DOCKET: EPA-HQ-OAR-2019-0534

# 2019 COMPLIANCE RECERTIFICATION APPLICATION REVIEW DOCUMENT (CARD)

**40 CFR §§ 191 & 194**

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Center for Waste Management and Regulations
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Washington, DC 20460

April 2022

# Introduction

The purpose of this document is to explain the basis for EPA's compliance determination for each of the individual compliance criteria described in 40 CFR 194. Each section below, titled for the specific regulatory citation being addressed, describes EPA's analysis of DOE's compliance recertification application (CRA) for the specific sections of 40 CFR Part 194 that have substantive requirements that DOE must meet. The sections of 40 CFR 194 that are not specifically addressed below include definitions and other procedural sections that do not include substantive requirements with which DOE must comply. The document also describes the changes since the last CRA, EPA's evaluation of the changes, and EPA's compliance decision for each section. Where needed, subsections are included to indicate the specific applicable compliance criteria under each section. Background information and previous compliance decisions for all compliance criteria can also be referenced in the docket, as seen in the following table.

The change in data cutoff dates between the different parts of the CRA-2019 submittal meant that the compliance arguments presented by DOE in the main body of its submittal in some cases were based on different data sets than were actually used in the DOE's supporting CRA-2019 deferred performance assessment (DPA). As part of its completeness review, EPA requested that DOE explain how this change in supporting data affected the compliance conclusions presented in the main body of its submittal (EPA Completeness Comment CC2-GEN-2). The complete text of this completeness comment, DOE's response, and the Agency's evaluation of that response can be found in Appendix A of EPA's TSD *Overview of EPA Review of U.S. Department of Energy 2019 WIPP Compliance Recertification Application Performance Assessment* (Docket ID No. EPA-HQ-OAR-2019-0534).

DOE's concluding remarks are transcribed below:

> "Based on information presented in both the CRA-2019 main body and subsequent DPA-2019, the DOE continues to demonstrate continued compliance with certification regulations, and neither affects the compliance conclusions presented in either document."

EPA understands the need for input data cutoff dates and DOE's accustomed method of establishing them. EPA also understands the unique conditions imposed by the delayed submittal of the DPA-2019 and accepts DOE's contention that the generalized rationale supporting continued compliance presented in the CRA-2019 main body also applies to the subsequently submitted DPA-2019, even though the two documents are based on different data sets.

The Section Updates Summary Table below notes whether DOE provided updates relevant to each of the sections DOE is to address.

**Section Updates Summary Table**

| Section | CRA-2019 |
|---|---|
| 40 CFR 194.8 | Updated |
| 40 CFR 194.15 | Updated |
| 40 CFR 194.21 | Updated |
| 40 CFR 194.22 | Updated |
| 40 CFR 193.23 | Updated |
| 40 CFR 194.24 | Updated |
| 40 CFR 194.25 | Updated |
| 40 CFR 194.26 | No Updates |
| 40 CFR 194.27 | Updated |
| 40 CFR 194.31 | Updated |
| 40 CFR 194.32 | Updated |
| 40 CFR 194.33 | Updated |
| 40 CFR 194.34 | Updated |
| 40 CFR 194.41 | No Updates |
| 40 CFR 194. 42 | Updated |
| 40 CFR 194.43 | No Updates |
| 40 CFR 194.44 | Updated |
| 40 CFR 194.45 | Updated |
| 40 CFR 194.46 | No Updates |
| 40 CFR 194.51-194.52 | Updated |
| 40 CFR 194.53 | Updated |
| 40 CFR 194.54 | Updated |
| 40 CFR 194.55 | Updated |

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**List of Acronyms and Abbreviations**

| | |
|---|---|
| AIC | Active Institutional Control |
| AMWTF | Advanced Mixed Waste Treatment Facility |
| ANL | Argonne National Laboratory |
| APCS | Abandonment of Panel Closures in South End of Repository |
| ASER | Annual Site Environmental Report |
| ATWIR | Annual TRU Waste Inventory Report |
| BLM | U.S. Bureau of Land Management |
| Brine A | Simulated Salado brine formulation |
| CAG | Compliance Application Guidance |
| CARD | Compliance Application Review Document |
| CBFO | Carlsbad Field Office |
| CC | Completeness Comment |
| CCA | Compliance Certification Application |
| CCDF | Complementary cumulative distribution function |
| CCO | Criticality Control Overpack |
| CCP | Central Characterization Program |
| CDF | Cumulative distribution function |
| CFR | Code of Federal Regulations |
| CH | Contact handled |
| Ci | Curie |
| CID | Comprehensive Inventory Database |
| CPR | Cellulosic, Plastic, and Rubber Material |
| CRA | Compliance Recertification Application |
| CRA14_SEN4 PA | Sensitivity study of CRA-2014 PA |
| CRA-2004 | First Compliance Recertification Application, March 2004 |
| CRA-2009 | Second Compliance Recertification Application, March 2009 |
| CRA-2014 | Third Compliance Recertification Application, March 2014 |
| CRA-2019 DPA | Deferred PA for the CRA-2019, December 2019 |
| CRA-2019 | Fourth Compliance Recertification Application, March 2019 |
| DATA0.FM1 | EQ3/6 thermodynamic database used for the CRA-2014 PA |
| DATA0.FM2 | Revised EQ3/6 thermodynamic database |
| DATA0.FM4 | Revised EQ3/6 thermodynamic database used for CRA-2019 DPA |
| DBDSP | Delaware Basin Drilling Surveillance Plan |
| DBE | Design Basis Earthquake |
| DBMAR | Delaware Basin Monitoring Annual Report |
| DBR | Direct Brine Release |
| DOE or the Department | U.S. Department of Energy |
| DP | Screened in for Disturbed Performance Scenarios |
| DPA | Deferred Performance Assessment |
| DRSPALL | Spallings released to accessible environment from a future drilling event |
| DRZ | Disturbed Rock Zone |
| DS | Steel surface area per unit disposal volume (m2/m3) |
| DT | Microsoft Excel Data Template Workbook File |

| | |
|---|---|
| EDTA | Ethylenediaminetetraacetic acid |
| EEF | Effective excess factor |
| EF | Excess factor |
| Eh | Oxidation/reduction potential |
| EP | Events and Processes |
| EPA or the Agency | U.S. Environmental Protection Agency |
| EPS | Extracellular polymeric substances |
| EQ3/6 | Geochemical modeling code used for CRA-2014 PA |
| ERDA-6 | Simulated Castile brine formulation |
| ERMS | Electronic Record Management System |
| EXP | Repository Experimental Area |
| FEPs | Features, Events, and Processes |
| FMT | Fracture Matrix Transport geochemical modeling code |
| FMT_021120.CHEMDAT | FMT thermodynamic database used for the CRA-2004 PA |
| FMT_050405.CHEMDAT | FMT thermodynamic database used for the PABC04 and PABC09 |
| FMT_970407.CHEMDAT | FMT thermodynamic database used for the PAVT |
| GWB | Generic Weep Brine, simulated Salado brine formulation |
| HCN | Historic, Current, or Near Future |
| HEPA | High-Efficiency Particulate Air |
| INL | Idaho National Laboratory |
| ISA | Isosaccharinic Acid |
| $K_d$ | Distribution coefficient |
| KIT | Karlsruhe Institute of Technology |
| kPa | Kilopascal |
| KPLA | Known Potash Leasing Area |
| LANL | Los Alamos National Laboratory |
| LANL-CO | Los Alamos National Laboratory – Carlsbad Operations |
| LMR | Life of Mine Reserve |
| LWA | Land Withdrawal Act |
| LWA | WIPP Land Withdrawal Area |
| LWB | Land Withdrawal Act Boundary |
| m | Molal, moles/kg $H_2O$ |
| M | Molar, moles/liter |
| MB | Marker bed |
| meq | Milliequivalent |
| MFC | Material Fuel Complex |
| MgO | Magnesium Oxide |
| MMgO | Total moles of emplaced MgO |
| MPa | Megapascal |
| MTHM | Metric Tons of Heavy Metal |
| MWd | Megawatt Days |
| NEA-TDB | Nuclear Energy Agency Thermochemical Database |
| NMBMMR | New Mexico Bureau of Mines and Mineral Resources |
| NMTSO | New Mexico Tech Seismic Observatory |
| NOI | Notice of Intent |
| NROR | North Rest-of-Repository |

| | |
|---|---|
| NWP | Nuclear Waste Partners |
| OCC | New Mexico Oil Conservation Commission |
| OCD | New Mexico Oil Conservation Division |
| OPS | Repository Operations Area |
| OPS/EXP | Operational and Experimental |
| ORNL | Oak Ridge National Laboratory |
| PA | Performance Assessment |
| Pa | Pascal |
| PABC | Performance Assessment Baseline Calculation |
| PABC04 | CRA-2004 Performance Assessment Baseline Calculations |
| PABC09 | CRA-2009 Performance Assessment Baseline Calculations |
| PAIR | Performance Assessment Inventory Report |
| PAVT | Performance Assessment Verification Testing |
| pcH | Negative log of the hydrogen ion concentration, molar units |
| PCN | Planned Change Notice |
| PCR | Planned change request |
| PCS | Panel Closure System |
| PGA | Peak Ground Acceleration |
| pH | Negative log of the hydrogen ion activity |
| pmH | Negative log of the hydrogen ion concentration, molal units |
| POP | Pipe Overpack |
| PVC | Polyvinylchloride |
| QA | Quality Assurance |
| RD | Requirements Document |
| RH | Remote handled |
| ROM | Run-of-Mine |
| ROMPCS | Run-of-Mine (Salt) Panel Closure System |
| RSI | Institute for Regulatory Science |
| Sb,eff | Effective brine saturation due to capillary action in the waste materials |
| SDDI | Salt Defense Disposal Investigation |
| SDI | Salt Disposal Investigation |
| SIT | Specific Ion Interaction Theory |
| Sm | Measured solubility |
| SNL | Sandia National Laboratories |
| SO-C | Screened out based on no, low, or beneficial consequence |
| SO-P | Screened out based on a very low probability of occurrence |
| SO-R | Screened out based on a regulatory directive |
| SP | Specific Procedure |
| SPR | Software Problem Report |
| SRNL-AD | Savannah River National Laboratory – Analytical Development |
| SROR | South Rest-of-Repository |
| SRS | Savannah River Site |
| SWB | Standard Waste Box |
| TDEM | Time Domain Electromagnetic |
| TIC | Total inorganic carbon |

| | |
|---|---|
| TRU | Transuranic |
| TSD | Technical Support Document |
| TWBIR | Transuranic Waste Baseline Inventory Report |
| UP | Screened in for Undisturbed Performance Scenarios |
| USDW | Underground Source of Drinking Water |
| USGS | United States Geological Survey |
| WAC | Waste Acceptance Criteria |
| WCS | Waste Control Specialists LLC |
| WDS | Waste Data System |
| WIPP | Waste Isolation Pilot Plant |
| WMP | Waste Material Parameter |
| WSM | Worldwide Stress Map |
| XANES | X-ray absorption near-edge spectroscopy |
| XRD | X-ray diffraction |

# Summary and Evaluation of Updated Sections

## Section 8 Approval Process for Waste Shipment from Waste Generator Sites for Disposal at the WIPP

### DOE Reported Changes

8(a) *Quality Assurance Programs at Waste Generator Sites.*

No changes.

8(b) *Waste Characterization Programs at Transuranic Sites.*

During the period covered by CRA-2019, EPA has approved shipment of contact-handled TRU (CH-TRU) waste to the WIPP facility from the following TRU waste sites: Advanced Mixed Waste Treatment Project (AMWTP); Idaho National Laboratory (INL)/Central Characterization Program (CCP); Los Alamos National Laboratory (LANL)/CCP; Oak Ridge National Laboratory (ORNL)/CCP; and Savannah River Site (SRS)/CCP. EPA has also approved shipment of remote-handled TRU (RH-TRU) waste to the WIPP facility from the following TRU waste sites: Argonne National Laboratory (ANL)/CCP; INL/CCP; ORNL/CCP; and SRS/CCP. EPA has also approved shipment of numerous individual waste streams, changes in waste characterization procedures, and changes in waste storage requirements during the period covered by CRA-2019, as documented in DOE (2019, Tables 8-1 and 8-2). During the period covered by CRA-2019, EPA has also performed numerous continued compliance inspections (italicized in the table below).

| Site | Description | Date Performed | Date Approved | Docket Number |
|---|---|---|---|---|
| AMWTP (CH) | Continued Compliance | Oct 2012 and Feb 2013 | April 25, 2013 | EPA Docket: A-98-49; II-A4-173 |
| | Continued Compliance | Nov 17-19, 2015 | April 4, 2016 | EPA Docket: A-98-49; II-A4-206; eDocket # EPA-HQ-OAR-2001-0012-0466 |
| | Tier 1: NDA-RBAS | July 14, 2015 | October 19, 2015 | EPA Docket: A-98-49; II-A4-200; eDocket # EPA-HQ-OAR-2001-0012-0459 |
| | Tier 1: Add LANL Debris Waste | Jun to Jul 2013 | September 16, 2013 | EPA Docket: A-98-49; II-A4-178 |
| | Tier 1: SDA Exhumed Solids and Debris | May 2013 | July 9, 2013 | EPA Docket: A-98-49; II-A4-174 |
| | Tier 1: MFC Solids and Debris | Oct to Dec 2012 | January 29, 2013 | EPA Docket: A-98-49; II-A4-169 |
| ANL-CCP (RH) | Tier 1: Solidified Liquids AERHDM | January 2014 | March 24, 2014 | EPA Docket: A-98-49; II-A4-181 |
| INL-CCP (CH) | Tier 1: SGRS Calibration | Dec 2012 | February 26, 2013 | EPA Docket: A-98-49; II-A4-172 |

| Site | Description | Date Performed | Date Approved | Docket Number |
|---|---|---|---|---|
| INL-CCP (CH/RH) | Continued Compliance | May 5-7, 2013 | July 16, 2013 | EPA Docket: A-98-49; II-A4-175 |
| | Continued Compliance | May 6-8, 2014 | July 15, 2014 | EPA Docket: A-98-49; II-A4-190 |
| INL-CCP (RH) | Tier 1: Lot 8B Waste | June to October 2014 | November 5, 2014 | EPA Docket: A-98-49; II-A4-194; eDocket # EPA-HQ-OAR-2001-0012-0441 |
| | Tier 1: Lot 8C Waste | May 19-21, 2015 | November 10, 2015 | EPA Docket: A-98-49; II-A4-201; eDocket # EPA-HQ-OAR-2001-0012-0459 |
| | Tier 1: Lot 5C Waste | May 19-21, 2015 | July 15, 2014 | EPA Docket: A-98-49; II-A4-185 |
| | Tier 1: Lot 5A Waste | Feb to June 2014 | September 10, 2014 | EPA Docket: A-98-49; II-A4-188 |
| | Tier 1: Lot 5C Liner 3 Waste | May 19-21, 2015 | September 8, 2015 | EPA Docket: A-98-49; II-A4-198; eDocket # EPA-HQ-OAR-2001-0012-0455 |
| | Tier 1: Lot 3 Waste | Dec 3-5, 2013 | November 10, 2014 | EPA Docket: A-98-49; II-A4-191; eDocket # EPA-HQ-OAR-2001-0012-0442 |
| | Tier 1: Lot 5B Waste | Dec 3-5, 2013 | April 16, 2014 | EPA Docket: A-98-49; II-A4-183 |
| LANL-CCP (CH) | Continued Compliance | Nov 19-21, 2013 | February 11, 2014 | EPA Docket: A-98-49; II-A4-179 |
| | Tier 1: MILCC (ISOCS) NDA System | Jun 4-5, 2013 | July 22, 2013 | EPA Docket: A-98-49; II-A4-176 |
| | Baseline Inspection | Feb 7-9, 2017 | October 4, 2017 | EPA Docket: A-98-49; II-A4-212; eDocket # EPA-HQ-OAR-2017-0231-0003 |
| | Tier 1: TA-54 Equipment | May 23-25, 2017 | October 13, 2017 | EPA Docket: A-98-49; II-A4-213; eDocket # EPA-HQ-OAR-2001-0012-0472 |
| | Tier 1: HENC 3 NDA System | Feb 10-12, 2015 | October 7, 2015 | EPA Docket: A-98-49; II-A4-199; eDocket # EPA-HQ-OAR-2001-0012-0456 |
| ORNL-CCP (CH) | Tier 1: MILCC2 (ISOCS) NDA System | Aug 5-6, 2014 | October 21, 2014 | EPA Docket: A-98-49; II-A4-192 |
| | Tier 1: VE Process | Aug 5-6, 2014 | November 10, 2014 | EPA Docket: A-98-49; II-A4-193; eDocket # EPA-HQ-OAR-2001-0012-0443 |
| | Tier 1: Solids SCG | Feb 4-6, 2014 | July 9, 2014 | EPA Docket: A-98-49; II-A4-189 |
| ORNL-CCP (CH/RH) | Continued Compliance | Aug 2-4, 2016 | June 14, 2017 | EPA Docket: A-98-49; II-A4-207; eDocket # EPA-HQ-OAR-2001-0012-0470 |
| | Continued Compliance and Tier 1: IQ3 NDA System | Feb 4-6, 2014 | June 8, 2014 | EPA Docket: A-98-49; II-A4-186 |
| ORNL-CCP (RH) | Tier 1: REDC Waste Appendices C-F | Feb to May 2017 | July 6, 2017 | EPA Docket: A-98-49; II-A4-209; eDocket # EPA-HQ-OAR-2001-0012-0471 |

| Site | Description | Date Performed | Date Approved | Docket Number |
|---|---|---|---|---|
| SNL-CCP (RH) | Baseline: Debris | June 24-25, 2014 | Not Issued | |
| SRNL-AD (RH) | Evaluation of Laboratory at SRS | Aug 9-11, 2016 | December 21, 2016 | EPA Docket: A-98-49; II-A4-208; eDocket # EPA-HQ-OAR-2001-0012-0468 |
| SRS-CCP (CH) | Tier 1: NABC NDA System 5 Foot Setback for SLB2s | Feb 2014 | March 24, 2014 | EPA Docket: A-98-49; II-A4-182 |
| | Continued Compliance | Aug 19-21, 2014 and Oct 15, 2014 | February 23, 2015 | EPA Docket: A-98-49; II-A4-195; eDocket # EPA-HQ-OAR-2001-0012-0449 |
| | Tier 1: NABC NDA System 5 Foot Setback for SWBs | Jan 2013 | February 21, 2013 | EPA Docket: A-98-49; II-A4-171 |
| SRS-CCP (RH) | Tier 1: Waste stream SR-RH-772F.01 | May 19-21, 2015 | November 25, 2015 | EPA Docket: A-98-49; II-A4-202; eDocket # EPA-HQ-OAR-2001-0012-0460 |
| | Tier 1: Waste Steam SR-RH-221H.01 | June 2013 | August 20, 2013 | EPA Docket: A98-49; II-A4-177 |
| | Tier 1: BCL Container BC0152 | June to Sept 2014 | December 31, 2014 | EPA Docket: A-98-49; II-A4-196; eDocket # EPA-HQ-OAR-2001-0012-0448 |
| | Tier 1: Mound Waste (SR-RH-MNDPAD1.01) | Mar to Apr, 2016 | June 15, 2016 | EPA Docket: A-98-49; II-A4-204; eDocket # EPA-HQ-OAR-2001-0012-0462 |
| | Tier 1: Sealed Sources (SR-RH-SDD.01) | Dec 3-5, 2013 | May 22, 2014 | EPA Docket: A-98-49; II-A4-184 |
| | Tier 1: Waste Stream SR-RH-235F.01 | Dec 2012 | February 12, 2013 | EPA Docket: A-98-49; II-A4-170 |
| | Tier 1: Waste Stream SR-RH-773A.01 | Feb to Apr 2017 | June 5, 2017 | EPA Docket: A-98-49; II-A4-210; eDocket # EPA-HQ-OAR-2001-0012-0471 |
| | Tier 1: Waste Stream SR-RH-SWD.01 | May 19-21, 2015 | August 3, 2015 | EPA Docket: A-98-49; II-A4-197; eDocket # EPA-HQ-OAR-2001-0012-0454 |

8(c) *Waste characterization programs at waste generator sites with prior approval*.

The previously approved waste characterization programs are included in Section 8b.

**EPA Evaluation**

8(a) The quality assurance programs at waste generator sites have been previously approved and have not been changed.

8(b) All changes have been previously approved by EPA as stated in DOE summary documentation (DOE 2019).

8(c) All changes have been previously approved by EPA as stated in DOE summary documentation (DOE 2019).

## Compliance Decision

Based on EPA's prior approval of all changes under Section 8, EPA determines that DOE continues to comply with the requirements of Section 194.8.

## References

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191, Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Section 8: Approval Process for Waste Shipment from Waste Generator Sites for Disposal at the WIPP (40 CFR 194.8). Carlsbad Field Office, Carlsbad, New Mexico.

# Section 14 and 15 Content of Compliance Certification and Compliance Recertification

## DOE Reported Changes

14 *Content of Compliance Certification.*

No change. Section 194.14 was intended to provide the baseline information for the WIPP compliance application that was submitted in 1996.

15(a)(1) *Compliance Recertification Application updated documentation: additional geologic, geophysical, geochemical, hydrologic, and meteorological information*.

See table below

| Category | CRA-2019 Updates |
|---|---|
| Geologic | • No new geologic mapping<br>• Core hole for a new ventilation shaft drilled and correlation with intake shaft geology documented |
| Geophysical | • 839 seismic events within 300 kilometers of the WIPP site between January 2013 to 2018. No notable events in Eddy and Lea counties. See Table 15-2 of Section 15 of CRA-2019 |
| Geochemical | • Culebra Kd values remain unchanged<br>• Groundwater level and quality continue to be sampled regularly. No significant change<br>• Radionuclide transmissivity fields remain unchanged |
| Hydrologic | • Three new monitoring wells have been added<br>• Three new WIPP monitoring wells have been drilled to replace deteriorating wells that were plugged and abandoned<br>• Updated hydrologic data and well construction and replacement information found in Appendix HYDRO-2019 |
| Meteorological | • No anomalous weather events or changes in climatic conditions reported |

15(a)(2) *Additional monitoring data, analyses, and results*.

DOE documented relevant changes in several CRA-2019 appendices. Data required for pre- and post-closure monitoring, including geotechnical and geoscience monitoring, are found in Appendix MON-2019. Parameters related to drilling rates, oil and gas production activities, and subsidence monitoring are found in Appendix DATA-2019, Sections DATA-2.0 and DATA-3.0. The updated list of boreholes in the WIPP vicinity is located in Attachment A of Appendix HYDRO-2019.

15(a)(3) *Laboratory experiments, analyses, and results by DOE and its contractors for the WIPP program.*

The list of experiments performed since CRA-2014 and their references can be found in CRA-2019 Appendix DATA-2019, Section DATA-10.2. Experiments were conducted in the areas summarized below.

| Experiment | References |
|---|---|
| Organic Ligands (EDTA, citrate) | Xiong (2016); Xiong, Kirkes, and Westfall (2017a); Xiong et al. (2017a) |
| Lead | Xiong (2013); Xiong et al. (2013); Xiong (2015a); Xiong (2015b); Xiong (2015c); Xiong (2017a); Xiong (2017b); Xiong (2014a); Xiong (2014b); Xiong (2015d) |
| Iron | Kim et al. (2017); Sisk-Scott and Icenhower (2016); Brush and Xiong (2014); Jang and Kim (2016) |
| Borate | Xiong, Kirkes, and Westfall (2013); Xiong et al. (2017c); Xiong et al. (2017d); Xiong et al. (2017e); Xiong, Kirkes, and Marrs (2017a); Xiong Kirkes, and Westfall (2017b); Xiong, Jang, and Icenhower (2015) |
| Microbiology | Bader et al. (2017); Kienzler and Swanson (2017); Swanson et al. (2015a); Swanson et al. (2016); Zengotita et al. (2017); Reed et al. (2015a) |
| Colloids | Xiong et al. (2017f); Mariner (2016); Xiong and Kim (2014); Jang (2014); Sisk-Scott, Kirkes, and Mariner (2016); Reed et al. (2019); Reed (2020) |
| Actinide Sorption, Solubility, Complexation, and Redox | Altmaier et al. (2012); Lucchini et al. (2013a); Reed et al. (2013a); Swanson and Simmons (2013); Reed and Altmaier (2014); Reed and Rabung (2015); Batuk et al. (2015); Hinz et al. (2015); Reed and Altmaier (2015); Swanson et al. (2015); Swanson et al. (2015); Reed and Patterson (2016); Reed et al. (2017); Emerson et al. (2017); Dugas et al. (2017); Yalcintas et al. (2017); Altmaier et al. (2017); Hazelton and Swanson (2017); Xiong, Kirkes, and Marrs (2017b); Xiong (2017b); Altmaier et al. (2016); Altmaier et al. (2015); Swanson et al. (2015b); Reed et al. (2015c); Reed et al. (2015b); Swanson et al. (2017); Richmann et al. (2014); Reed et al. (2013b); Lucchini et al. (2013b); Reed et al. (2012) |
| Waste Compaction Behavior | Broome et al. (2012); Broome et al. (2014); Broome et al. (2016); Orlowski (2015). |
| Salt Reconsolidation | Hansen et al. (2014); Hansen (2015a); Hansen (2015b); Hansen (2016a); Hansen (2016b); Herrick, Reedlunn, and (Jensen 2017); Mills (2017) |
| Panel Closure | Herrick (2016) |
| WIPP Stratigraphy | Powers (2016); Sobolik (2017) |

15(a)(4) *Changes to activities or assumptions from most recent compliance application*.

