Title 40 CFR Part 191
Subparts B and C
Compliance Recertification Application 2014
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 2014
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(40 CFR § 194.24)

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Acronyms and Abbreviations

AK	acceptable knowledge
AMWTF	Advanced Mixed Waste Treatment Facility
ATWIR	Annual Transuranic Waste Inventory Report
CAO	Carlsbad Area Office
CARD	Compliance Application Review Document
CBFO	Carlsbad Field Office
CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CH	contact-handled
Ci	curie
CID	Comprehensive Inventory Database
CPR	cellulose, plastic and rubber
CRA	Compliance Recertification Application
DBR	direct brine release
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FMT	Fracture-Matrix Transport
GWB	generic weep brine
HSG	headspace gas
ICP	Idaho Cleanup Project
INL	Idaho National Laboratory
kg	kilogram
LANL	Los Alamos National Laboratory
LWA	Land Withdrawal Act
m^3	cubic meters
NDA	nondestructive assay
NDE	nondestructive examination
PA	performance assessment
PABC	Performance Assessment Baseline Calculation
PAIR	Performance Assessment Inventory Report
PAVT	Performance Assessment Verification Test
PCR	Planned Change Request
PDP	performance demonstration program

QA	quality assurance
QAO	quality assurance objective
QAPD	Quality Assurance Program Document
QAPP	Quality Assurance Program Plan
rem	roentgen equivalent man
RFETS	Rocky Flats Environmental Technology Site
RH	remote-handled
RTR	real-time radiography
SRS	Savannah River Site
TRU	transuranic
TWBID	Transuranic Waste Baseline Inventory Database
TWBIR	Transuranic Waste Baseline Inventory Report
VE	visual examination
WAC	Waste Acceptance Criteria
WAP	Waste Analysis Plan
WCPIP	Waste Characterization Program Implementation Plan
WDS	Waste Data System
WIPP	Waste Isolation Pilot Plant
WTWBIR	WIPP Transuranic Waste Baseline Inventory Report
WUF	waste unit factor
WWIS	WIPP Waste Information System
yr	year

Elements and Chemical Compounds

Am	americium
An	actinide
An(III)	general actinide in the +3 oxidation state
An(IV)	general actinide in the +4 oxidation state
An(V)	general actinide in the +5 oxidation state
CH_4	methane
Cm	curium
CO_2	carbon dioxide
Cs	cesium
EDTA	ethylenediaminetetraacetic acid

$f(CO_2)$	fugacity of carbon dioxide
$Mg_5(CO_3)_4(OH)_2 \cdot 4H_2O$	hydromagnesite
Mg	magnesium
$Mg(OH)_2$	brucite
MgO	magnesium oxide
Np	neptunium
pH	the negative, common logarithm of the activity of H^+
Pu	plutonium
Sr	strontium
Th	thorium
$Th(OH)_4$	thorium hydrate
U	uranium

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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 which demonstrates that the use of process knowledge to quantify components in waste for disposal conforms with the quality assurance requirements found in Section 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 Section 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, such as audits, to verify compliance with this section.

24.2 Background

The U.S. Department of Energy (DOE) first demonstrated and documented compliance with the U.S. Environmental Protection Agency (EPA) radioactive waste disposal requirements found in 40 CFR Part 191 (U.S. EPA 1993) in its Compliance Certification Application (CCA) (U.S. DOE 1996a). The EPA reviewed the CCA against its Certification Criteria, found in 40 CFR Part 194 (U.S. EPA 1996), and certified that the DOE Waste Isolation Pilot Plant (WIPP) complies with the radioactive waste disposal regulations set forth in 40 CFR Part 191 Subparts B and C (Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste) (U.S. EPA 1998a). In its demonstration of compliance, the DOE developed a computational modeling system to predict the future performance of the repository for 10,000 years (yrs) after closure. The system, called the WIPP Performance Assessment (PA), must consider both natural and man-made processes and events that affect the disposal system. The PA system is used to demonstrate compliance with the containment requirements of 40 CFR 191.13 (U.S. EPA 1993) and to provide input values to the compliance assessments. Compliance assessments may be regarded as a subset of PA, as defined in Section 54.

The WIPP PA requires many input parameters to represent the complex coupled processes that are expected to occur throughout the 10,000-yr regulatory time period. Some of these parameters relate directly to the transuranic (TRU) waste inventory. The TRU waste inventory includes information about materials in the waste (wood, metal, soil, etc.), materials used to package waste (steel drums, plastic liners, etc.), emplacement materials (cellulose, plastic, and rubber [CPR]), radionuclides in the waste, and key chemicals in the waste that are expected to impact or have a role in the performance of the repository. The TRU waste information needed as input to the WIPP PA is waste volumes, waste materials, packaging materials, emplacement materials, radionuclide activities, complexing agents (ethylenediaminetetraacetic acid [EDTA], acetate, citrate, oxalate, acetic acid, citric acid, and oxalic acid), and oxyanions (sulfate, nitrate, and phosphate).

TRU waste inventory has been reported by the DOE since 1994. The first inventory was reported as the *Waste Isolation Pilot Plant Transuranic Waste Baseline Inventory Report* (WTWBIR) (U.S. DOE 1994). This initial report was followed by WTWBIR Revision 1 (U.S. DOE 1995a), and two additional baseline reports, *Transuranic Waste Baseline Inventory Report* (TWBIR) Revisions 2 and 3 (U.S. DOE 1995b and U.S. DOE 1996b, respectively).

The TWBIR Revisions 2 and 3, included in the CCA, Appendix BIR, reported the TRU waste inventory basis for the CCA WIPP PA and the Performance Assessment Verification Test (PAVT) (U.S. DOE 1997). Following the receipt of the CCA PAVT analysis, the EPA ruled in May 1998 that the WIPP met the requirements for permanent disposal of TRU waste (U.S. EPA 1998a).

The first shipment of radioactive TRU waste from the nation's nuclear weapons complex arrived at the WIPP site in late March 1999. This marked the time for subsequent recertification of the WIPP every five years after initial waste receipt, as required by the Land Withdrawal Act (LWA) (U. S. Congress 1996). Thus, the first Compliance Recertification Application (CRA), CRA-2004 (U.S. DOE 2004), was submitted to the EPA by the DOE in March 2004. In the CRA-

2004, the DOE prepared a TRU waste inventory that was published in Appendix DATA, Attachment F and associated annexes.

During its review of the PA submitted in the CRA-2004, the EPA directed the DOE to conduct the CRA-2004 Performance Assessment Baseline Calculation (PABC) (Cotsworth 2005). Leigh, Trone, and Fox (Leigh, Trone, and Fox 2005) defined the inventory for the CRA-2004 PABC (Leigh et al. 2005). This inventory information was later published in the Transuranic Baseline Inventory Report-2004 (U.S. DOE 2006).

Following the receipt of the CRA-2004 PABC analysis, the EPA ruled on March 29, 2006, that the DOE demonstrated continued compliance with the requirements of 40 CFR § 194.24, and the repository was recertified for the first time (U.S. EPA 2006a).

After the CRA-2004, the DOE began to update the inventory on an annual basis. The inventory for the CRA-2009 PA (U.S. DOE 2009a and U.S. DOE 2009b) was the same inventory used for the CRA-2004 PABC (Leigh, Trone, and Fox 2005). The EPA reviewed the inventory updates, mainly the *Annual Transuranic Waste Inventory Report-2007* (ATWIR-2007) (DOE 2008a) and the ATWIR-2008 (DOE 2008b), and determined that a new performance assessment, the CRA-2009 PABC, needed to be conducted in order to include the increase in chemical components and other chemical properties. The EPA directed the DOE to perform the CRA-2009 PABC using the inventory contained in the ATWIR-2008 in its first completeness letter, dated May 21, 2009, items 1-G-3 and 1-23-1 (Cotsworth 2009a); thus, the *Performance Assessment Inventory Report-2008* (PAIR-2008) (Crawford et al. 2009) was produced for the CRA-2009 PABC.

Upon receipt and the determination of completeness (EPA 2010a) of the CRA-2009 PABC analysis, the EPA ruled on November 18, 2010, that the DOE demonstrated continued compliance with the requirements of 40 CFR § 194.24 and the repository was recertified for the second time (EPA 2010b).

The CRA-2014 inventory is presented in Section 24.8, Changes or New Information Since the CRA-2009 Recertification, and is based on the unscaled ATWIR-2012 (DOE 2012a) and the scaled (disposal) PAIR-2012 (Van Soest 2012), both with a data cut-off date of December 31, 2012.

24.3 1998 Certification Decision

24.3.1 40 CFR § 194.24(a)

In accordance with the requirements of 40 CFR § 194.24(a), the DOE provided in the CCA a description of existing TRU waste, a list of approximate quantities of waste components and, to the extent practicable, descriptions of TRU waste to be generated. This information was provided by the DOE in the form of waste profiles that were reviewed by the EPA. Upon completion of the review of these profiles, the EPA found the DOE in compliance with section 194.24(a) (Compliance Application Review Document [CARD] 24, Section 24.A.6, pp. 24-7 through 24-9) (U.S. EPA 1998b).

24.3.2 40 CFR § 194.24(b)(1)

In accordance with the requirements of 40 CFR § 194.24(b)(1), the DOE presented the results of its waste characteristics and components analyses in the CCA, Chapter 4.0 and Appendices MASS, WCA, SOTERM, and SA. The DOE indicated that the following characteristics were expected at the time of the CCA to have a significant effect on disposal system performance: radionuclide solubilities (including oxidation state distributions); formation of colloidal suspensions containing radionuclides; production of gas from the waste (hydrogen, and microbial substrate/nutrients for methane (CH_4) gas generation); shear strength, compactability (waste compressibility), and particle diameter; radioactivity in curies (Ci) for each isotope; and TRU radioactivity at closure.

These characteristics were included in the PA for the CCA. The EPA concluded that the DOE generally performed a thorough and well documented analysis, adequately identified all waste characteristics and, except for actinide (An) solubility and shear strength, appropriately assessed them as PA input parameters. The CCA PAVT was run using modified parameters, which satisfied the EPA's concerns (CARD 23, p. 23-10, and Section 12.4, pp. 23-42 through 23-68 (U.S. EPA 1998c), and CARD 24, Section 24.B.6, pp. 24-26 through 24-31 (U.S. EPA 1998b)).

24.3.3 40 CFR § 194.24(b)(2)

In accordance with the requirements of 40 CFR § 194.24(b)(2), the DOE identified a number of waste components and characteristics that would be important to performance. The EPA reviewed these components and characteristics and identified several issues with the DOE's treatment of them in the CCA PA. However, through independent analysis and changes made in the CCA PAVT, these issues were resolved and the EPA determined that the DOE complied with this section (CARD 24, Section 24.C.5, pp. 24-40 and 24-41) (U.S. EPA 1998b).

24.3.4 40 CFR § 194.24(b)(3)

In accordance with the requirements of 40 CFR § 194.24(b)(3), the DOE provided a list of those waste characteristics and components that were excluded from consideration in the PA for various reasons. The EPA had questions pertaining to assumptions and conclusions made by the DOE regarding organic ligands, but concluded that the DOE's treatment of organic ligands in the PA was adequate based on relevant literature and bounding assumptions using 1000 times the EDTA concentrations expected to be present in the repository (CARD 24, Section 24.D.5, pp. 24-43 and 24-44) (U.S. EPA 1998b).

24.3.5 40 CFR §§ 194.24(c)(1), (e)(1), (e)(2)

In accordance with the requirements of 40 CFR §§ 194.24(c)(1), (e)(1), and (e)(2), the DOE specified the limiting value of the following waste material components: ferrous metals (minimum 2×10^7 kilograms [kg]); CPR (maximum 2×10^7 kg); free water emplaced with the waste (maximum 1,684 cubic meters [m^3]); and nonferrous metals (metals not containing iron) (minimum 2×10^3 kg). In addition to these limits, the DOE provided plausible combinations of upper and lower limits and a rationale for these limits, the results of modeling code runs, the demonstration of numeric compliance, and the greatest release estimates. These limits, model

runs, maximum calculated releases, and release estimates were found to be adequately described according to the EPA (CARD 24, Section 24.F.5, pp. 24-58 through 24-65) (U.S. EPA 1998b).

The EPA also agreed that the PA appropriately accounted for the upper and lower limits because fixed values were used.

In a determination of compliance with sections 194.24(e)(1) and (e)(2), the EPA reviewed the DOE's description of system controls, chain-of-custody information, controls in place to track the WIPP TRU waste, waste record keeping and accountability systems, and the WIPP Waste Acceptance Criteria (WAC) requirements and controls. The EPA reviewed the CCA and determined that the DOE adequately referenced and summarized the WIPP WAC in the CCA (CARD 24, Section 24.H.5, pp. 24-80 through 24-84) (U.S. EPA 1998b).

24.3.6 40 CFR § 194.24(c)(2)

In accordance with 40 CFR § 194.24(c)(2), the DOE proposed using nondestructive examination (NDE). Real-time radiography (RTR) and visual examination (VE) were used to quantify the amounts of specific waste material components in TRU waste. The DOE described numerous nondestructive assay (NDA) instrument systems to determine radionuclides in the waste and described the equipment and instrumentation for NDA, RTR, and VE found in facilities. The DOE also provided information about performance demonstration programs (PDPs) intended to show that data obtained by each NDA method could meet data quality objectives established by the DOE including sensitivity, precision, and accuracy relative to limiting values.

The EPA found the methods described, when implemented appropriately, were adequate to characterize the important waste material components and radionuclides in TRU waste (CARD 24, Section 24.I.6, pp. 24-87 through 24-89) (U.S. EPA 1996 and U.S. EPA 1998b).

24.3.7 40 CFR § 194.24(c)(3)

In accordance with 40 CFR § 194.24(c)(3), the EPA determined that the DOE adequately described the use of acceptable knowledge (AK) only for legacy debris waste at the Los Alamos National Laboratory (LANL) (Dials 1997; U.S. EPA 1996; CARD 24; U.S. EPA 1998b).

24.3.8 40 CFR § 194.24(c)(4)

In accordance with the requirements of 40 CFR § 194.24(c)(4), the DOE described the system of documented controls used for waste characterization activities that described the management, operations, and quality assurance (QA) aspects of the program ensuring data completeness, accuracy, and discrepancy resolution prior to waste receipt at the WIPP. The DOE indicated that this system of controls would be monitored by the DOE/Carlsbad Field Office (CBFO) audit and surveillance program. In addition, the DOE provided descriptions of the documentation, data fields, and features of the WIPP Waste Information System (WWIS).

The EPA determined that the DOE provided an adequate description of the system controls and processes for maintaining centralized command and control over TRU waste characterization activities. This was inspected and verified by the EPA at LANL. Conditions 2 and 3 of the 1998

Certification Decision specified that the DOE was prohibited from shipping waste for disposal at the WIPP until the EPA approved site-specific waste characterization programs and controls (CARD 24, Section 24.H.5, pp. 24-80 through 24-84) (U.S. EPA 1998b).

