaware Basin Monitoring Annual Report December 2022. DOE/WIPP-22-2308. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2022b. WIPP Subsidence Monument Leveling Survey 2021. February 2022. DOE/WIPP 22-3613. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2022c. Waste Isolation Pilot Plant Geotechnical Analysis Report for July 2020 – June 2021. October 2022. Volumes 1 and 2. DOE/WIPP- 22-3610. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2022d. Waste Isolation Pilot Plant Annual Site Environmental Report for2021. September 2022. DOE/WIPP-22-3591. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2022e. Annual Transuranic Waste Inventory Report–2022, Revision 0. December 2022. DOE/TRU-22-3425. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2023a. WIPP Subsidence Monument Leveling Survey 2022 (April 2023). DOE/WIPP 22-3697. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2023b. Waste Isolation Pilot Plant Geotechnical Analysis Report for July 2021 – June 2022. October 2023. Volumes 1 and 2. DOE/WIPP-23-3610. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2023c. Waste Isolation Pilot Plant Annual Site Environmental Report for 2022. September 2023. DOE/WIPP-23-3591. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2023d. Waste Isolation Pilot Plant Annual Change Report 2021/2022. Revision 1. November 2023. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2023e. Waste Isolation Pilot Plant Annual Change Report 2022/2023. Revision 0. November 2023. DOE/WIPP-23-2500. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2023f. Annual Transuranic Waste Inventory Report – 2023. Revision 0. February 2024. DOE/TRU-23-3425. Carlsbad, NM: Carlsbad Field Office. *

U.S. DOE. 2023g. Compliance Monitoring Implementation Plan for 40 CFR 191.14(b), Assurance Requirement. Revision 9. DOE/WIPP 99-3119. Carlsbad, NM: Carlsbad Field Office.

U.S. DOE. 2024a. Waste Isolation Pilot Plant Delaware Basin Monitoring Annual Report. January 2024. DOE/WIPP-23-2308. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2024b. Waste Isolation Pilot Plant. Geotechnical Analysis Report for July 2022 – June 2023. October 2024. Volumes 1 and 2. DOE/WIPP-24-3610. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2024c. Waste Isolation Pilot Plant Annual Site Environmental Report for 2023. September 2024. DOE/WIPP-24-3591. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2024d. Waste Isolation Pilot Plant Annual Change Report 2023/2024. December 2024. DOE/WIPP-24-2500. Revision 0. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2024e. Annual Transuranic Waste Inventory Report – 2024. December 2024. DOE-TRU-2024-3425.0. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2025a. Waste Isolation Pilot Plant Delaware Basin Monitoring Annual Report. February 2025. DOE/WIPP-24-2308. Carlsbad, NM: Carlsbad Field Office.*

U.S. DOE. 2025b. WIPP Subsidence Monument Leveling Survey 2023. February 2025. DOE/WIPP 23-3697. Carlsbad, NM: Carlsbad Field Office.*

U.S. Environmental Protection Agency (EPA). 1988. The Clean Air Act Assessment Package – 1988 (CAP–88) A Dose and Risk Assessment Methodology for Radionuclide Emissions to Air; Volume 1; User's Manual.

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): 5224–5245.

U.S. EPA. 1998. 40 CFR Part 194: Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Certification Decision; Final Rule. *Federal Register*, vol. 63 (May 18, 1998): 27354–406.

Van Soest, G. 2019. Performance Assessment Inventory Report – 2019 For the National Environmental Policy Act Additional Panels Evaluation. Carlsbad, NM: Los Alamos National Laboratory. INV-1912-01-01-01. LA-UR-19-32088.*

Van Soest, G. 2022a. Performance Assessment Inventory Report – 2021 For the Replacement Panels Planned Change Request. Carlsbad, NM: Los Alamos National Laboratory. INV-2201-03-01-01. LA-UR-22-20490.*

Van Soest, G. 2022b. Performance Assessment Inventory Report – 2022. Carlsbad, NM: Los Alamos National Laboratory. INV-2212-01-01-01.*

Van Soest, G. 2025a. Full Repository Performance Assessment Inventory Report – 2024. Carlsbad, NM: Los Alamos National Laboratory. INV-2501-02-01-01.8.*

Van Soest, G. 2025b. Interim State Performance Assessment Inventory Report – 2024. Carlsbad, NM: Los Alamos National Laboratory. INV-2505-02-01-01. LA-UR-25-24935.*

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

Wagner, S.W., and M. Thomas. 2016. Trigger Value Derivation Report, Revision 3. Carlsbad, NM: Sandia National Laboratories: ERMS 566313.