See table below.

| Changes | Action | Summary of Activity |
|---|---|---|
| Underground excavation | Status of excavation and waste emplacement | As of December 31, 2017, Panels 1 through 7 have been mined completely and panels 1 through 6 are filled with waste. Some waste has been emplaced in Panel 7 and Panel 8 is partially mined. |
| Experiments in the repository | Heating tests | Using bedded salt as host for heat generating radioactive materials. Prototype canister heater started collecting data in 2017 in W-20 and N-150 |
| | Segmented Enriched Germanium Assembly and Multiple Element Germanium Array | Ended March 2015 |
| | Enriched Xenon Observatory | Stopped in 2014 and resumed in 2016 |
| | Dark Matter Time Projection Chamber | Stopped data collection in 2014 |
| | Low background radiation experiment | Ongoing since 2009 |
| Planned Change Notices | Excavation and Construction of a New Ventilation Shaft and Associated Access Drifts | EPA acknowledged receipt in a letter dated January 22, 2018 |
| | Panel 7 Configuration of TRU Waste Emplacement (August 28, 2017) | No additional waste to be placed in Room 7, Panel 7 due to contamination from radiological incident in 2014 |

| Changes | Action | Summary of Activity |
|---|---|---|
| | Volume of Record (June 22, 2018) | DOE plans to update how waste volume is calculated in the repository |
| PA Changes | Abandonment of Planned Panel Closures in Entrances to Panels 3, 4, 5, and 6, and Abandonment of Emplacement of Waste in Panel 9 | Inclusion of an approach to accommodate the operational decisions to not emplace panel closures in Panels 3, 4, 5, and 6, and to not emplace waste in Panel 9 |
| | Additional Shaft and Drifts | Inclusion of an approach to accommodate an additional shaft connecting the repository to the surface, as well as an additional mined region in the repository north end to accommodate drifts that lead to the new shaft |
| | Brine Radiolysis | Refinement of the gas generation process model to include brine radiolysis |
| | Probability of Encountering Pressurized Brine during a Drilling Intrusion | An update to the probability that a drilling intrusion into a repository excavated region will intersect the Castile brine reservoir modeled in BRAGFLO |
| | Steel Corrosion Rates | Refinement to the corrosion rates of steel under humid and inundated conditions |
| | Waste Shear Strength | Refinement to the effective shear strength of WIPP waste |
| | Colloid Enhancement Parameters | Refinement to colloid enhancement parameters associated with actinide mobilization |
| | Hydromagnesite to Magnesite Conversion Rate | Refinement to the hydromagnesite to magnesite conversion rate |
| | Iron Sulfidation | Removal of two chemical reactions associated with iron sulfidation |
| | Northernmost Panel Closure Representation Correction | Correction to the length of the northernmost panel closure representation in the BRAGFLO grid |
| | Drilling Rate and Plugging Pattern Probabilities | Updates to drilling rate and plugging pattern parameters |
| | Waste Inventory Information | Updates to WIPP waste inventory parameters |
| | Radionuclide Solubilities and their Uncertainty | Updates to radionuclide solubilities and their associated uncertainty |
| | Borehole Permeability Model Parameter Update | An update to the BH_OPEN:RELP_MOD parameter |
| | BRAGFLO Grid Flexibility | Introduction of new materials to define properties in some disturbed rock zone areas |
| | Hardware and Code Updates | Hardware and computational code updates, including two codes that have been qualified for WIPP PA and added to the Software Baseline |

15(a)(5) *Description of waste emplaced since last recertification application.*

DOE updates for emplaced waste at the WIPP repository, waste stored at the waste generator sites, and waste anticipated to go to WIPP are discussed in the Annual Transuranic Waste Inventory Report-2018 (ATWIR 2018) and in the Performance Assessment Inventory Report-2018 (Van Soest 2018), though parts of CRA-2019 report waste from ATWIR 2017 prior to submission of the Deferred Performance Assessment (2019-DPA). DOE has emplaced a total of 34,300 $m^3$ of contact-handled (CH) waste and 2,280 $m^3$ of remote-handled (RH) waste. The projected volume of waste is 24,700 $m^3$ for CH waste and 349 $m^3$ for RH waste. Table 3-10 of ATWIR 2018 lists total activity in Curies (Ci). The largest contributing waste stream comes from the Savannah River Site. Total activity is converted to EPA units in Kicker (2019b), Table 3.

15(a)(6) *Significant information relevant to the disposal system compliance not previously included.*

See table below.

| Issue | Summary |
|---|---|
| APCS (Abandonment of Panel Closures in the South) | Approach treats the abandoned Panel 9 as a surrogate for its replacement (i.e., modeling as though waste had actually been emplaced in the abandoned panel) and to treat the now-empty waste panel access drifts as having relatively high porosities and permeabilities for the 10,000-year EPA regulatory period. |
| Borehole plugging patterns and deep drilling rates | DOE changed the method for calculating plugging pattern probabilities from one defined by the area of the entire New Mexico portion of the Delaware Basin to a narrower one based only on the part of the Delaware Basin within New Mexico's Known Potash Leasing Area (KPLA). The approach accounts for most of the order of magnitude jump in probability of continuous plug use from 4% to 40%in the CRA-2019 PA, based on the field data collected by DOE. |
| Geochemistry database and solubility calculations | Updates to radionuclide solubilities and database used to calculate solubilities, including updates in hydromagnesite solubility, organic ligand aqueous speciation and solid phases, organic ligand Pitzer parameters, iron solubilities and solid phases, iron Pitzer parameters, and lead solubilities and solid phases. Changes were also made to assumption of calcite precipitation in solubility calculations. |
| Colloids | No change to mineral fragment colloid parameters. Updates performed for humic, intrinsic, and microbial colloid parameters. |
| Radiolysis of brine and waste | Brine radiolysis by saturated waste has been added to gas generation model, gas generation by radiolysis of cellulosic, plastic, and rubber materials was screened out, and radiolysis of adsorbed water under unsaturated conditions was not considered. |
| Actinide solubility uncertainty | For the CRA-2019, DOE used the CRA-2014 uncertainty distributions with modifications. |

15(a)(7) *Requests by EPA for additional information*.

The Agency submitted numerous requests to DOE for additional information during the completeness and technical review of the 2019 CRA. The docket categories in which these can be found are listed below.

1. QA Audits/Inspections and their approvals: **EPA-HQ-OAR-2001-0012**
2. WC Audits/Inspections and their approvals: **EPA-HQ-OAR-2001-0012**
3. Background/support documents (TSDs, fact sheets): **EPA-HQ-OAR-2019-0534**
4. Correspondence/information submitted by DOE (including responses to EPA requests, e.g., completeness and technical issues): **EPA-HQ-OAR-2019-0534**
5. Correspondence/information sent to DOE by EPA (including completeness and technical requests for additional information): **EPA-HQ-OAR-2014-0534**
6. 2019 CRA Compliance Application Review Documents (CARDs): **EPA-HQ-OAR-2019-0534**

15(b) *Information still valid from previous recertification applications summarized and referenced.*

DOE adopted the same format that EPA uses to document compliance with regulation 40 CFR part 194, EPA's CARDs. This included a DOE rule section with supporting appendices. DOE continued to summarize topics and provided new information where appropriate. DOE did remove some appendices and add new ones in the 2019 CRA.

**EPA Evaluation**

14 Since DOE complied with the sections of 194.14 in the original certification, EPA finds that DOE complies with all sections of 194.14 for the 2019 CRA.

15(a)(1) EPA finds DOE adequately complies with this Section.

15(a)(2) EPA reviewed DOE's documentation and confirmed that DOE has not modified any of the parameter selection arguments or conclusions since the original CCA nor have the parameter monitoring programs been changed. DOE continues to conclude that even though some monitored parameters have changed, no new parameters need to be added nor did the parameter monitoring programs need to be modified. DOE did not change any argument or conclusion that justified why a parameter was considered significant or insignificant for CRA-2019 nor did DOE change its pre-closure or post-closure program plans or activities.

15(a)(3) See below table for EPA evaluation. For details on EPA's review, please refer to *Evaluation of the Compliance Recertification Application (CRA-2019) Actinide Source Term, Gas Generation, Backfill Efficacy, Water Balance, and Culebra Dolomite Distribution Coefficient Values* (Docket ID No. EPA-HQ-OAR-2019-0534).

| Experiment | EPA Evaluation |
|---|---|
| Organic Ligands (EDTA, citrate) | Experimental discrepancies in $Ca_2EDTA{\cdot}7H_2O(s)$ experiments render the log K and $Na^+/CaEDTA^{2-}$ interaction coefficients unacceptable for the database. Solubility constants for the citrate mineral earlandite were ultimately chosen from Hummel et al. (2005), but EPA's review found that the phase is missing from the geochemistry database. |
| Lead | DOE performed multiple experiments on lead but ultimately determined that the presence of solid phases in the experiments would require additional evaluation of the data. DOE instead decided to use data from Powell et al. (2009) in the parameterization of the Pb(II) model for DATA0.FM4 which does not include any Pitzer parameters for aqueous species. The new Pb data included in the database are incomplete and should not be included in WIPP PA calculations. |
| Iron | Only $Fe^{2+}$ hydrolysis and carbonate aqueous species and solid phases are included in DATA0.FM4. Data are not included for modeling the effects of organic ligands, sulfate, sulfide, or phosphate on Fe(II) aqueous speciation or solid phase precipitation. Parameterization of Fe solids and Pitzer parameters appear adequate. Omission of Fe interactions with sulfate and sulfide species was unintentional. |
| Borate | No changes to the PA were made using data from these analyses. EPA believes the geochemistry database needs updating to consider the effects of borate on geochemistry, especially the potential effects of borate on Am(III) solubility. |
| Microbiology | No new changes regarding microbial gas generation have been incorporated into the PA as a result of experiments. Current data on microbial transport do not adequately support justification for rapid microbial filtration in the Culebra (FEP N71) as experiments are on crushed dolomite that does not simulate its fractures and vugs. DOE has updated the PROPMIC and CAPMIC microbial colloid parameters based on new experiments. EPA finds that these updates do not address uncertainty found in the literature. |

| | |
|---|---|
| Colloids | The Agency finds DOE's humic colloid parameter update adequate. Mineral fragment colloid parameters remain unchanged based on DOE work. Experimental investigations indicate magnesium mineral fragment colloid formation to be unlikely. To address this uncertainty of pseudocolloid formation from MgO hydration and carbonation products, EPA recommends that DOE perform sequential filtration experiments with brine samples from the MgO hydration and carbonation experiments after spiking the solution aliquots with Th(IV) and a +III actinide or analogue such as Nd(III). EPA finds DOE's intrinsic Am(III) and Th(IV) colloid parameters do not adequately account for the available project-specific and literature data. |
| Actinide Sorption, Solubility, Complexation, and Redox | DOE continues to use Pu(III) in 50% of PA realizations and Pu(IV) in the other 50%. EPA disagrees with this approach and finds that this significantly underestimates releases when combined with changes to the database. DOE has also performed multiple actinide solubility and complexation experiments though updates to the EQ3/6 Am(III) and Th(IV) Pitzer and complexation parameters were not made for CRA-2019. These updates should be included in CRA-2024 or sooner. |
| Waste Compaction Behavior | DOE is performing hydrostatic, triaxial, and uniaxial strain tests on surrogate waste to provide conservative estimate of degraded containers and TRU waste materials at the end of the 10,000 year regulatory period. EPA believes that the results of these tests will be helpful in defining waste properties during the post closure period. |
| Salt Reconsolidation | DOE is investigating reconsolidation of granular salt since it is an important consideration at the WIPP. EPA believes that studying processes by which crushed or granular salt reconstitutes itself into a solid material exhibiting properties of native salt is key to understanding properties attributable at various stages of reconsolidation. |
| Panel Closure | DOE is calibrating constitutive models against experiments with simple, uniform, stress states, and DOE then expects those models to predict the evolution of the underground. EPA believes that these calibrations will provide additional confidence in the model predictions since many uncertainties in the underground can make it difficult to conclusively say whether a given model matches the underground measurements. |
| WIPP Stratigraphy | DOE is developing reference stratigraphy for the WIPP by examining existing cores to provide a standard for comparing the results of different models of mechanical behavior of the WIPP underground.<br><br>DOE has also developed a Test Plan describing laboratory experiments designed to measure, evaluate and quantify the effects of shear displacement along a bedding interface or clay seam on shear and fracture strength of the interface and accompanying salt. The purpose of these lab tests is to provide data that DOE will use to develop a constitutive model for shear strength and fracturing along bedding interfaces and seams. EPA believes that the reference stratigraphy will provide DOE a frame of reference for interpreting geomechanical test results and developing constitutive relationships will improve understanding of shear stresses and strains on bedding interfaces that DOE can translate to current geomechanical and WIPP performance assessment models. |

15(a)(4) See table below for EPA's evaluation.

| Changes | Action | EPA Evaluation |
|---|---|---|
| Underground excavation | Status of excavation and waste emplacement | Adequate; DOE continues to periodically update EPA on underground excavation and waste emplacement activities |
| Experiments in the repository | Heating tests | Approved via letter (Lee Veal to Kirk Lachman) dated 11/04/2019 |

| Changes | Action | EPA Evaluation |
|---|---|---|
| | Segmented Enriched Germanium Assembly and Multiple Element Germanium Array | EPA approved in 2009 and prior |
| | Enriched Xenon Observatory | EPA approved in 2009 and prior |
| | Dark Matter Time Projection Chamber | EPA approved in 2009 and prior |
| | Low background radiation experiment | EPA approved in 2009 and prior |
| Planned Change Notices | Excavation and Construction of a New Ventilation Shaft and Associated Access Drifts | EPA letter sent on September 28, 2020 not objecting to new shaft construction |
| | Panel 7 Configuration of TRU Waste Emplacement (August 28, 2017) | No EPA response necessary |
| | Volume of Record (June 22, 2018) | No EPA response provided |
| PA Changes | Abandonment of Planned Panel Closures in Entrances to Panels 3, 4, 5, and 6, and Abandonment of Emplacement of Waste in Panel 9 | The results (of DOE's CRA19_CL analysis and EPA's CRA19_COMP analysis) confirmed that the APCS approach overestimated calculated repository releases as compared with empty drifts that were assumed to creep close over longer periods to the similar low porosity and permeability endpoints as intact halite |
| | Additional Shaft and Drifts | Adequate; corresponding changes to the numerical models were included in CRA-2019 and documented |
| | Brine Radiolysis | Adequate. Will need further refinement for CRA-2024 |
| | Probability of Encountering Pressurized Brine during a Drilling Intrusion | Adequate. Update made per EPA request after CRA-2014 review |
| | Steel Corrosion Rates | Adequate |
| | Waste Shear Strength | Adequate; TAUFAIL was modified according to EPA review of CRA-2014 |
| | Colloid Enhancement Parameters | Mineral fragment colloid parameters remain adequate. Humic colloid update is adequate. Bounding values from experiments used to derive the parameters should be used for Am and Th intrinsic colloids. Microbial colloid parameters do not adequately consider uncertainty in the literature |
| | Hydromagnesite to Magnesite Conversion Rate | Adequate |
| | Iron Sulfidation | Adequate |
| | Northernmost Panel Closure Representation Correction | Adequate |
| | Drilling Rate and Plugging Pattern Probabilities | Adequate for drilling rate, but EPA requests DOE reevaluate methodology to better address lag in deep drilling rate from unknown depth boreholes;<br><br>EPA's review of borehole plugging pattern changes concluded they are not adequately justified in consideration of both the regulatory requirements and actual practices, and DOE should revert to older approved methodology or propose alternatives for EPA review |
| | Waste Inventory Information | The details of the CRA-2019 DPA inventory are presented in the Annual Transuranic Waste Inventory Report (ATWIR) – |

| Changes | Action | EPA Evaluation |
|---|---|---|
| | | 2018 (DOE 2018), and the Performance Assessment Inventory Report (PAIR) – 2018 (Van Soest 2018). See CARD 24 for details on evaluation of waste inventory parameters |
| | Radionuclide Solubilities and their Uncertainty | +III, +IV, and +V solubilities are underestimated due to errors in the geochemistry database and initial model assumptions |
| | Borehole Permeability Model Parameter Update | Adequate |
| | BRAGFLO Grid Flexibility | Adequate |
| | Hardware and Code Updates | The Agency concludes that the versions of the computer codes used for CRA-2019 DPA are approved for use in PA compliance calculations on the Solaris cluster with the SunOS operating system |

15(a)(5) DOE generally kept the same categories of waste for the 2019-DPA. The major changes were changes to waste volumes and radioactive content since the CRA-2014. The scaled radioactivity of the waste to 2033 has increased since CRA-2014 mainly due to the addition of the Savannah River Site plutonium waste stream SR-KAC-PuOx, which increases the volume of plutonium by about six metric tons. Anticipated waste volume has decreased slightly since CRA-2014. EPA found DOE's inventory estimates of waste projected to be emplaced at WIPP to be reasonable and adequate. EPA expects any changes in projected inventory by DOE presently listed as not WIPP bound waste, will be included in future inventory estimates. The changes need to be fully explained, justified, and confirmed by the use of a new compliant performance assessment calculation. The volume of record change identified by DOE was not implemented in this CRA-2019.

15(a)(6) During EPA's review of DOE's CRA-2019 documents, the Agency identified several technical concerns that had the potential to increase calculated repository releases. EPA performed sensitivity studies to evaluate the effect of those concerns on predictions of WIPP performance. The Agency's evaluations of the results of those studies are presented in *Overview of EPA Review of U.S. Department of Energy 2019 WIPP Compliance Recertification Application Performance Assessment*, Docket ID No. EPA-HQ-OAR-2019-0534. EPA has identified and evaluated several technical concerns shown in the table below.

EPA examined the combined effects of all the EPA-identified issues in its CRA19_COMB analysis. EPA found that direct brine releases are strongly influenced by the degree of waste panel isolation. By treating the now-empty waste panel access drifts as retaining high permeability and porosity for the 10,000-year EPA regulatory period and discounting most of the isolation capabilities of the constructed panel seals that remained, DOE's APCS methodology did not simulate the isolation of waste panels that are likely to occur. As a result, DOE's use of the APCS methodology in the 2019 CRA provided an unlikely starting point for evaluating the sensitivity of releases to EPA concerns. When the non-conservative borehole plugging, chemistry, and microbial assumptions in the 2019 CRA were removed in EPA's sensitivity studies, the conservative overestimates of the APCS approach remained. Because of this, the EPA believes that the sensitivity study results were influenced by the conservatism of the APCS

approach and those results also conservatively overestimated repository releases though total releases remained below regulatory limits.

In the past, DOE has used the previous CRA PA as the point of comparison with the current PA. However, given the issues identified by EPA for this PA, DOE should not use the CRA-2019 assessment as a new baseline without some parameter adjustments for WIPP performance assessment comparisons. EPA will work with DOE, as needed, to develop an appropriate model to use for comparisons with future PA calculations. Based on the Agency's review and calculations, the Agency finds that the repository continues to meet the numerical standards at 40 CFR 191.13 as well as the compliance assessment requirements for the undisturbed case.

| Issue | EPA Evaluation |
|---|---|
| Plutonium oxidation state | DOE has not updated this assumption since the CCA. Impacts evaluated in EPA GCHM_S3 sensitivity study. The results of this sensitivity study showed that, although the combined effects of EPA's geochemistry parameter changes materially increased calculated repository releases, the mean total repository releases remained below the regulatory release limits. |
| APCS | Impacts evaluated in the CRA19_COMP sensitivity study and compared with DOE's CRA19_CL model to examine impacts of APCS approach. The results demonstrate that the CRA-2019 PA model using the APCS approach calculated greater repository releases than if the empty repository rooms had been treated as creep closed but total releases remain below regulatory limits. |
| Borehole plugging patterns and deep drilling rates | • Approach does not consider that many future boreholes at WIPP may be not be abandoned using continuous plugs and probability may be lower than 40% as used in the CAR-2019 PA. New approach ignores a number of abandoned boreholes directly southeast of WIPP but just outside the KPLA that may otherwise be relevant geological analogs. Drilling rate methodology underestimates or creates a lag in the deep drilling rate and calculated releases in each PA as compared with a methodology that does not assume all boreholes with incomplete data are shallow.<br>• Impacts of changes to borehole plugging pattern probability methodology evaluated in EPA PLG_PROB sensitivity study. The results of this sensitivity study showed that DOE's new approach materially affected calculated repository releases though remaining within the regulatory release limits. EPA's review concluded they were not adequately justified in consideration of both the regulatory requirements and actual practices, and DOE should revert to older approved methodology or propose alternatives for EPA review.<br>• EPA analyzed the impact of automatically including boreholes of unknown depth as shallow; EPA requests DOE reevaluate methodology to better address lag between actual drilling of boreholes and its incorporation into PA calculations. |
| Geochemistry database and solubility calculations | • Errors in the geochemical database used to perform actinide solubility calculations include errors in DOE's selection of organic ligand stability constants and Pitzer parameters and the inclusion of lead solubility and aqueous speciation data. These errors result in an underprediction of releases, especially for the +III actinides<br>• DOE actinide solubility calculations in brine assumed calcite would precipitate to saturation. This is unrepresentative of the WIPP system, is not reflected in the rest of the PA, and has important implications towards repository water balance, the availability of radionuclides for transport, the effectiveness of the MgO barrier to control CO2 and pH, and on the physical properties of room closure.<br>• Impacts evaluated in GCHM_S0 sensitivity study. Analysis shows DOE underestimated DBR and total releases, although the repository continues to remain in compliance. EPA expects DOE to update the database and its assumptions regarding calcite precipitation for future PAs. |

| | |
|---|---|
| Colloids | • Large variability reported in the scientific literature was not reflected in the CRA-2019 PA microbial colloid proportionality constants because DOE determined these parameters based on a single organism. Microbial colloid enhancement parameters used in the CCA provided more defensible and bounding maximum microbial colloid concentrations.<br>• Parameters for Am(III) and Thorium (Th) (IV) intrinsic colloids did not adequately represent the available laboratory data.<br>• Impact evaluated in GCHM_S2 sensitivity study. Analysis shows DOE remains within the regulatory release limits. DOE should use microbial colloid proportionality constants that adequately address the variability in the literature, CCA-based microbial colloid maximum values, and revised Am(III) and Th(IV) intrinsic colloid parameters that bound laboratory data. |
| Radiolysis of brine and waste | Implementation for CRA-2019 is adequate but should continue to be refined due to the increased importance of Pu in the waste inventory and the potential effects on repository releases of increased gas generation shortly after repository closure. |
| Actinide solubility uncertainty | • Following discussions with DOE during EPA's completeness determination process, DOE added more data to the uncertainty distribution that EPA finds would skew solubility calculations towards an overly conservative and unrepresentative increase.<br>• Use of the modified CRA-2014 uncertainty distribution is appropriate for the CRA-2019 PA. Prior to the next PA, EPA recommends that DOE perform an evaluation of the relative advantages and disadvantages of other potential approaches for addressing +III and +IV actinide solubility uncertainties to improve confidence in the current approach. |

15(a)(7) DOE responded to all requests for information made by EPA.

15(b) DOE provided relevant information for CRA-2019.

**Compliance Decision**

Based on a review and evaluation of the 2019 CRA and supplemental information provided by DOE and recognizing that this section has not changed since the CCA, EPA determines that DOE continues to comply with the requirements for Section 194.15.

EPA received several public comments. Please see Appendix 15-A for details.

**References**

Kicker, D. 2019b. *Analysis Package for Inventory EPA Units in the 2019 Compliance Recertification Application Performance Assessment (CRA-2019 PA).* Carlsbad, New Mexico: Sandia National Laboratories. ERMS 571372.

Reed, D.R. 2020. *Supporting Document Justification for the Pu(III) Intrinsic Colloid Parameter (CONCINT) Based on Plutonium Filtration Data.* LA-UR 20-29679, Los Alamos National Laboratory, Carlsbad, New Mexico.

Shrader, T. 2017. Letter to Lee Veal. Subject: Planned Change Notice Regarding the Excavation and Construction of a New Ventilation Shaft and Associated Access Drifts at the WIPP. September 29, 2017. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

U.S. DOE. 2017. *Annual Transuranic Waste Inventory Report–2017, Revision 0 (December).* Carlsbad Field Office, Carlsbad, NM. DOE/TRU-17-3425.

U.S. DOE. 2017. *Annual Transuranic Waste Inventory Report–2018, Revision 0 (November).* Carlsbad Field Office, Carlsbad, NM. DOE/TRU-18-3425.

U.S. EPA. 2018. Letter from Veal, L., EPA to Shrader, T., DOE. Responding to the DOE's Planned Change Notice regarding the construction of a new ventilation shaft, January 22, 2018. U.S. EPA, Washington, DC.

U.S. EPA. 2019. Letter from Veal, L., EPA to Lachman, K., DOE. November 4, 2019. U.S. EPA, Washington, DC.

U.S. EPA. 2020. Letter from Veal, L., EPA to Knerr, R., DOE. September 28, 2020. U.S. EPA, Washington, DC.

Van Soest, G.D. 2018. *Performance Assessment Inventory Report – 2018.* INV-PA-18, Rev. 0. Los Alamos National Laboratory – Carlsbad Operations, Carlsbad, New Mexico.

# Section 21 Inspections

## DOE Reported Changes

21(a)(1), 21(a)(2), and 21(b) *Inspections, sampling, and records.*

EPA performed two site inspections at the WIPP since the previous recertification.

Monitoring inspections examine monitoring of geomechanical, hydrological, waste activity, drilling related, and subsidence parameters which were identified in the 1996 Compliance Certification Application (CCA) to meet the requirements of 40 CFR Part 194.42(a). Geochemical parameters include creep closure, extent of deformation, initiation of brittle deformation, displacement of deformation features, and subsidence measurements. Hydrological parameters include Culebra groundwater composition and change in Culebra groundwater flow direction. Drilling-related parameters include drilling rate and the probability of encountering a Castile brine reservoir, and waste activity is tracked as a monitored parameter. The list of inspections EPA performed is listed below.

| Date of Inspection | Inspection Type | Inspection Results | Reference |
|---|---|---|---|
| October 24-26, 2017 | Inspections at the WIPP to examine DOE's ability to monitor the 10 parameters listed in the CCA section 7.0 Table 7.7. | EPA found that the site has continued to effectively implement the monitoring programs at the WIPP throughout facility for all areas reviewed. The inspectors also confirmed that the results of DOE monitoring programs are included in annual reports. The inspection team did not identify any findings or concerns. | U.S. EPA 2018 |
| May 14-15, 2019 | Inspections at the WIPP to examine the DOE's ability to monitor the 10 parameters listed in the CCA section 7.0 Table 7.7. | EPA found that the site has continued to effectively implement the monitoring programs at the WIPP throughout facility recovery for all areas reviewed. The inspectors also confirmed that the results of DOE monitoring programs are included in annual reports. The inspection team did not identify any findings or concerns. | U.S. EPA 2020 |

EPA continued to inspect WIPP to verify that waste is being emplaced in the underground facility in the manner described in DOE's CCA and subsequent recertifications. Please see each inspection report for details of each inspection. Reports are located in e-docket EPA-HQ-OAR-2001-0012-0477 and EPA-HQ-OAR-2001-0012-0487 (via https://www.regulations.gov). The list of inspections EPA performed is listed below.

| Date of Inspection | Inspection Type | Inspection Results | Reference |
|---|---|---|---|
| October 24-26, 2017 | Inspections at WIPP to verify the proper emplacement of waste and MgO in the WIPP repository. | EPA concluded that DOE's emplacement activities are adequate based on interviews with the contractors and documentation provided by the DOE Carlsbad Field Office (CBFO). EPA confirmed that cellulosic, plastic and rubber material (CPR) is appropriately tracked and recorded, and magnesium oxide (MgO) balances are calculated properly. Because of the safety training and equipment required to enter the active waste panel, the Agency was unable to directly observe waste emplacement procedures in the underground, and the site did not provide photographs of waste emplacement activities. A review of available records provided evidence that waste emplacement is taking place according to procedure. EPA did not identify any findings or concerns regarding waste emplacement during this inspection. | U.S. EPA 2018 |
| May 14-15, 2019 | Inspections at WIPP to verify the proper emplacement of waste and MgO in the WIPP repository. | EPA inspectors noted that procedures for notifying the Agency had not taken place for two heater experiments in the WIPP underground, one of which required EPA approval due to its location outside the areas designated for experiments. Additional information subsequently provided by CBFO allowed EPA to determine that the experiments did not alter either the facility's ability to safely emplace waste or the current certified design of the disposal system (see letter to DOE dated November 4, 2019). Deviations from procedures for notification and approval led to two inspection concerns, detailed in the Emplacement Inspection Report.<br><br>During the inspection on May 15, 2019, inspectors requested documents related to internal approval of the heater experiments and cited in the 2017 Annual Change Report. CBFO did not deliver these records until July 17, 2019. In its final inspection report, EPA found that this was a violation of § 194.21(b), which requires that records requested by the EPA, if not immediately available, must be delivered within 30 calendar days. Since the records had been delivered before the inspection report was issued, the Agency did not require a formal response to this finding. | U.S. EPA 2020 |

EPA performed no other inspections for the purposes of verifying compliance with 40 CFR part 194 since the 2014 CRA. EPA did not receive any public comments on DOE's continued compliance with the inspections requirements of Section 194.21.

21(c) and 21(d) No changes.