24.3.9 40 CFR § 194.24(c)(5)

In accordance with the requirements of 40 CFR § 194.24(c)(5), the DOE described the PDP for NDA as required by the WIPP Quality Assurance Program Plan (QAPP). Under this CBFO program, the PDP standards address activity ranges relative to WAC limits, QAPP quality assurance objectives (QAOs), and NDA method detection limits. (See CARD 22 [U.S. EPA 1998d] for additional discussion of QA for waste characterization activities.) The EPA reviewed the updated PDP Plan for NDA and concluded that the DOE provided adequate information regarding the NDA PDP for LANL and the Rocky Flats Environmental Technology Site (RFETS) at the time of inspections. The EPA confirmed through inspections at LANL that the system of controls and the measurement techniques described and implemented at LANL were adequate to characterize waste and ensure compliance with the limits of waste components for disposal at the WIPP (CARD 22, Section 22.B-5, pp. 22-7 and 22-8) (U.S. EPA 1998d). The RFETS was later certified to ship waste to the WIPP.

24.3.10 40 CFR §§ 194.24(d) and (f)

In accordance with the requirements of 40 CFR §§ 194.24(d) and (f), the DOE had (1) assumed random waste loading and (2) evaluated the potential consequences resulting from the nonrandom loading of the highest-activity waste stream containing at least 810 drums in the WIPP. As a result of the evaluation, the DOE determined that a final waste loading plan was in fact unnecessary for the WIPP. The EPA therefore concluded that the DOE adequately cross-referenced the resultant waste distribution assumptions from the waste loading plan with the waste distribution assumptions used in the PA by random distribution of radioactive waste in the repository (CARD 24, Section 24.J.6, pp. 24-94 through 24-96) (U.S. EPA 1998b).

24.3.11 40 CFR § 194.24(g)

In accordance with the requirements of 40 CFR § 194.24(g), the DOE identified the following LWA limits to demonstrate compliance:

- Curie limits for remote-handled transuranic (RH-TRU) waste: 5.1 million Ci (approximately 1.89×10^{17} becquerels).

- Total capacity of RH-TRU and contact-handled transuranic (CH-TRU) waste that may be disposed: 6.2 million ft^3 (175,564 m^3).

- RH-TRU waste will not exceed 1,000 rem (roentgen equivalent man) per hour, no more than 5 percent (%) by volume of RH-TRU will exceed 100 rem per hour, and RH-TRU will not exceed 23 Ci per liter maximum activity level (averaged over the volume of the canister).

- In addition, the DOE provided numerous tables that presented the WIPP waste inventory in terms of activity (in Ci) and total volumes (in m^3). The EPA reviewed this information,

including the process the DOE outlined for controlling the waste and the use of the WWIS, and determined that the DOE had an adequate program for tracking and controlling the waste (CARD 24, Section 24.K.5, pp. 24-98 and 24-99) (U.S. EPA 1998b).

24.3.12 40 CFR § 194.24(h)

The EPA found the DOE in compliance with the provisions of 40 CFR § 194.24(h). Inspections, such as audits, and records are addressed by the EPA in CARD 22 (U.S. EPA 1998d).

24.4 Changes in the CRA-2004

24.4.1 40 CFR § 194.24(a)

To meet the requirements of section 194.24(a), the DOE described and categorized the TRU waste currently emplaced in the WIPP and the waste that existed or was expected to be generated at the DOE TRU waste sites in the CRA-2004 (U.S. DOE 2004). The DOE developed a descriptive methodology for collecting and grouping waste information obtained from each TRU waste site. The DOE also described and categorized the TRU waste that was currently emplaced in the WIPP and the waste that existed or was expected to be generated at the DOE TRU waste sites. The emplaced waste was tracked as reported in the WWIS and was included in the CRA-2004 inventory. The details of the CRA-2004 inventory are presented in the CRA-2004, Chapter 4.0, Appendix TRU WASTE-2004, and Appendix DATA-2004, Attachment F.

As a result of responses to questions from the EPA during its review of the CRA-2004 PA, the DOE was directed to conduct a new PA for recertification to incorporate inventory changes, as well as other technical changes (Cotsworth 2005). The new inventory components and radiological estimates were reported in TWBIR-2004 (U.S. DOE 2006) and subsequently summarized in the CRA-2004 PABC Inventory Report (Leigh, Trone, and Fox 2005).

24.4.1.1 Inventory Description

The CRA-2004 PABC Inventory Report, Table 4 (Leigh, Trone, and Fox 2005) lists the volumes of emplaced CH-TRU waste as of September 30, 2002 (the cutoff for inclusion in the CRA-2004 PA), and August 1, 2005 (the cutoff for inclusion in the CRA-2004 PABC). Table 5 of the same report lists the stored and projected CH-TRU waste estimates used for the CCA, the CRA-2004 PA, and the CRA-2004 PABC. The projected inventory information is derived from the updated waste stream profile forms and reflects each site's best determination of the waste expected to be generated. This inventory information is originally presented in the CRA-2004, Chapter 4.0, Section 4.1.3. Leigh, Trone, and Fox (Leigh, Trone, and Fox 2005), Tables 9 and 10, show the anticipated nonradioactive components of the TRU waste inventory.

For PA to model a full repository, the DOE used a scaling factor in the same manner used in the CCA. However, unlike in the CCA, the CRA-2004 also used this scaling methodology on RH-TRU waste. The techniques of inventory scaling are presented in TWBIR-2004 (U.S. DOE 2006).

24.4.1.2 Number of Curies

The radionuclide activity expected to be placed in the WIPP decreased from the CCA estimate of 3.44 million Ci to 2.32 million Ci in the CRA-2004 PABC Inventory Report (Leigh, Trone, and Fox 2005, Section 4.4, p. 36). Table 14 of the CRA-2004 PABC Inventory Report listed the activity by radionuclide for the CCA PA, the CRA-2004 PA, and the CRA-2004 PABC.

The new inventory items since 1998 that were included in the CRA-2004 PA and the CRA-2004 PABC inventory are listed below.

- Idaho National Laboratory (INL) Buried Waste—The DOE included the INL pre-1970 buried waste in the CRA-2004 PABC Inventory Report (Leigh, Trone, and Fox 2005) as a result of an April 2003 Federal District Court judgment against the DOE on the buried waste. The CRA-2004 PABC Inventory Report (Leigh, Trone, and Fox 2005) estimated 17,998 m^3 of TRU waste in five waste streams from the pre-1970 buried waste at INL.

- Supercompacted Waste—Supercompacted waste from INL's Advanced Mixed Waste Treatment Facility (AMWTF) was included in the CRA-2004 PABC TRU waste inventory estimate. After an extensive analysis of this waste (Marcinowski 2003), the EPA concluded that the supercompacted waste could be considered within the existing waste envelope and PA. The EPA approved the disposal of the supercompacted waste (Marcinowski 2004). Prior to shipping this waste, the EPA conducted a waste characterization inspection of the AMWTF (Gitlin 2005).

- Hanford Tank Waste—The DOE Office of River Protection determined that waste from 12 of the 177 tanks at the Hanford site was TRU waste or would be TRU waste after treatment. Descriptions of these tanks and their waste streams and generating processes are given in CARD 24, Table 24-1 (U.S. EPA 1998b). Patterson (Patterson 2005a and Patterson 2005b) presents the DOE's documentation for these TRU tanks.

- Hanford Waste from K-Basin—The DOE's CRA-2004 PABC TRU waste inventory also included two waste streams, RL-W445 and RL-W446, consisting of approximately 50 m^3 of waste, from the Hanford K-East and K-West Basins (Patterson 2005a and 2005b).

- Container Types—Container types new to the CRA-2004 PABC inventory included the ten-drum overpack, 5 × 5 × 8 boxes, 100-gallon drums, and pipe overpacks within drums. The container types were considered in the CRA-2004 PABC inventory development process since it was important to estimate the amount of CPR in the WIPP (Leigh, Trone, and Fox 2005, Section 4.2, p. 30).

- Organic Ligands—Four organic ligands were included in the Fracture-Matrix Transport (FMT) calculations of An solubilities: acetate, citrate, EDTA, and oxalate (Detwiler 2004a). Further discussion on organic ligands for the CCA can be found in the CCA, Appendix SOTERM, Section 5.0, and CARD 24, Section 24.C.5, pp. 24-40 and 24-41) (U.S. EPA 1998b). Organic ligands are further discussed in the CRA-2004 PA (Attachment SOTERM, Section 5.0, p. 42) and U.S. EPA (U.S. EPA 2006c).

Details of and changes occurring in the inventory processes and descriptions are discussed further in CARD 24 (U.S. EPA 2006d).

24.4.2 40 CFR § 194.24(b)(1)

There were no major changes to the waste characteristics between the CCA PAVT and the CRA-2004 PABC, but the DOE did change some of the waste components used in the PA. These changes are summarized in Table 24-2 of CARD 24 (U.S. EPA 2006d) and are presented here in Table 24-1.

Table 24-1. Significance and Changes in Components and Characteristics

Waste Component or Characteristic Used in PA	Increase or Decrease From CCA to CRA-2004 PABC	Significance
Radioactivity (Ci/m^3)	Decrease	Used in calculating releases
Solubility	Increase and decrease, depending on oxidation state	Higher solubility can lead to higher releases
Organic Ligands—complexing agents	Similar amounts	Increases solubility
Amount of Metals	Decrease	Maintains reducing environment, but also contributes to gas generation
Amount of CPRs	Increase	May increase gas generation from microbial processes
Oxyanions: nitrate, sulfate, and phosphate	Similar, but overall increase	Nutrients for microbes - affects gas generation
Cement	Decrease	Volume-related component
Shear Strength	No change	Affects mechanical releases during a drilling intrusion
Particle Diameter	The CRA-2004 PABC used the particle diameter determination from expert panel findings during the original certification	Used to calculate spallings releases
Formation of Colloidal Suspensions	No change in parameterization	Colloids can facilitate transport of radionuclides in groundwater

24.4.2.1 Assessment of Waste Characteristics and Waste Characteristic Input Parameters

In the CCA, the DOE identified several waste characteristics as being potentially important to the PA (the CCA, Appendix WCA, Section WCA.6, pp. WCA-42 and WCA-43) based on available information, including uncertainties and the WIPP system characterization. These analyses were summarized in the CCA, Appendices WCA, SOTERM, and MASS, and were augmented by the DOE's responses to the EPA comments (CARD 24, Sections 24.B.5 and 24.B.6, pp. 24-12 through 24-31) (U.S. EPA 1998b). The CRA-2004 identifies the same important characteristics, and also states that organic ligands could be important to solubility. The CRA-2004 PABC, therefore, includes the ligands in the solubility calculations (Brush and Xiong 2005).

24.4.2.2 Solubility

The DOE originally stated in the CCA that solubility of actinides was among the major characteristics of the radionuclides expected to affect disposal system performance (the CCA, Appendix WCA, Section WCA.4, pp. WCA-30 through WCA-34). The DOE assessed the solubility of thorium (Th), uranium (U), neptunium (Np), plutonium (Pu), and americium (Am) (Appendix SOTERM, U.S. DOE 1996a).

In addition, the DOE assumed that cesium (Cs) and strontium (Sr) were completely (100%) soluble; therefore, the concentrations of these two radionuclides were determined from the quantities listed in the inventory (the CCA, Appendix WCA, p. 30).

The DOE used the FMT geochemical modeling code and its associated database to calculate solubilities. No changes were made to the FMT code or conceptual models for the CRA-2004 PA or the CRA-2004 PABC. However, revisions were made to the input FMT database since the CCA PAVT. These changes included the addition of new aqueous An species to the database and revisions to existing species data because of the availability of new experimental data (see Appendix PA, Attachment SOTERM, U.S. DOE 2004). The DOE used the generic weep brine (GWB) Salado brine chemistry formulation instead of the Brine A formulation used in the CCA PA and PAVT. The most significant differences between the brine formulations were the lower magnesium concentration and higher sulfate concentration in GWB relative to Brine A. Comparison of geochemical modeling results using the two brine formulations indicated that GWB brines had slightly lower predicted An(III) solubilities and higher An(V) solubilities compared to Brine A.

24.4.2.3 Performance Assessment Parameters Related to Solubility

The solubility of actinides in the III, IV, V, and VI oxidation states for both the Castile and Salado brines were calculated by the DOE with the assumption that pH and the fugacity of carbon dioxide ($f(CO_2)$) were controlled by the brucite ($Mg(OH)_2$) –hydromagnesite ($Mg_5(CO_3)_4(OH)_2{\cdot}4H_2O$) buffer. The solubilities from the CCA and the CRA-2004 are listed in Table 24-3 of CARD 24 (U.S. EPA 2006d).

The uncertainty ranges for the actinides in the CRA-2004 PA were the same as those used in the CCA (Bynum 1996). The uncertainties in the An solubilities were used to define the range for Latin hypercube sampling of the An concentrations in the PA, assuming a log cumulative distribution (CARD 24, Section 24.B.5, pp. 24-15 and 25-16) (U.S. EPA 1998b).

24.4.2.4 Formation of Colloidal Suspensions Containing Radionuclides

Formation of colloidal suspensions was evaluated by the DOE as an important group of waste characteristics. Actinides can be mobilized in colloidal form as intrinsic colloids or absorbed on nonradioactive colloidal particles. In the CCA, the DOE determined that four types of colloids may be present in the WIPP repository: intrinsic colloids, mineral fragment colloids, humic colloids, and microbial colloids (the CCA, Appendix WCA, Section WCA.4.2, pp. WCA-34 through WCA-36). These colloids were modeled in the CRA-2004 PABC and were unchanged

from the CCA (see CARD 24, Sections 24.B.5 and 24.B.6, pp. 24-12 through 24-31 [U.S. EPA 1998b], and CCA Appendix SOTERM, Section 6.0 [U.S. DOE 1996a]).

The DOE implemented the colloidal An source term differently in the CRA-2004 PA than in the CCA. In the CCA, the DOE assumed all vectors would have a microbial colloid contribution to the An source term. For the CRA-2004 PA, the DOE assumed there would be microbial colloid transport only in vectors with microbial degradation. In the CRA-2004 PABC it was assumed that all vectors included microbial activity and thus included microbial colloid transport.

24.4.2.5 Production of Gas From the Waste (Including Microbial Substrate and Nutrients)

Gas generation included hydrogen gas generation as well as carbon dioxide (CO_2) and CH_4 generation by microbial degradation. Anoxic corrosion produces hydrogen gas and microbial action on microbial substrates such as CPR, as well as other microbial nutrients (nitrate, sulfate and phosphate), which produce CO_2 and CH_4.

The same conceptual model was used for microbial gas generation in the WIPP repository for both the CCA and the CRA-2004. Information about the models used for the CCA and the CRA-2004 can be found in the CCA, Appendix SOTERM, Section SOTERM-8.2.2, and Appendix PA-2004, Attachment SOTERM-2004, Section SOTERM-2.2.2, respectively.

Microbial gas generation rates used in the average stoichiometry model were based on experimental data from microbial consumption of papers (cellulose) under inundated and humid conditions (Wang and Brush 1996). A gas-generation rate is determined in BRAGFLO (fluid flow code) for the humid and inundated rates based on the effective liquid saturation (CRA-2004, Chapter 6.0, Section 6.4.3.3). These gas generation rates were calculated from the initial linear part of the experimental curve of CO_2 as a function of time (Appendix PA-2004, Attachment PAR-2004) (Wang and Brush 1996).

For the CRA-2004 PABC, the DOE requested a change to the gas generation rate PA parameters based on the DOE's review of additional experimental data collected over the last 10 years (Nemer and Stein 2005; Nemer, Stein, and Zelinski 2005). The gas generation experiments exhibited two rates: an initial higher rate, and a second lower rate. The DOE proposed to the EPA that the long-term rate be the gas generation rate used in the PA calculations, with the initial higher rate incorporated as an initial higher pressure.