Wagner, S.W., and A. Hayes. 2019. Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2018 (January 2019). WBS 4.3.1. Carlsbad, NM: Sandia National Laboratories. ERMS 570837.*

Wagner, S.W., and A. Hayes. 2020. Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2019 (January 2020). WBS 4.3.1. Carlsbad, NM: Sandia National Laboratories. ERMS 572775.*

Ward, A.L. 2024. An Alternative Conceptual Model for Radiolysis Effects on Chemical Conditions in Salt Repositories. IGSC Safety Case Symposium 2024: Moving Towards the Construction of a Safe DGR – Getting Real. NEA/RWM/R(2024)8, 517-523.

Waste Isolation Pilot Plant. 2025. Subsidence Survey Data Acquisition Report, Rev. 10 (September 2025). WP 09-ES4001. Carlsbad, NM: Carlsbad Field Office.

Xiong, Y., L. Kirkes, J. Knox, C. Marrs, and H. Burton. 2018a. Am(III)/Nd(III) Interactions with Borate: Experimental Investigations of $Nd(OH)_3$ (micro cr) Solubility in Mixtures of NaCl and $MgCl_2$ in Equilibrium with Borax. Carlsbad, NM: Sandia National Laboratories. SAND2018-3288A.*

Xiong, Y., L. Kirkes, C. Marrs, J. Knox, and H. Burton. 2018b. Experimental Determination of Nd(III) Solubility in Mixtures NaCl and $MgCl_2$: Applications to Nuclear Waste Management. Sandia National Laboratories. SAND2018-0308A.*

Xiong, Y., L. Kirkes, and T. Westfall. 2018c. Experimental Determination of Solubilities of Brucite [$Mg(OH)_2$(cr)] in Na_2SO_4 Solutions with Borate to High Ionic Strengths: Interactions of $MgB(OH)_4^+$ with Na_2SO_4. Journal of Solution Chemistry (2018) 47:595-610.*

Xiong, Y., and L. Kirkes. 2019. Characterization Milestone Report on Test Plan TP 10-01, "Experimental Study of Thermodynamic Parameters of Borate in WIPP Relevant Brines at Sandia National Laboratories Carlsbad Facility." Revision 0. Carlsbad, NM: Sandia National Laboratories. ERMS 572061. *

Yalcintas, E., X. Gaona, M. Richmann, K. Dardenne, M. Altmaier, and D. Reed. 2019. Spectroscopy and Solubility of U(IV) in Dilute to Concentrated NaCl Solutions in the Presence of EDTA at pHm 1-11. Carlsbad, NM: Los Alamos National Laboratory. LA-UR-28330, Revision 1.*

Zhang, L., L. Kirkes, and J. Jang. 2020a. First End-of-year Report on Test Plan TP 20-01 Revision 0, "Solubility and Complexation of Lead in Non-Sulfidic Brines of WIPP-Relevance." Carlsbad, NM: Sandia National Laboratories. ERMS 574291.*

Zhang, L., L. Kirkes, and J. Jang. 2020b. Modeling of the Stability of Lead Solid Phases at the WIPP Conditions. Carlsbad, NM: Sandia National Laboratories. SAND2020-0803A.*

Zhang, L., P. Hora, J. Jang, L. Kirkes, and C. Miller. 2021. Analysis Report on Iron and Lead Corrosion in WIPP-Relevant Conditions. Work associated with TP 06-02, GEOC-21-06. Carlsbad, NM: Sandia National Laboratories. ERMS 576094.*