**EPA Evaluation**

21(a)(1) and 21(a)(2) EPA continued to find the overall parameter monitoring and waste emplacement programs adequate. See tables above for details on EPA inspections.

21(b) The records issue noted in the 2019 inspection is closed, and the DOE is in compliance with requirements pertaining to the availability of records.

21(c) and 21(d) No changes.

**Compliance Decision**

Based on a review and evaluation of the 2019 CRA and supplemental information provided by DOE (DOE 2019b), EPA determines that DOE continues to comply with the requirements for Section 194.24.

**References**

U.S. EPA. 2018. Letter from Lee Ann B. Veal, Director, Radiation Protection Division, EPA, to Todd R. Shrader, Manager, Carlsbad Field Office. August 21, 2018. EPA Inspections [Number EPA-WIPP-10.24-26a, b and c] of the Waste Isolation Pilot Plant, October 24-26, 2017.

U.S. EPA. 2020. Letter from Lee Ann B. Veal, Director, Radiation Protection Division, EPA, to Gregory Sosson, Acting Manager, Carlsbad Field Office. January 28, 2020. EPA Inspections of the Waste Isolation Pilot Plant, March 19-21 and May 14-16, 2019.

# Section 22 Quality Assurance

## DOE Reported Changes

22(a) to 22(d) *Quality assurance program and implementation.*

Section 21 of the 2019 Compliance Recertification Application (CRA) (DOE 2019) lists updates to the Quality Assurance Program Document (QAPD) as well as the addition and deletion of several procedures to CBFO.

22(e) *Execution of QA programs through inspections, record reviews, and record keeping requirements.*

DOE has provided an updated list of TRU waste sites approved to ship CH and RH waste.

## EPA Evaluation

22(a) to 22(d) The EPA evaluation process to recertify the WIPP's QA Programs in 2019 was similar to the prior EPA evaluation processes (e.g., 1996 CCA, 2004 CRA, 2009 CRA, and 2014 CRA). The EPA reviewed documents provided by DOE for the 2019 CRA and finds the documents and updates appropriate.

22(e) The table below provides a list of the EPA audits conducted during the 2019 CRA compliance period. EPA increased its surveillance of the WIPP QA Programs' performance to strengthen the quality of work that supports the isolation of the TRU waste in the WIPP repository. EPA auditors observed many of the audits conducted by CBFO's QA Organization that are listed in Appendix AUD of the 2019 CRA. Based on a large sample of CBFO QA audits, EPA has the following general conclusions regarding the audits listed in Appendix AUD of the 2019 CRA:

1. The CBFO QA audits were properly planned and scheduled
2. The audits were properly performed in accordance with written procedures or checklists by qualified personnel who did not have direct responsibility for performing the activities being audited.
3. The audit results were properly documented and reported to and reviewed by responsible DOE management.
4. Follow-up actions were taken by DOE as required by corrective action plans and documented in final audit reports.

**Table 22-1. List of EPA's Audits and Inspections of DOE's QA Programs that Support the 2019 CRA**

| Sites | Activity | Date of Audit | Description |
|---|---|---|---|
| Advanced Mixed Waste Treatment Project (AMWTP) | Audit | September 24, 2014 to February 26, 2015 | Remote audit of the AMWTP QA program for NQA-1-1989 compliance. EPA docket no: A-98-49; II-A1-122 Remote audit of the AMWTP QA program for NQA-1-1989 compliance. EPA docket no: A-98-49; II-A1-121 |
| Advanced Mixed Waste Treatment Project (AMWTP) | Audit | January 16, 2016 | EPA Element 18 Audit of The Advanced Mixed Waste Treatment Project Quality Assurance Program |
| Sandia | Inspection | April 2012 | EPA observed an audit conducted by the Carlsbad Field Office. Dates of audit: December 7-8, 2011. This audit (A-12-05) evaluated the quality assurance program of the Sandia National Laboratories Nuclear Waste Management Program. II-A1-110 |
| Sandia-CO | Audit | May 1-29, 2014 and July 22-24, 2014 | Verification of implementation of SNL-CO's QA program relative to requirements of NQA-1 Standard NQA-1-1989. EPA Docket No. A-98-49; II-A1-115, EPA-HQ-OAR-2001-0012-0445 |
| Carlsbad Field Office (CBFO) | Audit | April 8-29, 2013 | Remote records audit of CBFO Technical Assistance Contractor. A-98-49; II-A1-111 |
| Carlsbad Field Office (CBFO) | Audit | June 18-20, 2013 | Audit of the quality assurance program relative to the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA) Standard NQA-1-1989. EPA Docket no. A-98-49; II-A1-112 |
| Carlsbad Field Office (CBFO) | Audit | July 22-24, 2014 | Audit of CBFO QA program for compliance with NQA-1-1989 elements. EPA Docket No. A-98-49; II-A1-117 |
| Carlsbad Field Office (CBFO) | Audit | January 6-February 12, 2015 | Audit of CBFO QA program for compliance with NQA-1-1989 elements. EPA Docket No. A-98-49; II-A1-120 |
| Carlsbad Field Office (CBFO) | Audit | September 1-3, 2015 | Audit of CBFO QA program for compliance with NQA-1-1989 elements. EPA Docket No. A-98-49; II-A1-121 |
| Carlsbad Field Office (CBFO) | Audit | September 20-22, 2016 | CBFO Document Control Audit A-16-27 |
| Carlsbad Field Office (CBFO) | Audit | October 17-19, 2017 | Audit of CBFO QA program for compliance with NQA-1-1989 elements. EPA-HQ-OAR-2001-0012-0475; AUD-CBFO-OCT-2017 |
| Sandia-CO | Audit | May 1-29, 2014 and July 22-24, 2014<br><br>June 18-20, 2013 | Verification of implementation of SNL-CO's QA program relative to requirements of NQA-1 Standard NQA-1-1989. EPA Docket No. A-98-49; II-A1-115, EPA-HQ-OAR-2001-0012-0445<br><br>Quality Assurance (QA) audit relative to the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA) Standard NQA-1-1989. EPA Docket no. A-98-49; II-A1-113 |
| Nuclear Waste Partnership LLC (NWP) | Audit | July 22-24, 2014 | Audit of NWP QA program for compliance with NQA-1-1989 elements. EPA Docket No. A-98-49; II-A1-118 |

| Sites | Activity | Date of Audit | Description |
|---|---|---|---|
| Nuclear Waste Partnership LLC (NWP) | Audit | January-November 2015 | Audit of NWP QA program for compliance with NQA-1-1989 elements. Final document has not been released at this time |
| Nuclear Waste Partnership LLC (NWP) | Audit | August 6 – September 24, 2015 | Audit of NWP QA program for compliance with NQA-1-1989 elements. Scope was limited and will be revisited at a later date. EPA Docket No. A-98-49; II-A1-123 |
| Nuclear Waste Partnership LLC (NWP) | Audit | February 13-15, 2018 | Audit of NWP QA program for compliance with NQA-1-1989 elements. EPA-OAR-2001-0012-0476; AUD-NWP-FEB-2018 |
| Los Alamos National Laboratory (LANL) | Audit | June 10 – July 8, 2014 | Audit of the QA program for the WIPP as it pertains to NQA-1-1989. EPA Docket No. A-98-49: II-A1-116 EPA-HQ-OAR-2001-0012-0445 |

## Compliance Decision

The EPA finds that DOE's QA Programs continue to be effective at evaluating activities that are important to the long-term isolation of transuranic waste. Based on the EPA's review of the effectiveness of CBFO's QA Program, the results of EPA audits and corrective action, audit observations, and the review of the 2019 CRA information, the EPA determines that DOE continues to comply with the Quality Assurance requirements of Section 194.22 and Section 194.8(a).

## References

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191 Subparts B and C Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, U.S. Department of Energy Waste Isolation Pilot Plant, Carlsbad Field Office, Carlsbad, NM. DOE/WIPP-19-3609, Rev. 0.

# Section 23 Models and Computer Codes

## DOE Reported Changes

23(a)(1) *Description of the conceptual models and scenario construction used to support any compliance application.*

For the 2019 recertification, DOE undertook an extensive rescreening process to determine which FEPs were still applicable to the disposal system and which changes were appropriate for the CRA-2019 PA. Of the 245 FEPs considered for the CRA-2019, 161 remain the same, 80 have been updated with new information, and four FEPs have had their screening decision changed (see CRA-2019 CARD 32 for EPA's review of FEPs).

Several changes were incorporated in the CRA-2019 PA compared to the CRA-2014 PA that related to the conceptual models and scenario construction used to support the 2019 CRA. The descriptions of the following changes are in Zeitler 2019a and Appendix PA-2019 section PA-1.0.

- Inclusion of an approach to accommodate the operational decisions to not emplace panel closures in Panels 3, 4, 5, and 6 and to not emplace waste in Panel 9.
- Inclusion of an approach to accommodate an additional shaft connecting the repository to the surface, as well as an additional mined region in the repository north end to accommodate drifts that lead to the new shaft.
- Refinement of the gas generation process model to include brine radiolysis.
- An update to the probability that a drilling intrusion into a repository excavated region will intersect the Castile brine reservoir modeled in BRAGFLO.
- Refinement to the corrosion rates of steel under humid and inundated conditions.
- Refinement to the effective shear strength of WIPP waste.
- Refinement to colloid enhancement parameters associated with actinide mobilization.
- Refinement to the hydromagnesite to magnesite conversion rate.
- Removal of two chemical reactions associated with iron sulfidation.
- Correction to the length of the northernmost panel closure representation in the BRAGFLO grid.
- Updates to drilling rate and plugging pattern parameters.
- Updates to WIPP waste inventory parameters.
- Updates to radionuclide solubilities and their associated uncertainty.
- An update to the BH_OPEN:RELP_MOD parameter.
- Introduction of new materials to define properties in some disturbed rock zone areas.

23(a)(2) *A description of plausible, alternative conceptual model(s) seriously considered but not used to support such application, and an explanation of the reason(s) why such model(s) was not deemed to accurately portray performance of the disposal system.*

The description of a supplemental CRA-2019 PA Calculation (CRA19_CL Analysis) is included in Zeitler *et al.* 2019.

23(a)(3)(i) *Conceptual models and scenarios reasonably represent possible future states of the disposal system;*

The screening decision for FEP W52 Radiolysis of Brine, formerly screened out, was changed to include in the CRA-2019 PA. It is part of the Gas Generation conceptual model. The change is documented in Zeitler *et al.* 2019.

23(a)(3)(ii) *Mathematical models incorporate equations and boundary conditions which reasonably represent the mathematical formulation of the conceptual models;*

No changes. DOE continued to document the various aspects of the mathematical models in numerous parts of the 2019 CRA, Appendix PA-2019, and Appendix MASS-2019. DOE documented mathematical model equations and initial and boundary conditions primarily in Appendix PA-2019 for the various codes. DOE continued to document each code's characteristics in the User's Manual (UM) and Analysis Packages (AP). DOE also continued to use these additional documents: The Requirements Document & Verification and Validation Plan (RD/VVP), the Implementation Document (ID), and the Validation Document (VD) as secondary references for the CRA-2019 PA codes.

23(a)(3)(iii) *Numerical models provide numerical schemes which enable the mathematical models to obtain stable solutions;*

No changes. Information used to evaluate the stability of numerical model numerical schemes continue to be provided in the VD and AP that DOE prepared for each of the CRA-2019 PA computer codes. DOE's approach has not changed since previous CRAs.

23(a)(3)(iv) *Computer models accurately implement the numerical models; i.e., computer codes are free of coding errors and produce stable solutions;*

No changes. DOE used the same computer code development process and requirements for the CRA-2019 PA computer codes as it has in the past, which consists of four primary development phases:1) requirements phase, 2) design phase, 3) implementation phase, and 4) software verification and validation.

23(a)(3)(v) *Conceptual models have undergone peer review according to § 194.27.*

No changes. No new conceptual model peer reviews were done in the 5-year reporting period and all previous conceptual model peer reviews were performed and documented according to 40 CFR 194.27 and NUREG-1297 and approved for use in WIPP PAs.

23(b) *Computer codes used to support any compliance application shall be documented in a manner that complies with the requirements of ASME NQA-2a-1990 addenda, part 2.7, to ASME NQA-2-1989 edition. (Incorporation by reference as specified in § 194.5.)*

No changes. DOE's computer code quality assurance program has not changed since the 2014 CRA. DOE demonstrates on an ongoing basis that PA computer software complies with regulations outlined in 40 CFR 194.22 – Quality Assurance and 194.23 – Models and Computer Codes. To demonstrate that computer software complies with disposal regulations the DOE established a life-cycle management process for software used to support the PA. The qualification approach for the software follows the life-cycle phases outlined in ASME NQA-2a-1990 addenda, part 2.7.

23(c) *Documentation of all models and computer codes included as part of any compliance application performance assessment calculation shall be provided. Such documentation shall include, but shall not be limited to:*

23(c)(1) *Descriptions of the theoretical backgrounds of each model and the method of analysis or assessment;*

Descriptions of the theoretical backgrounds of each model and the method of analysis or assessment for the CRA-2019 were primarily contained in UM, VD, ID, and RD/VVP for each code. CRA-2014 PA calculations were done on the WIPP PA computing cluster running a VMS operating system. WIPP PA codes have since been migrated to a cluster running a Solaris operating system. Subsequent to the migration of codes to the Solaris system, for CRA-2019 PA, Sandia National Laboratories (SNL) made and documented additional code changes to account for bug fixes, added functionality, and the addition of two codes to the Software Baseline that were previously qualified and used under SNL's Nuclear Waste Management Procedure NP 9-1: Analyses (SCREEN_NUTS and CCDFVECTORSTATS).

23(c)(2) *General descriptions of the models; discussions of the limits of applicability of each model; detailed instructions for executing the computer codes, including hardware and software requirements, input and output formats with explanations of each input and output variable and parameter (e.g., parameter name and units); listings of input and output files from a sample computer run; and reports on code verification, benchmarking, validation, and quality assurance procedures;*

Documentation for the CRA-2019 regarding DOE's compliance with Section 194.23(c) (2) was primarily contained in the UM, AP, VD, ID, and RD/VVP for each code.

23(c)(3) *Detailed descriptions of the structure of computer codes and complete listings of the source codes;*

The information relevant to compliance with Section 194.23(c)(3) is contained in the ID for each modeling code.

23(c)(4) *Detailed descriptions of data collection procedures, sources of data, data reduction and analysis, and code input parameter development;*

The changes to the Performance Assessment Parameter Database (PAPDB) for the CRA-2019 PA were managed under Revision 2 of SNL's Nuclear Waste Management Procedure NP 9-2:

Parameters, dated April 25, 2017. In summary, the process of entering database information into the PAPDB begins with a thorough review and documentation of the changes to the database since the previously approved baseline PA. For the CRA-2019 PA, the previously approved baseline was the CRA-2014 PA and the changes were documented in Kim and Feng 2019. Kim and Feng 2019 was then used as the source document for completing Parameter Data Entry forms NP 9-2-1. The completed forms were reviewed by DOE/SNL for accuracy and completeness before entering the changes into the PAPDB.

23(c)(5) *Any necessary licenses; and*

No changes. As in the CCA, no licenses from software vendors were required to operate the codes essential for the WIPP PA. Most computer codes for the WIPP PA were developed by and programmed by SNL or its contractors as custom software and require no license to execute or use the computer codes documented in the CCA and supplementary materials. MODFLOW and PEST are public domain codes and are readily accessible.

23(c)(6) *An explanation of the manner in which models and computer codes incorporate the effects of parameter correlation.*

An explanation of the manner in which models and computer codes incorporate the effects of parameter correlation is included in Kim and Feng 2019. Parameter correlations affect only the Latin Hypercube sampling (LHS) sampled parameters. Two types of parameter correlations are used. They are defined as explicit parameter correlation and induced parameter correlation. Correlations can be induced by the assignment of a sampled parameter value to a non-sampled value and by limiting the range of one sampled value by the value selected for another. This second method used to be implemented using LHS_EDIT to modify selected parameters after LHS has generated the sampled data (Kirchner 2013). For the CRA-2019 PA, however, LHS version 2.44 was used, in which the functionality of LHS_EDIT is included and the LHS_EDIT code is no longer needed (Zeitler 2019b).

23(d) *The Administrator or the Administrator's authorized representative may verify the results of computer simulations used to support any compliance application by performing independent simulations. Data files, source codes, executable versions of computer software for each model, other material or information needed to permit the Administrator or the Administrator's authorized representative to perform independent simulations, and access to necessary hardware to perform such simulations, shall be provided within 30 calendar days of a request by the Administrator or the Administrator's authorized representative.*

No changes. Section 194.23(d) requires DOE to support EPA as requested and to provide access to PA code and input data as needed. EPA was able to remotely access and independently conduct six sensitivity studies on the WIPP PA cluster at Carlsbad, NM to support the agency’s 2019 CRA review.

**EPA Evaluation**

23(a)(1) EPA's 2019 CRA review of compliance with 40 CFR 194.23 (a) (1) focused on any changes to FEPs, conceptual models, scenarios, or models since the 2014 CRA. During its CRA-2019 review, EPA found the information documenting DOE's FEPs reevaluation process to be generally complete (see also CRA-2019 CARD 32—Scope of Performance Assessments, for a more complete discussion of FEPs at the WIPP site).

The summary of EPA's evaluation of the 15 changes related to the conceptual models and scenario construction incorporated in the CRA-2019 PA is in EPA Technical Support Document (TSD) *Overview of EPA Review of U.S. Department of Energy 2019 WIPP Compliance Recertification Application Performance Assessment* (EPA-HQ-OAR-2019-0534). EPA's detailed reviews of each change are in EPA TSDs referenced in the Overview TSD.

23(a)(2) The original comprehensive description of the Abandonment of Panel Closures in the South (APCS) approach is presented in Zeitler et al. 2017. Upon review, the EPA found that the assumptions in the APCS approach were not physically realistic but did compensate for the uncertainties in treating the abandoned Panel 9 as a surrogate for its replacement. One of DOE's commitments coupled with EPA's acceptance was to demonstrate the conservatism of the APCS approach. The qualified, parallel PA model is called the CRA19_CL model. As expected, the isolation provided by treating the empty waste panel access drifts as well as the empty Operational and Experimental Areas of the repository as immediately creep closing resulted in lower repository releases than were calculated by the DOE's CRA-2019 PA model that ignored such closure. Although the results demonstrated that the CRA-2019 PA model using the APCS approach conservatively calculated greater releases than the CRA19_CL model, upon review the Agency found that the CRA19_CL model did not include rapid consolidation and healing of the disturbed rock zones (DRZs) surrounding these empty drifts. This finding was based on the recognition that if the drifts healed to approach the properties of intact halite, the surrounding DRZs would also heal in a like manner. EPA separately analyzed the effects of DRZ healing using the Agency's CRA19_COMP model, which modified DOE's model to also treat the DRZs as immediately creep closing to the same properties of intact halite, consistent with the process described previously for the empty drifts. The results confirmed that the APCS approach overestimated calculated repository releases as compared with empty drifts that were assumed to creep close over longer periods to the similar low porosity and permeability endpoints as intact halite. A detailed review of the CRA19_CL model is in EPA TSD *Review of the APCS Approach to Analyzing WIPP Repository Performance in the CRA-2019 Performance Assessment* (Docket ID No. EPA-HQ-OAR-2019-0534)

23(a)(3)(i) Upon review, EPA concluded DOE's decision to include FEP W52 in WIPP PA was appropriate. Detailed technique review of the WIPP gas generation model is in EPA TSD *Evaluation of the Compliance Recertification Application (CRA-2019) Actinide Source Term, Gas Generation, Backfill Efficacy, Water Balance, and Culebra Dolomite Distribution Coefficient Value*s (EPA-HQ-OAR-2019-0534). No other changes were made to the conceptual models for the CRA-2019 PA and all conceptual models used in the CRA-2019 PA were previously peer-reviewed and found to be adequate. Therefore, WIPP conceptual models

continue to represent future states of the disposal system. EPA finds that DOE continues to comply with Section 194.23(a)(3)(i).

23(a)(3)(ii) EPA reviewed the primary sources of information on the mathematical models employed in the CRA-2019 PA: Appendix PA-2019, UM, and AP for each code. Mathematical formulations continue to be adequately explained and were reasonable. DOE continues to adequately document and describe simplifications of conceptual models in the CRA-2019 PA and continues to provide an adequate technical basis to support the mathematical formulations.

EPA also reevaluated the functional tests for the CRA-2019 PA computer codes, described in the VD for each computer code, to ensure that the codes' functionalities have not changed, and that DOE's tests of the computer code demonstrate that the code continues to perform as specified in the Requirements Document. EPA reviewed the testing of each code to verify that DOE adequately tested the functional requirements listed for each computer code. This analysis and testing indicated that equations and boundary conditions were properly incorporated into the mathematical models and boundary conditions were reasonable representations of how the conceptual models should be implemented. EPA's detailed review is in EPA TSD *Review of WIPP Performance Assessment Models and Computer Codes* (EPA-HQ-OAR-2019-0534). EPA found that DOE continues to comply with Section 194.23(a)(3)(ii) for the 2019 CRA.

23(a)(3)(iii) EPA reviewed all relevant documentation on numerical model solution schemes, which continue to be primarily contained in CRA-2019 Appendix PA-2019, AP, and supplementary information (e.g., UM, VD). EPA also reviewed the QA documentation packages for each code for completeness and technical adequacy. For the CRA-2019, EPA reviewed the testing used to qualify each code for use in the CRA-2019 PA. EPA found that DOE continues to adequately set the range of functional tests for each code to verify that the code will perform as expected and provide reasonable results. EPA's detailed review is in EPA TSD *Review of WIPP Performance Assessment Models and Computer Codes* (EPA-HQ-OAR-2019-0534). EPA found that DOE continues to comply with the requirements of Section 194.23(a)(3)(iii).

23(a)(3)(iv) EPA reviewed all of the relevant documentation (i.e., DD, RD/VVP, and VD) on each of the major codes and CRA-2019 Appendix PA-2019. EPA's detailed review is in EPA TSD *Review of WIPP Performance Assessment Models and Computer Codes* (EPA-HQ-OAR-2019-0534). EPA found that each performance assessment code produced results that show continued compliance with this requirement. EPA was able to determine that the CRA-2019 PA computer codes continued to comply with Section 194.23(a)(3)(iv).

23(a)(3)(v) All model peer reviews were performed and documented according to 40 CFR 194.27 and NUREG-1297 and approved for use in WIPP PAs. Therefore, EPA concludes that DOE continued to comply with Section 194.23(a)(3)(v).

23(b) Based on a review and evaluation of the 2019 CRA and supplemental information provided by DOE (life-cycle documents for codes in table 1), EPA determines that DOE continues to comply with the requirements for Section 194.23(b) for CRA-2019.

23(c)(1) In its 2019 CRA review, the codes that EPA reviewed in this CRA include BRAGFLO, CCDFGF, CCDFGFVECTOR_STATS, EPAUNI, GENMESH, LHS, MATSET, PANEL, PREBRAG, PRELHS, and SCREEN_NUTS. EPA found DOE's description of the theoretical background of each code to be adequately documented, particularly in each UM and the various APs. EPA's detailed review is in EPA TSD *Review of WIPP Performance Assessment Models and Computer Codes* (EPA-HQ-OAR-2019-0534). EPA found that DOE's level of documentation continues to be adequate and consistent with the level of documentation produced previously. DOE continues to be in compliance with Section 194.23(c)(1) for CRA-2019.

23(c)(2) EPA reviewed all of the relevant documentation on the requirements specified in Section 194.23(c)(2) for the following codes: BRAGFLO, CCDFGF, CCDFGFVECTOR_STATS, EPAUNI, GENMESH, LHS, MATSET, PANEL, PREBRAG, PRELHS, and SCREEN_NUTS. EPA determined that DOE documents for the CRA-2019 continued to fulfill the requirements of 194.23(c)(2) after reevaluating these documents and evaluating the code verification, bench marking, and validation documentation. EPA's detailed review is in EPA TSD *Review of WIPP Performance Assessment Models and Computer Codes* (EPA-HQ-OAR-2019-0534).

23(c)(3) During its 2019 CRA review, EPA examine all of the relevant documentation, in particular, the ID for each computer code on the requirements specified in Section 194.23(c)(3), for the following codes: BRAGFLO, CCDFGF, CCDFGFVECTOR_STATS, EPAUNI, GENMESH, LHS, MATSET, PANEL, PREBRAG, PRELHS, and SCREEN_NUTS. EPA continues to find the detailed descriptions of the structure of the computer codes to be adequate. The CRA-2019 documentation of computer codes continues to adequately describe the structure of computer codes with sufficient detail to allow EPA to understand how software subroutines were linked and how to execute the CRA-2019 PA codes. DOE continues to comply with Section 194.23(c)(3) for CRA-2019.

23(c)(4) EPA performed a thorough review of the parameters and parameter development process for the CRA-2019 PA. For the CRA-2019 PA parameter review, EPA continued to focus its review on parameters that have changed or were new since the previous recertification. EPA's review of the parameters and parameter development is described in detail in Appendix B of the overview TSD, *Overview of EPA Review of U.S. Department of Energy 2019 WIPP Compliance Recertification Application Performance Assessment* (EPA-HQ-OAR-2019-0534). EPA determined that DOE continued to comply with Section 194.23(c)(4) for CRA-2019.

23(c)(5) EPA continued to verify that no licenses from software vendors are required to operate the codes essential for the WIPP PA for the 2019 CRA. EPA determined that DOE continued to comply with Section 194.23(c)(5) for CRA-2019.

23(c)(6) EPA verified that the 2019 CRA continues to contain a complete discussion of how parameter correlations were incorporated into the PA, as well as an adequate explanation of the mathematical functions used to describe the correlation implementation in the CRA-2019 PA (Appendix PA-2019, Kim and Feng 2019, Section 4.0). EPA analyzed the computational aspects of the LHS computer program and the functional tests that implement the correlation check. EPA determined that DOE continues to comply with Section 194.23(c)(6) for CRA-2019.

Based on EPA's review and evaluation of the 2019 CRA and supplemental information provided by DOE (life-cycle documents), the agency determines that DOE continues to comply with the requirements for Section 194.23(c) for the 2019 CRA. The Agency also concludes that the versions of the computer codes specified in Table 23-1 are approved for use in PA compliance calculations on the Solaris cluster with the SunOS operating system.