The DOE used Latin hypercube sampling in the CRA-2004 PA for the following gas-generation-related parameters:

- Inundated steel corrosion rate
- Probability of microbial degradation of plastics and rubbers (in the event of microbial gas generation)
- Biodegradation rate of inundated and humic cellulosics
- Factor β for microbial reaction

24.4.2.6 Performance Assessment Parameters Related to Shear Strength, Compactability (Compressibility), and Particle Diameter

There were no changes in these parameters from the CCA PAVT through the CRA-2004 PABC.

24.4.2.7 Radioactivity in Curies

In the CCA (Sections 3.1 and 3.2, and Appendix WCA), the DOE indicated that the radioactivity of each isotope was important to the PA because it directly affected the waste unit factor (WUF) (number of million Ci of TRU isotopes in the WIPP inventory) (see the CCA, Appendix WCA, Table WCA-1). Since the same approach was used in the CRA-2004, the approach is summarized here.

At the time of the CCA, the following radionuclides were determined by the DOE to be important (the CCA, Appendix WCA, Figure WCA-4):

- Cuttings/cavings/spallings release: ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am, ^{233}U, ^{234}U, ^{90}Sr, ^{137}Cs, ^{244}Cm
- Direct brine release (DBR): ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{243}Am, ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{229}Th, ^{230}Th, ^{232}Th, ^{237}Np, ^{243}Cm, ^{244}Cm, ^{245}Cm
- Long-term groundwater release: ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{241}Am, ^{233}U, ^{234}U, ^{229}Th, ^{230}Th

The DOE indicated that U and Th isotopes were required in DBR assessments because, although they comprise negligible fractions of the total EPA unit, they did influence the total quantity of dissolved radionuclides (the CCA, Appendix WCA, p. WCA-22). In addition, the DOE indicated that although EPA units for ^{90}Sr and ^{137}Cs at the time of WIPP closure were significant, they are not included in direct release of brine because they rapidly decay within the first few hundred years after closure and result in "negligible impact on the PA" (the CCA, Appendix WCA, p. WCA-26). In addition, the DOE indicated that if a DBR occurred early after closure, the total brine released would be minimal and the ^{90}Sr and ^{137}Cs would still, therefore, play a minor role in compliance (the CCA, Appendix WCA, p. WCA-26).

The DOE justified the radionuclide list for the long-term groundwater pathway (releases to the Culebra Dolomite Member of the Rustler Formation [hereafter referred to as Culebra]) in the CCA, Appendix WCA, Section WCA.3.2.3, pp. WCA-26 and WCA-27.

In the CRA-2004 PABC, the selection of isotopes for modeling transport in the disposal system using NUTS and PANEL was described in Appendix TRU WASTE-2004, Section TRU WASTE-2.0. PANEL runs included nearly all isotopes of the six actinides studied in the Actinide Source Term Program: Th, U, Np, Pu, Am, and curium (Cm). NUTS runs explicitly included five isotopes: ^{230}Th, ^{234}U, ^{238}Pu, ^{239}Pu, and ^{241}Am (Garner and Leigh 2005).

24.4.2.8 PA Parameters Related to Radioactivity in Curies of Each Isotope

The DOE used the information from the update of the CCA inventory to define the isotope inventory for the CRA-2004 PA (the CRA-2004, Chapter 4.0). The CRA-2004 PABC Inventory

Report (Leigh, Trone, and Fox 2005, Table 14, p. 37) provides the radioactivity in Ci of each isotope used in the CRA-2004 PABC.

24.4.2.9 TRU Radioactivity at Closure

The CRA-2004 PABC Inventory Report, Table 14 (Leigh, Trone, and Fox 2005) lists the DOE inventory at closure, based upon the September 2002 cutoff and the CRA-2004 PABC update as described in Section 24.4.1. The CRA-2004 PABC Inventory Report indicated that the inventory estimate was 2.32×10^6 Ci and the WUF was 2.32, with inventory activity decayed to the year 2033.

24.4.2.10 PA Parameters Related to TRU Radioactivity at Closure

The 2.32 WUF was the number of millions of curies of alpha-emitting TRU radionuclides with half-lives longer than 20 years used in the calculation of the EPA normalized unit. Overall, activity at 2033 for all TRU radionuclides has decreased from 2.55×10^6 Ci reported in the CCA, to 2.48×10^6 Ci in the CRA-2004 inventory estimate, to 2.32×10^6 Ci in the CRA-2004 PABC inventory estimate. The DOE discussed the WUF value in the CRA-2004 PABC Inventory Report (Leigh, Trone, and Fox 2005, p. 36).

24.4.3 40 CFR § 194.24(b)(2)

The DOE indicated that ferrous metals, cellulose, organic chelating agents, radioactivity in curies of each isotope, alpha-emitting TRU radionuclides with half-lives greater than 20 years, solid waste components (e.g., soils and cementitious materials), sulfates and nitrates were expected to have a significant effect on disposal system performance and so were used in the CCA PA, CRA-2004 PA, and the CRA-2004 PABC. Most of the inventory amounts of the listed components changed and were discussed in Appendix PA-2004, Attachment SOTERM-2004, Table SOTERM-4; Leigh, Trone, and Fox (Leigh, Trone, and Fox 2005); and U.S. EPA (U.S. EPA 2006e). The only significant change was the incorporation of organic ligands in the An solubility PA calculations. The DOE updated the FMT thermodynamic databases with information related to organics to account for the organic ligands' affect on An solubility (Appendix PA-2004, Attachment SOTERM-2004, Section SOTERM-5.0). Organic ligand inventories were recalculated for the CRA-2004 PABC (Brush and Xiong 2005).

Changes and details on the effects of components on disposal system performance are discussed further in CARD 24 (U.S. EPA 2006d).

24.4.4 40 CFR § 194.24(b)(3)

The DOE provided a list of waste characteristics and components that were excluded from consideration in the PA for various reasons, such as negligible impact (the CCA, Appendix WCA, Table WCA-4 and Appendix TRU WASTE-2004, Section TRU WASTE-6.0). The effect of organic ligands, however, is incorporated into the CRA-2004 PABC (Brush and Xiong 2005).

24.4.5 40 CFR §§ 194.24(c)(1), (e)(1), and (e)(2)

For the CRA-2004 PA, the DOE did not make any changes to the limits identified in the CCA or their implementation in the CRA-2004 PA. In reviewing the CRA-2004 PA, the EPA identified that the packaging materials for the INL supercompacted waste were omitted from the CPR total, but these packaging materials were included in the CRA-2004 PABC as part of the inventory estimate. See CARD 24 (U.S. EPA 2006d) for further discussion.

24.4.6 40 CFR § 194.24(c)(2)

As noted in 40 CFR § 194.24(b), the DOE did not modify the list of CCA components and characteristics requiring quantification. Therefore, the CRA-2004 did not identify any significant changes to the measurement techniques used in the waste characterization program (i.e., VE, RTR, AK, and NDA). In addition, the CRA-2004 did not propose changes to the current waste characterization program through use of different NDA and NDE characterization methodologies. The CRA-2004 indicated that the location of NDA and NDE methodology documentation and information regarding QAOs had changed since the CCA. There were also several minor changes to the characterization program. The changes the EPA identified are specified in CARD 24 (U.S. EPA 2006d).

24.4.7 40 CFR § 194.24(c)(3)

The CRA-2004 was revised to show that the AK process was presented in the CH-TRU WAC. The CH-TRU WAC was revised to include more discussion of AK with respect to radionuclides (U.S. DOE 2002). Modifications made to the CH-TRU WAC since the CCA that were pertinent to AK included the use of existing AK collected prior to the implementation of a QA program under 40 CFR § 194.22(a), methods for confirming isotopic ratios using AK, required and supplemental AK documentation, discrepancy resolution and data limitation identification, and AK-radioassay data measurement comparisons as a means to assess comparability. Existing AK collected prior to the implementation of a QA program under section 194.22(a) may be qualified by peer review, corroborating data, confirmatory testing, or collection of data under an equivalent QA program. See CARD 24 (U.S. EPA 2006d) for further discussion.

24.4.8 40 CFR § 194.24(c)(4)

The DOE uses the WWIS to track data for emplaced waste in the WIPP. For the CCA, the WWIS used Oracle Version 7, and for the CRA-2004, the WWIS used Oracle Version 9; there were no other changes. The CRA-2004 included the statement, “additional computing system upgrades may be implemented in the future.” See CARD 24 (U.S. EPA 2006d) for further discussion.

24.4.9 40 CFR § 194.24(c)(5)

The DOE described the changes to the PDP in the CRA-2004, Chapter 4.0, Section 4.3.3.1, PDP (p. 4-49). There were three significant changes in Section 4.3.3.1 relative to the CCA: (1) the QAPP is no longer referenced as the document defining the PDP QAO requirements, (2) the PDP Plan was removed as a reference and replaced by the statement, “the NDA PDP plans are revised

as required," and (3) the section no longer contains a detailed description of the isotopes to be analyzed and the configuration of the PDP tests. Other minor changes are addressed in CARD 24 (U.S. EPA 2006d).

The DOE also revised the quality document hierarchy for waste characterization activities by making the Carlsbad Area Office (CAO) Quality Assurance Program Document a higher-tier document and the QAPP of lesser importance. This new document hierarchy is shown in the CRA-2004, Chapter 4.0, Figure 4-3, which replaced the CCA, Chapter 4.0, Figure 4-6.

24.4.10 40 CFR §§ 194.24(d) and (f)

The DOE did not use a performance-based waste loading scheme for waste emplacement in the WIPP, and the DOE assumed random waste loading in its performance and compliance assessments. Prior to the CRA-2004, the EPA requested that the DOE analyze waste loading with respect to supercompacted waste, and the DOE identified that clustering of waste would not affect performance (Marcinowski 2003; Park and Hansen 2003; Marcinowski 2004). See CARD 24 (U.S. EPA 2006d) for further discussion.

24.4.11 40 CFR § 194.24(g)

The DOE uses the WWIS to track the limitations on TRU waste disposal described in the WIPP LWA. For the CCA, the WWIS used Oracle Version 7, and for the CRA-2004, the WWIS used Oracle Version 9; there were no other changes. The CRA-2004 included the statement, "additional computing system upgrades may be implemented in the future." See CARD 24 (U.S. EPA 2006d) for further discussion.

24.4.12 40 CFR § 194.24(h)

The EPA found the DOE in compliance with provisions of section 194.24(h). Inspections, such as audits, and records are addressed by the EPA in CARD 22 (U.S. EPA 2006b).

24.5 EPA's Evaluation of Compliance for the 2004 Recertification

24.5.1 40 CFR § 194.24(a)

The EPA reviewed the CRA-2004 and supplemental information to determine whether they provided sufficiently complete descriptions of the chemical, radiological, and physical composition of the emplaced, existing, and to-be-generated waste proposed for disposal in the WIPP. The EPA also reviewed the DOE's description of the approximate quantities of waste components (for both existing and to-be-generated waste). The EPA considered whether the DOE's waste descriptions were of sufficient detail to enable the EPA to conclude that the DOE did not overlook any component that is present in TRU waste and has significant potential to influence releases of radionuclides.

Based on the EPA's review and evaluation of this information and the consideration of public comments, the EPA determined that the DOE continued to comply with the requirements of section 194.24(a) (U.S. EPA 2005a, U.S. EPA 2006c, U.S. EPA 2006e, and U.S. EPA 2006f).

24.5.1.1 Chemical, Physical, and Radiological Description of Existing Waste

The EPA reviewed descriptions of the chemical, radiological, and physical components of the waste, which were documented in the CRA-2004 and supporting documents. This information was collected using methods similar to those used during the CCA, which were determined to be reasonable by the EPA.

The EPA concluded on the basis of this information that the CRA-2004 and supplemental information adequately described the chemical, radiological, and physical characteristics of each waste stream proposed for disposal at the WIPP. The EPA further concluded that the information presented by the DOE in the CRA-2004 provides adequate characterization of existing WIPP waste for use in PA.

The EPA concluded that the DOE's development of the disposal inventory was sufficient for PA purposes. The EPA agreed with the DOE that the use of projected waste inventory for scaling the CH-TRU WIPP inventory to meet the total WIPP capacity was appropriate. The DOE's use of the inventory scaling process was similar to that used in the CCA and was adequate for projecting inventory estimates.

24.5.1.2 Waste Forms and Packaging: Supercompacted Waste

The EPA approved the disposal of supercompacted waste from AMWTF at the WIPP (Marcinowski 2004). The CRA-2004 characterized, represented, and considered supercompacted waste from INL in the recertification inventory.

24.5.1.3 Waste Forms and Packaging: Container Types

The DOE's assortment of containers was expected to meet the metal limit regardless of container type, because they all are metal containers. The EPA found the container types used in the CRA-2004 PA to be reasonable.

24.5.1.4 Waste Forms and Packaging: Inclusion of Waste Packaging in Inventory

During the initial review of the recertification application, the EPA found that the DOE did not include emplacement materials in the CRA-2004 PA calculations (Cotsworth 2004a). These materials could contribute to gas generation. The DOE stated (Detwiler 2004b) that these materials accounted for only a 12.7% increase in CPR if they were included in the PA, and that they would have no effect on compliance. However, the DOE did include the additional emplacement material volume and mass in the CRA-2004 PABC (Leigh, Trone, and Fox 2005, Section 1.3.3, p. 11); therefore, the emplacement materials were reflected in the release estimates. The CRA-2004 PABC showed that the WIPP still complied with the new CPR amounts in the inventory. Thus, the use of increased CPR amounts was adequate, and the amount used in the CRA-2004 PABC established a new limit.

24.5.1.5 Number of Curies, Waste Streams, and Volume

The DOE estimated the activity in curies in the inventory on a site-by-site, waste-stream-by-waste-stream basis. The EPA required that the DOE produce a "list of the waste components and their approximate quantities." The EPA reviewed the estimate in the CRA-2004, Chapter 4.0, Appendix TRU WASTE-2004, and the TRU Waste Baseline Inventory Database (LANL 2005), and found sufficiently specific information on the species and quantities of individual radioisotopes in the waste.

24.5.1.6 Organic Ligands

The EPA requested that the DOE provide additional information regarding the possible effects of organic ligands concentrations on An solubilities in the WIPP repository (Cotsworth 2004b). In its response, the DOE described the results of a series of calculations designed to determine the sensitivity of An(III), An(IV), and An(V) solubilities to increases in organic ligand concentrations and the possible effects of microbially produced acetate and lactate. The EPA reviewed the updated calculations related to the effect of organic ligands on An solubility and determined that organic ligands are potentially important (U.S. EPA 2006c). The DOE included the effects of solubility of organic ligands in the CRA-2004 PABC and the CRA-2004 and supplemental information; therefore, the EPA found that the DOE appropriately included organic ligands in the CRA-2004 PABC (U.S. EPA 2006f).

24.5.1.7 Hanford Waste

In the CRA-2004, the DOE identified that it included waste from 12 tanks from Hanford – nine tanks of CH-TRU waste and three tanks of RH-TRU waste. The volume of the CH-TRU waste was estimated to be approximately 3,932 m^3 (2% of the total CH-TRU waste and 2% of the total inventory) and the RH-TRU waste was estimated at approximately 4,469 m^3 (63% of total RH-TRU waste and 2.5% of the total inventory). The DOE stated that these 12 tanks were considered TRU waste, although the tanks were managed as high-level waste. Furthermore, the DOE pointed out, if the waste was high-level waste, then by law it could not go to the WIPP. The DOE included waste from the 12 tanks in the CRA-2004 PA and the CRA-2004 PABC and began discussion about establishing a TRU waste determination process in the future.

