Title 40 CFR Part 191
Subparts B and C
Compliance Recertification Application 2019
for the
Waste Isolation Pilot Plant

Waste Characterization
(40 CFR 194.24)

United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

Compliance Recertification Application 2019
Waste Characterization
(40 CFR 194.24)

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Acronyms and Abbreviations

AK	acceptable knowledge
ATWIR	Annual Transuranic Waste Inventory Report
CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CH	contact-handled
Ci	curie
CRA	Compliance Recertification Application
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
HWFP	Hazardous Waste Facility Permit
INL	Idaho National Laboratory
kg	kilogram
LANL	Los Alamos National Laboratory
LWA	Land Withdrawal Act
m^3	cubic meters
PA	performance assessment
PABC	Performance Assessment Baseline Calculation
PAIR	Performance Assessment Inventory Report
PDP	Performance Demonstration Program
RH	remote-handled
RL	Hanford (Richland) Site
SRS	Savannah River Site
TRU	transuranic
TWBIR	Transuranic Waste Baseline Inventory Report
WDS	Waste Data System
WIPP	Waste Isolation Pilot Plant

Elements and Chemical Compounds

EDTA	ethylenediaminetetraacetic acid
Pu	plutonium

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24.0 Waste Characterization (40 CFR 194.24)

24.1 Requirements

194.24 Waste Characterization
(a) Any compliance application shall describe the chemical, radiological and physical composition of all existing waste proposed for disposal in the disposal system. To the extent practicable, any compliance application shall also describe the chemical, radiological and physical composition of to-be-generated waste proposed for disposal in the disposal system. These descriptions shall include a list of the waste components and their approximate quantities in the waste. This list may be derived from process knowledge, current non-destructive examination/assay, or other information and methods.
(b) The Department shall submit in the compliance certification application the results of an analysis which substantiates:
(1) That all waste characteristics influencing containment of waste in the disposal system have been identified and assessed for their impact on disposal system performance. The characteristics to be analyzed shall include, but shall not be limited to: Solubility; formation of colloidal suspensions containing radionuclides; production of gas from the waste; shear strength; compactability; and other waste-related inputs into the computer models that are used in the performance assessment.
(2) That all waste components influencing the waste characteristics identified in paragraph (b)(1) of this section have been identified and assessed for their impact on disposal system performance. The components to be analyzed shall include, but shall not be limited to: metals; cellulosics; chelating agents; water and other liquids; and activity in curies of each isotope of the radionuclides present.
(3) Any decision to exclude consideration of any waste characteristic or waste component because such characteristic or component is not expected to significantly influence the containment of the waste in the disposal system.
(c) For each waste component identified and assessed pursuant to paragraph (b) of this section, the Department shall specify the limiting value (expressed as an upper or lower limit of mass, volume, curies, concentration, etc.), and the associated uncertainty (i.e., margin of error) for each limiting value, of the total inventory of such waste proposed for disposal in the disposal system. Any compliance application shall:
(1) Demonstrate that, for the total inventory of waste proposed for disposal in the disposal system, WIPP complies with the numeric requirements of §194.34 and §194.55 for the upper or lower limits (including the associated uncertainties), as appropriate, for each waste component identified in paragraph (b)(2) of this section, and for the plausible combinations of upper and lower limits of such waste components that would result in the greatest estimated release.
(2) Identify and describe the method(s) used to quantify the limits of waste components identified in paragraph (b)(2) of this section.
(3) Provide information that demonstrates that the use of acceptable knowledge to quantify components in waste for disposal conforms with the quality assurance requirements of §194.22.
(4) Provide information which demonstrates that a system of controls has been and will continue to be implemented to confirm that the total amount of each waste component that will be emplaced in the disposal system will not exceed the upper limiting value or fall below the lower limiting value described in the introductory text paragraph (c) of this section. The system