**Table 23-1. Computer Codes Approved by the Agency**

| Computer Code | CCA | 2004 CRA<br><br>2004 PABC | 2009 CRA<br><br>2009 PABC | 2014 CRA | 2019 CRA |
|---|---|---|---|---|---|
| ALGEBRACDB | 2.35 | 2.35 | 2.35 | 2.36 | 2.36 |
| BLOTCDB | -- | -- | 1.37 | 1.38 | 1.38 |
| BRAGFLO | 4.0 | 5.0 | 6.0 | 6.02 | 7.0 |
| CCDFGF | 1.01 | 5.0A | 5.02 | 6.02 | 7.03 |
| CCDFGFVECTOR_STATS | --- | --- | --- | --- | 1.01 |
| CCDFSUM | 1.01 | 2.00 | 2.00 | 2.0 | 2.0 |
| CUTTINGS_S | 5.03 | 5.04A | 6.02 | 6.03 | 6.03 |
| DRSPALL | NA | 1.0 | 1.10 | 1.22 | 1.22 |
| DTRKMF | NA | 1.0 | 1.0 | 1.01 | 1.01 |
| EPAUNI | 1.14 | 1.15A | 1.15A | 1.16 | 1.19 |
| GENMESH | 6.08 | 6.08 | 6.08 | 6.09 | 6.10 |
| GROPECDB | 2.12 | 2.12 | 2.12 | 2.13 | 2.13 |
| ICSET | 2.21 | 2.22 | 2.22 | 2.23 | 2.23 |
| LHS | 2.32Z0 | 2.41 | 2.42 | 2.43 | 2.44 |
| MATSET | 9.0 | 9.10 | 9.10 | 9.21 | 9.24 |
| MODFLOW2000 | NA | 1.60 | 1.60 | 1.70 | 1.70 |
| MWT3D | --- | --- | 2.51 | 2.51 | 2.51 |
| NONLIN | --- | --- | 2.01 | 2.02 | 2.02 |
| NUTS | 2.02 | 2.05A | 2.05C | 2.06 | 2.06 |
| PANEL | 3.6 | 4.02 | 4.03 | 4.04 | 5.0 |
| PEST | NA | 5.51 | 9.11 | 9.12 | 9.12 |
| POSTBRAG | 4.00 | 4.00 | 4.00 | 4.02 | 4.02 |
| POSTLHS | 4.07 | 4.07 | 4.07A | 4.08 | 4.08 |
| POSTSECOTP2D | 1.02 | 1.04 | 1.04 | 1.05 | 1.05 |
| PREBRAG | 6.0 | 7.00 | 8.00 | 8.03 | 9.0 |
| PRECCDFGF | 1.0 | 1.00B | 1.01 | 2.0 | 2.0 |
| PRELHS | 2.10 | 2.10 | 2.30 | 2.40 | 2.44 |
| PRESECOTP2D | 1.20 | 1.22 | 1.22 | 1.23 | 1.23 |
| RELATE | 1.43 | 1.43 | 1.43 | 1.45 | 1.45 |
| SCREEN_NUTS | --- | --- | --- | --- | 1.02 |
| SECOTP2D | 1.30 | 1.41 | 1.41A | 1.43 | 1.43 |
| STEPWISE | 2.20 | 2.21 | 2.21 | 2.22 | 2.22 |
| SUMMARIZE | 2.10 | 2.20 | 3.01 | 3.02 | 3.02 |

23(d) Sandia National Laboratory (SNL) uses the Linux Concurrent Versions System (CVS) file management systems for controlling, tracking changes, and monitoring user access for source code, executables, simulation input and output files. Most calculations performed on the WIPP PA Solaris Cluster also take advantage of the WIPP Performance Assessment Parameter Database (PAPDB) to control the use of key modeling parameters. The execution of WIPP PA codes on the Solaris Cluster for regulatory calculations is orchestrated using a collection of

scripts. The run control scripts export all input files and executables from access-controlled CVS libraries and parameters from the PAPDB. DOE identified points of contact to facilitate the process for EPA to perform independent simulations, to provide ready access to the hardware and software needed to perform simulations related to the evaluation of the 2019 CRA, and to assist EPA personnel in exercising DOE computer codes as needed. EPA determined that DOE continues to comply with Section 194.23(d) for CRA-2019.

EPA did not receive any public comments on DOE's continued compliance with the model and computer code requirements of Section 194.23.

**Compliance Decision**

Based on the foregoing evaluation, EPA determined that DOE continues to comply with the model and computer code requirements in Section 194.23.

**References**

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# Section 24 Waste Characterization

## DOE Reported Changes

24(a) *Chemical, radiological and physical composition of existing and to-be-generated waste.*

DOE tracks the waste emplaced at WIPP using the WIPP Waste Data System (WDS). For the waste that is stored or to-be-generated at the waste generator sites, DOE developed a descriptive methodology for grouping waste information obtained from each generator site. Both sets of data are stored and updated annually in the Comprehensive Inventory Database (CID). DOE adopted the same approach for the CRA-2019 DPA as with the CRA-2014 PA. The details of the CRA-2019 DPA inventory are presented in the Annual Transuranic Waste Inventory Report (ATWIR) – 2018 (DOE 2018), and the Performance Assessment Inventory Report (PAIR) – 2018 (Van Soest 2018).

24(b)(1) *Waste characteristics influencing containment of waste.*

Characteristics analyzed in the performance assessment can influence waste containment are discussed in Appendix PA, Section PA-1.1.12 and in Knerr (2020). The table below lists changes between the CRA-2014 PA and the CRA-2019 DPA.

| 24(b)(1): Waste Component or Characteristic Used in PA | Change | 24(b)(2): DOE Assessment of Impact to Performance | Reference |
|---|---|---|---|
| Radioactivity ($Ci/m^3$) | Increase | Required to calculate potential releases and compliance release limits | Kicker (2019) |
| Solubility | +III: decrease<br>+IV: increase<br>+V: increase<br>+VI: no change<br><br>Addition of SR-KAC-PuOx waste containing a classified adulterant | Higher solubility can lead to higher releases<br><br>Presence of adulterant does not impact actinide solubility and is expected to maintain expected repository chemical conditions. | Table 14 in Domski and Sisk-Scott (2019); Appendix SOTERM, Table 32 and 33<br><br>Knerr (2022); Wade (2022) |
| Organic ligands – complexing agents | Acetate: increase<br>Oxalate: decrease<br>Citrate: decrease<br>EDTA: increase | Higher organic ligand concentrations could lead to increases in actinide solubility | Domski and Sisk-Scott (2019); Appendix SOTERM, Table 32 and 33 |
| Amount of Ferrous Metals | Increase | Maintains reducing environment; increased amounts may increase potential gas generation | Van Soest (2018) |
| Lead Inventory | Increase | May increase gas generation and impact actinide solubilities | Van Soest (2018) |
| Amount of Cellulosics, Plastics, Rubbers | Increase | May increase gas generation from microbial processes | Van Soest (2018) |

| 24(b)(1): Waste Component or Characteristic Used in PA | Change | 24(b)(2): DOE Assessment of Impact to Performance | Reference |
|---|---|---|---|
| Amount of oxyanions: nitrate, sulfate, and phosphate | Nitrate: decrease<br>Phosphate: increase<br>Sulfate: decrease | May increase actinide solubility and provide microbial nutrients that lead to higher gas generation rates | Van Soest (2018) |
| Cement | Decrease | Significant volume changes may lead to increases in actinide solubilities | Van Soest (2018) |
| Shear Strength, Compactability, Compressability | Decrease | Lesser waste strength may result in greater potential drilling releases | Zeitler (2019); Appendix PA, Section PA-1.1.6 |
| Formation of colloidal suspensions | Am(III): increase<br>Pu(III): decrease<br>Th(IV): decrease<br>U(VI): decrease<br>Np(IV): decrease<br>Pu(IV): decrease<br>Np(V): decrease<br>U(VI): decrease | Increases in colloidal content of the actinide source term will increase DBR release and may facilitate transport in the far field | Appendix GEOCHEM Table 61; Appendix SOTERM Table 8, Table 9, Section 3.5.1 |
| Gas Generation | Addition of radiolysis, removal of Fe sulfidation reactions, update of anoxic corrosion | Affects repository pressure and brine saturation | Appendix SCR Section 6.5.1.6; Zeitler (2018a and b); Zeitler (2019) |

24(b)(2) *Identification and assessment for impact of waste components.*

DOE has identified and assessed the impact of waste components influence the waste characteristics in (b)(1). See the above table.

24(b)(3) *Decision to exclude consideration of waste characteristics or components.*

No changes. DOE has referenced Section 24 of CRA-2014 for this section in Knerr (2020) which ultimately refers to Table TRUWASTE-6 of CRA-2004.

24(c)(1) *Total inventory of proposed waste within regulatory limits.*

DOE has provided a new upper bound for the radionuclide inventory by including the most recent DOE inventory data in Table 1 of Knerr (2020). All other limits remain the same.

24(c)(2) and (c)(3) *Methods used to quantify limits of waste and acceptable knowledge.*

Following the February 2014 fire and radiological release incidents, the WIPP Documented Safety Analysis (DOE 2016b) and the Waste Acceptance Criteria (U.S. DOE 2016c) have been changed to require “enhanced acceptable knowledge (AK)” methods to be implemented to help ensure that chemical and physical incompatibilities in the waste are identified prior to shipment to the WIPP. In addition, a Generator Site Technical Review program (U.S. DOE 2016d) has been implemented to evaluate site processes that produce waste or materials that will become

waste prior to implementation of the waste certification processes. A Technical Assist Program (TAP) has also been implemented to help the TRU waste generator sites to enhance any activity that has the potential to affect the ability of waste to be compliantly characterized and certified for disposal at WIPP.

24(c)(4) *System of controls.*

The WDS is the digital system of controls implemented by DOE to meet the requirements of §194.24(c)(4) and confirm that the total amounts of each waste component emplaced in the disposal system fall within the limits set by §194.24(c). This has not changed since CRA-2014.

24(c)(5) *Controls QA.*

The Performance Demonstration Programs (PDPs) for analysis of simulated headspace gases and for RCRA constituent analysis of solidified wastes has been canceled. The two PDPs were canceled upon approval by the New Mexico Environment Department (NMED) of DOE's modifications to the WIPP Hazardous Waste Facility Permit (HWFP).

24(d) *Waste loading scheme.*

DOE does not use a waste loading scheme for waste emplacement and assumes a random waste loading in its performance and compliance assessments instead. This has been the case since the CCA and on through CRA-2019 as described by Kicker (2019).

24(e)(1) *Emplacement of waste not to exceed upper limit.*

See 24(c)(1) for a description of changes since 2014.

24(e)(2) *Emplacement of waste not to exceed lower limits.*

See 24(c)(1) for a description of changes since 2014.

24(f) *Assumed waste loading conditions.*

DOE does not use a waste loading scheme for waste emplacement and assumes a random waste loading in its performance and compliance assessments instead. This has been the case since the CCA and on through CRA-2019 as described by Kicker 2019.

24(g) *Total inventory below limits of transuranic waste.*

DOE uses the Waste Data System (WDS) to track compliance with the limitations on CH-TRU and RH-TRU waste volumes described in the WIPP LWA. Although the inventory has changed, the method of demonstrating compliance with volume limitations has not.

24(h) *Inspections and records reviews.*

EPA performed inspections in 2013 (A-98-49, Il-B3-127), 2015 (EPA-HQ-OAR-2001-0012-0458), 2016 (EPA-HQ-OAR-2001-0012-0469) and 2017 (EPA-HQ-OAR-2001-0012-0477) and verified the use of the WDS system. EPA also performed an audit on the week of August 9, 2021 to verify implementation of waste characteristics in the CRA-2019 DPA (Attachment B, *Overview of EPA Review of U.S. Department Of Energy 2019 WIPP Compliance Recertification Application Performance Assessment,* Docket ID No. EPA-HQ-OAR-2019-0534).

**EPA Evaluation**

24(a) EPA inspections (A-98-49, Il-B3-127, EPA-HQ-OAR-2001-0012-0458, EPA-HQ-OAR-2001-0012-0469, and EPA-HQ-OAR-2001-0012-0477) and records reviews have confirmed that DOE's description of the chemical, radiological and physical composition of existing waste and waste proposed for disposal at WIPP meets the requirements of 40 CFR 194.24(a). EPA is aware that changes in the volume of record calculation methodology were implemented by DOE after the cutoff date of December 31, 2017 occurred and therefore do not apply to the waste inventory used in the CRA-2019 DPA. Inclusion of ATWIR 2017 data in CRA-2019 Section 24 served no purpose, because these data were not used in compliance calculations and create the potential for confusion. For future CRAs, DOE must include the same data in Section 24 of the CRA as is used in the accompanying PA, which were ATWIR-2018 and PAIR-2018 for the CRA-2019 DPA.

24(b)(1) Details of EPA's evaluation can be found in *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* (EPA-HQ-OAR-2019-0534) and are summarized below. EPA notes that the table provided in Knerr (2020) to support this Section is incomplete as it did not include brine radiolysis and binding of $Ca^{2+}$ with organic ligands, which are waste components and characteristics that are used in the CRA-2019 DPA. DOE must update this table for future compliance applications.

| **Waste Component or Characteristic Used in PA** | **24(b)(1) and 24(b)(2) Evaluation** |
|---|---|
| Radioactivity ($Ci/m^3$) | Increase occurred due to higher inventories of $^{241}Am$, $^{238}Pu$, $^{239}Pu$, and $^{240}Pu$. |
| Solubility | EPA has identified numerous issues with DOE's calculation of baseline actinide solubilities stemming from errors in the initial input assumptions as well as the geochemical database used to make the calculations. Results cause an underestimation in potential releases. EPA has performed sensitivity analysis using corrected input assumptions and database values and finds that WIPP continues to remain in compliance. EPA expects these issues to be corrected for future PAs.<br><br>EPA has also reviewed classified DOE scoping experiments on the SR-KAC-PuOx waste adulterant and agrees with DOE's assessment that brine-adulterant interactions are heavily mediated by iron redox chemistry which will maintain the expected repository chemical conditions and cause no impact to actinide solubility. The Agency anticipates continuing to review new data on this adulterant as DOE further pursues its characterization of this material. |
| Organic ligands – complexing agents | No significant increase or decrease compared to the CRA-2014 PA. EPA has identified numerous issues with the organic ligand stability constants and Pitzer |

| Waste Component or Characteristic Used in PA | 24(b)(1) and 24(b)(2) Evaluation |
|---|---|
| | parameters used to calculate complexation with actinides. Results cause an underestimation in potential releases. EPA has performed sensitivity analysis using corrected organic ligand calculations and finds that WIPP continues to remain in compliance. However, EPA expects these issues to be corrected by DOE for future PAs. |
| Amount of Ferrous Metals | Steel surface area used for CRA-2019 DPA is reasonable. For future calculations, EPA expects DOE to use emplaced, stored, and scaled anticipated container counts used to estimate CPR emplacement and operation materials in the WIPP inventory to calculate steel surface area. |
| Lead Inventory | Lead inventory is significantly higher than CRA-2014 but its impact to gas generation will be insignificant. See EPA's chemistry TSD in support of this CARD for more details. |
| Amount of Cellulosics, Plastics, Rubbers | No issues |
| Amount of oxyanions: nitrate, sulfate, and phosphate | No issues |
| Cement | EPA and DOE calculations for CRA-2019 show that this will likely have no significant effects on actinide solubilities. |
| Shear Strength, Compactability, Compressability | No issues |
| Formation of colloidal suspensions | EPA has identified numerous issues with the colloidal calculations used to estimate colloidal suspension in the PA, particularly with intrinsic and microbial colloids. Results cause an underestimation in potential releases. EPA has performed a sensitivity analysis using corrected colloid parameters that shows WIPP is still below release limits and in compliance. However, EPA expects DOE to refine the parameters accordingly for future PAs. |
| Gas Generation | Radiolysis: EPA finds inclusion of radiolysis acceptable for CRA-2019 and expects DOE to refine the parameters further for future performance assessments.<br><br>Fe sulfidation: No issues<br><br>Anoxic corrosion: No issues |

24(b)(2) See table above.

24(b)(3) DOE has referenced Section 24 of CRA-2014 in Knerr (2020) which refers to Table TRUWASTE-6 of CRA-2004. EPA notes that this is an outdated table and includes processes that are now included in the CRA-2019 DPA: brine radiolysis, organic ligand complexation of actinides, and binding of $Ca^{2+}$ with organic ligands. DOE must update this table for future compliance applications along with justification for exclusion of waste characteristics and components.

24(c)(1) EPA considers the radionuclide inventory used in the PA as de facto upper limits (FDMS Docket ID No. EPA-HQ-OAR-2014). Therefore, the inventory that is used in performance assessment calculations to determine compliance with release standards re-sets the limits on radionuclide emplacement at WIPP at each recertification. Also, EPA believes that

estimates of waste components set limits on waste emplacement. For example, CPR that is estimated for each PA inventory establishes the maximum amount of CPR that can be emplaced in the repository." Thus, the CRA-2019 CPR inventory establishes a new CPR limit. When these values are used in a compliant performance assessment, DOE verifies that these waste characteristics, upper and lower limits, still comply with release standards. EPA verified that DOE appropriately continued to identify waste components that require limits, and that these limits continue to be reasonable. Upper limits of iron, CPR, etc. are measured at the time waste characterization is performed to prepare waste for shipment to WIPP and the accumulated information is captured in the WIPP WDS and the WIPP inventory database. EPA verified that the WDS system and inventory database are adequate for verifying waste emplaced in EPA's annual emplacement inspections (see CARD 21).

24(c)(2) and (c)(3) EPA found DOE's documentation adequate to support the conclusion that the steps being taken will improve waste characterization, certification, and management practices.

24(c)(4) The system of controls implemented in the WDS remain unchanged since CRA-2014. EPA reviewed the WDS by annual inspections to determine its ability to track waste content information from generators to the repository and found this change is acceptable. EPA performed baseline, Tier 1 change, and continued compliance inspections at all operational sites listed in CARD 8. EPA concluded that waste characterization of WIPP-bound waste is according to the requirements of this section and using the EPA approved systems of controls – processes, procedures, and equipment.

24(c)(5) The changes to the PDPs were appropriately made with the approval of the New Mexico Environment Department. EPA's quality assurance requirements were not applicable. Otherwise, DOE continues to meet EPA quality assurance requirements that the total volumes of each waste component will be consistent with the limiting values proscribed in the LWA.

24(d) The SR-KAC-PuOx waste stream represents about 3.5% of the total WIPP waste volume, but contains approximately 30% of the radionuclides that cause radiolytic gas generation and brine consumption in WIPP PA. If this waste stream is emplaced in a limited number of panels, these panels may exhibit higher radiolytic gas generation rates and brine consumption than other panels. For future PAs. EPA expects DOE to evaluate whether calculations adequately address the potential effects of segregation of this waste stream in a limited number of panels on brine consumption, gas generation, and repository releases.

24(e)(1) See evaluation for 24(c)(1).

24(e)(2) See evaluation for 24(c)(1).

24(f) See evaluation for 24(d).

24(g) EPA reconfirmed the accuracy of the WDS in tracking compliance with the volume limitations on CH-TRU and RH-TRU waste during multiple inspections described in 24(h) above.

24(h) Not applicable.

**Compliance Decision**

Based on a review and evaluation of the 2019 CRA and supplemental information provided by DOE (DOE 2019b), EPA determines that DOE continues to comply with the requirements for Section 194.24. However, EPA has residual concerns with how several waste component parameters are modeled in PA that should be resolved for future PAs. EPA's concerns with those changes are identified in the foregoing evaluation and the corresponding TSD for Section 194.24.

**References**

DOE (U.S. Department of Energy). 1996 Title 40 CFR Part 191 Compliance Certification Application (October) Appendix WCA. Carlsbad, NM: Carlsbad Field Office. DOE/CAO 1996-2184

DOE (U.S. Department of Energy) 2016b. Waste Isolation Pilot Plant Documented Safety Analysis, DOE/WIPP 07-3372, Revision 5b, April 2016.

DOE (U.S. Department of Energy) 2016c. Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant, DOE/WIPP-02-3122, Revision 8.0, July 5, 2016.

DOE (U.S. Department of Energy) 2016d. Waste Isolation Pilot Plant Generator Site Technical Review Plan, DOE/CBFO 16-3563, Revision 0, June 2016.

DOE (U.S. Department of Energy) 2017. Annual Transuranic Waste Inventory Report–2017, Revision 0 (December). Carlsbad Field Office, Carlsbad, NM. DOE/TRU-17-3425.

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Van Soest, G.D. 2018. Performance Assessment Inventory Report – 2018. Los Alamos National Laboratory Carlsbad Operations. Carlsbad, NM. INV-1812-09-01-01

Zeitler, T.R. 2018a. Cumulative Distribution for STEEL:CORRMCO2 for the CRA-2019 PA. Carlsbad, NM: Sandia National Laboratories. ERMS 570869

Zeitler, T.R. 2018b. Bounding Calculation of the Cumulative Distribution for STEEL:HUMCORR. Carlsbad, NM: Sandia National Laboratories. ERMS 569807

Zeitler, T.R. 2019. A Summary of EPA/DOE Defined Parameters to be Implemented in the CRA-2019 PA. Carlsbad, NM: Sandia National Laboratories. ERMS 570879

# Section 25 Future State Assumptions

## DOE Reported Changes

Section 25(a) *FEPs screening except for certain N (natural) FEPs and the future state assumption.*

The DOE addresses the requirements of Section 25(a) through a screening process that evaluates current features, events, and processes (FEPs) that could affect future repository performance for consideration in WIPP PA. The screening of FEPs for the CRA-2019 PA is described in CRA--2019, Appendix SCR-2019. Although the screening process has not changed since the CRA-2014, the screening arguments for many FEPs have been updated and the screening decisions for four FEPs have changed.

- The natural FEP N26 *Density Effects on Groundwater Flow* and the human-induced FEP H36 *Borehole-Induced Geochemical Changes (for units other than the Culebra)* were formerly screened out due to low consequence and are now screened out due to beneficial consequence.
- The waste-induced FEP W52 *Radiolysis of Brine,* formerly screened out due to low consequence, is now screened in to undisturbed performance (UP) scenarios due to new analyses that demonstrate radiolysis of brine is no longer an insignificant contributor to overall gas generation.
- The waste-induced FEP W114 *Mechanical Degradation of Panel Closures,* formerly accounted for in UP scenarios, is now screened out due to low probability as a result of the use of run-of-mine salt instead of concrete in panel closures.

In addition, the future state assumption requirement in Section 25(a) was used by DOE to justify a change in the area over which boreholes are sampled to determine the frequencies of different borehole plugging patterns for PA. This change is further discussed in EPA's CARD 33.

Section 25(b) *Natural (hydrogeologic, geologic, and climate-related) FEPs and the future state assumption.*

The DOE addresses the requirements of Section 25(b) through the same FEP screening process as Section 25(a) but with a focus on natural features, events, and processes. As described in CRA-2019, Appendix SCR-2019 the screening arguments have changed for three natural FEPs: N2 *Brine Reservoirs*; N12 *Seismic Activity*; and N71 *Microbes* with reference to a new PA parameter, new data, and edits for clarity and updated references to experiments, respectively. The screening decision has changed for one natural FEP (N26 *Density Effects on Groundwater Flow*) as described above.

## EPA Evaluation

EPA believes that DOE's FEP screening is an appropriate process for evaluating future state assumptions as required in 40 CFR 194 Sections 25(a) and 25(b). EPA also supports DOE's continuing effort to update FEP screening arguments, incorporate current information relevant to those arguments, and change their conclusions as current information dictates. EPA agrees with

DOE's screening decision changes for natural, human and waste-induced FEPs as being timely and appropriate.

Of the 245 FEPs in DOE's proposed baseline for the CRA-2019 PA, 161 FEPs were unchanged from the CRA-2014 PA and 84 FEPs were updated with new information. EPA accepted DOE's screening classifications and arguments for 71 of the 84 changed FEPs, however, the Agency had residual concerns for the remaining 13. Additionally, EPA has questions concerning 10 FEPs that the Agency considers to have changed since 2014 but DOE had concluded "no change." EPA expects DOE to resolve these concerns in the Department's CRA-2024 FEP baseline review. EPA also recommends that a new FEP be added to the baseline to address a process that has been included in PA (brine consumption by radiolysis) which is related to FEP W52 (gas generation of brine by radiolysis) but the process does not appear to be addressed separately as a FEP. Details of EPA's review of future state assumptions as developed through the FEP screening process are presented in EPA's TSD *Review of Changes to WIPP Performance Assessment Features, Events, and Processes in the 2019 CRA* (Docket ID No. EPA-HQ-OAR-2019-0534).

Although EPA has identified residual concerns for the DOE to address, none of these concerns are likely to measurably affect current PA repository performance. The Agency continues to conclude that DOE's FEP baseline review is an appropriate process for evaluating future state assumptions as required in 40 CFR 194 Sections 25(a) and 25(b).

EPA did not receive any public comments on DOE's continued compliance with the scope of future state assumption requirements of Section 194.25.

**Compliance Decision**

Based on a review and evaluation of the 2019 CRA and supplemental information provided by the DOE (CRA-2019, Appendix SCR-2019), EPA determines that DOE continues to comply with the requirements for Section 194.25.

**Reference**

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191, Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix SCR-2019. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico. (CRA-2019)

# Section 26 Expert Judgment

## DOE Reported Changes

*26 Expert judgment, by an individual expert or panel of experts, may be used to support any compliance application.*

No changes to Section 26 were reported.

## EPA Evaluation

There are no changes to Section 26 nor did EPA receive any public comments.

## Compliance Decision

DOE continues to comply with the requirements for Section 26.

# Section 27 Peer Review

## DOE Reported Changes

Section 27(a) *Topics requiring peer review: conceptual models, waste characterization, engineered barriers.*

No changes.

Section 27(b) *Processes required for peer reviews*.

DOE has updated its protocol for implementing peer reviews to add clarification for items such as terminology and records keeping.

Section 27(c) *Documentation requirements for peer reviews*.

Same as 27(b).

## EPA Evaluation

No new peer reviews have been conducted since the CRA-2014, hence none were available for evaluation. The EPA reviewed the updated DOE Management Procedure MP 10.5 *Peer Review, Revision 9* (DOE 2016a and 2016b), and found it to continue to be compatible with NUREG–1297, *Peer Review for High-Level Nuclear Waste Repositories* (NRC 1988), as required in 40 CFR 194.27(b).

EPA did not receive any public comments on DOE's continued compliance with the scope of peer review requirements of Section 194.27.

## Compliance Decision

EPA determines that DOE continues to comply with the requirements for Section 194.27.

## References

DOE (U.S. Department of Energy) 2016a. CBFO Management Procedure: Peer Review (Revision 9). MP No. 10.5. Carlsbad, NM: Carlsbad Field Office.

DOE (U.S. Department of Energy) 2016b. Interim Change Notice #1 to CBFO MP 10.5, Revision 9, Peer Review. Memorandum, September 21, 2016. Carlsbad, NM: Carlsbad Field Office.

NRC (U.S. Nuclear Regulatory Commission) 1988. Peer Review for High-Level Nuclear Waste Repositories. NUREG-1297. Washington D.C.

# Section 31 Application of Release Limits

## DOE Reported Changes

31 *Release limits calculated using the total activity, in curies, that will exist in the disposal system at the time of disposal*.

The DOE continued to use the required methodology to demonstrate repository compliance in the CRA-2019. The principal changes since the CRA-2014 were an updated waste inventory and the migration of PA codes, including ORIGEN_S (used to perform decay calculations) and EPAUNI (used to perform EPA unit conversions) from the WIPP PA Alpha Cluster to the WIPP PA Solaris Cluster. The most significant inventory change was the addition of the SR-KAC-PuOx waste stream which significantly increased the projected total waste activity at repository closure.

## EPA Evaluation

Ten key radionuclides ($^{241}$Am, $^{244}$Cm, $^{137}$Cs, $^{238}$Pu, $^{239}$Pu, $^{240}$Pu, $^{241}$Pu, $^{90}$Sr, $^{233}$U, and $^{234}$U) account for 99.94% of the EPA units in the CRA-2019 waste inventory at the time of repository closure (Kicker 2019, p. 9). The individual contributions of these ten radionuclides to the total activity of TRU waste isotopes in the CRA-2014 and CRA-2019 waste inventories are shown in Table 31-1. The waste inventories are decayed using the ORIGEN-S code to 2033, the assumed closure date for the WIPP, and to various other dates up to 10,000 years to assess the effects of various intrusion times on disturbed repository performance scenarios. The total activity in the CRA-2019 inventory, decayed to 2033, is 5.66E+06 Curies as compared with 3.17E+06 Curies in the CRA-2014 inventory. The largest contribution to total activity in Curies in the CRA-2019 inventory at repository closure is from $^{241}$Pu, followed by its decay product, $^{241}$Am.