The EPA allowed this waste to be included in the PA inventory for recertification and the DOE demonstrated that with the Hanford tank waste, the WIPP would continue to comply with the EPA's disposal regulations. However, it was noted that before any Hanford tank waste could be shipped to the WIPP, the DOE must demonstrate during characterization that the waste is, in fact, TRU waste that can legally go to the WIPP (CARD 24; U.S. EPA 2006d).

24.5.1.8 K-Basin Waste

The sludges from the K-Basin storage pools consist of debris, silt, sand, and material from operation of the pools at Hanford. The 50.4 m^3 of sludges contaminated with radionuclides associated with spent nuclear fuel that was exposed to water in the pools were included in the CRA-2004 PABC.

The EPA allowed this waste in the PA inventory because the waste form was similar to other waste going to the WIPP, was low in volume, and required processing and characterization before being shipped to the WIPP. In addition, the EPA stated the DOE must demonstrate that the waste meets technical and legal requirements prior to disposal.

24.5.1.9 INL Waste

The pre-1970 buried waste included in the CRA-2004 PABC (Leigh et al. 2005) is found in Appendix DATA-2004, Attachment F, Annex I, as waste stream IN-Z001. It was designated as non-WIPP TRU waste, but the DOE decided to include it in the CRA-2004 PABC because of a 2003 judgment against the DOE related to its removal at INL. This waste was not included in the CRA-2004 PA because the court judgment came after the September 30, 2002, cutoff date for inventory development (Leigh, Trone, and Fox 2005; Lott 2004). This waste appeared to be similar to other WIPP waste streams, but must still meet the WIPP WAC and remains subject to the EPA's inspection and approval process before being disposed of at the WIPP.

24.5.1.10 Other Issues

The DOE identified and corrected one error between the CRA-2004 PA and the CRA-2004 PABC concerning LANL CH-TRU waste stream LA-TA-55-48. This waste stream was a low-volume, high-radioactivity waste stream that skewed the results of the PA complimentary cumulative distribution functions upward. Upon further review, the DOE identified that this waste stream was mischaracterized; the Pu fissile gram equivalent mass was greater than shipping requirements allowed (Crawford 2004). The DOE reevaluated the waste stream, and modified the waste stream radioactivity and volume for the CRA-2004 PABC. Since this was an estimate and the waste will be characterized before going to the WIPP, the modification was found to be reasonable.

24.5.2 40 CFR § 194.24(b)(1)

For the CCA, the EPA reviewed information on waste characteristics and components in a number of technical documents. This review encompassed references, experimental programs, logical arguments, and modeling. The EPA determined all relevant waste characteristics and components were identified and evaluated. For the CRA-2004, the EPA focused on changes and new information that could affect the DOE's analyses and findings.

The EPA concluded that, with the combination of the CRA-2004, supplemental information, and the CRA-2004 PABC, the DOE continued to comply with the requirements for section 194.24(b)(1) (U.S. EPA 2006d).

24.5.2.1 Solubility

The EPA's review identified two areas in which the DOE did not adequately address solubility. First, the DOE did not update the U(VI) solubility to incorporate new data that became available since the certification decision. The data indicated that the U(VI) solubility should be higher than that used by the DOE in the CRA-2004 PA. Second, the DOE did not update the solubility uncertainty ranges used for An solubility oxidation states based on new data.

For the CRA-2004 PABC, the EPA stated that the solubility of U(VI) needed to be changed to a fixed value of 1×10^{-3} molar because of experimental data that became available after the CCA. In addition, the EPA required that new solubility uncertainty ranges, based on the FMT database and currently available experimental solubility data, be incorporated into the CRA-2004 PABC. The DOE made additional changes to the calculation of the An(III), An(IV), and An(V) solubilities based on revised thermodynamic data for the An(IV) actinides, a different Salado brine formulation, and revised concentrations of organic ligands. These changes were properly implemented as discussed in Section 7 of *Technical Support Document for* S*ection 194.24: Evaluation of the Compliance Recertification Actinide Source Term and Culebra Dolomite Distribution Coefficient Values* (U.S. EPA 2005b).

A summary of changes and improvements incorporated into the calculation of An solubilities for the CRA-2004 PABC that have been implemented since the CCA PAVT include the following:

- Organic ligand complexation data were incorporated into the FMT thermodynamic database so the effects of organic ligands on An(III), An(IV) and An(V) solubilities can be calculated directly. The organic ligand concentration changes, which in all cases but oxalate are defined by the inventory, were the result of corrections to the masses of organic ligands identified in the CRA-2004 PABC inventory (Leigh, Trone, and Fox 2005) and the minimum estimated brine volume required for a release from the repository.

- The TRU waste inventory data, including actinides, were updated.

- The FMT thermodynamic database for actinides was updated and used to calculate the An(III), An(IV), and An(V) solubilities. Most importantly, the free energy formation constant value for thorium hydrate ($Th(OH)_4$)(aq) was lowered, leading to better agreement between experimental and modeling results (Xiong 2005).

- Magnesium oxide (MgO)-reacted Salado GWB and Castile (ERDA-6) brines were used to calculate An solubilities. GWB, which has a lower magnesium (Mg) and higher sulfate content, replaces Brine A as the Salado brine formulation for An solubility calculations (Brush et al. 2006).

- Instantaneous equilibria among major GWB and ERDA-6 relevant minerals were assumed and the chemical environment was made more uniform due to the elimination of nonmicrobial vectors in PA.

- Correction of the minimum brine volume necessary for DBR (Stein 2005).

- Revision of the estimated U(VI) solubility to 0.001 molar accounts for the new data (U.S. EPA 2005b).

- Recalculation of An solubility uncertainties based on a much larger number of solubility measurements, with separate distributions developed for the An(III), An(IV), and An(V) solubilities (Xiong, Nowak, and Brush 2005).

24.5.2.2 Colloids

The CCA PAVT included microbial colloid transport of actinides for all vectors. The CRA-2004 PA included different assumptions about the colloidal source term concentrations for microbial and nonmicrobial vectors, with no microbial colloid transport of actinides assumed for nonmicrobial vectors. However, for the CRA-2004 PABC, it was assumed that all vectors included microbial activity. Therefore, the DOE included microbial colloid transport of actinides for all CRA-2004 PABC vectors (Brush 2005). This approach was, therefore, the same for the CCA PAVT and CRA-2004 PABC, and was consistent with the EPA's direction that all vectors include microbial activity.

24.5.2.3 Production of Gas from the Waste

Microbial degradation of CPR may influence the WIPP repository performance because of its effects on repository chemistry and gas generation. The EPA reviewed the approach and assumptions used by the DOE to model microbial degradation for the CRA-2004 PA. The EPA's comments to the DOE focused on the probability of significant microbial degradation, the nature of the microbial degradation reactions likely to occur in the repository, and microbial gas generation rates. As a result of the EPA's review and comments, the DOE changed the modeling of microbial degradation processes for the CRA-2004 PABC. Specifically, the EPA instructed the DOE to assume that microbial degradation of CPR would occur in all CRA-2004 PABC vectors.

During the review of the CRA-2004 PA, the DOE informed the EPA that the microbial gas generation experiments had continued and additional information related to microbial gas generation rates in the WIPP repository had become available since the CCA PA and the CCA PAVT. In the letter (Cotsworth 2005) directing the DOE to perform the CRA-2004 PABC, the EPA allowed the DOE to propose a new gas generation rate scheme based on the new experimental data.

At the EPA's direction, the DOE changed the probability of microbial degradation to account for new evidence regarding the presence and viability of microbes capable of degrading CPR in the WIPP repository. The revised probability parameters resulted in microbial degradation in all vectors for the CRA-2004 PABC. However, the DOE asserted that uncertainties remained regarding the viability of microbes in the repository because of different conditions in the repository compared to the conditions in the experiments. The DOE therefore introduced an additional sampled parameter, BIOGENFC. This parameter, which has a uniform distribution from 0 to 1, was multiplied by the microbial gas generation rates to effectively reduce the humid and inundated microbial gas generation rates from the experimentally determined long-term rates.

24.5.3 40 CFR §§ 194.24(b)(2) and (b)(3)

The concentrations of organic ligands were reevaluated for the CRA-2004 PABC An solubility calculations based on a revised estimate of the minimum amount of brine that could lead to a release from the repository. In addition, new data regarding the possible complexation of An(IV)

by EDTA were identified. These data were evaluated to determine the potential significance of EDTA to the An solubility calculations for the WIPP repository conditions.

During the EPA's review of the important waste components, the EPA identified that only organic ligands had been addressed differently than in the CCA. Organic ligands could increase An solubility, but the EPA determined that the DOE had adequately included their effects in the CRA-2004 PABC (U.S. EPA 2006d).

24.5.4 40 CFR §§ 194.24(c)(1), (e)(1), and (e)(2)

In the CCA, the EPA found that the DOE identified those waste components that required limits, and that the limits were reasonable and quantifiable. The EPA's main concern was that the waste components be kept to levels that ensure the repository remains in compliance with the disposal standards. The waste components of special concern were the amounts of CPR and their potential to generate gases that contribute to increased pressure in the repository.

As with the CCA, the DOE did not provide the associated uncertainty for the waste material component limits in the CRA-2004. The EPA identified two related issues regarding this claim of no uncertainty. The first was to ensure that the inventory remains within the waste component limits established by the DOE, and the second is that the performance of the repository was not compromised by the uncertainty in the inventory. This section required that the DOE identify the associated uncertainty for each limiting value. In the CRA-2004, as in the CCA, the DOE stated that the waste material component limits were fixed values with no associated uncertainties.

However, the EPA requested that the DOE review the issue of uncertainty. The DOE stated (Leigh 2006, p. 6) that the "sum of the weights of individual components in a container can at most differ from the total weight of the container by 5 percent." For the CCA, the EPA agreed with this approach, since the limiting value could be used to represent the "upper end" of an uncertainty value. However, the lack of information on the waste component inventory was of concern for the future, especially with the CPR materials, since they had the greatest potential to affect performance.

Since the inventory emplaced in the WIPP was at a fraction of the total inventory expected in the future, and since a significant fraction of the inventory was estimated and to be emplaced in the future, the EPA found that the use of point estimates was acceptable for the waste components and radionuclides for this recertification. In addition, the EPA found that since only a limited amount of waste has been emplaced, the inventory and its associated uncertainty was below the respective limiting values. However, the EPA suggested the DOE improve its knowledge of the measurement uncertainty for the next recertification and include these uncertainties into the PA process (U.S. EPA 2006d).

24.5.5 40 CFR § 194.24(c)(2)

Since the 1998 certification decision, the waste characterization program had been implemented at several DOE waste generator sites. This represented a change in activities since approval of the CCA, because only LANL was approved at that time. Since 1998, the EPA had approved

waste characterization at the larger generator sites, namely the AMWTF, Hanford, INL, RFETS, and the Savannah River Site (SRS). In addition, characterization was approved at the small generator sites Lawrence Livermore National Laboratory and the Nevada Test Site. These sites continued to characterize CH-TRU waste for disposal at the WIPP through the CRA-2004.

Based on the EPA's review of the CRA-2004, including the new information and references presented therein, the EPA agreed that the methods used to quantify the limits of waste components had not changed substantially since the 1998 certification decision. The EPA kept abreast of all the changes to the program, including information source document changes that transpired after the EPA's 1998 certification decision. Changes implemented up to the 2002 CH-TRU WAC and Waste Analysis Plan (WAP) referenced in the CCA had not affected the sites' abilities to adequately quantify waste components in individual containers. The DOE, therefore, continued to require each waste site to characterize radiological contents of every container of CH-TRU waste streams destined for WIPP disposal using the EPA-approved NDA systems. Similarly, each site continued to examine each TRU waste container to ensure the absence of prohibited items using the EPA-approved RTR and/or VE procedures (U.S. EPA 2006d).

24.5.6 40 CFR § 194.24(c)(3)

The EPA's WIPP regulations required the DOE to "provide information which demonstrates that the use of process knowledge to quantify components in waste for disposal conforms to the quality assurance requirements found in 40 CFR § 194.22" (U.S. EPA 1996, p. 5240).

The EPA found the information presented in the CRA-2004 adequate and that the adherence of TRU waste sites to the CRA-2004-based AK process will allow them to meet their regulatory obligations.

24.5.7 40 CFR § 194.24(c)(4)

The EPA determined that the general description of the WWIS in the CRA-2004 was adequate (CARD 24, pp. 24-44, U.S. EPA 2006d). Hardware modifications and software upgrades described in the CRA-2004 were necessary to maintain system reliability, security, and performance. The EPA reviewed the WWIS during its inspections of the WIPP and TRU waste generator sites and was aware of the changes to the WWIS since the CCA. The EPA determined that the WWIS adequately gathers, stores, and processes information pertaining to TRU waste destined for or disposed of at the WIPP (U.S. EPA 2006d).

The DOE stated that a majority of the 130 WWIS data fields were pertinent to demonstrate compliance with TRU waste transportation and disposal requirements. The EPA verified that the DOE adequately tracked more than these 130 data fields in the WWIS. The DOE had not changed its tracking methodology and in fact has added parameters to be tracked in the WWIS.

24.5.8 40 CFR § 194.24(c)(5)

The QAPP and the Methods Manual were replaced by the WAC and the New Mexico Environment Department WAP for the CRA-2004. The EPA was aware of these changes to the program requirements documents. The wording changes regarding the description of the PDP

test and the removal of the PDP plan did not affect the EPA's ability to ensure that the DOE has implemented a series of intercomparability tests for NDA equipment that develop similar results. The elimination of the PDP test description from the CRA-2004 required that the DOE make available to the EPA the PDP plans and test descriptions so the EPA could ensure that the program was indeed acting as a "true blind sample" program. The change in PDP certification from the facility to the equipment was acceptable.

The EPA continued to ensure, through audits and inspections, that the waste characterization program sufficiently met QA requirements. The inspection program was the primary method by which the EPA determined the implementation of QA controls to the waste characterization program.

The DOE's changes to the PDP program did not affect the EPA's ability to assess the implementation of quality controls to the waste characterization program. The wording changes allowed the DOE more flexibility in developing PDP tests. The changes to the QA document hierarchy do not lessen the implementation of quality controls to the waste characterization program.

Based on the EPA's review and evaluation of the CRA-2004 and supplemental information provided by the DOE, the EPA determined that the DOE continues to comply with the requirements for section 194.24(c)(5) (U.S. EPA 2006d).

24.5.9 40 CFR §§ 194.24(d) and (f)

In PAs, the DOE has assumed random waste emplacement. In the CCA, the EPA asked for additional analysis assuming clustering of waste. The DOE performed an analysis and showed that clustering waste streams would not significantly affect PA results. Indeed, RFETS waste was eventually clustered in the WIPP (Park and Hansen 2003). In addition, the EPA required the DOE to conduct another analysis assuming nonrandom waste emplacement as part of the review of supercompacted waste from INL. The results showed that nonrandom placement of waste was not significant (e.g., Appendix PA-2004, Attachment MASS-2004, Section MASS-21.0). Thus, no waste loading assumptions were necessary in PA calculations for CRA-2004.