of controls shall include, but shall not be limited to: Measurement; sampling; chain of custody records; record keeping systems; waste loading schemes used; and other documentation.
(5) Identify and describe such controls delineated in paragraph (c)(4) of this section and confirm that they are applied in accordance with the quality assurance requirements found in §194.22.
(d) The Department shall include a waste loading scheme in any compliance application, or else performance assessments conducted pursuant to §194.32 and compliance assessments conducted pursuant to §194.54 shall assume random placement of waste in the disposal system.
(e) Waste may be emplaced in the disposal system only if the emplaced components of such waste will not cause:
(1) The total quantity of waste in the disposal system to exceed the upper limiting value, including the associated uncertainty, described in the introductory text to paragraph (c) of this section; or
(2) The total quantity of waste that will have been emplaced in the disposal system, prior to closure, to fall below the lower limiting value, including the associated uncertainty, described in the introductory text to paragraph (c) of this section.
(f) Waste emplacement shall conform to the assumed waste loading conditions, if any, used in performance assessments conducted pursuant to §194.32 and compliance assessments conducted pursuant to §194.54.
(g) The Department shall demonstrate in any compliance application that the total inventory of waste emplaced in the disposal system complies with the limitations on transuranic waste disposal described in the WIPP LWA.
(h) The Administrator will use inspections and records reviews, such as audits, to verify compliance with this section.

24.2 Background

The criteria in 40 CFR 194.24 (U.S. EPA 1996) require the U.S. Department of Energy (DOE) to identify and describe quantitative information on those physical, chemical, and radiologic characteristics of the transuranic (TRU) waste that can impact disposal system performance at the Waste Isolation Pilot Plant (WIPP). The DOE is required to establish limits on the quantities of different waste components (i.e., metals; cellulosics; radionuclides). These limits must be established based on the total inventory proposed for disposal such that when used in performance assessment (PA), the results comply with the containment requirements of 40 CFR 191.13 (U.S. EPA 1993) and with the limitations on TRU waste as identified in 40 CFR 194.24 (U.S. EPA 1996). The U.S. Environmental Protection Agency (EPA) may use audits and inspections described in 40 CFR 194.22 to verify compliance with the requirements of 40 CFR 194.24.

When used in PA modeling, the DOE applies a scaling methodology to the projected inventory (not yet generated) so that when combined with the stored (already generated) and emplaced (already in WIPP) inventories simulate that the WIPP repository is filled to its legislated capacity of 6.2 million cubic feet of TRU waste at the time of closure, as identified in the WIPP Land Withdrawal Act (LWA) (U.S. Congress 1996). The scaled inventory will be published in the Performance Assessment Inventory Report (PAIR) that will be used for the deferred PA.

The TRU waste inventory was first reported in 1994 (U.S. DOE 1994) and has been collected annually since 2007. Table 24-1 provides a brief history of the inventory documentation used to support the Compliance Certification Application (CCA) (U.S. DOE 1996a) and subsequent Compliance Recertification Applications (CRAs).

Table 24-1. Inventory Documents for Compliance Applications

Title	Purpose
Transuranic Waste Baseline Inventory Report (TWBIR), Revision 2 (U.S. DOE 1995) TWBIR, Revision 3 (U.S. DOE 1996b)	Used in the CCA and Performance Assessment Verification Test to show that the WIPP facility was in compliance with the disposal standards.
Appendix DATA-2004, Attachment F of Title 40 CFR 191, Subparts B and C, Compliance Recertification 2004 (U.S. DOE 2004)	Provided updated TRU waste inventory information for the CRA-2004 (U.S. DOE 2004).
TWBIR–2004 (U.S. DOE 2006)	This was a revision of Appendix DATA-2004, Attachment F. Provided updated TRU waste inventory information to support the CRA-2004 Performance Assessment Baseline Calculation (PABC) and was used for CRA-2009 (U.S. DOE 2009).
Performance Assessment Inventory Report (PAIR)–2008 (Crawford et al. 2009)	Provided TRU waste inventory information from the Annual Transuranic Waste Inventory Report (ATWIR)–2008 (U.S. DOE 2008) in the required format for the CRA-2009 PABC.
PAIR–2012 (Van Soest 2012)	Provided TRU waste inventory information from the ATWIR–2012 (U.S. DOE 2012) in the required format for the CRA-2014 (U.S. DOE 2014) PA.
ATWIR–2017 (U.S. DOE 2017)	Provides updated TRU waste inventory information for this recertification application.