**Table 31-1. Total Activities of Dominant WIPP Waste Isotopes at Repository Closure and at 10,000 Years**

| Radio-nuclide | Half-life (y) | Activity at 0 Years | | | | Activity at 10,000 Years | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Ci | | EPA Units | | Ci | | EPA Units | |
| | | CRA14 | CRA19 | CRA14 | CRA19 | CRA14 | CRA19 | CRA14 | CRA19 |
| Am241 | 432.7 | 7.05E+05 | 1.14E+06 | 3.42E+03 | 3.46E+03 | 7.90E-02 | 1.31E-01 | 3.83E-04 | 3.97E-04 |
| Cm244 | 18.1 | 9.97E+03 | 3.94E+04 | - | - | 0.00E+00 | 0.00E+00 | - | - |
| Cs137 | 30.07 | 2.35E+05 | 2.51E+05 | 1.14E+02 | 7.60E+01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Pu238 | 87.7 | 6.01E+05 | 9.65E+05 | 2.92E+03 | 2.92E+03 | 2.97E-29 | 4.76E-29 | 1.44E-31 | 1.44E-31 |
| Pu239 | 24100 | 5.74E+05 | 8.74E+05 | 2.79E+03 | 2.65E+03 | 4.31E+05 | 6.56E+05 | 2.09E+03 | 1.99E+03 |
| Pu240 | 6560 | 1.75E+05 | 3.19E+05 | 8.51E+02 | 9.67E+02 | 6.07E+04 | 1.11E+05 | 2.95E+02 | 3.35E+02 |
| Pu241 | 14.29 | 6.63E+05 | 1.87E+06 | - | - | 0.00E+00 | 0.00E+00 | - | - |
| Sr90 | 28.8 | 2.09E+05 | 1.97E+05 | 1.01E+02 | 5.96E+01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| U233 | 159200 | 1.39E+02 | 1.27E+02 | 6.73E-01 | 3.85E-01 | 1.33E+02 | 1.22E+02 | 6.45E-01 | 3.69E-01 |
| U234 | 246000 | 2.42E+02 | 4.86E+02 | 1.18E+00 | 1.47E+00 | 4.45E+02 | 8.09E+02 | 2.16E+00 | 2.45E+00 |
| **Total:** | | 3.17E+06 | 5.66E+06 | 1.02E+04 | 1.01E+04 | 4.92E+05 | 7.67E+05 | 2.39E+03 | 2.32E+03 |

Source: Kicker 2019, Table 11; ERMS 571372.

The approach used by DOE to implement EPA's methodology for calculating cumulative releases is described in Kicker (2019, Section 3). In summary, releases in Curies are calculated as probabilistic uncertainties for each key radionuclide decayed to 2033, those releases are then normalized by dividing by the total activity of the repository TRU waste inventory expressed in millions of Curies, converted to EPA units, and the results are summed to determine total releases in EPA units. The total releases are then compared with the EPA's regulatory 10,000-year cumulative release limits of 1 EPA unit at a probability of exceedance of 1 in 10 and 10 EPA units at a probability of exceedance of 1 in 1,000. Table 31-1 shows that these release limits are only a small fraction of the total repository waste inventory in EPA units. The total CRA-2019 TRU waste inventory was 1.01E+04 EPA units decayed to 2033. This total was little changed from the total CRA-2014 inventory of l.02E+04 EPA units, also decayed to 2033, due to the normalizing effect of expressing the total inventory of individual radionuclides as a fraction of the total repository inventory.

The SR-KAC-PuOx waste stream consists primarily of plutonium oxides and is new since the CRA-2014 PA. The effect of this waste stream on the CRA-2019 WIPP inventory is evident in Figure 31-1, where 29% of the projected waste activity at repository closure is due to this stream (Kicker 2019, pp. 14-15). Waste inventory changes for the CRA-2019 are reviewed in CARD 24 and additional, detailed information is presented in EPA's Technical Support Document *Review*

*of the Baseline Waste Inventory Used in the CRA-2019 Performance Assessment* (Docket ID No. EPA-HQ-OAR-2019-0534).

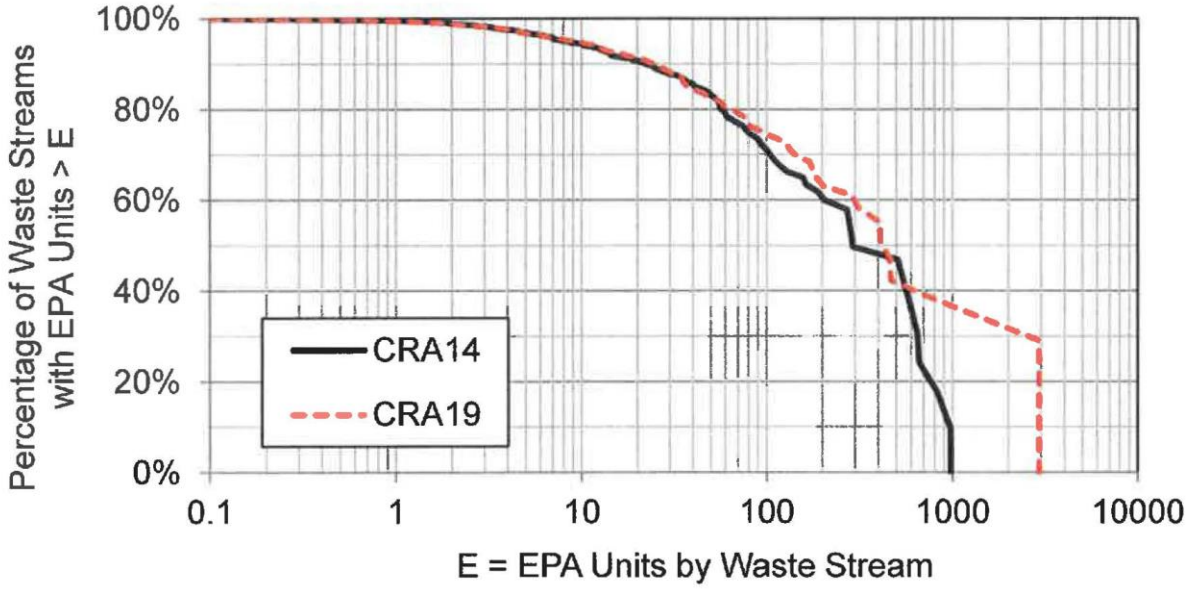


Figure 31-1. Cumulative WIPP repository total waste activity by waste stream decayed to year 2033 (from Kicker 2019, Figure 1).

ORIGEN-S Version 6 and EPAUNI Version 1.19 were used in the CRA-2019 PA. The EPA reviewed and approved the verification of and documentation for these codes in its CRA-2014 review. The EPA verified that the decay calculations performed by the ORIGEN-S code and used in EPAUNI were done correctly.

The ORIGEN_S and EPAUNI codes were migrated to the new WIPP PA Solaris Cluster at the same time as the other PA codes and the procedures used by the DOE to certify successful migration were applied to all codes. During the CRA-2019 review, EPA reviewed the hardware and code changes made during the code migration to the Solaris Cluster and found them to be appropriate. EPA also reviewed the DOE's comparative performance checks and found that the migration had not affected the decay and release calculation results. Descriptions of these performance checks are presented in EPA's CRA-2019 CARD 23 and in EPA's Technical Support Document *Review of Changes to WIPP Performance Assessment Computer Models and Codes in the CRA-2019 Performance Assessment* (Docket ID No. EPA-HQ-OAR-2019-0534).

In conclusion, migration of the ORIGEN_S and EPAUNI codes to the new WIPP PA Solaris Cluster was reviewed and the migrated codes were found to continue to correctly calculate radioactive decay and releases in EPA units. The DOE's application of release limits therefore remains appropriate and acceptable for use in WIPP PA.

EPA received no public comments on DOE's continued compliance with the application of release limit requirements of Section 194.31.

## Compliance Decision

Based on a review and evaluation of the CRA-2019, EPA determines that DOE continues to comply with the requirements for Section 194.31.

## References

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191 Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant. DOE/WIPP-19-3609, Rev. 0 Carlsbad Field Office, Carlsbad, New Mexico.

Kicker, D. 2019. Analysis Package for Inventory EPA Units in the 2019 Compliance Recertification Application Performance Assessment (CRA-2019 PA). Carlsbad, NM: Sandia National Laboratories. ERMS 571372.

# Section 32 Scope of Performance Assessments

## DOE Reported Changes

32(a) *FEPs baseline for PA, natural processes and events, mining, and drilling during the regulatory time frame*

DOE reviewed each of the 245 FEPs in the CRA-2014 baseline for continuing applicability to repository performance and found that no new FEPs needed to be added and no existing FEPs needed to be deleted. DOE updated the screening arguments for 84 out of the 245 FEPs with new information since the 2014 CRA. Four of the updated FEPs had their screening decisions changed: one changed from excluded to included; another changed from included to excluded; and two remained excluded but for different reasons. The screening arguments were updated mainly because of changes in the WIPP waste inventory, changes in panel closure designs, updated Delaware Basin monitoring data, the addition of a new shaft, and an updated colloidal source term.

32(b) *Effects of mining on hydraulic conductivity of hydrogeologic units of the disposal system*

No changes.

32(c) *Human-induced FEPs and time frames affecting the disposal system*

Human-induced activities that have occurred prior to disposal or are expected to occur soon after disposal are identified as HCN (Historic, Current, and Near-Future) in CRA-2019 Appendix SCR-2019, Table SCR-2. Although changes were made in the screening argument for FEP H36 Borehole-Induced Geochemical Changes, this FEP continued to be screened out and the screening argument change had no effect on PA.

32(d) *Low probability processes and events*

No screening classifications were changed for those FEPs that were eliminated from consideration in PA on the basis of low probability.

32(e) *FEPs screening.*

See summary for 32(a).

## EPA Evaluation

Detailed documentation of EPA's review of DOE's CRA-2019 FEP baseline is presented in EPA Technical Support Document (TSD) *Review of Changes to WIPP Performance Assessment Features, Events, and Processes in the 2019 CRA.* A summary of key findings follows.

EPA found that the changes made by DOE to the FEPs baseline since the CRA-2014 were necessary and appropriate. The most important changes made by DOE were those that affected

whether a FEP was either included or excluded from consideration in the scope of performance assessments (PA). FEP W114 *Mechanical Degradation of Panel Closures,* formerly accounted for in PA, was screened out due to low probability as a result of using native crushed salt instead of concrete as the sealing material in panel closures. This was appropriate because the crushed salt will consolidate and seal, and its functionality as a sealant will not degrade but will rather improve over time. Alternatively, FEP W52 *Radiolysis of Brine*, formerly screened out, was included in the CRA-2019 PA. This FEP was formerly excluded due to low consequence but is now included due to new analyses demonstrating that radiolysis of brine is no longer an insignificant contributor to overall gas generation because of changes in the projected waste inventory at repository closure. DOE's decision to include FEP W52 in the CRA-2019 PA was appropriate.

EPA found that although DOE's screening documentation adequately explained the rationale for including or excluding specific FEPs in the CRA-2019 PA, the Agency had residual concerns for 13 out of the 84 FEPs identified by DOE as changed for the CRA-2019 PA. In addition, five FEPs or groups of FEPs that were not considered by DOE to have changed were identified by EPA as meriting updated evaluations. The following four FEPs may require additional analysis and were identified by the Agency as deserving special attention from DOE when preparing the CRA-2024 PA.

**FEP N71 Microbes.** The role of microbes in facilitating radionuclide transport is a potentially important feature of the Culebra release pathway. The DOE conclusion that microbes are rapidly filtered out in the Culebra is inadequately supported and needs to be reevaluated for the CRA-2024 PA.

**FEP H26 Groundwater Extraction.** Recent pumping from a private well on the Mills Ranch affected groundwater flow in the Culebra in a manner that was not anticipated in the WIPP PA. The potential impact of this type of groundwater extraction on the Culebra release pathway needs to be reevaluated for the next PA.

**FEP H31 Natural Borehole Fluid Flow.** A new method for calculating borehole plugging frequencies introduced by DOE in the CRA-2019 PA has not been accepted by EPA. An EPA sensitivity study comparing the old and new methods is detailed in the TSD *Review of Borehole Drilling Rate and Plugging Pattern Frequency Calculations in the CRA-2019 Performance Assessment.* It demonstrated that releases for both remained below compliance limits. EPA expects DOE to revert to the previously-approved methodology for calculating plugging pattern probabilities in the CRA-2024 PA, or otherwise propose alternative methods that may be approved by EPA prior to that time.

**FEP W23 Subsidence.** DOE's assumption that the effects of subsidence due to repository excavations are intrinsically incorporated in the Culebra transmissivity fields is inadequately supported. Current screening arguments are based on the 1994 repository design that has subsequently been changed and additional changes are anticipated. EPA is unaware of any documentation describing how Culebra transmissivity fields based on geohydrologic field data have been modified to account for subsidence that has not yet occurred. EPA expects that the screening argument for this FEP will be reevaluated for the CRA-2024 PA.

Although none of the concerns identified by EPA were likely to individually have a significant enough impact on repository performance to exceed regulatory limits, EPA expects DOE to address and resolve these concerns in the Department's 2024 FEP review for all FEPs identified by the Agency as having residual concerns. In conclusion, EPA accepts SNL's updated FEP baseline as sufficient for determining the scope of the CRA-2019 PA and therefore satisfies the requirements of 40 CFR Section 194.32.

EPA did not receive any public comments on DOE's continued compliance with the scope of PA requirements of Section 194.32.

**Compliance Decision**

Based on the foregoing evaluation and review of CRA-2019 and supplemental documentation provided by DOE, EPA determines that DOE continues to comply with the scope of PA required in Section 194.32 but expects DOE to address and resolve the concerns raised by the Agency as part of the Department's 2024 FEP baseline review.

**Reference**

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191, Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix SCR-2019. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico. (CRA-2019)

# Section 33 Consideration of Drilling Events in Performance Assessment

## DOE Reported Changes

33(a) *Deep and shallow drilling that may potentially affect the disposal system*.

DOE updated the methodology used in the CRA-2019 PA for determining the probability of encountering pressurized brine (GLOBAL_PBRINE) (DOE 2019, Appendix PA-2019, Section PA-1.1.4).

33(b) *Likelihood and consequences of drilling events for inadvertent and intermittent intrusion in the Delaware Basin, and the frequency of deep and shallow drilling*.

DOE updated the deep drilling rate from $6.73 \times 10^{-3}$ boreholes/km$^2$ per year in the CRA-2014 PA to $9.90 \times 10^{-3}$ boreholes/km$^2$ per year (99 boreholes/km$^2$ over 10,000 years as reported by the Delaware Basin Monitoring Program) in the CRA-2019 PA (DOE 2019, Appendix PA-2019, Section PA-1.1.11). This change reflected increased drilling primarily by the oil and gas industry. DOE continued to screen out shallow drilling events as having no consequence in WIPP PA.

33(c) *Future drilling practices and technology consistent with current drilling practices in the Delaware Basin, and natural processes that will degrade or affect the capability to transmit fluids in boreholes*.

One consequence of deep drilling events is the plugging configuration or pattern used to plug and abandon a borehole when a well is permanently closed. DOE changed the methodology for calculating plugging pattern frequencies in the CRA-2019 (DOE 2019, Appendix PA-2019, Section PA-1.1.11).

33(d) *Effects of techniques used for resource recovery subsequent to drilling*. No changes.

## EPA Evaluation

33(a) Use of the updated methodology for determining the probability of encountering pressurized brine (GLOBAL_PBRINE) was mandated by EPA following its review of a revised methodology introduced by DOE in the CRA-2014 PA that was not found to be acceptable (Veal 2017). EPA finds the change to methodology used in the CRA-2019 acceptable.

33(b) DOE routinely updates the drilling rates in its CRAs using the assumptions and processes described in this section. DOE's analyses are based on data collected within the entire Texas and New Mexico parts of the Delaware Basin and published in the DOE's *Delaware Basin Monitoring Annual Reports* (see, for example, DOE 2018). This overall approach was approved by EPA and used to date for all recertifications including CRA-2019.

However, in reviewing the drilling rate calculations, EPA found that DOE's longstanding practice to assume that all wells with unknown depths due to incomplete documentation at the

time of reporting as shallow rather than deep has led to an additional lag in PA calculations estimated at 1-2 years over the past decade due to a significant resurgence in oil and gas drilling. While the deep drilling will get fully captured within a few years, this approach underestimates current deep drilling rates, and overestimates shallow drilling rates, thus impacting repository releases in PA and WIPP performance because deep wells are a direct input parameter. EPA examined the impact of this practice by using an alternative methodology for categorizing boreholes of unknown depth at the time of reporting that assigns them as shallow or deep in the same ratio as the total number of known shallow and deep boreholes in the basin and incorporating this methodology into an EPA-run sensitivity study. Using EPA's alternative methodology, the deep drilling rate was recalculated as $10.91 \times 10^{-3}$ boreholes/km$^2$ per year and it contributed to a small but noticeable increase in PA releases, although they were still well within EPA release limits. EPA accepts DOE's drilling rate for CRA-2019 but requests that DOE reconsider its drilling rate methodology for CRA-2024 to better address the lag time between drilling of boreholes and its capture in the PA. Given the high amount of drilling activity over recent years, the drilling rate increase was higher than for previous recertifications, creating a larger discrepancy between the actual drilling rate if complete information was immediately available and what is reported periodically. Additional discussion of this practice is presented in EPA's TSD *Review of Borehole Drilling Rate and Plugging Pattern Frequency Calculations in the CRA-2019 Performance Assessment* (Docket ID No. EPA-HQ-OAR-2019-0534).

33(c) DOE routinely updates the borehole plugging pattern frequencies in its CRAs using the assumptions and processes described in this section. DOE's analyses have been based on wells abandoned since 1988 within the New Mexico portion of the Delaware Basin. However, in the CRA-2019 PA, DOE reduced the area over which the frequencies of different plugging patterns were calculated, from the entire New Mexico portion of the Delaware Basin to a subset of that area called the Known Potash Leasing Area (KPLA) (DOE 2018). The KPLA is a special use area where borehole plugging practices are restricted to protect potash reserves (OCD 1988). This change significantly decreased calculated repository releases because of the more stringent requirement for continuous plugs within the KPLA that would preclude fluid flow into and out of the repository. Specifically, the probability of solid, continuous cement plugs (Type VI) being installed through the salt section jumped from 4% in CRA-2014 to 40% in CRA-2019.

The plugging and abandonment of wells in the KPLA is controlled by New Mexico's Oil Conservation Division (OCD) Order R-111-P (OCD 1988). This order gives the OCD District Supervisor discretionary authority to waive the continuous plug requirement in barren areas within the KPLA where economic grade potash ore is absent. This authority appears to be frequently exercised because field data collected by DOE shows that, as of 2018, 60% of plugged and abandoned boreholes within the KPLA were not installed with continuous cement plugs and instead used other plugging configurations more typical of outside the KPLA (DOE 2018). These were the numbers used in CRA-2019 that had the probability of the Type VI, continuous plugs for future boreholes at 40% in PA.

DOE has shown that the WIPP is in such a barren area because economic grade potash ore is not present (DOE 1996, Appendix MASS, Attachment MASS 15-5). Current practice within the KPLA therefore indicates that continuous plugs would likely not be required for future abandoned boreholes at the WIPP. In such a situation the same BLM/State plugging

requirements would, by default, apply to the WIPP site as are applied to the rest of the Delaware Basin in New Mexico. This conclusion further supports the appropriateness of the original DOE proposal to base plugging frequency calculations over a broader area that included all plugged and abandoned boreholes within the entire New Mexico portion of the Delaware Basin.

An additional concern is that the part of the KPLA considered in DOE's new approach is a small subset of the larger New Mexico part of the Delaware Basin and provides less representative samples of plugging practices. This concern applies to both the reduced geographical area and the reduced sample size of the KPLA. The WIPP site is at the far eastern edge of the KPLA and restricting the sample to the area of the KPLA does not include plugged and abandoned wells that are within the Delaware Basin and adjacent to the WIPP LWA but just outside the KPLA. Such wells are clearly relevant geologic analogs for evaluating future plugging practices at the WIPP site and were included in the historic approach that considered all wells in the New Mexico part of the basin.

In view of the foregoing concerns with DOE's drilling rate calculations and KPLA-based plugging proposal, EPA found that the approach used by DOE in calculating the deep drilling rate should be reevaluated for use in WIPP PA. EPA concludes that the basis for DOE's change in the plugging pattern probabilities is not adequately justified in consideration of both the regulatory requirements and actual practices in the area surrounding WIPP, as reflected in the data provided. Therefore, EPA expects DOE to utilize the prior approved methodology for the next recertification or propose a new methodology that could be approved by EPA beforehand. An EPA sensitivity study using the older methodology with CRA-2019 data demonstrated releases in PA are still below regulatory limits, and this plus additional discussion of the Agency's review are presented in EPA's TSD *Review of Borehole Drilling Rate and Plugging Pattern Frequency Calculations in the CRA-2019 Performance Assessment* (Docket ID No. EPA-HQ-OAR-2019-0534).

33(d) EPA concludes that the requirements of Section 33(d) continue to be met.

EPA did not receive any public comments on DOE's continued compliance with the scope of compliance assessments requirements of Section 194.33.

**Compliance Decision**

Based on a review and evaluation of the CRA-2019 and supplemental information provided by DOE (DOE 2019, Appendix PA-2019), EPA determines the following.

- DOE continues to comply with the requirements of Section 194.33(a).
- DOE continues to adhere to the general assumptions and processes described in Section 194.33(b) for updating drilling rates and therefore continues to meet the requirements of this section. EPA accepts DOE's drilling rate for CRA-2019 but requests that DOE reconsider its drilling rate methodology for CRA-2024 to better address the lag time between the drilling of boreholes and their capture in the PA, especially as drilling activity remains high in the Delaware Basin.
- DOE continues to adhere to the general assumptions and processes described in Section 194.33(c) for calculating plugging pattern frequencies and therefore continues to meet the

requirements of this section. However, EPA concludes that the basis for DOE's change in the plugging pattern probabilities is not adequately justified in consideration of both the regulatory requirements and actual practices in the area surrounding WIPP, as reflected in the data provided. Therefore, EPA expects DOE to utilize the prior approved methodology for the next recertification or propose a new methodology that could be approved by EPA beforehand.

- DOE continues to comply with the requirements of Section 194.33(d).

**References**

DOE (U.S. Department of Energy). 1996 Title 40 CFR Part 191 Compliance Certification Application (October) Appendix MASS. Carlsbad, NM: Carlsbad Field Office. DOE/CAO

DOE (U.S. Department of Energy) 2018. Delaware Basin Monitoring Annual Report. Carlsbad, NM: DOE/WIPP-18-2308 Rev. 1. Carlsbad Field Office, Carlsbad, New Mexico. September.

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191, Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix PA-2019. Carlsbad Field Office, Carlsbad, New Mexico.

OCD (New Mexico Oil Conservation Division, Energy, Minerals, and Natural Resources Department) 1988. Potash Areas of Eddy and Lea Counties, New Mexico. Order R-111-P, Case 9316, April 21, 1988. Santa Fe, New Mexico.

Veal, Lee 2017. Letter from Lee Veal (EPA) to Todd Shrader (DOE). U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, D.C. December 4.

# Section 34 Results of Performance Assessments

**DOE Reported Changes**

34(a) *The results of performance assessments shall be assembled into "complementary, cumulative distribution functions" (CCDFs) that represent the probability of exceeding various levels of cumulative release caused by all significant processes and events.*

No changes. DOE developed CCDFs for the 2019 Compliance Recertification Application using the same process and CCDF computational technique as in the CCA and previous CRAs. Only the values represented by the CCDFs changed, reflecting parameter updates, error corrections, and code improvements made since the 2014 CRA (Zeitler et al. 2019).

34(b) *Probability distributions for uncertain disposal system parameter values used in performance assessments shall be developed and documented*

268 parameter values and probability distributions were changed or added in the 2019 CRA. Probability distributions for uncertain parameter values are discussed in Zeitler (2019). Most of these changes were related to inventory, the panel closure redesign and solubility changes, but some were related to modeling assumption changes (see 2019 CRA CARD 23, 2019 CRA Appendix PA, and Kim and Feng 2019).

34(c) *Computational techniques, which draw random samples from across the entire range of the probability distributions developed pursuant to paragraph (b) of this section, shall be used in generating CCDFs and documented.*

No changes. DOE continued to use the Latin Hypercube Sample (LHS) methodology for sampling uncertain parameters for the 2019 CRA PA (Appendix PA, Sections 2.2.4 and 5; Kim and Feng 2019, Section 3 and App. A). There is no change in the methodology for the 2019 CRA.

34(d) *The number of CCDFs generated shall be large enough such that, at cumulative releases of 1 and 10, the maximum CCDF generated exceeds the 99th percentile of the population of CCDFs with at least a 0.95 probability. Values of cumulative release shall be calculated according to Note 6 of Table 1, appendix A of part 191 of this chapter.*

No changes. DOE continued to generate 300 CCDFs in three sets (replicates) of 100 for the 2019 CRA PA (Appendix PA, Sections 2.1.3 and 2.2.4). There is no change in the methodology for the 2019 CRA.

34(e) *Display the full range of CCDFs generated.*

No changes. There were no changes to the approach used by DOE in the CRA-2019 PA. The full range of CCDFs generated by DOE for the CRA-2019 PA can be found in Appendix PA, Section PA-9.5.

34(f) *Demonstrate at least a 95 percent level of statistical confidence that the mean of the population of CCDFs meets the containment requirements of § 191.13.*

No changes. In the 2019 CRA DOE used the same general approach to calculate the statistical confidence for release limits as used in the CCA and previous CRAs (Appendix PA, Section PA-9.5). The results of the CRA-2019 PA reflect database updates and changes in the models used to calculate those results. Figure 34-1 shows that the results of the CRA-2019 PA are substantially different from the results of the CRA-2014 PA. These differences are due to the cumulative effects of 16 key changes to the computational processes in the CRA-2019 PA. These changes are summarized in CRA-2019 Appendix PA, Section PA-1.1.