Based on the EPA's review and evaluation of the CRA-2004 and supplemental information provided by the DOE, and because the DOE showed that waste loading assumptions were not necessary for use in PA, the EPA determined that the DOE continues to comply with the requirements for sections 194.24(d) and (f) (U.S. EPA 2006d).

24.5.10 40 CFR § 194.24(g)

The DOE has several years of experience with the WWIS and, through the EPA's inspections, the DOE has shown the WWIS to be effective in tracking and controlling waste disposed of at the WIPP. The DOE had not characterized or shipped any RH-TRU waste at the time of the CRA-2004.

Based on a review and evaluation of the CRA-2004 and supplemental information provided by the DOE, the EPA determined that the DOE continues to comply with the requirements for section 194.24(g) (U.S. EPA 2006d).

24.5.11 40 CFR § 194.24(h)

The EPA found the DOE in compliance with provisions of section 194.24(h). Discussion of inspections and records, such as audits, is addressed by the EPA in CARD 22 (U.S. EPA 2006b).

24.6 Changes or New Information Between the CRA-2004 and the CRA-2009 (Previously: Changes or New Information Since the 2004 Recertification)

24.6.1 40 CFR § 194.24(a)

To meet the section 194.24(a) requirements in the CRA-2004, the DOE described and categorized the TRU waste currently emplaced in the WIPP at that time and the waste that existed at various DOE facilities. The details of the inventory used for the CRA-2009 (U.S. DOE 2009a and U.S. DOE 2009b) were presented in the CRA-2004, Chapter 4.0 and Appendix TRU WASTE-2004, and the CRA-2004 PABC inventory (see Appendix BIR) was summarized in the CRA-2004 PABC Inventory Report (Leigh, Trone, and Fox 2005). The combination of the inventory presented in Appendix TRU WASTE-2004 and the CRA-2004 PABC Inventory Report was referred to as the CRA-2004 PABC Inventory Report. The inventory for the CRA-2009 PA was the same inventory used for the CRA-2004 PABC. Since the CRA-2004 PABC was completed, the *Annual Transuranic Waste Inventory Report–2007* (U.S. DOE 2008a) was published and provides updated inventory information. The DOE anticipated this inventory update would have only a small impact on normalized releases relative to the CRA-2009 PA, and was not significant for compliance. Therefore, the DOE was in compliance with section 194.24(a).

24.6.2 40 CFR § 194.24(b)(1)

There were no changes to the waste characteristics between the CRA-2004 PABC inventory and the CRA-2009 inventory, but the DOE did add inventory parameters used in the PA. Leigh, Trone, and Fox (Leigh, Trone, and Fox 2005) gave a comprehensive description of the projected inventory used for the CRA-2004 PABC. The CRA-2009 PA used the CRA-2004 PABC inventory with one set of modifications. The CRA-2004 PABC included CPR materials in the waste and container (packaging) materials that were also used in the CRA-2009 PA, but the CPR contents in emplacement materials were erroneously omitted from the CRA-2004 PABC (Nemer 2007). To correct this omission, six new parameters representing the density of CPR materials in emplacement materials were created and used in the CRA-2009 PA. Four additional parameters, which represent the density of cellulose and rubber materials in container (packaging) materials, were also created for the CRA-2009 PA (Nemer 2007).

Table 24-2 lists the names and descriptions of the CPR parameters used in the CRA-2009 PA, including the 10 additional parameters. The addition of the four container (packaging) CPR parameters was done solely for bookkeeping purposes, since container (packaging) materials do

not contain cellulose or rubber materials, as seen by the zero values in Table 24-2. The CRA-2009 PA used all the CPR parameters shown in Table 24-2.

There were no changes between the CRA-2004 PABC and CRA-2009 PA in the methodology and data used to calculate An solubilities or their colloidal concentration in the WIPP brine. The microbial assumptions and gas generation rates associated with this also remained unchanged in the CRA-2009 PA. Therefore, the DOE was in compliance with section 194.24(b)(1).

24.6.3 40 CFR § 194.24(b)(2)

The DOE determined that the components identified below were expected to have a significant effect on disposal system performance (see the CCA, Appendix WCA), and so were used in the CRA-2004 PABC.

- Ferrous metals
- Cellulose and chelating agents (i.e., organic ligands) as they pertain to enhanced An mobility
- Radioactivity in curies of each isotope
- alpha-emitting TRU radionuclides, $t_{1/2} > 20$ years ($t_{1/2}$ is the half-life)
- Radionuclides
- Solid waste components (e.g., soils and cementitious materials)
- Sulfates
- Nitrates

Table 24-2. CPR Parameters Used in the CRA-2009 PA

Name	Description	Value (kg/m^3)
WAS_AREA: DCELLCHW	Average density of cellulosics in CH-TRU waste materials	60.0
WAS_AREA: DCELLRHW	Average density of cellulosics in RH-TRU waste materials	9.3
WAS_AREA: DCELCCHW[a]	Average density of cellulosics in CH-TRU waste container (packaging) materials	0.0
WAS_AREA: DCELCRHW[a]	Average density of cellulosics in RH-TRU waste container (packaging) materials	0.0
WAS_AREA: DCELECHW[a]	Average density of cellulosics in CH-TRU waste emplacement materials	1.22
WAS_AREA: DCELERHW[a]	Average density of cellulosics in RH-TRU waste emplacement materials	0.0
WAS_AREA: DPLASCHW	Average density of plastic in CH-TRU waste materials	43.0
WAS_AREA: DPLASRHW	Average density of plastic in RH-TRU waste materials	8.0
WAS_AREA: DPLSCCHW	Average density of plastic in CH-TRU waste container (packaging) materials	17.0
WAS_AREA: DPLSCRHW	Average density of plastic in RH-TRU waste container (packaging) materials	3.1
WAS_AREA: DPLSECHW[a]	Average density of plastic in CH-TRU waste emplacement materials	8.76
WAS_AREA: DPLSERHW[a]	Average density of plastic in RH-TRU waste emplacement materials	0.0
WAS_AREA: DRUBBCHW	Average density of rubber in CH-TRU waste materials	13.0
WAS_AREA: DRUBBRHW	Average density of rubber in RH-TRU waste materials	6.7

Name	Description	Value (kg/m^3)
WAS_AREA: DRUBCCHW[a]	Average density of rubber in CH-TRU waste container (packaging) materials	0.0
WAS_AREA: DRUBCRHW[a]	Average density of rubber in RH-TRU waste container (packaging) materials	0.0
WAS_AREA: DRUBECHW[a]	Average density of rubber in CH-TRU waste emplacement materials	0.0
WAS_AREA: DRUBERHW[a]	Average density of rubber in RH-TRU waste emplacement materials	0.0

[a]Newly created for the CRA-2009 PA

These components in the CRA-2009 inventory were not changed from the CRA-2004 PABC inventory that was used for the CRA-2004 recertification decision. Therefore, the DOE was in compliance with section 194.24(b)(2).

24.6.4 40 CFR § 194.24(b)(3)

The DOE provided a list of those waste characteristics and components that were excluded from consideration in the PA for various reasons, such as negligible impact (Appendix TRU WASTE-2004, Section TRU WASTE-6.0, and Appendix PA-2009). There were no changes in the exclusion decisions for the important waste components and characteristics in the CRA-2009 PA since the CRA-2004 recertification decision. Therefore, the DOE was in compliance with section 194.24(b)(3).

24.6.5 40 CFR §§ 194.24(c)(1), (e)(1), and (e)(2)

The inventory used for the CRA-2009 PA was the same as the CRA-2004 PABC inventory. Therefore, the waste components and their associated uncertainties for the CRA-2009 were not changed since the CRA-2004 PABC. The only change from the CRA-2004 PABC was a change in the emplaced MgO.

In April 2006, the DOE submitted for EPA approval a Planned Change Request (PCR) to reduce the MgO excess factor from 1.67 to 1.2 (Moody 2006). To justify its request, the DOE used reasoned arguments regarding health-related transportation risks to the public, the cost of emplacing MgO, and the uncertainties inherent in predicting the extent of microbial consumption of CPR materials during the 10,000-yr WIPP regulatory period. The EPA responded that the "DOE needs to address the uncertainties related to MgO effectiveness, the size of the uncertainties, and the potential impact of the uncertainties on long-term performance" (Gitlin 2006).

The DOE carried out an uncertainty analysis (Vugrin, Nemer, and Wagner 2006) and several supporting analyses (Brush and Roselle 2006; Brush et al. 2006; Clayton and Nemer 2006; Deng et al. 2006; Kanney and Vugrin 2006; Kirchner and Vugrin 2006) in response to the EPA's request for additional information on the uncertainties related to MgO effectiveness. Appendix MgO-2009, Section MgO-6.2.4.4 (U.S. DOE 2009c) provided a complete description of the DOE uncertainty analyses. As part of this effort, Kirchner and Vugrin (Kirchner and Vugrin 2006) quantified the uncertainties in the estimates of the CPR material quantities emplaced in the WIPP disposal rooms. Their analysis was based on the differences between the masses of CPR

materials measured by RTR and VE, paired by waste container. They assumed that the VE measurements were the more accurate values and, because they observed no significant bias in the RTR measurements in a room, Kirchner and Vugrin (2006) then used Monte Carlo methods "to simulate potential errors in the RTR measurements and to construct a distribution representing the uncertainty in the CPR [materials] in a room," and concluded that "the uncertainty [standard deviation] on the total mass of CPR [materials] in a room would be less than 0.3%."

Based on these results, measurement uncertainty in the mass of CPR materials was not expected to significantly impact the expected mass of CPR materials in a room and consequently had little impact on repository performance. In addition, a limited amount of waste was emplaced relative to total capacity of the repository. It followed that the inventory and its associated uncertainty remained below the limiting value for the mass of CPR in the CRA-2009 PA, and the DOE remained in compliance with sections 194.24(c)(1), (e)(1), and (e)(2).

24.6.6 40 CFR § 194.24(c)(2)

As noted in section 194.24(b), the DOE did not modify the list of CRA-2004 components and characteristics requiring quantification. Therefore, the CRA-2009 did not identify any significant changes to the measurement techniques used in the waste characterization program (i.e., VE, RTR, AK, NDA).

Since the CRA-2004, the WIPP had received RH-TRU waste. RH-TRU waste normally contains more gamma-emitting radionuclides than CH-TRU waste (mostly ^{137}Cs), and the characterization method used to determine radionuclide activity is a Dose-to-Curie methodology as identified in the *Remote-Handled TRU Waste Characterization Program Implementation Plan*, Revision 0D (U.S. DOE 2003). RH-TRU waste normally contains more metal container material parameters because the preferred method for hot-cell operation is to place the waste into 30- or 55-gallon drums before placement into the RH-TRU canister. The addition of RH-TRU waste did not modify the list of components and characteristics requiring quantification. Therefore, the DOE was in compliance with section 194.24(c)(2).

24.6.7 40 CFR § 194.24(c)(3)

Since the CRA-2004, the AK process is now presented in the WIPP WAC, Revision 6.2 (U.S. DOE 2008c) for both the CH-TRU and RH-TRU waste. The WIPP WAC was revised to include more discussion of AK with respect to radionuclides (WAC, Appendix A). Modifications made to the WAC since the CRA-2004 that were pertinent to AK include the following:

- Use of existing AK collected prior to the implementation of a QA program under section 194.22(a) may be qualified in accordance with an alternative methodology and employs one or more of the following methods: peer review, corroborating data, confirmatory testing, and collection of data under an equivalent QA program for both the CH-TRU and RH-TRU waste.

- Methods for confirming isotopic ratios using AK (i.e., methods pertinent to sites generating weapons grade Pu vs. heat grade) for both the CH-TRU and RH-TRU waste.

- Required and supplemental AK documentation for both the CH-TRU and RH-TRU waste.
- Discrepancy resolution and data limitation identification for both the CH-TRU and RH-TRU waste.
- AK radioassay data measurement comparisons as a means to assess comparability for both the CH-TRU and RH-TRU waste.

These modifications effectively focused on the WIPP WAC to address specific allowances and requirements with respect to AK needs for radionuclide data on both the CH-TRU and RH-TRU waste. The revised WAP (New Mexico Environment Department 2008) retained AK requirements of data assembly, compilation, etc., included in the CRA-2004 and the CCA. Therefore, the DOE was in compliance with section 194.24(c)(3).

24.6.8 40 CFR § 194.24(c)(4)

The WWIS used the Oracle Version 9 database management system at the time of the CRA-2004 as described in CRA-2004, Chapter 4.0, Section 4.3.2. The computing system for CRA-2009 was Oracle Version 10g. Appendix TRU WASTE-2004, Section TRU WASTE-5.0, briefly described the WWIS as part of a system of controls that address sections 194.24(c)(4) and (c)(5), requirements for computer software for nuclear facility applications. Since the submittal of the CRA-2004, the WWIS had been updated to include data fields required for the disposal of RH-TRU waste. The WWIS was also modified by the addition of data fields to meet additional tracking and control requirements imposed on RH-TRU waste by the LWA. The WWIS was also updated since the CRA-2004 to track the amount of MgO emplaced in the repository. This addition was added to ensure the excess factor of 1.2 is met throughout the repository. The WWIS User's Manual, Appendix F (U.S. DOE 2008d), contained the WWIS Data Dictionary, which defines each data field for CH-TRU and RH-TRU waste. Therefore, the DOE was in compliance with section 194.24(c)(4).

24.6.9 40 CFR § 194.24(c)(5)

The DOE described the PDP program in the CRA-2004, Chapter 4.0, Section 4.3.3.1 PDP (p. 4-49). Since the CRA-2004, revisions were made to both the *Performance Demonstration Program Plan for Nondestructive Assay of Boxed Wastes for the TRU Waste Characterization Program*, Revision 1 (U.S. DOE 2008e), and the *Performance Demonstration Program Plan for Nondestructive Assay of Drummed Wastes for the TRU Waste Characterization Program*, Revision 1 (U.S. DOE 2005). The most important changes to these documents were implemented to better represent current practices, simplify and clarify the scoring section, clarify the explanation of the derivation of scoring criteria, and update the two NDA PDP Plans to be consistent with one another. The *Performance Demonstration Program Plan for Analysis of Simulated Headspace Gases*, Revision 6.1 (U.S. DOE 2007) was also revised since CRA-2004. The most important changes described the relationship between the Carlsbad Technical Assistance Contractor and the commercial suppliers of the headspace gas (HSG) PDP services, as well as the standard gases used to prepare the HSG PDP samples. Prior to this revision, the HSG PDP sample preparation contractor was a DOE national laboratory. Therefore, the DOE was in compliance with section 194.24(c)(5).

24.6.10 40 CFR §§ 194.24(d) and (f)

The CRA-2009 did not change in reference to provisions in sections 194.24(d) and (f) since the CRA-2004 decision. Therefore, the DOE was in compliance with sections 194.24(d) and (f).

24.6.11 40 CFR § 194.24(g)

The CRA-2009 inventory was unchanged from the CRA-2004 PABC inventory. Since the CRA-2004, the DOE had characterized and shipped RH-TRU waste. The WWIS was also modified by the addition of data fields to meet additional tracking and control requirements imposed on RH-TRU waste by the LWA. Therefore, the DOE was in compliance with section 194.24(g).