For the CCA (U.S. DOE 1996a) and each subsequent CRA, the EPA has reviewed the information provided and has determined that the DOE continues to comply with the criteria of 40 CFR 194.24. Information and data from previous compliance certification and recertification applications that form the basis of past DOE compliance positions and past EPA decision documents are found in the CRA-2014 (U.S. DOE 2014).

24.3 Changes or New Information since the CRA-2014

24.3.1 40 CFR 194.24(a)

To meet the requirements of 40 CFR 194.24(a), the DOE described and categorized the TRU waste inventory emplaced in the WIPP repository and the waste that existed or was expected to be generated at TRU waste sites since the CRA-2014, which was based on the inventory with a cutoff date of December 31, 2011. The TRU waste inventory used in the CRA-2019 (March 2019 submittal) is based on the ATWIR-2017 (U.S. DOE 2017) inventory data with a cutoff date of December 31, 2016.

Volumes and characteristics (radiological and non-radiological) of waste that a TRU waste generator site may report as coming to the WIPP facility depend on factors that vary over time. Changes to the TRU waste inventory may be attributed to:

- Availability and confidence in supplemental characterization information or process knowledge.
- Site estimates of projected TRU waste stream volumes.
- Continuing waste emplacement at the WIPP facility.
- Regulations on the federal and state level.
- Waste program management decisions at the generator site, the WIPP facility, and the national level.
- Site funding for waste management on sites.
- Inventory standardized collection methodologies and data check enhancements.

The data presented in Tables 24-2 through Table 24-6 are obtained from documents cited in the table footnotes; however, in some cases the data were supplemented by database queries or reports so they could be presented in the appropriate units or totals. To discuss changes in the inventories, the unscaled values are presented in the subsequent sections, as applicable, since scaled values do not provide a one-to-one comparison for the existing waste.

24.3.1.1 TRU Waste Volume

Tables 3-1 and 3-2 of the ATWIR-2017 (U.S. DOE 2017) list the stored and projected volumes of contact-handled (CH) TRU and remote-handled (RH) TRU waste by TRU waste site, respectively. Table 24-2 lists the total (sum of stored, projected, and emplaced) volumes by waste type for the CRA-2014 and CRA-2019.

Table 24-2. Total CH and RH TRU Waste Volumes (m^3)

	CRA-2014[1] (cutoff 12/31/2011)	**CRA-2019[2]** (cutoff 12/31/2016)
CH	147,000	166,000
RH	3,840	3,400

[1]U.S. DOE 2012; [2]U.S. DOE 2017

Since the CRA-2014, the inventory volume for CH-TRU waste has increased and RH-TRU waste has decreased. The increase in CH-TRU waste can be mainly attributed to the Savannah River Site (SRS), Los Alamos National Laboratory (LANL), and the Hanford (Richland) Site (RL), with a total increase between the three sites of approximately 19,000 cubic meters (m^3). SRS increased approximately 4,500 m^3 due to waste stream SR-T001-WSB-1 changing from

Potential to WIPP-bound and as directed by DOE in response to a Record of Decision (U.S. DOE 2016a), documenting the addition of waste stream SR-KAC-PuOx (i.e., six metric tons), which contains approximately 4,200 m^3 of plutonium (Pu) oxide from K-Area. LANL's projected volume increased approximately 6,500 m^3 due to new waste generation estimates more accurately reflecting the ongoing and future activities. RL showed a net increase of approximately 3,600 m^3 primarily due to projected soil remediation and decontamination and decommission (D&D) activities.

The decrease in RH-TRU waste volume is mainly attributed to RL, with a decrease of about 600 m^3. This decrease was primarily due to new estimates in uncontained waste for waste stream RL618-08 based on ongoing retrieval and projected D&D efforts. For more details on the specific volume changes, refer to ATWIR-2012 (U.S. DOE 2012) for the CRA-2014 and ATWIR-2017 (U.S. DOE 2017) for the CRA-2019.