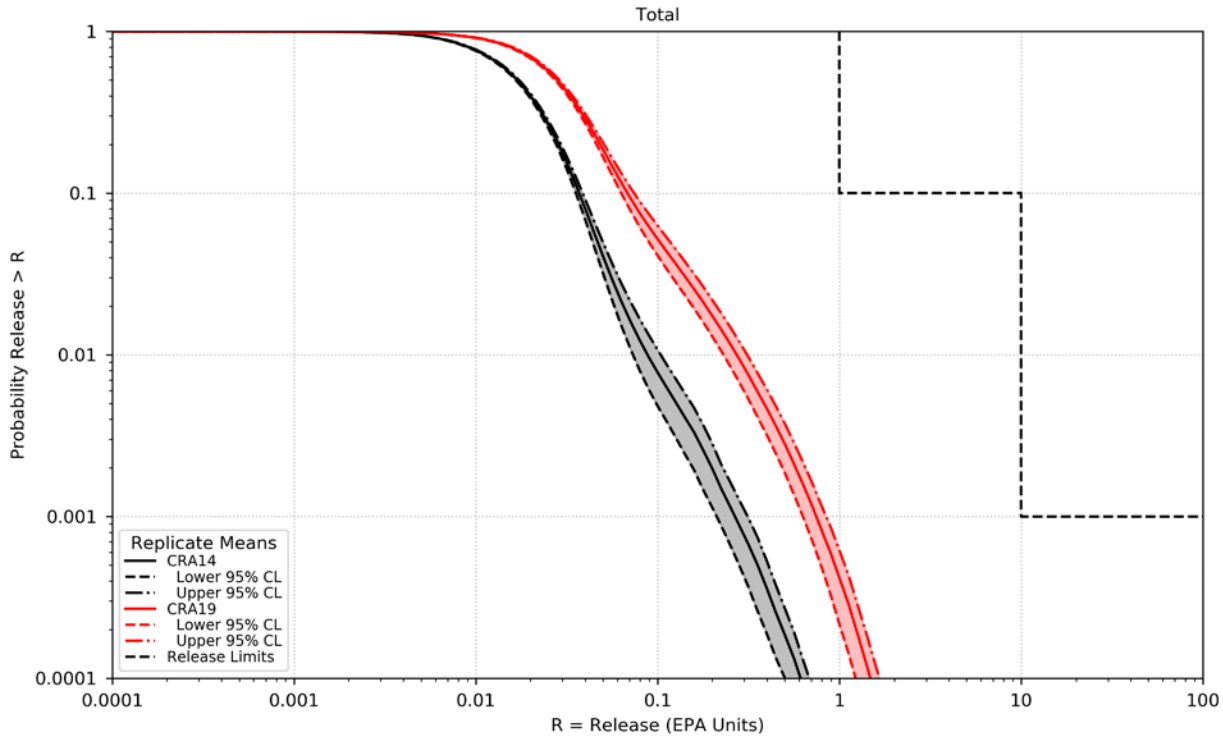


Figure 34-1. Overall mean CCDFs for total normalized releases with confidence limits for CRA-2014 and CRA-2019 (from DOE 2019, Appendix PA, Figure PA-73).

**EPA Evaluation**

34(a) DOE continued to use selected computer codes and input parameters to generate estimates of radionuclides for a large number of release scenarios (see EPA Technical Support Document *Overview of EPA Review of U.S. Department of Energy 2019 WIPP Compliance Recertification Application Performance Assessment*, Docket ID No. EPA-HQ-OAR-2019-0534). DOE has displayed the PA results as CCDFs (DOE 2019, Appendix PA, Figure PA-73) in accordance with this section. In total, 300 CCDFs (100 for each of the three replicates) were constructed and presented in the 2019 CRA PA (2019 CRA, Appendix PA). Normalized release results for ten thousand future simulations were again used to calculate each of the 300 CCDF curves. In

addition, DOE provided CCDFs for individual pathways and by replicate in Appendix PA. Figure 34-1 presents the overall mean CCDFs for total normalized releases. This figure shows that the EPA release limits have been met within the prescribed confidence bounds. EPA's analysis concluded that DOE adequately presented the PA results in CCDFs, which show the probability of exceeding various levels of cumulative releases. Based on a review and evaluation of the 2019 CRA and supplemental information provided by DOE, EPA determined that DOE continues to comply with the requirements for Section 194.34(a) for 2019 CRA.

34(b) EPA's evaluations of the 16 database and model changes made in the CRA-2019 PA are summarized along with descriptions of the changes in Section 2.0 of the Agency's Overview Technical Support Document (TSD). Half of the 16 changes were made at the request of EPA and the other half were made by DOE. Upon review, EPA had residual technical and regulatory concerns concerning five of the changes that are explained in greater detail in Section 2.0 of the Overview TSD. In addition to the changes in the CRA-2019 PA identified by DOE and listed in the Overview TSD Section 2.0, EPA has identified additional residual concerns that DOE did not address such as the likelihood that plutonium concentrations in WIPP brines will be controlled exclusively by the solubility of Pu(III) solids in equilibrium with dissolved Pu(III) in repository brine. Key additional concerns are summarized in EPA's Overview TSD and references to supporting TSDs. EPA reviewed DOE's parameter selection and probability distributions, and the Agency found that DOE continued to adequately document the probability distributions and discuss the data from which it was generated and the method by which the probability distribution of each of the sampled variables was created. Based on a review and evaluation of the 2019 CRA and supplemental information provided by DOE, EPA determined that DOE continues to comply with the requirements for Section 194.34(b) for the 2019 CRA.

34(c) EPA determined in the CCA and previous CRAs that the LHS sampling method ensures that parameter values will be selected from the entire range of the probability distributions because LHS stratifies the probability distributions into a number (100, in this case) of equal-probability regions and then samples one value from each region. EPA notes that LHS sampling continues to be appropriate for generating random samples in the CRA-2019 PA (Appendix PA, Section PA-6.4). Based on a review and evaluation of the 2019 CRA and supplemental information provided by DOE, EPA determined that DOE continues to comply with the requirements for Section 194.34(c) for 2019 CRA.

34(d) DOE generated three sets of 100 CCDFs each and discussed the statistical confidence levels for the set of CCDFs (Appendix PA, Sections 2.1.3 and 2.2.4). Based on the analysis in the 2019 CRA and the fact that DOE used the same approach in the 2019 CRA as in the CCA and previous CRA PAs, EPA concurs with DOE's 2019 CRA analyses. EPA determined that DOE continues to comply with the requirements for Section 194.34(d) for 2019 CRA.

34(e) DOE presented and discussed the results of the performance assessment analysis in the 2019 CRA Appendix PA, Figures PA-69 to PA-71. Based on a review and evaluation of the 2019 CRA and supplemental information provided by DOE and the fact that DOE included the full range of CCDFs as required by this section, EPA determined that DOE continues to comply with the requirements for Section 194.34(e) for 2019 CRA.

34(f) DOE shows the overall mean of the total normalized releases for the 300 CCDFs, along with the 95% confidence levels about the overall mean for the total normalized releases of the 2019 PA in Figure 34-1. EPA verified that there is at least a 95 percent level of statistical confidence that the mean of the population of CCDFs meets the containment requirements of 40 CFR 191.13. EPA determined that DOE continues to comply with the requirements for Section 194.34(f) for 2019 CRA.

**Compliance Decision**

Based on a review of the 2019 CRA and supplemental information provided by DOE, EPA is not in agreement with some of the changes made to the database and models in the CRA-2019 PA. EPA's concerns with those changes are identified and addressed in the foregoing evaluation and the Agency's Overview TSD Section 2.0. However, based on the foregoing evaluation, EPA's analyses of the concerned parameters, and EPA's sensitivity study, the EPA determined that DOE continues to comply with the requirements of Section 194.34.

EPA did not receive any public comments on DOE's continued compliance with the scope of requirements for results of performance assessments in Section 194.34.

**References**

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Papenguth, H.W. 1996. *Parameter Record Package for Colloidal Actinide Source Term Parameters. Mobile-Colloidal-Actinide Source Term. 4. Microbes.* Memorandum to C.T. Stockman, Sandia National Laboratories, Albuquerque, New Mexico, May 7, 1996, ERMS 235856.

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Zeitler, T.R., J. Bethune, S. Brunell, B. Day, D. Kicker, J. Long, and R. Sarathi, 2019. Summary Report for the 2019 Compliance Recertification Application Performance Assessment (CRA-2019 PA). Carlsbad, NM: Sandia National Laboratories. ERMS 571376.

# Section 41 Active Institutional Controls

## DOE Reported Changes

41(a) *Descriptions of proposed active institutional controls*.

No changes.

41(b) *100-year maximum period of active institutional control*.

No changes.

## EPA Evaluation

Based on EPA's review of the activities and conditions in and around the WIPP site, EPA did not identify any significant changes in the planning and execution of the DOE's active institutional controls (AICs) plan since the 1998 Certification Decision.

The CRA-2019 adequately describes the proposed AICs and their location and function, and identifies the basis for their assumed effectiveness. EPA confirms that DOE's CRA-2019 performance assessment uses the maximum allowable credit for AICs against human intrusion (100 years). EPA continues to find reasonable DOE's assertion that AICs will completely prevent human intrusion for 100 years.

EPA did not receive any public comments on DOE's continued compliance with the AICs requirements of Section 194.41.

## Compliance Decision

EPA's CRA-2014 acceptance of DOE's proposed active institutional controls remains unchanged for CRA-2019.

## References

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191, Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Section 41. DOE/WIPP-19-3609, Rev. 0, Carlsbad Field Office, Carlsbad, New Mexico.

# Section 42 Monitoring

## DOE Reported Changes

42(a) *DOE shall conduct an analysis of the effects of disposal system parameters on the containment of waste in the disposal system and shall include the results of such analysis in any compliance application.*

DOE has committed to monitoring ten parameters addressed in this section: two human activity related (drilling rate and probability of encountering a brine reservoir), two hydrology related (changes in groundwater flow and change in groundwater composition), five geotechnical related (subsidence, creep closure, extent of deformation, initiation of brittle deformation, and displacement of deformation features), and one waste activity related.

The two accidents in February 2014 resulted in interrupted routine geotechnical monitoring between February 2014 to January 2017. Because of the February 2014 incident, there was also a gap in underground maintenance, resulting in several roof falls in 2015 and 2016, most notably in in Panel 7, Room 4 (DOE 2016, Reedlunn and Bean 2019). DOE decided to abandon Panel 9 due to the limited maintenance in the area as it was deemed a hazard to WIPP workers (Shrader 2017). WIPP's geotechnical monitoring program demonstrated to EPA during a November 2016 inspection that the team's geotechnical monitoring allowed them to predict the roof falls and to provide DOE with the information the Department needed to preemptively take action (EPA-HQ-OAR-2001-0012-0469).

For human activity, DOE notes an increased deep drilling rate of 99 boreholes/km$^2$ and no new Castile brine encounters have been reported since CRA-2014. Waste activity has also increased due to the restart of shipments, but falls below trigger values (DOE 2018, Wagner and Hayes 2018). Hydrological programs report that groundwater composition remains stable and that Culebra groundwater flow velocities remain within the range that they are modeled in the PA, although there is an increase in flow velocity that has been attributed to pumping by the Mills Ranch private well. DOE decided that overall, these do not result in changes significant enough to reassess monitoring programs or PA-related parameters, conceptual models, or FEPs decisions.

DOE has reassessed what monitoring parameters should be included or updated in the monitoring program (termed the MONPAR analysis, Wagner 2018). In addition to using monitoring results discussed above, DOE also examines experimental activities, WIPP operational changes, changes to activities and conditions from the EPA, and performance assessment changes. Wagner (2018) documents most of the MONPAR analysis, and Sosson (2020) supplements that analysis with the effects of PA changes on the MONPAR analysis. These documents determine that the MONPAR analysis that has occurred since CRA-2014 remain valid.

42(b) *Documentation and substantiation of decisions to monitor a particular disposal system parameter*.

No changes.

42(c) *Pre-closure monitoring*.

No changes.

42(d) *Post-closure monitoring*.

No changes.

42(e) *Pre-closure and post-closure monitoring plans for monitoring the performance of the disposal system*.

No changes.

**EPA Evaluation**

42(a) EPA reviewed CRA-2019 Section 42, CRA-2019 Appendix DATA-2019, CRA-2019 Appendix MON-2019, Wagner and Hayes (2018), Wagner (2018), Sosson (2020) and other monitored parameter related documents and find that the documentation adequately address all aspects of Section 42.

EPA has also inspected DOE's parameter monitoring program semi-annually since the 2014 CRA (See Table 42-1 for a summary of these inspections). The inspections continue to verify that DOE's process and monitoring programs are adequate. The Agency found DOE's parameter monitoring program and the response to changes in parameters to be adequate. Monitoring inspection reports can be obtained from Docket A-98-49, Category II-B3.

| Date of Parameter Monitoring Inspection | Inspection Results: [See Inspection Reports for Details] |
|---|---|
| November 7 to 9, 2016 | EPA concludes that the monitoring program covers the ten monitoring parameters required by EPA's 1998 Certification Decision. Monitoring sample collection, and sample/data analysis procedures were complete and appropriate; staff were adequately trained and implemented the procedures adequately; and appropriate quality assurance measures are applied. DOE has maintained adequate parameter monitoring during the past year and has the procedures and requirements in place to sustain their program into the next year. See EPA-HQ-OAR-2001-0012-0469 for more details. |
| October 24 to 26, 2017 | EPA concludes that the monitoring program covers the 10 monitoring parameters required by EPA's 1998 Certification Decision. Sample collection and sample/data analysis procedures were complete and appropriate, staff were adequately trained and implemented the procedures adequately, and appropriate quality assurance measures are applied. EPA continues to find that DOE has maintained adequate parameter monitoring during the past year and has the procedures and requirements in place to sustain the program into the next year. See EPA-HQ-OAR-2001-0012-0477 for more details. |

| Date of Parameter Monitoring Inspection | Inspection Results: [See Inspection Reports for Details] |
|---|---|
| May 14 to 16, 2019 | EPA concludes that the monitoring program covers the ten monitoring parameters required by the Agency's 1998 Certification Decision. Sample collection and sample/data analysis procedures were complete and appropriate, staff were adequately trained and implemented the procedures adequately, and quality assurance measures were applied. The EPA continues to find that the DOE has maintained adequate parameter monitoring during the past year and has the procedures and requirements in place to sustain the program into the next year. See EPA-HQ-OAR-2001-0012-0487 for more details. |

42(b) to 42(e) No updates, so the previous determination of compliance for CRA-2014 remains.

## Compliance Decision

Based on a review of the information in the 2019 CRA, supplemental information provided in Sosson (2020), and EPA's annual inspections of the WIPP monitoring program, EPA determines that DOE continues to comply with the requirements of Section 194.42.

## References

Reedlunn, B. and Bean, J. 2019. Simulations of Pipe Overpack Container Compaction at the Waste Isolation Pilot Plant. October 2019, Carlsbad, NM. SAND2019-1211.

Shrader, T. 2017. *Installation of Ventilation Barriers and Prohibiting Personnel Access to Equivalent Panel 9 Area.* Letter to Allen Perrin, Acting Director, Radiation Protection Division, U.S. Environmental Protection Agency Office of Radiation and Indoor Air, Washington, DC, April 18, 2017.

Sosson, G. 2020. *Response 2 US Environmental Protection Agency's 2019 Compliance Recertification Application Completeness Comments Letter Dated March 23, 2020 from Tom Peake to Mike Brown.* Letter to Ms. Lee Ann B. Veal, Director, Radiation Protection Division, U.S. Environmental Protection Agency Office of Radiation and Indoor Air, Washington, DC, July 8, 2020.

U.S. DOE. 2016. WIPP UPDATE: October 14, 2016, Plans Call for Controlled Withdrawal from South End of Underground.

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

Wagner, S. and A. Hayes. 2018. Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2017. January 2018, Carlsbad, NM. WBS 4.3.1. ERMS 569255.

Wagner, S.W. 2018. Reassessment of MONPAR Analysis for Use in the 2019 Compliance Recertification Application. Carlsbad, NM: Sandia National Laboratories. ERMS 569616.

# Section 43 Passive Institutional Controls

## DOE Reported Changes

43(a) *Descriptions of proposed passive institutional controls.*

No changes.

43(b) *Period of time passive institutional controls are expected to endure.*

No changes.

43(c) *Justification of credit for passive institutional controls.*

No changes.

## EPA Evaluation

43(a) to 43(c) There are no updates to this section, so the previous determination of compliance for CRA-2014 remains.

EPA did not receive any public comments on DOE's continued compliance with the scope of passive institutional controls requirements of Section 194.33.

## Compliance Decision

Based on a review and evaluation of the 2019 CRA and the lack of changes from CRA-2014, EPA's acceptance of DOE's proposed passive institutional controls remains unchanged for 2019 and DOE continues to comply with the requirements for Section 194.43. However, EPA anticipates an update to this section in the future pending the outcome and incorporation of the Nuclear Energy Agency's Preservation of Records, Knowledge and Memory (RK&M) across Generations (NEA 2020), an international initiative on the topic of passive institutional controls that was completed in 2019 and made available in 2020. This commitment is according to DOE's extension request for the Passive Institutional Controls Program Schedule (Moody 2010), and previously discussed in CRA-2014 and EPA's corresponding CARD 43 (EPA 2017).

## References

Moody, D.C. 2010. Letter to Mr. Mike Flynn (Subject: Request for Extension in the Passive Institutional Controls Program Schedule). 28 July 2010. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

NEA (2020), Preservation of Records, Knowledge and Memory (RK&M) Across Generations: Final Report of the RK&M Initiative, Radioactive Waste Management, OECD Publishing, Paris. https://doi.org/10.1787/50292bbb-en.

U.S. Department of Energy (DOE) 2019. Title 40 CFR Part 191, Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Section 43. Carlsbad Field Office, Carlsbad, New Mexico.

U.S. Department of Energy (DOE). 2014. Title 40 CFR Part 191 Subparts B and C. Compliance Recertification Application for the Waste Isolation Pilot Plant, Section 43 (March). Carlsbad Field Office, Carlsbad, NM. DOE/WIPP 2014-3503.

U.S. Environmental Protection Agency (EPA). 2017. Recertification CARD No. 43: Passive Institutional Controls. Compliance Application Review Documents for the Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR 191 Disposal Regulations. Washington, DC: Office of Radiation and Indoor Air. EPA Docket FDMS Docket ID No. EPA-HQ-OAR-2014-0609-0060.

# Section 44 Engineered Barriers

## DOE Reported Changes

44(a) *Disposal systems shall incorporate engineered barriers.* No changes.

44(b) *Evaluation of engineered barriers*.

Information relating to the emplacement of magnesium oxide (MgO), hydration tests and related experimental studies that have occurred since the CRA-2014 are found in Appendix MgO-2019.

44(c) *Considerations in evaluating engineered barriers*. No changes.

44(d) *Effect of barrier on existing or soon-to-be-generated waste*. No changes.

44~~(e)~~ *Evaluation of barriers alone or in combination*. No changes.

## EPA Evaluation

44(a) and 44(c) to 44(e) There are no updates to these subsections, so the previous evaluations of compliance are unchanged. See DOE (2019, Section 44).

44(b) From 2013 to February 2014 when the WIPP was shut down as a result of the radiological incident and underground truck fire (*see* 82 FR 33106, July 19, 2017), 73 reactivity tests on MgO were conducted, resulting in an average reactivity of 96.2 mol %. This average reactivity meets the EPA's requirement of 96 mol %.

MgO shipments resumed in January 2016. From January 2016 to December 2017, 39 reactivity tests were completed, with an average reactivity of 96.0 mol %. This average reactivity meets the EPA's requirement of 96 mol %.

## Compliance Decision

Based on EPA's continued review of the activities and conditions in and around the WIPP site, EPA did not identify any significant changes in the requirement for engineered barriers. The CRA-2019 documentation accurately reflects the 1998 Certification and previous recertification decisions' conclusion that MgO is the only engineered barrier that meets EPA's requirements (EPA 2017).

Based on a review and evaluation of the CRA-2019 documentation, EPA determines that DOE continues to comply with the requirements for Section 194.44.

## References

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191, Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Section 44. Carlsbad Field Office, Carlsbad, New Mexico.

U.S. Environmental Protection Agency (EPA). 2017. Recertification CARD No. 44: Engineered Barriers. Compliance Application Review Documents for the Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR 191 Disposal Regulations. Washington, DC: Office of Radiation and Indoor Air. EPA Docket FDMS Docket ID No. EPA-HQ-OAR-2014-0609-0065.

# Section 45 Consideration of the Presence of Resources

## DOE Reported Changes

45 *Information that demonstrates that the favorable characteristics of the disposal system compensate for the presence of resources in the vicinity of the disposal system and the likelihood of it being disturbed as a result. If performance assessments predict that the disposal system meets the containment requirements of § 191.13, the Agency will assume that the requirements of this section and § 191.14(e) have been fulfilled.*

Several changes were incorporated into CRA-2019 Section 45 (Consideration of the Presence of Resources). Much of the information for Section 45 is derived from various WIPP monitoring programs and the Features, Events, and Processes (FEPs) screening. Most of these changes do not significantly affect Performance Assessment (PA) calculations but serve to incorporate the most recent information available related to resource exploitation in the vicinity of the WIPP site, including oil and gas and potash mining. However, changes to borehole drilling rates, borehole plugging pattern probabilities, and the GLOBAL:PBRINE parameter do have direct impacts on PA calculations. The following table summarizes FEPs changes related to the presence of resources:

| FEP Number and Name | DOE Reported Change |
|---|---|
| N2 Brine Reservoirs | Updated by referencing new PA parameter GLOBAL:PBRINE |
| H1 Oil and Gas Exploration | Updated with new drilling rate |
| H4 Oil and Gas Exploitation | Updated with new drilling rate |
| H3 Water Resources Exploration | Updated with most recent monitoring information |
| H5 Groundwater Exploitation | Updated with most recent monitoring information |
| H23 Blowouts | Updated with new parameter GLOBAL:PBRINE |
| H28 Enhanced Oil and Gas Production - OB | Updated per EPA comment regarding enhanced oil and gas production techniques in the Delaware Basin |
| H31 Natural Borehole Fluid Flow | Updated to reflect BRAGFLO corrections for open borehole parameters and to reflect new plugging probabilities. |
| H32 Waste-Induced Borehole Flow | Updated to reflect new plugging probabilities |
| H58 Solution Mining for Potash | Updated with information regarding solution mining activities in the region per EPA comment. |
| H59 Solution Mining for Other Resources | Updated with new information regarding brine wells in the region |
| W40 Brine Inflow | Updated to reflect new parameter distribution for PBRINE, and elimination of panel closures in south end of repository. |
| W42 Fluid Flow Due to Gas Production | Updated to reflect new parameter distribution for PBRINE and the removal of two sulfidation reactions refinement of the hydromagnesite conversion process. |

## EPA Evaluation

EPA reviewed the activities and conditions in and around the WIPP site based primarily on the documentation included with DOE's recertification application, plus comments and DOE's responses to EPA's completeness review. For example, noting that the map of potash mine areas in the 2018 Delaware Basin Monitoring Annual Report (DBMAR) (DOE 2018) was outdated from 2007, EPA requested an updated map as part of its completeness review (EPA

Completeness Comment CC4-MON-2). EPA did not identify any significant changes related to the presence of resources since CRA-2014 beyond those identified by DOE.

For CRA-2019, DOE incorporated a new parameter GLOBAL:PBRINE in accordance with EPA direction (EPA 2017). This parameter is for the probability of encountering a Castile Brine Reservoir beneath WIPP that would increase brine within the repository, leading to increased Direct Brine Releases. A detailed evaluation and discussion of this and the remainder of the FEPs in the table above may be found in the FEPs TSD *Review of Changes to WIPP Performance Assessment Features, Events, and Processes in the 2019 CRA* (Docket ID No. EPA-HQ-OAR-2019-0534).

For the CRA-2019 Deferred Performance Assessment (DPA), DOE used a deep borehole drilling rate of 99.0 boreholes per $km^2$ over 10,000 years based on numbers reported in the 2018 DBMAR. This is a significant increase from the rate of 67.3 boreholes/$km^2$/10,000 years used in the CRA-2014 PA and reflects high oil and gas activity in the region. However, it is the continuation of a longer trend that has been documented since the 1996 WIPP CCA and through all subsequent recertifications. During the recertification review, EPA noted that a significant number of boreholes in the Delaware Basin Drilling Surveillance Program (DBDSP) lacked depth information at the time of reporting in recent years, for example over 3000 in 2017 and 2018. DOE's current approach categorizes boreholes without complete records available at the time of reporting as "drilling or waiting on paperwork" and automatically categorizes boreholes lacking depth information as shallow, which means they are excluded from PA calculations at the time of reporting. As complete information becomes available, the boreholes are then properly categorized in the DBDSP database according to their actual depth. EPA explored this issue using an alternative methodology assuming that unknown depth boreholes would follow the historic ratio of deep to shallow and found DOE's method effectively creates an additional 1–2-year lag in PA calculations, especially when drilling activity is high as has been the case over the past decade. EPA accepts the deep drilling rate used for CRA-2019 but requests DOE re-examine its methodology for future PAs.

For the CRA-2019 DPA, DOE made a change from the previously established methodology, used since the 1996 CCA, for the area over which it calculates borehole plugging pattern probabilities. Previously, borehole plugging patterns were evaluated over the entire New Mexico portion of the Delaware Basin. For CRA-2019, DOE restricted its approach to only look at plugged boreholes located in the Known Potash Leasing Area (KPLA), also known as the R-111-P area, inside the Delaware Basin in New Mexico only. The WIPP LWA area was designated out of and added to the KPLA which surrounds it on roughly three sides. The practical implications on the PA are that the probability of the most protective borehole plugging configuration (i.e., solid, continuous cement Type VI plugs) that minimizes brine flow in and out of the repository increased from 4% to 40.3% from CRA-2014 to CRA-2019 and the other, less protective configurations decreased. EPA sent several questions and comments during the completeness review related to borehole plugging. EPA's review determined that this change was not adequately justified by regulatory considerations nor actual practices as reflected in field data collected by DOE and its contractors. For these reasons, EPA expects DOE to utilize the CRA-2014 methodology for future PAs or propose a new one that can be approved by EPA. Sensitivity studies performed by EPA using CRA-2019 data with the prior borehole plugging

methodology demonstrated that predicted releases are still below regulatory limits but higher than those in the DPA. Therefore, EPA accepts DOE's calculations using the KPLA-only methodology in CRA-2019 but not for future PA calculations without further justification.

Further discussion on both drilling rates and borehole plugging patterns are in CARD 33 in this document and the TSD *Review of Borehole Drilling Rate and Plugging Pattern Frequency Calculations in the CRA 2019 Performance Assessment* (Docket ID No. EPA-HQ-OAR-2019-0534).

EPA did not receive any public comments on DOE's continued compliance with the scope of compliance assessments requirements of Section 194.45.

**Compliance Decision**

Based on a review and evaluation of the 2019 CRA, 2019 DPA, the supplemental information in Appendices, responses to EPA completeness comments provided by DOE, and an assessment of changes since 2014 CRA, EPA determines that DOE continues to comply with the requirements for Section 194.45. However, EPA requests DOE to re-evaluate the methodology for calculating its deep borehole drilling rate and expects DOE to revert to the previously-approved methodology of calculating borehole plugging pattern probabilities that go into PA calculations, or otherwise propose alternative methods that may be approved by EPA prior to that time.

**References**

U.S. Department of Energy (DOE). 2018. Delaware Basin Monitoring Annual Report Rev. 1. (September 2018) Carlsbad, NM: Carlsbad Field Office. DOE/WIPP-18-2308.

U.S. Environmental Protection Agency (EPA). 2017. Technical Support Document for the *Probability of Encountering Castile Brine Beneath the WIPP Waste Panels Using the TDEM Block Method*. June 2017. Washington, DC: Office of Radiation and Indoor Air. Docket EPA-HQ-OAR-2014-0609-0047.

# Section 46 Removal of Waste

## DOE Reported Changes

46 *Documentation to demonstrate removal of waste from the disposal system is feasible for a reasonable period of time after disposal, including analysis of the technological feasibility of mining the sealed disposal system, given present technology levels.*

No changes. The DOE submitted a Planned Change Notice (DOE 2017) for a new ventilation shaft and associated access drifts, but these have no foreseeable direct impact on waste removal after closure and are separate and isolated from waste disposal rooms and would not be involved in removal activities.

## EPA Evaluation

EPA verified that no significant changes have been made in the overall planning or execution of the DOE's strategy for removal of waste since EPA's 1998 certification decision. However, EPA's review for CRA-2014 found that CCA Appendix WRAC had not been updated to reflect changes to repository design, waste characteristics, and container characteristics. In response, DOE rewrote and updated parts of Appendix WRAC for CRA-2014 to reflect these changes. At the beginning of its CRA-2019 review, EPA noted that the updated Appendix WRAC-2014 had not yet been made publicly available on DOE's WIPP website for CRA-2014, although it could be found in the docket. DOE quickly corrected the omission and added it to the WIPP CRA-2014 website. No changes to either Section 46 or Appendix WRAC were made for CRA-2019.