24.6.12 40 CFR § 194.24(h)

The DOE continued to comply with the inspection and records requirements. This is discussed in the CRA-2009, Section 22. Therefore, the DOE was in compliance with section 194.24(h).

24.7 EPA's Evaluation of Compliance for the 2009 Recertification

24.7.1 40 CFR § 194.24(a)

The EPA reviewed the CRA-2009 and supplemental information to determine whether it provided a complete description of the chemical, radiological and physical composition of the emplaced, existing, and to-be-generated waste proposed for disposal in the WIPP repository. The EPA also reviewed the DOE's description of the approximate quantities of waste components (for both existing and to-be-generated waste). The EPA considered whether the DOE waste descriptions were of sufficient detail to enable the EPA to conclude that the DOE did not overlook any component that was present in TRU waste and had significant potential to influence releases of radionuclides. The following information is a summary of the EPA's evaluation.

Chemical, Physical, and Radiological Description of Existing Waste

The CRA-2009 and supplemental information adequately described the chemical, radiological, and physical characteristics of each waste stream proposed for disposal at the WIPP facility.

The EPA noted the following changes in the waste: the DOE listed the to-be-generated (projected) waste in ATWIR-2008 (DOE 2008b). The projected waste was categorized similarly to existing waste (e.g., heterogeneous debris, filter material, soil). The amounts were ultimately expressed in density terms (kg/m^3) for PA purposes (U.S. EPA 2010c, Section 24.1.6).

The EPA concluded that the DOE's development of the disposal inventory was sufficient for PA purposes. The EPA continued to agree with the DOE that the use of projected waste inventory for scaling the WIPP CH-TRU and RH-TRU inventories to meet the total WIPP capacity was appropriate.

Waste Forms and Packaging

The only change for waste form and packaging since the CRA-2004 was that RH-TRU waste shipments had begun and the RH emplacement canisters were used for RH disposal operations. With their introduction, the metal in the repository increased. The DOE discovered that, "the CPR contents in emplacement materials were erroneously omitted from the CRA-2004 PABC" (Clayton et al. 2010). The DOE corrected this error in the CRA-2009 PA and the CRA-2009 PABC calculations (U.S. EPA 2010c, Section 24.1.6).

Number of Curies, Waste Streams and Volume

The DOE continued to estimate the number of curies in the inventory on a site-by-site, waste stream level using a reasonable process. The EPA required that the DOE produce a "list of the waste components and their approximate quantities." In addition to the radioisotope inventory information, the DOE also provided sufficient information on the chemical and physical waste components with descriptions in the ATWIR-2008 (DOE 2008b) and PAIR-2008 (Crawford et al. 2009) (U.S. EPA 2010c, Section 24.1.6).

Organic Ligands

The DOE properly included the impact of the increased organic ligands waste inventory in the CRA-2009 PABC calculations (U.S. EPA 2010c, Section 24.1.6).

Hanford Waste and K-Basin Waste

The original 12 tanks (9 tanks of CH waste and 3 tanks of RH waste) and the K-Basin knock-out pot sludge from Hanford that were included in the CRA-2004 PA were removed from the anticipated waste stream inventory and were not included in the CRA-2009 PABC calculations (U.S. EPA 2010c, Section 24.1.6).

Based on the review of the chemical, physical, and radiological descriptions of existing waste, waste forms, packaging, number of curies, waste streams, volumes, organic ligands, Hanford and K-basin waste and supplemental information, the EPA determined that the DOE continued to comply with the requirements of 194.24(a) (U.S. EPA 2010c, Section 24.1.7).

24.7.2 40 CFR § 194.24(b)(1)

In the CRA-2009, the EPA focused on changes and new information in the DOE analyses that could impact disposal system performance based on changes in waste characteristics, such as solubility, colloids, and gas generation. The EPA concluded that, with the combination of the CRA-2009, supplemental information, and the CRA-2009 PABC, the DOE performed an adequate update to the CCA and the 2004 recertification (U.S. EPA 2010c, Section 24.2.6).

The most recent 2008 inventory data on organic ligands (Crawford et al. 2009) showed that organic ligand quantities increased dramatically for acetic acid, citric acid, sodium citrate, and sodium EDTA. The EPA requested that the DOE consider the updated inventory of organic ligands and the extent to which ligands are likely to affect actinide solubilities. Moody (Moody 2009a and Moody 2009b) responded to the EPA's request and agreed to perform a new PA, the

CRA-2009 PABC, that included updated concentrations of EDTA, acetate, citrate, and oxalate concentrations, based on the information provided in Crawford et al. (Crawford et al. 2009), and provided documentation of the CRA-PABC to the EPA.

Other changes for the CRA-2009 PABC include changes to the MgO excess factor and MgO reactivity test procedure, and re-evaluation of the actinide distribution coefficients used in the CRA-2009 PABC to account for the effects of higher organic ligand concentrations (U.S. EPA 2010c, Section 24.2.6).

The uncertainty ranges for the actinides in the CRA-2009 were also changed for the CRA-2009 PABC and are listed in Table 24-3.

Table 24-3. Cumulative Distribution Function (CDF) Ranges Established by the Revised Actinide Solubility Uncertainty Analysis for the CRA-2009 PABC

Actinide Oxidation State	CDF Range
III	-4.20 to 2.70
IV	-2.25 to 3.30

Source: Xiong et al. 2009, Table 7 and Table 11

No changes were made to the colloidial actinide source term conceptual model or its implementation since the CCA PAVT. Data developed since the CCA PAVT indicated that the current model was likely to conservatively overestimate colloidal associated actinides in the source term.

The DOE was aware of experiments that the Argonne National Laboratory had performed on the structure of plutonium nanocolloids; however, the inclusion of intrinsic colloids in the PA conservatively takes into consideration the formation and transport of these colloids (U.S. EPA 2010c, Section 24.2.6).

The gas generation conceptual model and model implementation were not changed in the CRA-2009 PA (U.S. EPA 2010c, Section 24.2.6).

The EPA determined that the DOE continued to comply with the requirements for section 194.24(b)(1) (U.S. EPA 2010c, Section 24.2.7).

24.7.3 40 CFR §§ 194.24(b)(2) and (b)(3)

In section 194.24(b)(2), the DOE calculated new solubility values for the CRA-2009 PABC based on the ATWIR-2008 and the PAIR-2008 (U.S. EPA 2010c, Section 24.3.6). In section 194.24(b)(3), the EPA verified that excluded waste characteristics and components had not changed since the CRA-2004 (U.S. EPA 2010c, Section 24.4.6). The EPA determined that the DOE continued to comply with the requirements for section 194.24(b)(3) (U.S. EPA 2010c, Sections 24.3.7 and 24.4.7).

24.7.4 40 CFR §§ 194.24(c)(1), (e)(1), and (e)(2)

The EPA verified that the DOE continued to appropriately identify waste components that required limits, and the limits were reasonable. The EPA verified that the WWIS system was adequate for verifying waste emplaced in the WIPP repository. The DOE submitted a PCR to decrease the amount of MgO from 1.67 to 1.2 times the emplaced CPR waste components. The EPA directed the DOE to perform an uncertainty analysis to verify that a decreased amount of MgO would still ensure control of repository chemistry and safe operation of the WIPP for the long-term. The DOE analysis (DOE Appendix MgO 2009, Section 6.2.4.4) showed and verified that, even with the uncertainty considered, compliance with the release standards was demonstrated (U.S. EPA 2010c, Section 24.5.6).

The EPA found that the DOE continued to identify the limits of important waste components and that the PA implementation was adequate. Based on the review and evaluation of the CRA-2009, and supplemental information provided by the DOE, the EPA determined that the DOE continued to comply with the requirements for sections 194.24(c)(1) and 194.24(e)(1, 2) (U.S. EPA 2010c, Section 24.5.7).

24.7.5 40 CFR § 194.24(c)(2)

The EPA performed baseline inspections and Tier 1 evaluations of both CH- and RH-TRU waste characterization activities. CRA-2009 CARD 8 includes a summary of the EPA waste characterization inspections completed at different sites (U.S. EPA 2010d).

The RH waste characterization processes implemented by the Central Characterization Project and approved by the EPA were different than those discussed in the RH Waste Characterization Program Implementation Plan (WCPIP). The DOE agreed to revise the WCPIP and seek EPA concurrence before its implementation. The DOE requested one specific exception (baseline waste characterization at the Bettis Atomic Power Laboratory). The DOE could not characterize waste at any new RH-TRU site until these revisions were finalized. Using the revised processes, RH-TRU sites would quantify the radiological and physical contents of the waste to demonstrate compliance (U.S. EPA 2010c, Section 24.6.6).

Based on the review and evaluation of the CRA-2009 and supplemental information provided by the DOE, the EPA determined that the DOE continued to comply with the requirements for section 194.24(c)(2) (U.S. EPA 2010c, Section 24.6.7).

24.7.6 40 CFR § 194.24(c)(3)

The EPA required TRU waste generator sites to prepare a detailed AK Summary document containing all waste-specific information in one place, with properly cited references. The EPA suggested that information not necessarily needed by TRU waste generator site personnel in the AK summary documents could be included in appendices and adequately referenced (U.S. EPA 2010c, Section 24.7.7).

Based on the review and evaluation of the CRA-2009 and supplemental information provided by the DOE, the EPA determined that the DOE continued to comply with the requirements for section 194.24(c)(3) (U.S. EPA 2010c, Section 24.6.7).

24.7.7 40 CFR § 194.24(c)(4)

The EPA reviewed the WWIS modification to track RH waste content information from generators to the repository and found this change was acceptable (U.S. EPA 2010c, Section 24.8.6).

Based on the review and evaluation of the CRA-2009 and supplemental information provided by the DOE, the EPA determined that the DOE continued to comply with the waste data tracking requirements for section 194.24(c)(4) (U.S. EPA 2010c, Section 24.8.7).

24.7.8 40 CFR § 194.24(c)(5)

The changes made to the PDP since 2004 did not affect compliance with 40 CFR 194.24(c)(5) (U.S. EPA 2010c, Section 24.9.6). Based on the review and evaluation of the CRA-2009 and supplemental information provided by the DOE, the EPA determined that the DOE continued to comply with the requirements for section 194.24(c)(5) (U.S. EPA 2010c, Section 24.9.7).

24.7.9 40 CFR §§ 194.24(d) and (f)

In the CRA-2009, the EPA asked for additional analysis assuming clustering of waste. The DOE performed an analysis that showed nonrandom placement of waste was not significant and no waste loading assumptions were necessary in PA calculations. Based on the review and evaluation of the CRA-2009 and supplemental information provided by the DOE, and because the DOE had shown that waste loading assumptions were not necessary for use in PA, the EPA determined that the DOE continued to comply with the requirements for sections 194.24(d) and 194.24(f) for the 2009 recertification (U.S. EPA 2010c, Section 24.10.7).

24.7.10 40 CFR § 194.24(g)

The EPA verified that the DOE was using the WWIS to keep track of waste emplaced at the WIPP repository in its annual emplacement inspections. These annual inspections confirmed that the DOE continued to comply with section 194.24 (g) (U.S. EPA 2010c, Section 24.11.5).

Based on the review and evaluation of the CRA-2009 and supplemental information provided by the DOE, the EPA determined that the DOE continued to comply with the requirements for this section (U.S. EPA 2010c, Section 24.11.6).

24.8 Changes or New Information Since the CRA-2009 Recertification

24.8.1 40 CFR § 194.24(a)

To meet the requirements of section 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-2009, which was based on the inventory in the CRA-2004 PABC with an inventory cutoff date of September 30, 2002 (herein referred to as the CRA-2009) (U.S. DOE 2006; Leigh et al. 2005; Leigh, Trone, and Fox 2005). As a result of a full technical evaluation of CRA-2009 from the EPA during its completeness review, the DOE was directed to conduct a new PA for recertification to incorporate inventory changes as well as other technical changes (Cotsworth 2009a and Cotsworth 2009b). The new inventory components and chemical estimates were reported in the ATWIR-2008 (U.S. DOE 2008b) and the PAIR-2008 with an inventory cutoff date of December 31, 2007 (Crawford et al. 2009), and subsequently summarized in the CRA–2009 PABC (Clayton et al. 2010).

The TRU waste inventory used in the CRA-2014 is based on the unscaled ATWIR-2012 (U.S. DOE 2012a; data as of December 31, 2011, the cutoff for inclusion in the CRA-2014 PA), which is then scaled to a disposal inventory in the PAIR-2012 (Van Soest 2012) that supports PA calculations. The TRU waste inventory collection process and associated radiological and non-radiological components collected have remained the same since the CRA-2009 and CRA-2009 PABC.

The TRU waste inventory has been collected annually since 2007 and has changed from year to year (see Table 24-4). The emplaced waste was tracked as reported in the Waste Data System (WDS) (formerly the WWIS), and was included in the CRA–2009 and CRA–2009 PABC inventories, and currently in the CRA–2014. Table 24-4 provides a brief history of the inventory documents.

Table 24-4. Historical Inventory Documents

Title	Purpose
WTWBIR, Revision 0 (U.S. DOE 1994)	Initial inventory of the DOE complex to report all defense TRU waste at the waste-stream level.
WTWBIR, Revision 1 (U.S. DOE 1995a)	First update made to the original inventory data reported.
TWBIR, Revision 2 (U.S. DOE 1995b)	Used to show that the WIPP facility was in compliance with the disposal standards.
TWBIR, Revision 3 (U.S. DOE 1996b)	
Appendix DATA-2004, Attachment F of *Title 40 CFR 191, Subparts B and C, Compliance Recertification 2004* (U.S. DOE 2004)	Provided updated inventory information for the first recertification of the WIPP in 2004 (CRA-2004).
TWBIR–2004 (U.S. DOE 2006)	This was a revision of Appendix DATA, Attachment F. Provided updated inventory to support the PABC (CRA-2004 PABC) and was used for CRA-2009.
ATWIR–2007 (U.S. DOE 2008a)	The first annual inventory report that contained both scaled (calculations to represent a full repository) and unscaled data.
ATWIR–2008 (U.S. DOE 2008b)	First annual inventory report that reported only unscaled data.
PAIR–2008 (Crawford et al. 2009)	Provided data from ATWIR–2008 in the required format for CRA-2009 PA baseline calculations (CRA-2009 PABC).
ATWIR–2009 (U.S. DOE 2009d)	Provided updated annual inventory information.
ATWIR–2010 (U.S. DOE 2010a)	Provided updated annual inventory information.
ATWIR–2011(U.S. DOE 2011a)	Provided updated annual inventory information.
ATWIR–2012 (U.S. DOE 2012a)	Provides updated inventory information for this recertification application.
PAIR–2012 (Van Soest 2012)	Provides data from ATWIR–2012 in the required format for CRA–2014 PA (CRA-2014).

Volumes and characteristics (both physical and 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 are attributed to:

- Availability and confidence in supplemental characterization information or process knowledge.
- Site estimates of projected TRU waste stream volumes. Changes in projected waste streams directly affect the CH and RH scaling factors that determine the disposal inventory for PA.
- Continuing waste emplacement at the WIPP facility.
- Regulations on the federal and state level.
- Waste program management decisions at the site, at the WIPP facility and on the national level.
- Site funding for waste management on sites.
- Inventory standardized collection methodologies and data check enhancements.

These are just a few of the interrelated factors that affect the estimates of waste stream volumes and associated characteristics.