24.3.1.2 Number of Curies

Tables 3-8 and 3-9 of ATWIR-2017 (U.S. DOE 2017) list the anticipated (sum of stored and projected) CH-TRU and RH-TRU radionuclide activities (decay and buildup corrected through 2016) by site and radionuclide, respectively. Table 24-3 lists the total (sum of stored, projected, and emplaced) CH and RH activities for the CRA-2014 and CRA-2019, which have different decay periods. The CRA-2014 total activity was decayed to the common year of 2011 and the CRA-2019 was decayed to the common year of 2016.

Table 24-3. Total CH and RH TRU Activity (Ci)

	CRA-2014[1] (cutoff 12/31/2011)	**CRA-2019[2]** (cutoff 12/31/2016)
CH	3,480,000	6,390,000
RH	1,200,000	1,180,000

[1]U.S. DOE 2012; [2]U.S. DOE 2017

Since the CRA-2014, the total activity for CH-TRU waste reported by the generator sites has increased by approximately 2.9 million curies (Ci). The majority of this increase (2.4 million Ci) is from SRS and is mainly due to the addition of the projected waste stream SR-KAC-PuOx. Another major factor to the increase of CH activity can be attributed to the LANL waste stream LA-MHD01.001, which increased around 600,000 Ci due to more accurate estimates in the data and a significant increase in projected waste. The total activity for RH-TRU waste has decreased since the CRA-2014 by approximately 20,000 Ci, which is a minor change considering the total RH TRU activity reported for CRA-2019 is 1.18 million Ci. This decrease is mainly attributed to the net change between a combined decrease of approximately 260,000 Ci from two generator sites, RL and Material and Fuels Complex, and a combined increase of approximately 240,000 Ci from Oak Ridge National Laboratory, Idaho National Laboratory (INL), and Argonne National Laboratory. For more details on these changes, refer to ATWIR-2012 (U.S. DOE 2012) for the CRA-2014 and ATWIR-2017 (U.S. DOE 2017) for the CRA-2019.

24.3.1.3 Waste, Packaging, and Emplacement Materials

Table 3-4 of the ATWIR-2017 (U.S. DOE 2017) lists the stored and projected waste and packaging components of the CH-TRU and RH-TRU waste inventory. Table 24-4 provides the total mass of non-radiological waste materials (iron, aluminum-based metal/alloys, other metal/alloys, other inorganic materials, cellulosic, rubber, plastics, cement, solidified inorganic and organic materials, and soils) in the TRU waste containers and packaging materials (cellulose, plastic, rubber, steel, and lead) associated with WIPP-approved containers for the CRA-2014 and CRA-2019. Table 24-4 reports the total (CH/RH anticipated and emplaced) waste and packaging materials.

Table 24-4. Total Waste and Packaging Materials (kg)

	CRA–2014[1] (cutoff 12/31/2011)	**CRA–2019[2]** (cutoff 12/31/2016)
Waste Materials	45,700,000	56,600,000
Packaging Materials	33,900,000	41,100,000

[1]U.S. DOE 2012 [2]U.S. DOE 2017

Since the CRA-2014, the total mass of waste and packaging materials have increased due to volume increases from SRS, LANL, and RL as reported in Section 24.3.1.1. In addition, the increase in the mass of waste materials is attributed to INL using characterized waste material data in place of historical estimates, as well as the reassignment of waste into the Advanced Mixed Waste Treatment Project's waste streams that are repackaged into drums, supercompacted into pucks, and placed into 100-gallon drums. It should also be noted that the supercompacted drum container itself is now being reported as additional metal waste instead of being reported as a steel packaging material. The changes at these sites accounted for an increase in approximately 10 million kilograms (kg) of waste material and 7 million kg of packaging material. Of the 10 million kg increase in waste material, approximately 5 million kg is attributed to INL, while the remaining 5 million is attributed to SRS, LANL, and RL. The 7 million kg increase in packaging material can be primarily attributed to a 3.2 million kg increase at RL, a 2.9 million kg increase at SRS and a 1.5 million kg increase at LANL. For more specific details on the waste and packaging material parameter changes refer to ATWIR-2012 (U.S. DOE 2012) for the CRA-2014 and ATWIR-2017 (U.S. DOE 2017) for the CRA-2019.