EPA did not receive any public comments on DOE's continued compliance with the removal of waste requirements of Section 194.46.

## Compliance Decision

Based on EPA's review of the activities and conditions in and around the WIPP site, EPA did not identify any significant changes in the planning and execution of the DOE's strategy for removal of waste since the 1998 Certification and previous Recertification Decisions (EPA 1998) aside from minor changes described in the updated CRA-2014 Appendix WRAC-2014 and evaluated in EPA CARD 46 (EPA 2017). The CRA-2019 provides documentation that the removal of waste from the disposal system is feasible for a reasonable period of time after disposal (DOE 2019, Section 46). EPA determines that DOE continues to comply with the requirements of Section 194.46.

## References

U.S. Department of Energy (DOE). 2019. Title 40 CFR Part 191 Subparts B and C Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Section 46 (March). Carlsbad, NM: Carlsbad Field Office. DOE/WIPP 19-3609.

U.S. Department of Energy (DOE). 2014. Title 40 CFR Part 191 Subparts B and C Compliance Recertification Application 2014 for the Waste Isolation Pilot Plant (March). Carlsbad, NM: Carlsbad Field Office. DOE/WIPP 2014-3503.

U.S. Department of Energy (DOE). 2017. Planned Change Notice Regarding the Excavation and Construction of a New Ventilation Shaft and Associated Access Drifts at the Waste Isolation Pilot Plant. Carlsbad, NM: Carlsbad Field Office.

U.S. Environmental Protection Agency (EPA). 1998. CARD No. 46: Removal of Waste. Compliance Application Review Documents for the Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR 191 Disposal Regulations: Final Certification Decision (May) (pp. 46-1 through 46-4). Washington, DC: Office of Radiation and Indoor Air.

U.S. Environmental Protection Agency (EPA). 2017. Recertification CARD No. 46: Removal of Waste. Compliance Application Review Documents for the Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR 191 Disposal Regulations. Washington, DC: Office of Radiation and Indoor Air. EPA Docket FDMS Docket ID No. EPA-HQ-OAR-2014-0609-0063.

# Section 51 and 52 Consideration of Protected Individual and Exposure Pathways

## DOE Reported Changes

51 *Assume an individual resides at the single geographic point on the surface where that individual would be expected to receive the highest dose from radionuclide releases.*

52 *All potential exposure pathways to individuals assume 2 liters per day drinking water consumption from any underground source of drinking water in the accessible environment.*

DOE used new census and water usage data to assess whether the assumption used for the Underground Source of Drinking Water (USWD) determination was still appropriate, and this was confirmed. This is documented in Appendix-IGP of CRA-2019. Beyond that, DOE did not report any significant changes to the information upon which EPA based the 1998 Certification and 2004, 2009, and 2014 CRA decisions of compliance with the requirements of Section 194.51 and 194.52.

The DOE submitted the CRA-2019 Performance Assessment (PA) after submitting the CRA-2019. As such, the results of DOE's CRA-2019 compliance assessments are documented in PA Summary Report Section 5.2.8, Appendix PA Section 8.4.2, and Sarathi (2019) Section 4.4. The compliance assessment results in those documents demonstrate that the WIPP disposal system continues to comply with the individual and groundwater protection standards.

## EPA Evaluation

Compliance assessments in Sections 194.51 through 194.55 implement the individual protection requirements of 40 CFR 191.15 and the groundwater protection requirements of subpart C of 40 CFR part 191 using methods similar to those of performance assessment. They can be considered a "subset" of performance assessment since they consider only natural (undisturbed) conditions and past or near-future human activities. Consideration of Protection Individual and Exposure Pathways apply to the individual protection requirements of 40 CFR 191.15 and the groundwater protection standards of 40 CFR 191 Subpart C. 40 CFR 194.51 requires that the DOE assumes an individual resides at the point where the dose from potential radionuclide releases from the WIPP would be greatest in the compliance assessments. 40 CFR 194.52 requires that DOE considers all the potential exposure pathways for radioactive contaminants from the WIPP in its compliance assessments. DOE's compliance assessment results demonstrate that the WIPP disposal system continues to comply with the individual and groundwater protection standards.

Based on EPA's review of the activities and conditions in and around the WIPP site and documentation provided, EPA did not identify any significant changes in the consideration of the protected individual and exposure pathways.

EPA did not receive any public comments on DOE's continued compliance with the consideration of protected individuals and exposure pathways requirements of Section 194.51 and 194.52.

## Compliance Decision

Based on the foregoing evaluation, EPA determines that DOE continues to comply with the scope of compliance assessments required in Section 194.51 and 194.52.

## References

EPA (U.S. Environmental Protection Agency) 1993. 40 CFR Part 191: Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes: Final Rule. *Federal Register*, vol. 58 (December 20, 1993): 66398–416.

EPA (U.S. Environmental Protection Agency) 1996. 40 CFR Part 194: Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Final Rule. *Federal Register*, vol. 61 (February 9, 1996): 5223–5245.

Sarathi, R., 2019 "Explanations of CAP MIC definition and usage in PA calculations, Memo to R. Camphouse," Sandia National Laboratories, ERMS 557731

U.S. Department of Energy (DOE) 2019. Title 40 CFR Part 191 Subparts B and C Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix PA-2019 Performance Assessment, U.S. Department of Energy Waste Isolation Pilot Plant, Carlsbad Field Office, Carlsbad, NM. DOE/WIPP-19-3609, Rev. 0

U.S. Department of Energy (DOE) 2019. Title 40 CFR Part 191 Subparts B and C Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix IGP-2019: Individual and Groundwater Protection Requirements, U.S. Department of Energy Waste Isolation Pilot Plant, Carlsbad Field Office, Carlsbad, NM. DOE/WIPP-19-3609, Rev. 0

Zeitler, T.R., J. Bethune, S. Brunell, B. Day, D. Kicker, J. Long, and R. Sarathi, 2019. Summary Report for the 2019 Compliance Recertification Application Performance Assessment (CRA-2019 PA). Carlsbad, NM: Sandia National Laboratories. ERMS 571376.

# Section 53 Consideration of Underground Sources of Drinking Water

## DOE Reported Changes

53 *Consideration of all underground sources of drinking water in the accessible environment expected to be affected by the disposal system over the regulatory time frame, including underground interconnections among surface water, groundwater, and underground sources of drinking water.*

DOE updated information regarding average household water consumption in communities near the WIPP from the latest census data. This is documented in CRA-2019, Appendix IGP-2019, Section IGP-2.1.1. The updated water consumption data show that the average per capita consumption is 272 gallons per day (gpd) (Table IGP-1).

No additional USDW[1] investigations were performed. No new wells were drilled in the WIPP vicinity, only replacement wells described in CRA-2019, Appendix HYDRO-2019, Section HYDRO-4.0.

## EPA Evaluation

Assessment of the likelihood that the WIPP will meet the individual dose limits and radionuclide concentration limits for groundwater is conducted through a process known as compliance assessment. Using the average value of 272 gpd (Table IGP-1) for 25 people (the approximate amount of people 15 service connections serves) (40 CFR 191.22), water usage is approximately 4.74 gallons per minute (gpm). DOE concludes that the sub-criterion of 5 gpm of production currently being used continues to accurately define a USDW and any change in this sub-criterion is not warranted. EPA concurs as the 5 gpm value appears bounding.

DOE continues to identify the Culebra member of the Rustler Formation, the Dewey Lake Formation, and Santa Rosa Formation as the only potential USDWs in the vicinity of the WIPP LWB. EPA has also been examining data from wells drilled within the study area since the 1998 Certification (DOE 1996) and previous CRAs and concludes that DOE applies adequately conservative assumptions to the data for a hypothetical USDW. In the 2018 Annual Site Environmental Report (ASER) (DOE 2019a) DOE presents recent total dissolved solids (TDS) data available from the WIPP Water Quality Sampling Program (WQSP) detection monitoring program wells. One WQSP well, well WQSP– 6A, drilled in the Dewey Lake, shows a TDS concentration of 3410 mg/l, below the 10,000 mg/L threshold defined in 40 CFR 191.22. All the other WQSP wells are completed in the Culebra, and show TDS concentration above 10,000 mg/L. These data are consistent with earlier data in reference to the USDW determinations, therefore changes to the earlier USDW determinations are not necessary. DOE also continues to monitor the PZ WIPP site wells, as noted in the ASER 2018, and the 2014 conclusions have not changed.

[1] Underground source of drinking water means an aquifer or its portion which: (1) Supplies a public water system, or (2) contains a sufficient quantity of ground water to do so and (i) currently supplies drinking water for human consumption or (ii) contains fewer than 10,000 milligrams per liter of total dissolved solids. (40 CFR 191.22)

For the 2019 CRA evaluation (DOE 2019c, DOE 2020), DOE notes that the maximum potential dose remains below the CCA value and continued compliance with the individual protection standard is maintained. The potential concentrations of contaminants in the hypothetical USDW and the maximum potential dose to a receptor that drinks from the hypothetical USDW continue to be bounded by the CCA analysis results.

**Compliance Decision**

EPA determines that DOE continues to comply with the requirements for Section 194.53.

**References**

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

U.S. DOE. 2019a. Waste Isolation Pilot Plant Annual Site Environmental Report for 2018 (ASER). Carlsbad, NM: Carlsbad Field Office. DOE-WIPP 19-3591.

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191 Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix HYDRO, DOE/WIPP-19-3609, Rev. 0 Carlsbad Field Office, Carlsbad, New Mexico.

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191 Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix IGP, DOE/WIPP-19-3609, Rev. 0 Carlsbad Field Office, Carlsbad, New Mexico.

U.S. DOE. 2020. Department of Energy Response 2 to EPA Completeness Comments. U.S. Department of Energy Carlsbad Field Office, July 2020.

# Section 54 Scope of Compliance Assessments

## DOE Reported Changes

54(a) *Identify the potential processes, events, or sequences of processes and events that may occur over the regulatory time frame, identify those that are included in the compliance assessment results; and identify those that are not included in the compliance assessment results.*

54(b) *For undisturbed performance include the effects of existing boreholes in the vicinity of the disposal system and the pathways they provide for migration of radionuclides as well as activities that occur or can be reasonably expected to occur in that vicinity prior to or soon after disposal that may affect individual and groundwater protection requirements.*

The DOE addresses the requirements of 40 CFR 194.54 through a formal evaluation of features, events, and processes (FEPs) that could affect undisturbed repository performance as documented in Appendix SCR-2019, and through supplemental information affecting individual and groundwater protection as documented in Appendix IGP of CRA-2019 (DOE 2019). Compliance assessment uses methods similar to those of performance assessment (for the containment requirements in 40 CFR 191.13 and can be considered a "subset" of performance assessment since it considers only natural (undisturbed) conditions and past or near-future human activities (such as existing boreholes) but does not include the long-term future human activities that are addressed in performance assessment.

For the 2019 CRA, the DOE reviewed 245 FEPs for continuing applicability to repository performance as affecting the potential radiation exposure of individuals and the possible levels of radioactive contamination of groundwater resulting from disposal of waste in the WIPP (DOE 2019, Appendix SCR-2019). Of the 245 FEPs, 84 were updated with new information since the 2014 CRA, and four of those updated had their screening decisions changed: one changed from excluded to included; another changed from included to excluded; and two remained excluded but for different reasons. The screening arguments were updated mainly because of changes in the WIPP waste inventory, changes in panel closure designs, updated Delaware Basin monitoring data, the addition of a new shaft, and an updated colloidal source term. EPA CARD 25 also discusses the FEPs review.

DOE reported no significant changes relating to Section 54 since the CRA-2014. Beyond the aforementioned FEPs updates, the only changes made were to the supplemental information needed to address the individual and groundwater protection requirements. These primarily affect the groundwater protection evaluation and included updating census data (the average number of persons per household) and water consumption data (the average consumption in gallons per capita per day) (DOE 2019, Appendix IGP-2019, Section IGP-2.0).

## EPA Evaluation

The EPA found that DOE's FEP analysis presented in CRA-2019 Appendix SCR-2019 and the data presented in Appendix IGP-2019 continued to provide useful information for addressing the

requirements of both Sections 54(a) and 54(b). The Agency found the changes made to these appendices since the 2014 CRA to be necessary and appropriate.

Although the screening arguments for most FEPs were accepted by EPA as adequate, some were found to require additional documentation. The EPA had two completeness comments for DOE dealing with natural FEPs under undisturbed conditions, CC4-SCR-6 and CC5-SCR-10. Both comments requested updates of the information used in the FEP screening process, but neither were anticipated to result in changes in the screening decision. The DOE agreed to provide updated information in its FEP baseline screening for the CRA-2024 PA. The EPA reviewed DOE's responses and found them to be adequate. Detailed results of the Agency's review of the CRA-2019 FEPs are documented in EPA's Technical Support Document (TSD) *Review of Changes to WIPP Performance Assessment Features, Events, and Processes in the CRA-2019* (Docket ID No. EPA-HQ-OAR-2019-0534).

The EPA also found that DOE's Appendix IGP-2019 provided, either directly or by reference, the supplemental information needed to address the individual and groundwater protection requirements of 40 CFR 191. EPA considers the CRA-2019 updates addressing Section 194.54 to be appropriate.

EPA did not receive any public comments on DOE's continued compliance with the scope of compliance assessments requirements of Section 194.54.

**Compliance Decision**

Based on the foregoing evaluation, EPA determines that the DOE continues to comply with the scope of compliance assessments required in Section 194.54.

**References**

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191 Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix IGP. DOE/WIPP-19-3609, Rev. 0 Carlsbad Field Office, Carlsbad, New Mexico.

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191 Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix SCR. DOE/WIPP-19-3609, Rev. 0 Carlsbad Field Office, Carlsbad, New Mexico.

EPA (U.S. Environmental Protection Agency) 1993. 40 CFR Part 191: Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes: Final Rule. *Federal Register*, vol. 58 (December 20, 1993): 66398–416.

# Section 55 Results of Compliance Assessments

## DOE Reported Changes

55 *Compliance assessments to consider and document uncertainty in the performance of the disposal system, including probability distributions for uncertain parameters and computational techniques to generate a range of estimated committed effective doses, radionuclide concentrations in USDWs, and estimated dose equivalents from USDWs.*

Compliance assessments address EPA's 10,000-year individual protection requirements applicable to the annual committed effective dose received by any member of the public in the accessible environment (40 CFR 194.51 and 194.52), as well as the groundwater protection requirements applicable to radioactive contamination of underground sources of drinking water in the accessible environment (40 CFR 194.53). Section 40 CFR 194.55 specifies how uncertainty in the performance of the disposal system is to be considered and documented when preparing the results of the compliance assessments.

DOE reported no changes to the methodology for demonstrating compliance with this section. Updates to USDW parameters are included in Appendix IGP-2019 along with the results of DOE's CRA-2019 compliance assessments. The documentation states that, although the database was updated (as described in EPA's CARD for Section 194.54), the bounding analysis computational methodology remained the same and demonstrated that the individual and groundwater protection standards continued to be met.

## EPA Evaluation

40 CFR 191.15 requires that WIPP be constructed in such a manner as to provide a reasonable expectation that, for 10,000 years after disposal, the undisturbed performance of the disposal system will not cause the annual committed effective dose equivalent to exceed 15 millirems (150 microsieverts) to any member of the public in the accessible environment. In addition, Section 191.24 requires that underground sources of drinking water be protected at least to the extent prescribed by the Safe Drinking Water Act regulations at 40 CFR Part 141.

The DOE has historically addressed the uncertainty requirements of 40 CFR 194.55 in two ways: 1) by assigning probability distributions for uncertain parameters and randomly sampling from those distributions in multiple realizations to obtain a range of possible outcomes, or 2) by assigning bounding values to uncertain parameters to obtain outcomes that conservatively overestimate radionuclide releases and exposure to those releases. The DOE selected the second of these options for demonstrating compliance with the individual and groundwater protection requirements.

The WIPP Land Withdrawal Boundary (LWB) and its vertical projection marks the edge of the accessible environment around the WIPP site and, as such, is the regulatory compliance point for individual and groundwater protection. The DOE assumed that the potentially exposed individual is located in the accessible environment at the point of maximum dose and is subject to all potential exposure pathways as required in 40 CFR 194.51 and 194.52. The DOE also assumed

that an underground source of drinking water exists in close proximity to the LWB even though available water quality and quantity data indicate that none currently exists near that boundary. The approach also conservatively assumes that all contaminants reaching the accessible environment under undisturbed conditions are directly available to a receptor. These assumptions maximize potential exposure and form the basis for DOE's bounding analysis. That analysis concluded that the individual and groundwater protection requirements were met. This bounding approach was first used by DOE in the 1996 CCA. It was approved at that time by EPA and the basic analytical methodology has continued to be used by DOE and approved by EPA since that time. The Agency concludes that, although the database has changed for the individual and groundwater protection requirements, the results continue to demonstrate compliance with these requirements. EPA did not receive any public comments on DOE's continued compliance with the results of compliance assessments requirements of Section 194.55.

**Compliance Decision**

Based on the foregoing evaluation, EPA determines that DOE continues to comply with the results of compliance assessments required in Section 194.55.

**References**

DOE (U.S. Department of Energy) 2019. Title 40 CFR Part 191 Subparts B and C, Compliance Recertification Application 2019 for the Waste Isolation Pilot Plant, Appendix IGP. DOE/WIPP-19-3609, Rev. 0 Carlsbad Field Office, Carlsbad, New Mexico.

EPA (U.S. Environmental Protection Agency) 1993. 40 CFR Part 191: Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes: Final Rule. *Federal Register,* vol. 58 (December 20, 1993): 66398–416.

EPA (U.S. Environmental Protection Agency) 1996. 40 CFR Part 194: Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Final Rule. *Federal Register,* vol. 61 (February 9, 1996): 5223–5245.

# Appendices and Attachments to CARDs

# Appendix 15-A Responses to CRA-2019 Comments

## Issue 1: Issues related to compliance checks by EPA on DOE and the WIPP outside of the 5 year recertification process

**Gregory Bishop (09/29/2021)**

What environmental actions are being taken to determine whether the Waste Isolation Pilot Plant continues to comply with the disposal regulation and compliance criteria? In the proposed rule it briefly mentions that, "The EPA's certification determination permitted the WIPP to begin accepting TRU waste for disposal, provided that other applicable conditions and environmental regulations were met." Is an environmental impact assessment going to be conducted where the previous TRU waste was disposed of? It is good that the WIPP's disposal standards are monitored every 5 years, but what are the human health implications if those standards are not met?

**Anonymous Public Comment (09/29/2021)**

As mentioned in the proposed rule, the EPA checks whether or not the WIPP is complying with the disposal regulations every FIVE years. For radioactive material such as TRU (which is disposed here) compliance needs to be checked much more frequently than that. If any toxic waste were to enter waterways it would be detrimental to not only humans but the surrounding areas. Not only do I think compliance needs to be checked much more often but I also think an element of surprise should be included. The WIPP should not know when the EPA is going to check their level of compliance because it allows opportunity to hide their mistakes. This process was written more than 20 years ago, when climate change was arguably less urgent. We are facing a massive crunch time in the realm of protecting the Earth and monitoring radioactive material should be at the top of the list.

**K. Scott (09/29/2021)**

The regular 5-year recertification process seems to be an effective way to keep track of the changes occurring at the site, however noting Goldstein and Gerus' comment, specifically regarding the 2014 leak, would it be advisable to have more frequent recertifications from a third-party organization? This organization can ensure more frequent checkups and documentation and approval of changes at the site. Any potential changes made by WIPP could be documented by the organization and could be used to see if they remain in compliance with the EPA's disposal regulations instead of having to wait the 5 years, later realize they were doing something that wasn't in compliance and then having to go back and reset the processes. And in the case of another dangerous incident like a leak caused by human error which exposed 22 workers to radiation, a more regularly documented list of changes at WIPP could help determine the cause of another random exposure event quicker.

**EPA's Response to Issue 1:**

On an on-going basis, aside from the periodic recertification of the WIPP, EPA communicates with DOE concerning the characterization of WIPP waste. DOE provides EPA with documentation relating to WIPP waste streams, including documentation for both contact handled and remote handled TRU waste streams. DOE confirms the relevant information by analyzing individual waste containers using the EPA approved processes, procedures and equipment. These steps allow DOE to demonstrate that it has procedures to characterize waste so that waste containers destined for WIPP disposal meet EPA's WIPP waste limits for physical and radiological contents of the waste. For waste that is in question, EPA evaluates the waste characteristic information prepared for remote handled waste. In the waste characterization process DOE provides historical information to document that the waste in question was defense related, and through radiological assay is able to conclude that the waste in question meets the definition of TRU waste and is appropriate for disposal at the WIPP. Radiological and physical characterization then confirm that the TRU waste in question (a) is remote handled waste; (b) exhibits the characteristics of debris waste; and (c) meets the regulatory limits of EPA's WIPP waste related requirements at 40 CFR 194.24.

EPA thoroughly inspects and approves the waste characterization processes in place at all waste characterization sites. As part of the waste characterization inspections and approvals, EPA is responsible for evaluating the adequacy of characterization methods used to identify and measure radiological and physical contents of the TRU waste that affect the long term containment and isolation of waste at the WIPP and for identifying that the WIPP-bound waste meets the disposal requirements under 40 CFR 194.24. EPA also reviews whether DOE has produced the necessary documentation to comply with the Agency's regulations.

Per 40 CFR part 194, EPA reviews DOE's CRA every 5 years. EPA also has the authority to request information from DOE and conduct inspections of the WIPP site at any time. EPA conducts annual inspections of waste emplacement, environmental monitoring, and the 40 CFR part 191 Subpart A radionuclide air emissions. DOE submits every two years the Biennial Environmental Compliance Report (BECR) for EPA review. DOE performs regular environmental monitoring of the site, and the data collected is available to EPA and included in the BECR. DOE is also required to submit Planned Change Requests (PCR) for any major change to the repository design or operation that would have a major impact on the PA, and Planned Change Notices for more minor changes to repository design and operation. A collection of all changes to the WIPP are cataloged and submitted to EPA by DOE on an annual basis, and EPA reviews this annual change report upon receipt.

Based on our evaluation of the CRA-2019, we have determined that there is a reasonable expectation that the WIPP will comply with the EPA's radioactive waste disposal regulations for the 10,000-year regulatory period. For the Agency's full evaluation of the application, please refer to the Federal Register and supplemental technical support documents, Docket No. EPA-HQ-OAR-2019-0534.

**Issue 2: DOE is not in compliance with the CRA because they have not fully implemented a safety regime that would prevent another incident like the 2014 incident.**

**D. Test (09/23/2020)**

I OPPOSE this regulation.

**K. Riggio (12/14/2020)**

I don't oppose this regulation, obviously there is evidence that they haven't been complying with the disposal regulations. And it's something should make sure is being followed.

**Kendall Goldstein and Cooper Gerus (04/01/2021)**

The WIPP CRA-2019 is incomplete and does not instill those reading it with confidence that the DOE is dedicated to implementing more stringent safety standards. Before recertification, the WIPP CRA-2019 should be amended to include third-party evaluations. The CRA-2014 was delayed because of a leak, and while this should have created fear and urgency, it seemed to have the opposite effect on the DOE. [Please refer to **Error! Reference source not found.** for the complete comment.]

**Tessco Technologies Inc.(11/18/2021)**

The Waste Isolation Pilot Plant should not be recertified this coming year. Before such a recertification can be granted, the WIPP should be required to focus on more safety measures to counteract their current problems, as well as to mitigate any future dangers that should arise. [Please refer to **Error! Reference source not found.** for the complete comment.]

**Ernesto Villasenor Jr. (11/18/2021)**

The 2019 Compliance Recertification Application for the Waste Isolation Pilot Plant cannot be recertified. Lack of incorporating safety standards and enforcement that would impede future accidents from occurring, especially those like the accidents of 2014, should be of paramount importance, especially with the possibility of the expansion and resulting increased activity at the WIPP site. Rather than to further increase safety standards and processes to control the WIPP site as it is, the DOE has proposed to increase the capacity and activity of how much transuranic radioactive waste will be coming in, placing the urgency on capacity and amount the WIPP site could potentially handle as opposed to placing the urgency on safety and ultimately, compliance with current regulations in place. [Please refer to **Error! Reference source not found.** for the complete comment.]

**EPA's Response to Issue 2:**

Until November 26, 2021, the Agency had not determined DOE's CRA-2019 as complete (*see* EPA's completeness determination, EPA-HQ-OAR-2019-5304; FRL-9213-01-OAR). This

completeness decision was reached after extensive back-and-forth discussions with the Department since the CRA and DPA submissions in March and December 2019, respectively, and included technical exchanges, email and letter communications, requests for more documentation, and requests for additional calculations. For its recertification decision, EPA continues to follow the procedures laid out by Congress as well as in 40 CFR part 194.

EPA's responsibility is the protection of human health and the environment, and the metric for recertification as laid out in the relevant regulations is protection of human health and the environment outside of the facility boundaries for 10,000 years after the closure of the facility. EPA believes that DOE fully incorporated all aspects of the waste (e.g., kitty litter) in the current version of the PA, and the Agency believes that DOE remains in compliance with all relevant EPA regulations. EPA's recertification for the WIPP is applicable to the radioactive portion of the waste. Please see the EPA evaluation and accompanying technical documentation prepared by EPA for further details.

The Agency reviewed the programmatic waste characterization changes instituted by DOE following the 2014 incident. When TRU waste is being approved for WIPP disposal, EPA routinely evaluates acceptable knowledge (AK) documents, including the Basis of Knowledge, the Chemical Compatibility Evaluation Memorandum, and the Interface Waste Management Documents List. These provide EPA with the evidence that CBFO has verified that the process of generating the waste or processing the waste did not create an unsafe situation with incompatible chemistry. The Agency also interviews AK and radiological characterization experts to verify that no high level waste (HLW) or spent nuclear fuel has been comingled with TRU waste. TRU sites must provide up to date AK documents and radiological characterization records specific to every Tier 1 change approval request. EPA pursues this verification step every time the Agency reviews revised AK documents (necessary to record what is being added to an approved remote-handled waste stream) and radiological characterization records.

The Agency's review and concurrence are necessary prior to DOE implementing significant waste characterization-specific changes to its previously-approved procedures (e.g., Waste Acceptance Criteria, Waste Characterization Program Implementation Plan) that incorporate the EPA's regulatory requirements. DOE's procedures implement various DOE Orders that cover the TRU waste management program. In addition, EPA can review applicable DOE internal guidance, directives or orders to confirm that DOE continues to ship only TRU waste to the WIPP for disposal in accordance with the WIPP LWA.

The Agency was able to conclude that the 2014 incident was primarily an operational phase issue. The New Mexico Environment Department (NMED) is the primary regulator for operations at the WIPP via the hazardous waste permit, and as such, had the primary responsibility for determining when operations could restart. Any non-compliance issues related to the operational phase are addressed by the state and it is the state that has the authority to close the WIPP based on any operational violations. Any mine safety issues are addressed by the Mine Safety and Health Administration of the Department of Labor. Consequently, EPA finds that the 2014 incident does not impact the CRA-2019 completeness determination as these operational issues are handled by NMED. EPA can also suspend, modify or revoke the certification if warranted. EPA did conduct an inspection of the WIPP facility in November 2016 (Docket ID

No. EPA-HQ-OAR-2001-0012-469), prior to the resumption of waste emplacement in January 2017. DOE has also acknowledged that recovery from the radiological release will result in design changes to the repository, which will need to be considered from a long-term perspective.