24.8.1.1 Inventory Databases

The CRA–2009 TRU waste inventory data were captured in the Transuranic Waste Baseline Inventory Database (TWBID) Revision 2.1, Version 3.13, data version 4.16. The TWBID was subsequently superseded with the Comprehensive Inventory Database v.1.00 S.100 (CID1), which was released in December 2006. All relevant TWBID data and information were migrated into the CID1. The CID1 data version D.7.00 supported the issuance of the ATWIR-2008 and PAIR-2008. The TRU waste inventory information then was migrated from CID1 to CID, v.2.00 S.2.00 (CID2), released in August 2011. The CID2 subsequently underwent a minor software update to v.2.01 S.2.01 in March 2012. The CID2 data version D.11.00 supported the issuance of the ATWIR–2012 and the PAIR–2012, which provide input to the CRA–2014.

The CID1 and CID2 were qualified to the software quality assurance requirements of the *Quality Assurance Program Document* (QAPD) (U.S. DOE 2010b). Some of the major enhancements to CID2 include tracking waste and packaging materials and chemical components in mass units (kilograms [kg]), which were formerly tracked in density (kg/m^3) and weight percent (wt %), respectively, and tracking radionuclide activities (Ci), which were formerly tracked in activity concentrations (Ci/m^3). Additionally, CID2 added an Excel® import feature that increased data entry efficiency. The CID2 was also designed to facilitate automated execution and input/output processing for the radioactive decay and buildup calculations using the ORIGEN-S module of SCALE 6 (ORNL 2009). ORIGEN Version 2.2 (ORNL 2002) was used for the decay and buildup calculations for the previous compliance applications. ORIGEN-S is qualified to the software quality assurance requirements of the QAPD (U.S. DOE 2010b).

24.8.1.2 Inventory Description

For PA to model a full repository, the DOE used the same scaling methodology used in the CRA–2009 and CRA–2009 PABC. The method of inventory scaling is presented in TWBIR–2004 (U.S. DOE 2006), Leigh, Trone and Fox (Leigh, Trone, and Fox 2005), and the PAIR–2008 (Crawford et al. 2009). The CRA–2009, CRA–2009 PABC, and CRA–2014 are based on different inventories; therefore, they employ different waste scaling factors (Table 24-5).

Table 24-5. Inventory Scaling Factors (unitless)

Type	CRA–2009[1] (cutoff 9/30/2002)	CRA–2009 PABC[2] (cutoff 12/31/2007)	CRA–2014[3] (cutoff 12/31/2011)
CH-TRU	1.48	5.72	2.66
RH-TRU	0.861	4.87	3.67

[1]U.S. DOE 2006; [2]Crawford et al. 2009; [3]Van Soest 2012

The CH and RH scaling factors, when applied to their respective site-reported projected volumes, artificially increase the volumes such that the sum of the stored, projected, and emplaced volumes meet but do not exceed the legislated limit on total volume (6.2 million cubic feet [Land Withdrawal Act]) and permitted limit on RH volume (250,000 cubic feet [Hazardous Waste Facility Permit]).The scaling factors will continue to change due to the estimated volumes of CH and RH stored, emplaced, and projected waste for each recertification. 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.

The data presented in Tables 24-6 through Table 24-10 are obtained from documents cited in the table footnotes, but in some cases the data were supplemented by database queries or reports so they could be presented in the appropriate units or totals.

24.8.1.3 TRU Waste Volume

For the CRA–2014, Table 3-1 and Table 3-2 of ATWIR–2012 list, by TRU waste site, the unscaled stored and projected volumes of CH-TRU and RH-TRU waste, respectively. Table 24-6 lists the total (sum of stored, projected, and emplaced) unscaled volumes by waste type for the CRA–2009, CRA–2009 PABC, and CRA–2014.

Table 24-6. Total CH and RH Waste Volumes (m^3)

	CRA–2009[1] (cutoff 9/30/2002)	CRA–2009 PABC[2] (cutoff 12/31/2007)	CRA–2014[3] (cutoff 12/31/2011)
CH	1.51×10^5	1.37×10^5	1.47×10^5
RH	7.40×10^3	2.91×10^3	3.84×10^3

[1]U.S. DOE 2006, LANL 2005 TWBID D.4.16; [2]U.S. DOE 2008b, LANL 2008 CID1 D.7.00; [3]U.S. DOE 2012a, LANL 2012 CID2 D.11.00

Between the CRA–2009 and the CRA–2009 PABC the major volume changes are due to: 1) resolution of legal issues with the State of Idaho. The 'Agreement to Implement', signed in July 2008, established requirements for retrieval of pre-1970 buried TRU waste. Prior to the 'Agreement to Implement', the Idaho Cleanup Project (ICP) had conservatively included additional volume to account for waste that could require disposal outside of Idaho, such as underburden soil, in addition to waste that was ultimately defined as 'targeted waste'. As a result of the 'Agreement to Implement', only "targeted waste" delineated in the Agreement was included in a revised ICP estimated CH volume. The revised estimate resulted in a decrease of approximately 10,500 cubic meters, and 2) the Hanford River Protection tank waste was removed from the WIPP-bound inventory, accounting for approximately 3,900 m^3 and 4,500 m^3 of the CH and RH volumes, respectively (U.S. DOE 2006 and U.S. DOE 2008a).

Between the CRA–2009 PABC and the CRA–2014, the inventory volume for both CH and RH waste has increased. The major increase in CH waste is attributed to the Hanford (Richland) site and INL, with a total increase between the two sites of approximately 7,000 m^3. The increase in RH waste volume is mainly attributed to Hanford, with an increase of about 1,300 m^3. For more details on the specific volume changes for the CRA–2009 PABC, refer to ATWIR–2008 (unscaled) and PAIR–2008 (scaled) (U.S. DOE 2008b; Crawford et al. 2009). For the CRA–2014, refer to the ATWIR–2012 (unscaled) and PAIR–2012 (scaled) (U.S. DOE 2012a; Van Soest 2012).

24.8.1.4 Number of Curies

Tables 3-10 and 3-11 of ATWIR–2012 (U.S. DOE 2012a) list the anticipated CH-TRU and RH-TRU radionuclide activities (decay and buildup corrected through 2011) by site and radionuclide, respectively. Table 24-7 lists the unscaled total (sum of stored, projected, and emplaced) CH and RH and activities for the CRA–2009, CRA–2009 PABC, and CRA–2014. These activities have different decay periods since, in the past, reporting period unscaled activities were not decayed to a common year, such as the closure year (2033).

Table 24-7. Total CH and RH Activity (Ci)

	CRA–2009[1] (cutoff 9/30/2002)	CRA–2009 PABC[2] (cutoff 12/31/2007)	CRA–2014[3] (cutoff 12/31/2011)
CH	4.30×10^6	3.56×10^6	3.48×10^6
RH	1.68×10^6	3.89×10^5	1.20×10^6

[1]U.S. DOE 2006, LANL 2005 TWBID D.4.16; [2]U.S. DOE 2008b, LANL 2008 CID1 D.7.00; [3]U.S. DOE 2012a, LANL 2012 CID2 D.11.00

Since the CRA–2009, the activity for CH waste has decreased consistently over the years. This is mainly due to more realistic estimates based on actual characterization data where the activity had previously been overestimated. Also contributing to the decrease, but to a much lesser extent, is the decay and buildup of radionuclide activities.

The ATWIR–2008 (U.S. DOE 2008b) began decaying unscaled activities to 2033 (WIPP facility closure) so that a comparison could be made with future collection years. The most significant decrease in activity since the CRA–2009 was due to the SRS, with a decrease of approximately 780,000 Ci due to two waste streams that were repackaged, characterized, and shipped. During the characterization of waste streams SR-W027-221H-HET and SR-MD-HET (formerly SR-W027-999-MD-HET), SRS realized that it had overestimated the activity of these two waste streams. Correction of the largest overestimate was for plutonium-238 (^{238}Pu), which caused this isotope to no longer be reported as the most predominant isotope in the CRA-2014, Section 31, Tables 31-4 and 31-5.

The re-evaluation of SRS activity is not the only reason that ^{238}Pu is not the dominate isotope for the CRA-2014 PA. Other contributing factors include the amount of projected waste SRS estimated for these two waste streams, and the effects of scaling the activity to a full repository. All of these factors contributed to the overall decrease in ^{238}Pu for the CRA–2014.

The RH activity increase between CRA–2009 PABC and the CRA–2014 is attributed to the Hanford (Richland) site. Hanford RH volume more than doubled, subsequently increasing the activity by approximately 530,000 Ci. For more details on these changes, refer to ATWIR–2008 (unscaled) and PAIR–2008 (scaled) for the CRA–2009 PABC, and ATWIR–2012 (unscaled) and PAIR–2012 (scaled) for the CRA–2014 (U.S. DOE 2008b; Crawford et al. 2009; U.S. DOE 2012a; Van Soest 2012).

24.8.1.5 Waste, Packaging, and Emplacement Materials

Table 3-4 of the ATWIR–2012 lists the unscaled stored and projected waste and packaging components of the CH-TRU and RH-TRU waste inventory. Table 24-8 lists the unscaled total (sum of CH and RH stored, projected, and emplaced) waste materials (iron, aluminum-based metal/alloys; other metal/alloys; other inorganic materials; cellulosic; rubber; plastics; cement; solidified inorganic and organic materials; soils; vitrified) and packaging materials (CPR, steel, lead) masses for the CRA–2009, CRA–2009 PABC, and CRA–2014.

Table 24-8. Total Waste and Packaging Materials (kg)

	CRA–2009[1] (cutoff 9/30/2002)	**CRA–2009 PABC[2]** (cutoff 12/31/2007)	**CRA–2014[3]** (cutoff 12/31/2011)
Waste Materials	9.45×10^7	5.34×10^7	4.57×10^7
Packaging Materials	3.51×10^6	3.03×10^7	3.39×10^7

[1]U.S. DOE 2006, LANL 2005 TWBID D.4.16; [2]U.S. DOE 2008b, LANL 2008 CID1 D.7.00; [3]U.S. DOE 2012a, LANL 2012 CID2 D.11.00

The waste materials have continuously decreased over the CRA time periods. This is mainly due to more realistic estimates based on actual characterization data where the masses of the packaging materials had previously been overestimated.

The largest single waste material decrease was related to the volume decrease for the ICP as reported in Section 24.8.1.3. Since ICP overestimated soil volume, this had a direct decrease in the soil mass for the waste material parameters. This accounted for approximately a 16 million kg decrease in soils between the CRA–2009 and the CRA–2009 PABC. The packaging materials have stayed fairly stable over the CRA reporting time frames, with the change in the total mass being related to the final container type stored and emplaced in the WIPP.

For more specific details on the waste and packaging material parameter changes refer to ATWIR–2008 (unscaled) and PAIR–2008 (scaled) for the CRA–2009 PABC, and ATWIR–2012 (unscaled) and PAIR–2012 (scaled) for the CRA–2014 (U.S. DOE 2008b; Crawford et al. 2009; U.S. DOE 2012a; Van Soest 2012).

Table 24-9 lists the total scaled emplacement material (cardboard slip sheets/stabilizer-cellulose; polypropylene supersacks, slip sheets, and stretch/shrink wrap-plastic) masses for the CRA–2009, CRA–2009 PABC, and CRA–2014.

Table 24-9. Total Scaled Emplacement Materials (kg)

CRA–2009[1] (cutoff 9/30/2002)	**CRA–2009 PABC**[2] (cutoff 12/31/2007)	**CRA–2014**[3] (cutoff 12/31/2011)
1.69×10^6	1.34×10^6	1.51×10^6

[1]U.S. DOE 2006; [2] Crawford et al. 2009; [3]Van Soest 2012

To determine the mass of emplacement materials when the WIPP repository is full, an analysis is performed for each CRA. The analysis uses scaled final form container data to determine the amount of emplacement materials required to emplace the total scaled number of final form containers in the WIPP repository. The emplacement material masses are only calculated using scaled container values; therefore, Table 24-9 only presents the scaled emplacement material masses.

Since scaled values are not comparable, some generalizations can be made as to why the values are different: 1) for each CRA, the scaling factors have changed, which has a direct change on the final values, 2) the emplacement materials will continue to change based on the actual containers that are emplaced in the WIPP repository, and 3) the analysis calculates what type of emplacement materials will be needed based on the estimated final containers reported by the sites. As these estimates change, so will the emplacement materials.

24.8.1.6 Organic Ligands and Oxyanions

Table 24-10 lists the total (sum of CH and RH stored, projected, and emplaced) scaled CH and RH organic ligands (acetate, acetic acid, citrate, citric acid, EDTA, oxalate, oxalic acid) and oxyanion (nitrate, phosphate, sulfate) masses for the CRA–2009, CRA–2009 PABC, and CRA–2014.

Table 24-10. Total Scaled Organic Ligands and Oxyanions (kg)

	CRA–2009[1] (cutoff 9/30/2002)	**CRA–2009 PABC[2]** (cutoff 12/31/2007)	**CRA–2014[3]** (cutoff 12/31/2011)
Organic Ligands	5.80×10^4	5.87×10^4	5.07×10^4
Oxyanions	3.22×10^6	2.52×10^6	2.38×10^6

[1]U.S. DOE 2006; [2]Crawford et al. 2009; [3]Van Soest 2012.

The data in Table 24-10 are presented as scaled data because the organic ligands and oxyanions are not tracked in the WDS; therefore, to account for their emplaced mass, an analysis is performed to account for all the organic ligands and oxyanions. This analysis is performed on the scaled data and is presented in the performance assessments inventory reports for the use in PA.

Since scaled values are not comparable for the organic ligands and oxyanions, the following generalizations are discerned: 1) for each CRA, the scaling factor has changed, which has a direct effect on the final values, 2) organic ligand and oxyanion masses have changed due to the development of additional AK documentation, and 3) the generator sites are reporting more accurate values for these components. For more specific details on organic ligand and oxyanion changes refer to ATWIR–2008 (unscaled) and PAIR–2008 (scaled) for the CRA–2009 PABC, and ATWIR–2012 (unscaled) and PAIR–2012 (scaled) for the CRA–2014 (U.S. DOE 2008b; Crawford et al. 2009; U.S. DOE 2012a; Van Soest 2012).

Based on the information presented in section 24.8.1, the DOE continues to demonstrate compliance with provisions of section 194.24(a).

24.8.2 40 CFR § 194.24(b)(1)

There were no major changes to the waste characteristics between the CRA–2009 PABC and the CRA–2014, but the DOE did update waste component information and add inventory parameters used in the WIPP PA. Additional parameters include the mass of waste and packaging materials, the solubilities calculated using multiples of the minimum brine volume necessary for a DBR to occur, and those to describe the additional biodegradation reactions implemented within the repository chemistry model. These changes are refinements to the implementation of the PA conceptual models; no changes were made to these models. Waste component changes are summarized in Table 24-11, and parameter value changes are discussed in the appropriate subsections below.

Based on the information presented in Section 24.8.2, the DOE continues to demonstrate compliance with provisions of section 194.24(b)(1).