Table 24-5 lists the total emplacement material (cardboard slip sheets/stabilizer-cellulose; polypropylene supersacks, slip sheets, and stretch/shrink wrap-plastic) mass for the CRA–2014. The DOE has deferred submittal of the CRA-2019 PA until after submission of the CRA-2019 (see Executive Summary 2019, Section 1.3). As such, the CRA-2014 PA continues to be the baseline calculation for the CRA-2019. To account for the total mass of the emplacement materials that will be in the repository at closure, an analysis (Van Soest 2012) has been performed for the CRA-2014 using a scaled final form inventory that represents a full repository. Since the DOE has elected to defer the CRA-2019 PA an analysis has not yet been performed for the CRA-2019. Once this analysis is performed, the mass of the emplacement materials for CRA-2019 will be contained in the PAIR that will be used for the deferred PA.

Table 24-5. Total Emplacement Materials (kg) (Scaled)

	CRA-2014[1] (cutoff 12/31/2011)	CRA-2019
Emplacement Materials	1,510,000	Not Available

[1]Van Soest 2012

24.3.1.4 Organic Ligands and Oxyanions

Table 24-6 lists the total (sum of CH and RH WIPP-bound stored and projected) organic ligands (acetate, acetic acid, citrate, citric acid, ethylenediaminetetraacetic acid [EDTA], oxalate, oxalic acid) and oxyanion (nitrate, phosphate, sulfate) masses for the CRA-2014 and CRA-2019.

Table 24-6. Total Organic Ligands and Oxyanions (kg)

	CRA-2014[1] (cutoff 12/31/2011)	CRA-2019[2] (cutoff 12/31/2016)
Organic Ligands	19,500	21,600
Oxyanions	1,070,000	888,000

[1]U.S. DOE 2012; [2]U.S. DOE 2017

Since the CRA-2014, the total mass of organic ligands has increased by approximately 2,100 kg and oxyanions has decreased by approximately 179,000 kg. The increase in organic ligands is due to generator sites adding new waste streams, developing acceptable knowledge (AK) documentation and collecting information out to calendar year 2050. The decrease in oxyanions is primarily from waste that either falls out of the TRU waste inventory as low level or has been shipped to the WIPP. Because the organic ligands and oxyanions are not tracked in the Waste Data System (WDS), an analysis will be performed to account for the emplaced mass in the PAIR that will be used for the deferred PA. For more details on these changes, refer to ATWIR-2012 (U.S. DOE 2012) for the CRA-2014 and ATWIR-2017 (U.S. DOE 2017) for the CRA-2019.

Based on the information presented in Section 24.3.1, the DOE believes it has demonstrated continued compliance with the provisions of 40 CFR 194.24(a).

24.3.2 40 CFR 194.24(b)(1), (b)(2), (b)(3), (c)(1), (d), (e)(1), (e)(2), and (f)

The DOE has deferred submittal of the CRA-2019 PA until after submission of the CRA-2019 (see Executive Summary 2019, Section 1.3). As such, the CRA-2014 PA continues to be the baseline calculation for the CRA-2019. The DOE believes it has demonstrated continued compliance with the provisions of 40 CFR 194.24(b)(1), (b)(2), (b)(3), (c)(1), (d), (e)(1), (e)(2), and (f).

24.3.3 40 CFR 194.24(c)(2) and (c)(3)

The February 2014 fire and radiological release incidents, and the subsequent Accident Investigation Board results, have resulted in a major revision to how waste generators characterize waste for disposal and how AK evaluations are performed for TRU waste, as explained below. The other measurement techniques such as real-time radiography, visual examination, and nondestructive assay have not changed since the CRA-2014.

24.3.3.1 Enhanced Acceptable Knowledge

There have been several major changes in the way AK waste characterization is performed since the CRA-2014. Changes to the waste characterization program resulted in revisions to the WIPP Documented Safety Analysis (U.S. DOE 2016b) and the Waste Acceptance Criteria (U.S. DOE 2016c) to require "enhanced AK" methods to be implemented to ensure that chemical and physical incompatibilities in the waste are identified prior to shipment to the WIPP.