**Issue 3: Generally supportive of EPA's oversight and concur with EPA action but with some concerns**

**Anonymous Public Comment (02/02/2020)**

I completely agree with the Environmental Protection Agency (EPA) continuously evaluating whether the Waste Isolation Pilot Plant (WIPP) complies with the EPA's environmental radiation protection standards for the disposal of radioactive waste. It is very important to keep the U.S. Department of Energy (DOE) accountable for their actions as radioactive waste is harmful to both humans and the environment. It's also important to have these five-year updates to make sure that there are no radioactive waste on the premise that meets the definition of high-level radioactive waste or has specific instructions from the Nuclear Regulatory Commission for alternate method of disposal. With these five-year updates, it also allows for complete facility check to make sure the WIPP is still functioning properly and containing all of the radioactive waste.

**Sean Frost (03/22/2021)**

When dealing with waste of any sort of waste, the main priority should be 1.) worker's safety, 2.) environmental safety, and 3.) local safety. The guidelines that the EPA has put in place are for the protection of these things, and the WIPP should have to continue to follow these regulations. As much as regulations can seem to be a burden or waste of time, they are important to everyday consumers like myself, to ensure the safety and wellbeing of our land. The US department of energy has been compliant up to this point, so there should be no reason to change that. The WIPP should be fine with this outcome as I'm sure they are following all the guidelines needed to maintain the plant and the safety and well-being of the local community and environment. The overall good of these guidelines outweighs any possible thoughts of removing the guidelines. And as well, would set a social standard moving forward to other plants that they must be compliant with environmental regulations.

**Anonymous Public Comment (09/29/2021)**

From the DOE's documentation, the WIPP seems to be complying with disposal regulations. In terms of monitoring, their procedures consider human, natural, and technical factors that may come into play during the disposal process with inspections that are done on random intervals that assure the system is up to par at any given moment. This is in conformity with the EPA's requirement for monitoring compliance "to detect substantial and detrimental deviations from expected performance." Of note in their waste characterization, however, is the significant increase in CH-TRU Curie activity. It has almost doubled in the 5 years since their last re-certification, while the volume of that waste has only gone up by about 12% within the same period. Otherwise, it seems like the WIPP is in compliance with EPA regulations. Continued monitoring seems like a wise choice by the EPA, given the nature of the waste being disposed.

**EPA's response to Issue 3:**

We thank the commenters for their support in our efforts in the recertification process. EPA concurs that DOE is complying with the regulations laid out in the LWA and 40 CFR parts 191 and 194, and notes that WIPP is solely for transuranic waste, and that EPA has authority over the radioactive waste portion of the waste. Based on our evaluation of the CRA-2019, we have determined that there is a reasonable expectation that the WIPP will comply with the EPA's radioactive waste disposal regulations for the 10,000 regulatory period. For the Agency's full evaluation of the application, please refer to the Federal Register and supplemental technical support documents, Docket No. EPA-HQ-OAR-2019-0534.

EPA conducts annual site inspections for waste emplacement, environmental monitoring, and the Subpart A radionuclide air emissions. As well, EPA evaluates both the annual change report submitted by DOE and any planned change notices and requests that DOE submits to EPA. As a waste characterization program EPA has a goal of performing an on-site waste characterization continuing compliance inspection/evaluation every 18 months at each generator site. During the pandemic the program had been unable to maintain that schedule, however, the plan is to resume those site inspections as soon as possible when travel is able to be performed.

**Subsection I (Summary of Comment and EPA response can be found above under Issue 2: DOE is not in compliance with the CRA because they have not fully implemented a safety regime that would prevent another incident like the 2014 incident)**

Comment submitted by Kendall Goldstein and Cooper Gerus (04/01/2021)

Heading: Kendall Goldstein and Cooper Gerus, EIC SP 2021

**THESIS**: The 2019 Waste Isolation Pilot Plant (WIPP) Compliance Recertification Application (CRA) is incomplete because it does not include a comprehensive mitigation plan in response to the 2014 transuranic (TRU) radioactive waste leak incident.

## I. Historical Background

### A. The WIPP was established in 1980 as a TRU radioactive waste storage facility "for the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States."[1]

The Waste Isolation Pilot Plant (WIPP), located outside of Carlsbad, New Mexico, was established under the Department DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980, has been accepting transuranic (TRU) radioactive waste from 16 sites across Colorado, Idaho, New Mexico, Nevada, Ohio, South Carolina, Tennessee and Washington, since 1999.[2] The TRU waste is stored underground in rooms hewn from a 2000-foot thick salt bed.[3] The WIPP is operated by Nuclear Waste Partnership (NWP), LLC, a private contractor, and overseen by the DOE; the DOE pays out portions of the WIPP annual contract based on NWP's performance.[4]

Every five years, the DOE must submit a Compliance Recertification Application (CRA) to the Environmental Protection Agency (EPA) in order to continue to receive TRU waste pursuant to the LWA.[5] At the recertification stage, the DOE has invited comments on the completeness of

[1] U.S. Congress 1980. The U.S. Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 190, Public Law 96-164, 93 Statute 1259,Washington, D.C., https://inis.iaea.org/collection/NCLCollectionStore/_Public/33/031/33031182.pdf

[2] U.S. Congress, 1996 Public Law 102-579. Waste Isolation Pilot Plant Land Withdrawal Act of 1992, as amended by Public Law 104-201, 1996. (Hereinafter, "LWA")

[3] "Transuranic Waste," AMERICAN NUCLEAR SOCIETY (2018), http://nuclearconnect.org/transuranic-waste#:~:text=Transuranic%20waste%20(also%20called%20TRU,atomic%20number%20higher%20than%2092)

[4] Adrian Hedden, "WIPP: DOE awards contractor 83 percent of available funds in annual performance evaluation." CARLSBAD CURRENT-ARGUS (June 26, 2020,) https://www.currentargus.com/story/news/local/2020/06/26/doe-awards-wipp-contractor-83-percent-available-funds/3242213001/

[5] WIPP 2019 CRA Executive Summary, p. 7.

the CRA before sending it to the EPA for a determination of its completeness.[6] This is the fourth CRA prepared by the DOE since the WIPP began receiving TRU waste.[7]

### B. In 2014, one of the TRU barrels inside the WIPP leaked due to a chemical reaction caused by human error.

A barrel of TRU waste ruptured when "chemically incompatible" contents within it caused it to combust, exposing 22 workers to radiation.[8] The barrels contain a variety of compounds used to stabilize the TRU waste and to prevent moisture from accumulating.[9] While the radiation exposure is not expected to threaten the health of the workers, the incident alarmed New Mexico state officials and experts who noted a lack of safety culture at the WIPP.[10] The chemical reaction was caused by a worker putting the wrong type of kitty litter in the barrel to wick away moisture.[11]

In response to the leak, the WIPP closed for cleaning between 2014-2017.[12] The cleanup effort cost the DOE nearly $500 million.[13] The human error that cause the leak, taken together with the cost of cleanup, incompleteness of the current CRA, and the potential impact of the WIPP on future generations, demonstrate the risks of operating the WIPP. While the WIPP undergoes extensive mitigation analyses, including preparation in response to power outages, equipment failure, and structural integrity issues, it does not provide a comprehensive plan to mitigate potential human error.[14]

## II. Argument

### A. The WIPP should not be recertified because the current Waste Isolation Pilot Plant (WIPP) Compliance Recertification Application (CRA) is incomplete.

The WIPP should not be recertified. The WIPP is governed by 1992 legislation, the WIPP Land Withdrawal Act (LWA). In the current application for recertification, the DOE has not adequately addressed issues that were discovered in the last iteration of the CRA. The evaluations that the Department of Energy submitted are all self-evaluations, and after the leak in 2014 the WIPP should seek external evaluation and support in creating new safety plans. In order

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[6] Id.

[7] Id.

[8] Laura Zuckerman, "Wrong kitty litter led to radiation leak at New Mexico nuke waste dump," REUTERS (Mar. 27, 2015) https://www.reuters.com/article/us-usa-nuclear-new-mexico/wrong-kitty-litter-led-to-radiation-leak-at-new-mexico-nuke-waste-dump-idINKBN0MN0C920150327

[9] Id.

[10] Id.

[11] Id.

[12] James Conca, "WIPP Nuclear Waste Repository Reopens For Business," FORBES (Jan 10, 2017, 6:00am EST) https://www.forbes.com/sites/jamesconca/2017/01/10/wipp-nuclear-waste-repository-reopens-for-business/?sh=340c17702052

[13] Id.

[14] Annual Mitigation Report for the WIPP, (Jul. 10, 2018) https://www.energy.gov/sites/prod/files/2018/07/f53/WIPP_2018_Annual_Mitigation_Report.pdf

to mitigate the potential accidents like this in the future the DOE should implement a comprehensive education program for WIPP workers to foster a strong safety culture. The seriousness of this leak cannot be understated. As the WIPP takes in more waste annually, the potential for accidents increases. The need for oversight and effective training can remedy this.

The WIPP LWA requires that the EPA "evaluate all changes in conditions or activities at the WIPP every five years to determine if the facility continues to comply with the Agency's disposal regulations"15; this means that the current application needs evaluation only on what has changed since the most recently approved Compliance Recertification Application.16 (These are abbreviated as CRA and then the year they were submitted, so the last application was CRA-2014 and the pending one is CRA-2019).17 One unique aspect about CRA-2019 is that the evaluation period is much shorter than the usual five year gap between applications, because CRA-2014 was not approved until 2017.18 This delayed approval was because of the safety concerns after the 2014 leak. Because of this, the CRA-2019 should be very thorough in creating new safety procedures, and what was submitted falls short of expectations.

### B. The 2019 CRA Performance Assessment (PA) is inadequate because the DOE has not accounted for necessary fundamental changes in the disposal processes since the 2014 leak.

Some sources have pointed out that the 2014 leak is due to the wrong type of kitty litter used in the containment barrels.19 An error like these seems careless, especially when the material being contained has the potential to be so harmful. The CRA-2019 does not have enough investigation into how to rectify this type of error, probably because it relies on the work done to achieve recertification in 2017 for the bulk of their effort for this cycle.

WIPP measures their effectiveness in containing TRU waste with a Performance Assessment that evaluates "the probability of radionuclide releases from the WIPP repository for 10,000 years after closure and characterizes the uncertainty in the distribution."20 They are not required to complete a Performance Assessment in the WIPP LWA, but provide one regardless.21 The CRA-2019 does not include a Performance Assessment because of the shortened evaluation period, but WIPP did submit a deferred Performance Assessment later in 2019.22 This report covers "processes and events that might affect the disposal system,"23 how

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[15] https://www.regulations.gov/document/EPA-HQ-OAR-2019-0534-0001

[16] Id.

[17] https://wipp.energy.gov/library/CRA/CRA%202019/CRA2019%20Section%20Executive%20Summary%20Final.pdf 8

[18] Id.

[19] https://www.reuters.com/article/us-usa-nuclear-new-mexico/wrong-kitty-litter-led-to-radiation-leak-at-new-mexico-nuke-waste-dump-idINKBN0MN0C920150327; https://www.forbes.com/sites/jamesconca/2017/01/10/wipp-nuclear-waste-repository-reopens-for-business/?sh=340c17702052.

[20] Id. at 10.

[21] Id.

[22] https://wipp.energy.gov/library/CRA/CRA-2019/CRA-15315-v2-CRA-2019_Appendix_PA_Final.pdf 1

[23] Id. at 15.

likely those processes and events are, and what would be the consequences.24 They then evaluated how much confidence they should place in their own answers.25 As comforting as it is that all iterations of WIPP's CRAs include these extra steps in self-evaluation, it is not sufficient to address the safety concerns following the leak. The Department of Energy should have an outside consultant evaluate all of WIPP's safety and containment procedures before they should receive their recertification.

## III. Conclusion

The WIPP CRA-2019 is incomplete and does not instill those reading it with confidence that the DOE is dedicated to implementing more stringent safety standards. Before recertification, the WIPP CRA-2019 should be amended to include third-party evaluations. The CRA-2014 was delayed because of a leak, and while this should have created fear and urgency, it seemed to have the opposite effect on the DOE.

[24] Id.

[25] Id.

**Subsection II (Summary of Comment and EPA response can be found above under Issue 2: DOE is not in compliance with the CRA because they have not fully implemented a safety regime that would prevent another incident like the 2014 incident)**

Comment submitted by Tessco Technologies Inc., (11/18/2021)

**From:** Goldsborough, Tyler <Goldsborough@tessco.com>

**Sent:** Wednesday, November 10, 2021 3:23 PM

**To:** A-AND-R-DOCKET

**Subject:** Docket ID No. EPA-HQ-OAR-2019-0534

**Attachments:** FINAL TG Enviro Comment .docx

Comment for Review Process to Determine Whether the Waste Isolation Pilot Plant Continues to Comply with theDisposal Regulations and Compliance Criteria.

Thank you!

Tyler Goldsborough

Human Resources

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Environmental Law Comment from Tyler Goldsborough of Tessco Technologies, Inc.

The Waste Isolation Pilot Plant should not be recertified this coming year. Before such a recertification can be granted, the WIPP should be required to focus on more safety measures to counteract their current problems, as well as to mitigate any future dangers that should arise.

The Waste Isolation Pilot Plant (WIPP), located in New Mexico, was established under the Department of Energy (DOE) National Security and Military Applications of Nuclear Energy Authorization Act of 1980, and has accepted transuranic (TRU) radioactive waste, waste that contains manmade elements heavier than uranium on the periodic table[1], from 16 sites across the United States since 1999[2]. The WIPP is currently operated by Nuclear Waste Partnership (NWP), LLC, and is overseen by the DOE.

In 2014, one of the TRU barrels inside the WIPP leaked. This was due to a chemical reaction ultimately caused by human error. A barrel of TRU waste ruptured when "chemically incompatible"[3] contents within it caused it to combust, exposing more than twenty workers to radiation. While the radiation exposure was not expected to threaten the health of the workers, the accident forced state officials and experts to witness the lack of a robust safety protocol at the WIPP. In response to the leak, the WIPP closed for cleaning for nearly three years, which ended up costing the DOE nearly $500 million.[4]

The WIPP is governed by legislation from two decades ago, the WIPP Land WithdrawalAct (LWA) of 1992[5]. In the current application for recertification, the DOE has not sufficiently addressed issues that were brought up in 2014 or in the pending 2019 application. The evaluations that the DOE submitted are all internal evaluations, and after the leak in 2014 the WIPP needs to instead seek external evaluation and support to create new safety plans. In order to lessen potential accidents like this in the future, the DOE needs to create a comprehensive education program for WIPP workers to create stronger and more comprehensive safety protocol. The seriousness of this leak cannot be understated. As the WIPP takes in more waste,the potential for accidents increases tenfold. The request for external oversight and effective training can help lessen the impact of accidents or stop them altogether.

The LWA requires that the EPA "evaluate all changes in conditions or activities at theWIPP every five years to determine if the facility continues to comply with the Agency's disposal regulations"[6]. This means that the current application is evaluated only on what has changed since the most recently approved Compliance Recertification Application (CRA).

[1] https://www.epa.gov/radiation/what-transuranic-radioactive-waste

[2] U.S. Congress, 1996 Public Law 102-579. Waste Isolation Pilot Plant Land Withdrawal Act of 1992, asamended by Public Law 104-201, 1996. (Hereinafter, "LWA")

[3] Laura Zuckerman, "Wrong kitty litter led to radiation leak at New Mexico nuke waste dump," REUTERS(Mar. 27, 2015) https://www.reuters.com/article/us-usa-nuclear-new-mexico/wrong-kitty-litter-led-to- radiation-leak-at-new-mexico-nuke-waste-dump-idINKBN0MN0C920150327

[4] Id.

[5] https://www.regulations.gov/document/EPA-HQ-OAR-2019-0534-0001

[6] https://www.regulations.gov/document/EPA-HQ-OAR-2019-0534-0001

WIPP currently measures their efficiency in containing TRU waste with a Performance Assessment.[7] Though they are not required to complete a Performance Assessment based on the LWA, they do usually complete one. This report covers "processes and events that might affectthe disposal system,"[8] how likely those processes and events are, and what would be the consequences. As reassuring as it may seem that every one of WIPP's CRAs include these extrasteps in self-evaluation, it is not enough to address the safety concerns following the leak. The EPA needs to have an outside consultant evaluate all of WIPP's safety and containment procedures before they can receive their recertification. The 2014 leak was due to the wrong type of kitty litter used in the barrels[9]. An error like this seems careless, especially when the material being contained, TRU waste, has the potential to be so dangerous. The CRA-2019 does not have an investigation into how to rectify this type of error[10], which is concerning for the future potential for such accidents.

The human error that caused the leak, alongside the cost of cleanup, the missing data from the pending CRA, and the potential harm of the WIPP on the health and wellness of the community, proves the risks of granting the WIPP recertification to continue operations. Before recertification, the WIPP's Performance Evaluations and Compliance Recertification Applicationmust be amended to include third-party evaluations. The 2014 leak was dangerous and avoidable, and the DOE has a duty to deny the recertification of the WIPP until a better protocol is in place to prevent these catastrophes.

[7] https://www.reuters.com/article/us-usa-nuclear-new-mexico/wrong-kitty-litter-led-to-radiation-leak-at- new-mexico-nuke-waste-dump-idINKBN0MN0C920150327; https://www.forbes.com/sites/jamesconca/2017/01/10/wipp-nuclear-waste-repository-reopens-for- business/?sh=340c17702052.

[8] https://wipp.energy.gov/library/CRA/CRA-2019/CRA-15315-v2-CRA-2019_Appendix_PA_Final.pdf

[9] https://www.reuters.com/article/us-usa-nuclear-new-mexico/wrong-kitty-litter-led-to-radiation-leak-at- new-mexico-nuke-waste-dump-idINKBN0MN0C920150327; https://www.forbes.com/sites/jamesconca/2017/01/10/wipp-nuclear-waste-repository-reopens-for- business/?sh=340c17702052.

[10] https://wipp.energy.gov/library/CRA/CRA-2019/CRA-15315-v2-CRA-2019_Appendix_PA_Final.pdf

**Subsection III (Summary of Comment and EPA response can be found above under Issue 2: DOE is not in compliance with the CRA because they have not fully implemented a safety regime that would prevent another incident like the 2014 incident)**

Comment submitted by Ernesto Villasenor Jr., Nov. 18th, 2021, EPA-HQ-OAR-2019-0534-0036

Perez, JuanB

From: Ernesto Villasenor <ernesto.villasenor@ubalt.edu>

Sent: Thursday, November 11, 2021 4:05 PM

To: A-AND-R-DOCKET

Subject: Docket ID No. EPA-HQ-OAR-2019-0534

Attachments: Public Comment_Final_EVillasenor.docx

To Whom It May Concern:

Hope this email finds you well.

Attached [below] you will find my comment to be included for Docket ID No. EPA-HQ-OAR-2019-0534. Should additional information be needed from my end, please do not hesitate to contact me either by email or by phone, which can be found in my signature.

Thank you in advance for your time.

Best,

Ernesto Villaseñor, Jr. (he/him)

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**Heading:** Docket ID No. EPA-HQ-OAR-2019-0534; Villasenor, Ernesto - Environmental Law

**Thesis:** The Department of Energy's Compliance Recertification Application for 2019 is incomplete and should not be recertified, as defined under the 1997 Waste Isolation Pilot Plant (WIPP) Compliance Criteria (40 CFR part 194), which determines whether a WIPP facility meets the Environmental Protection Agency's generic disposal standards for high-level and TRU radioactive waste.

**History, Background, Compliance Criteria**

The Waste Isolation Pilot Plant (WIPP), located in Carlsbad, New Mexico, was authorized in 1980 under subsection 213 of the Department of Energy's (DOE) National Security and Military Applications of Nuclear Energy Authorization Act "for the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States."[1]

WIPP is a disposal system for transuranic (TRU) radioactive waste, which is waste that contains more than 100 nano-curies per gram of alpha-emitting radioactive isotopes. This waste can consist of the following: rags, equipment, tools, protective gear, and sludges that have become contaminated during atomic energy defense activities.[2] The radioactive component of TRU waste primarily consists of man-made elements during the process of nuclear fission and are chiefly isotopes of plutonium. Exceptions to radioactive waste being defined as TRU waste are: 1) if the waste also meets the definition of high-level radioactive waste; 2) has been specifically exempted from regulation with the concurrence of the Environmental Protection Agency's (EPA) Administrator, or; 3) has been approved for an alternate method of disposal by the Nuclear Regulatory Commission.[3]

In order for the WIPP to be in compliance, the WIPP must meet the EPA's genericdisposal standards for high-level and TRU radioactive waste as defined in the 1997 WIPPCompliance Criteria (40 CFR part 194).[4] These criteria are defined as followed:

- Provides guidance for interpretation and implementation of the disposal standards specifically for the WIPP site
- The Compliance Criteria describe what information the DOE must provide and how the EPA evaluates WIPP's performance and provides ongoing independent oversight

[1] Frequently Asked Questions about WIPP, New Mexico Energy, Minerals and Natural Resources Department (2021),https://www.emnrd.nm.gov/wipp-transportation-safety-program/frequently-asked-questions-about-wipp/

[2] What is Transuranic Radioactive Waste, Radioactive Protection, United States Environmental Protection Agency, (April 28, 2021), https://www.epa.gov/radiation/what-transuranic-radioactive-waste

[3] Jonathan D. Edwards, Review Process to Determine Whether the Waste Isolation Pilot Plant Continues to Comply with the Disposal Regulations and Compliance Criteria, Regulations.gov (September 12, 2019), https://www.regulations.gov/document/EPA-HQ-OAR-2019-0534-0001.

[4] EPA's Role at the Waste Isolation Pilot Plant (WIPP), Radiation Protection, United States Environmental Protection Agency (June 15, 2021), https://www.epa.gov/radiation/epas-role-waste-isolation-pilot-plant-wipp#compliance-criteria.

- The agency implements its environmental radiation protection standards, set forth under 40 CFR part 191, by applying the WIPP Compliance Criteria, 40 CFR part 194, to the disposal of TRU radioactive waste at the WIPP

The EPA's radiation protection standards under 40 CFR part 191 limit the following: releases of radioactive materials from disposal systems for radioactive waste, requiring implementation of measures to provide confidence for compliance with the radiation release limits; and limits doses to members of the public and protects groundwater resources by establishing maximum concentrations for radionuclides in groundwater.[5] Under the 1992 WIPP Land Withdrawal Act (LWA) Section 8(f), the EPA is required to evaluate all changes in conditions or activities at the WIPP every five years to determine if the facilities continue to comply with the Agency's disposal regulations.[6]

**February 2014 Accidents and Release of TRU Radioactive Waste**

On February 14, 2014, a radiological event occurred in the WIPP storage area, resulting in the release of americium and plutonium from TRU radioactive waste.[7] This release was detected by an air monitor, which directed the air through high-efficiency particulate air (HEPA) filters in the surface exhaust building.[8] However, this release was not contained and resulted in the leakage directly into the environment from an exhaust duct.

The impact of the accident resulted in the following: 21 individuals were identified to have initially tested positive for low level amounts of internal contamination approximately one month after the incident; the incident led to the closure of the WIPP site for three years and more than $500 million to clean up and make necessary changes that resulted in the accident; and reducing the storage capacity of the WIPP and unsuitable for storage of TRU radioactive waste.[9]

An Accident Investigation Board was appointed and began an investigation on March 3, 2014, completing the first phase of the investigation on March 28, 2014.[10] The Board concluded that "a thorough and conservatively considered hazard analysis, coupled with a robust, tested and well maintained HEPA filter capable exhaust ventilation system could have prevented the unfiltered above ground release," rendering the leakage preventable.[11]

[5] Id.

[6] Waste Isolation Pilot Plant Land Withdrawal Act, Pub. L. No. 102-579, §8(f)

[7] 2014 Radiological Event at the WIPP, Radiation Protection, United States Environmental Protection Agency (July 13, 2021), https://www.epa.gov/radiation/2014-radiological-event-wipp.

[8] Office of Envi. Management, U.S. Dept. of Energy: Radiological Release Event at the Waste Isolation Pilot Plant on Feb. 14, 2014, 12-13 (April 2014).

[9] Reinhard Knerr, Supplement Analysis for The Waste Isolation Pilot Plant Site-Wide Operations, DOE/EIS-0026-SA-12 (2021)

[10] Id.

[11] Id.

The Board identified an array of root causes and contributing causes to the accident that occurred on February 14, 2014. These include, but are not limited to, the following:[12]

1. The cumulative effect of inadequacies in ventilation system design and operability compounded by degradation of key safety management programs and safety culture resulted in the release of radioactive material from the underground to the environment, and the delayed/ineffective recognition and response to the release
2. Implementation of the NWP Conduct of Operations Program is not fully compliant with DOE O 422.1, Conduct of Operations, and impacted the identification of abnormal conditions and timely response
3. NWP does not have an effective maintenance program. The condition of critical equipment and components, including continuous air monitors, ventilation dampers, fans,sensors, and the primary system status display were degraded to the point where the cumulative impact on overall operational readiness and safety was not recognized or understood.
4. NWP does not have an effective Nuclear Safety Program in accordance with 10 CFR 830Subpart B, Safety Basis Requirements. There has been a reduction in the conservatism inthe Documented Safety Analysis (DSA) hazard/accident analysis and corresponding Technical Safety Requirement (TSR) controls over time, commencing with EM Headquarters delegation of safety basis approval authority (SBAA) in late 2009. For example, 15 of 22 design basis accidents were removed from the latest revision without any clear justification, including the elimination of a roof/rib fall event in an open waste panel. Several other examples are provided in Chapter 3, Nuclear Safety Program. In addition, the DSA and TSRs contain errors, there is a lack of DSA linkage to supporting hazard analyss information, and there is confusion over the back fall accident descriptionin a closed versus open panel.

These findings only demonstrate a lack of incorporating safety standards and enforcement by the DOE in operating the WIPP site.

**Incompleteness of the Current Compliance Recertification Application**

Earlier this year, the DOE published a report detailing the feasibility and possible plan to build two new areas for an increase in waste capacity, mitigating the impact in reduction of capacity from the accidents of 2014.[13] However, the original design of the WIPP only limited the operation of it until 2024 – the report published by the DOE pushes the closure date to 2033 and drastically increases the shipments towards the end of the newly proposed closure date in the expansion report. These new drastic changes in potential increased shipments and potential new streams of waste were not included in the submitted CRA.[14]

[12] Office of Envi. Management, U.S. Dept. of Energy: Radiological Release Event at the Waste Isolation Pilot Plant on Feb. 14, 2014, 12-13(April 2014).

[13] Reinhard Knerr, Supplement Analysis for The Waste Isolation Pilot Plant Site-Wide Operations, DOE/EIS-0026-SA-12 (2021)

[14] Id.

## Conclusion

Given the findings, the 2019 Compliance Recertification Application for the Waste Isolation Pilot Plant cannot be recertified. Lack of incorporating safety standards and enforcement that would impede future accidents from occurring, especially those like the accidents of 2014, should be of paramount importance, especially with the possibility of the expansion and resulting increased activity at the WIPP site. Rather than to further increase safety standards and processes to control the WIPP site as it is, the DOE has proposed to increase the capacity and activity of how much transuranic radioactive waste will be coming in, placing the urgency on capacity and amount the WIPP site could potentially handle as opposed to placing the urgency on safety and ultimately, compliance with current regulations in place.