Table 24-11. Significance and Changes in Components and Characteristics

Waste Component or Characteristic Used in PA	Increase or Decrease From CRA–2009 PABC to CRA–2014	Significance
Radioactivity (Ci/m^3)	Decrease	Used in calculating releases
Solubility	Increase and decrease, depending on oxidation state	Higher solubility can lead to higher releases
Organic Ligands—complexing agents	Decrease	Increases solubility
Amount of Metals	Decrease	Maintains reducing environment, but also contributes to gas generation
Amount of CPRs	Decrease	May increase gas generation from microbial processes
Oxyanions: nitrate, sulfate, and phosphate	Increase and decrease	Nutrients for microbes - affects gas generation
Cement	Decrease	Volume-related component
Shear Strength	Increase	Affects mechanical releases during a drilling intrusion
Particle Diameter	No change	Used to calculate spallings releases
Formation of Colloidal Suspensions	Increase and decrease	Colloids can facilitate transport of radionuclides in groundwater

24.8.2.1 Assessment of Waste Characteristics and Waste Characteristic Input Parameters

In the CCA, the DOE identified several waste characteristics as being potentially important to PA. The CRA–2014 identifies the same important characteristics as in the CCA. As was first done in the CRA–2004, the CRA–2014 continues to assert that organic ligands could be important to solubility and therefore organic ligands are included in the solubility calculations (Brush and Domski 2013a).

There were no changes to the conceptual models since the CRA–2009 PABC.

24.8.2.2 CRA–2014 Radioactivity in Curies

The DOE used the information from the PAIR–2012 (Van Soest 2012) as the basis for the PA isotope inventory for the CRA–2014. The CRA-2014 PA Radionuclide Inventory Screening Analysis (Kicker and Zeitler 2013) discusses the methodology used by the DOE to determine the WIPP repository radionuclide inventory information for use in CRA–2014 PA calculations. The parameters for the initial radionuclide inventory decayed to the WIPP facility closure date, and those calculated based on the initial radionuclide inventories such as the WUF, and the initial lumped radionuclide inventories were updated for use in the CRA–2014 (Kicker and Zeitler 2013).

24.8.2.3 CRA-2014 Solubility and Organic Ligands

The CRA–2014 includes new solubility values for Th(IV), Np(V) and Am(III) (Brush and Domski 2013a), and new solubility uncertainty factors (Brush and Domski 2013b). The DOE also implemented a new method for calculating the organic ligand concentrations for the minimum brine volumes necessary for a DBR by adding additional parameters (Camphouse 2013). The DOE utilized EQ3/6, Version 8.0, and the thermodynamic database DATA0.FMT.R2, also known as DATA0.FM1, for the analyses performed in support of the CRA–2014. The CRA–2014 continues to include the effects of organic ligands in the solubility calculations, as was first done in the CRA–2004.

More details are provided in Appendix SOTERM-2014, Sections SOTERM-3 and SOTERM-4 on the refinement of the baseline solubilities and solubility uncertainties and in Appendix MASS-2014, Section MASS-2.6.10 on the implementation of variable brine volume.

24.8.2.4 CRA-2014 Parameters Related to Metals, CPR and Oxyanions

The CRA–2014 used the inventory described in the PAIR–2012 (Van Soest 2012) to update the parameters related to metals, CPRs and oxyanions. Previous inventory reports included the densities of the waste and packaging materials, but the PAIR–2012 reports the masses of the waste and packaging materials. This change allows the reported values to be directly used in PA, and the conversion from densities to masses is no longer necessary. Twenty-two new parameters, shown in Table 24-12, were added to represent the new waste and packaging material mass values reported in the PAIR–2012 (Camphouse 2013).

Table 24-12. Waste and Packaging Material Parameters Added for the CRA–2014.

Material	Property	Description
WAS_AREA	CELCCHW	Mass of cellulosics in CH waste container materials
	CELCRHW	Mass of cellulosics in RH waste container materials
	CELECHW	Mass of cellulosics in CH waste emplacement materials
	CELERHW	Mass of cellulosics in RH waste emplacement materials
	CELLCHW	Mass of cellulosics in CH waste
	CELLRHW	Mass of cellulosics in RH waste
	IRNCCHW	Mass of iron containers, CH waste
	IRNCRHW	Mass of iron containers, RH waste
	IRONCHW	Mass of iron-based material in CH waste
	IRONRHW	Mass of iron-based material in RH waste
	PLASCHW	Mass of plastics in CH waste
	PLASRHW	Mass of plastics in RH waste
	PLSCCHW	Mass of plastic liners, CH waste
	PLSCRHW	Mass of plastic liners, RH waste
	PLSECHW	Mass of plastic in CH waste emplacement materials
	PLSERHW	Mass of plastic in RH waste emplacement materials
	RUBBCHW	Mass of rubber in CH waste
	RUBBRHW	Mass of rubber in RH waste
	RUBCCHW	Mass of rubber in CH waste container materials
	RUBCRHW	Mass of rubber in RH waste container materials
	RUBECHW	Mass of rubber in CH waste emplacement materials
	RUBERHW	Mass of rubber in RH waste emplacement materials

24.8.2.5 CRA-2014 Production of Gas from the Waste

Two changes related to the gas generation from the waste were implemented in the CRA–2014 PA: the refinement of the repository water balance and the update to the anoxic steel corrosion rate. Each is discussed below.

24.8.2.5.1 Repository Water Balance

As part of the CRA–2009, the EPA noted several issues for possible additional investigation, including the potential implementation of a more detailed repository water balance (U.S. EPA 2010c). The main objective of refining the repository water balance is to include the major gas- and brine-producing and consuming reactions in the existing conceptual model (Appendix PA-2014, Section PA-1.1.8). The CRA–2014 implements the same biodegradation pathways as implemented in the CRA–2009 PABC, but the generation of water is also considered. All reactions are further described in Camphouse (Camphouse 2012).

The CRA–2014 PA includes the following gas and brine reactions:

- Iron hydroxide with hydrogen sulfide, which consumes gas and produces water
- MgO hydration, which consumes water and produces brucite
- Carbonation of brucite to form Hydromagnesite
- Transformation of hydromagnesite to form magnesite, which produces water

BRAGFLO 6.02 was revised to include these additional reactions (see Appendix PA–2014, Section PA-4.2.5). As a result, several new parameters were added (see Table 24-13). Clayton (Clayton 2013) describes the justification of the chemistry parameter values used for the CRA-2014.

Table 24-13. Chemistry Parameters Added for the CRA-2014

Material	Property	Description
REFCON	DN_HYDRO	Hydromagnesite density
REFCON	MW_HYDRO	Hydromagnesite molecular weight
REFCON	STCO_*xy*	Stoichiometric coefficients for reaction *x*, species *y*
WAS_AREA	BRUCITEC, BRUCITES	MgO inundated hydration rate in Castile and Salado brines
WAS_AREA	BRUCITEH	Humid MgO hydration rate
WAS_AREA	HYMAGCON	Hydromagnesite conversion rate

24.8.2.5.2 Refinement of the Steel Corrosion Rate (STEEL:CORRMCO2)

In the WIPP PA, model gas generation is assumed to result from the microbial degradation of CPR materials and the anoxic corrosion of steel (see Appendix PA-2014, Sections PA-1.1.4 and

PA-4.2.5). The parameter STEEL:CORRMCO2 represents the anoxic steel corrosion rate for brine-inundated steel in the absence of microbially produced CO_2.

The DOE has updated both the distribution type and values for the parameter STEEL:CORRMCO2 for the CRA-2014 PA based on the experimental corrosion data reported by Roselle (Roselle 2013). Because the STEEL:CORRMCO2 parameter represents the corrosion rate as a constant in PA calculations, the best estimate of the corrosion rate is represented by the mean of the empirical data reported in Roselle (Roselle 2013). The uncertainty on the mean in this case is represented by a Student-t distribution. The DOE has updated both the distribution type and values for the parameter STEEL:CORRMCO2 for the CRA–2014 PA based on the experimental corrosion data reported by Roselle (Roselle 2013).

24.8.2.6 CRA-2014 Parameters Related to Waste Shear Strength

The parameter related to the waste shear strength was revised for the CRA-2014. Based on the recommendations of Herrick and Kirchner (Herrick and Kirchner 2013), the DOE included a refined distribution for the parameter BOREHOLE:TAUFAIL in the CRA–2014 PA calculations (Appendix PA-2014, Section PA-1.1.5). The DOE has updated the parameter for the CRA-2014 from a loguniform distribution with a range of 0.05 – 77.0 Pa, to a uniform distribution with a range of 2.22 – 77.0 Pa to best estimate the uncertainty range for parameter BOREHOLE:TAUFAIL.

24.8.2.7 CRA–2014 Formation of Colloidal Suspensions

The colloid enhancement parameters were re-examined for the CRA–2014 (Appendix PA-2014, Section PA-1.1.11). Based on the recommendations of Reed et al. (Reed et al. 2013), the DOE has updated the PA colloid parameters. Specifically, the PA parameter properties CONCINT, PROPMIC and CAPMIC were changed. More details are provided in SOTERM-2014, Section SOTERM-4.6.

24.8.3 40 CFR §§ 194.24(b)(2) and (b)(3)

The CRA–2014 identifies the same important waste characteristics as in the CCA, and also identifies organic ligands as being potentially important to PA. The CRA–2014 includes organic ligands in the solubility calculations (Brush and Domski 2013a). Most of the inventory amounts of the listed components have changed since the CRA–2009 PABC; these are described in the PAIR–2012 (Van Soest 2012).

The DOE provided a list of those waste characteristics and components that were excluded from consideration in the CCA PA for various reasons, such as negligible impact. There were no changes in the exclusion decisions for the important waste components and characteristics since the CRA–2009 PABC recertification decision. Therefore, the DOE continues to demonstrate compliance with provisions of section 194.24(b)(2) and (b)(3).

24.8.4 40 CFR §§ 194.24(c)(1), (e)(1), and (e)(2)

The rationale has changed for establishing or not establishing limits for the waste components identified as potentially significant in the CCA. The minimum emplacement limit for nonferrous metals has been eliminated. All other limits remain the same, and their implementation into the CRA-2014 PA has not changed.

The minimum emplacement value for nonferrous metals was established in the CCA as the minimum amount needed to bind to organic ligands, thereby reducing the impact of organic ligands on the solubility of radionuclides (the effects of organic ligands were not included in the CCA PA). Since the CRA-2004, the effect of organic ligands on actinide solubility has been included in the PA. The minimum emplacement limit is no longer necessary to eliminate the effect of organic ligands on the actinide solubility in the PA, however the mass of nonferrous metals will continue to be tracked as part of the DOE waste inventory.

In its evaluation of the CCA, the EPA concluded that while there is no limit for the radionuclide inventory, the EPA considers the radionuclide inventory used in the PA to be a *de facto* upper bound (U.S. EPA 2010c, Section 24.5.3). Therefore the inventory that is used in PA calculations to determine compliance with release standards resets the limits on radionuclide emplacement at the WIPP. Thus, the DOE is proposing a new upper bound for the radionuclide inventory by including the most recent DOE inventory data from the PAIR–2012 (Van Soest 2012) in the CRA–2014 PA.

Based on the information above, the DOE continues to demonstrate compliance with the provisions of section 194.24(c)(1), (e)(1), and (e)(2).

24.8.5 40 CFR § 194.24(c)(2)

As noted in Section 28.8.4 (40 CFR § 194.24(b)), the DOE did not modify the list of CRA–2009 components and characteristics requiring quantification. Therefore, the CRA–2014 does not identify any significant changes to the measurement techniques used in the waste characterization program (i.e., VE, RTR, AK, NDA).

Since the CRA–2009, the standard large box 2 has been added to handle oversized waste items, and the shielded container (see Appendix DATA-2014, DATA-B-1.3) has been conditionally approved by the EPA (Edwards 2011) to dispose of high gamma waste as CH, but will be accounted against the RH limits. The WIPP WAC (U.S. DOE 2008c) was revised to remove all references to limited VE (i.e., document all contents of a waste container) for CH waste. Revision 6.5 of the WAC (U.S. DOE 2010c) clarified the language regarding liquid prohibition and VE. The term "residual liquid" was replaced with "observable liquid." Observable liquid is liquid that can be seen by a trained radiography operator or by a trained operator performing VE of the waste. This terminology can be implemented consistently during characterization regardless of waste type. These changes, along with the addition of the standard large box 2, shielded containers, and the removal of all references to limited VE for CH waste, do not modify the list of components and characteristics requiring quantification. Therefore, the DOE is in compliance with section 194.24(c)(2).

24.8.6 40 CFR § 194.24(c)(3)

Since the CRA–2009, the AK process has not changed for CH and RH waste. The process is described in CRA-2009, Section 24.6.7. The DOE has added a gravimetric or dimensional analysis for RH unique waste streams where the activity on or within a waste stream is identified as discreet pieces of irradiated materials to estimate the activity content of the waste container or to confirm AK information for the same measurements. For the gravimetric method, the data are controlled under the formal measurement control program specified in the QAPD. The quality assurance objectives of 194.22(c) are specified for both methods (U.S. DOE 2011b). Therefore, the DOE is in compliance with section 194.24(c)(3).

24.8.7 40 CFR § 194.24(c)(4)

The WWIS used the Oracle Version 10g database management system at the time of the CRA–2009, as described in CRA–2009, Section 24.6.8. The WWIS was retired in December 2009, and replaced with the WDS to provide DOE with a modern approach to process controls and data sharing. The WDS uses Oracle DB 11g, 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 2013) is not included in the WDS User's Manual (U.S. DOE 2012b), but is included as a reference to this section for consistency with the CRA–2009. Appendix MON-2014, Section MON-3.6, briefly describes the WDS and its function for the monitoring program that was developed to meet commitments contained in the DOE's application to the EPA, 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 is in compliance with section 194.24(c)(4).

24.8.8 40 CFR § 194.24(c)(5)

The DOE describes the PDP program in the CRA–2009, Section 24, Waste Characterization. Since the CRA–2009, both the *Performance Demonstration Program Plan for Nondestructive Assay of Boxed Wastes for the TRU Waste Characterization Program*, Revision 3 (U.S. DOE 2011c) and the *Performance Demonstration Program Plan for Nondestructive Assay of Drummed Wastes for the TRU Waste Characterization Program*, Revision 3 (U.S. DOE 2011d) have been revised. The most important changes to these documents were implemented to simplify sample preparation team requirements and instructions, better define the process to address failures of the tested NDA systems to meet NDA PDP criteria, single out the non-interfering matrix standard waste box and non-interfering matrix drum as distinct from other matrices tested and define their use for specialized circumstances, and to improve the descriptions of NDA PDP components and inventory of materials. The *Performance Demonstration Program Plan for Analysis of Simulated Headspace Gases*, Revision 7 (U.S. DOE 2010d) has also been revised since CRA–2009 to implement a change removing the compound *cis*-1,2-dichloroethylene from the target compound list. Therefore, the DOE is in compliance with section 194.24(c)(5).

24.8.9 40 CFR §§ 194.24(d) and (f)

For the CRA–2014 PA, the DOE did not make any changes to the waste loading scheme since the CRA–2009 PABC. The DOE did not use a performance-based waste loading scheme for waste emplacement in the WIPP repository, and the DOE assumed random placement of waste in its performance and compliance assessment. Therefore, the DOE continues to demonstrate compliance with provisions of section 194.24(d) and (f).

24.8.10 40 CFR § 194.24(g)

The CRA–2014 inventory has changed from the CRA–2009 PABC inventory and is described in Section 24.8.1 (40 CFR § 194.24(a)). The WDS tracks compliance with the limitations on CH-TRU and RH-TRU waste described in the WIPP LWA. Therefore, the DOE is in compliance with section 194.24(g).

24.8.11 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 is in compliance with section 194.24(h).

24.9 References

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