24.3.3.2 Certification Program Changes

The National TRU Program instituted a Generator Site Technical Review program (U.S. DOE 2016d) designed to evaluate (through observations, document reviews, and interviews) the site processes that produce waste or materials that will become waste prior to the implementation of the waste certification processes.

The DOE's Technical Assist Program (TAP) will perform technical assist visits to the TRU waste generator sites throughout the DOE's weapons complex. The TAP scope can include any activity that has the potential to affect the ability of waste to be compliantly characterized and certified for disposal at WIPP. Through TAP visits, DOE will ensure that measures are being taken by TRU waste generator site programs to improve their waste management practices and the documentation of the processes (inputs and outputs) of their early waste management activities directly related to the processing of nuclear materials prior to being declared waste.

Based on the information presented in Section 24.3.3, the DOE believes it has demonstrated continued compliance with the provisions of 40 CFR 194.24(c)(2) and (c)(3).

24.3.4 40 CFR 194.24(c)(4)

The WIPP Waste Information System was retired in December 2009, and replaced with the WDS to provide the DOE with a modern approach to process controls and data sharing as described in CRA-2014, Section 24.8.7. The WDS used the Oracle Version 11g database management system at the time of the CRA-2014, as described in CRA-2014, Section 24.8.7. The WDS now uses Oracle DB 12c, and a web interface for user access. The EPA was provided with system access to the WDS in 2009. The WDS Data Dictionary (U.S. DOE 2018a) is not included in the WDS User's Manual (U.S. DOE 2018b), but is included as a reference to this section for consistency with previous CRA submissions. Appendix MON-2014, Section MON-3.5, briefly describes the WDS and its function for the monitoring program that was developed to meet commitments contained in the CRA-2014, which demonstrated compliance with radioactive waste disposal regulations 40 CFR Part 191 Subparts B and C and the certification

criteria in 40 CFR Part 194. Therefore, the DOE believes it has demonstrated continued compliance with the provisions of 40 CFR 194.24(c)(4).

24.3.5 40 CFR 194.24(c)(5)

The DOE describes the Performance Demonstration Program (PDP) in the CRA-2014, Section 24, Waste Characterization (U.S. DOE 2014). Since the CRA-2014, both the *Performance Demonstration Program Plan for Nondestructive Assay of Boxed Wastes for the TRU Waste Characterization Program, Revision 5* (U.S. DOE 2015a) and the *Performance Demonstration Program Plan for Nondestructive Assay of Drummed Wastes for the TRU Waste Characterization Program, Revision 5* (U.S. DOE 2015b) have been revised. The most significant changes to the PDP documents was the New Mexico Environment Department's approval of DOE's modifications to the WIPP Hazardous Waste Facility Permit (HWFP) to remove all references to the Performance Demonstration Program Plans for Analysis of Simulated Headspace Gases and RCRA Constituents Analysis of Solidified Wastes (Skibitski 2013). Also incorporated in subsequent revisions to the PDP documents were editorial changes, updates to the Carlsbad Field Office organizational structure, the addition of a change history section, and minor changes to the configuration forms. The Performance Demonstration Program Plan for Analysis of Simulated Headspace Gases and the Performance Demonstration Program Plan for RCRA Constituents Analysis of Solidified Wastes have been canceled in accordance with the modifications to the WIPP HWFP. Therefore, the DOE believes it has demonstrated continued compliance with the provisions of 40 CFR 194.24(c)(5).

24.3.6 40 CFR 194.24(g)

The CRA-2019 inventory has changed from the CRA-2014 inventory and is described in Section 24.3.1. The WDS tracks compliance with the limitations on CH-TRU and RH-TRU waste described in the WIPP LWA (U.S. Congress 1996). Therefore, the DOE believes it has demonstrated continued compliance with the provisions of 40 CFR 194.24(g).

24.3.7 40 CFR 194.24(h)

The DOE continues to comply with the inspection and records requirements, as discussed in Section 22 of this application. Therefore, the DOE believes it has demonstrated continued compliance with the provisions of 40 CFR 194.24(h).

In conclusion, the DOE believes it has demonstrated continued compliance with all provisions of 40 CFR 194.24.

24.4 References

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

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