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TRANSURANIC WASTE ACCEPTANCE CRITERIA FOR THE WASTE ISOLATION PILOT PLANT

Revision 11

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U.S. Department of Energy
Carlsbad Field Office

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Carlsbad Field Office

Approved by:	/signature on file/ Reinhard Knerr, Manager Carlsbad Field Office	10/4/2022 Date
Approved by:	/signature on file/ Kenneth Princen, Assistant Manager Office of the National TRU Program Waste Certification & Disposal	9/29/2022 Date

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CHANGE HISTORY SUMMARY

REVISION NUMBER	DATE ISSUED	DESCRIPTION OF CHANGES
9	10-18-2018	• Typographical corrections. • Additions to the list of acronyms. • Removal of the exclusion of POCs containing combustible waste from being shipped to WIPP. • Update to the list of definitions in Appendix C. • Addition and deletion of text in Appendices H and I for consistency with Page Change 1 to Revision 6a of the DSA. The changes to Appendix H and I are due to an assessment performed February 27, 2017 through March 3, 2017, to confirm the readiness of the CBFO and NTP to effectively execute a set of responsibilities described in the WIPP DSA, Chapter 18.
10	08-14-2020	• Incorporation of remote-handled (RH) transuranic (TRU) waste acceptance requirements/criteria taken from the Remote-Handled TRU Waste Characterization Program Implementation Plan, thus harmonizing contact- handled (CH) and RH waste acceptance criteria on a single platform. • Consolidation of Chapter 4 of the WAC (titled “Waste Acceptance Requirements and Criteria for RH Waste”) into Chapter 3 (retitled “Waste Acceptance Requirements for TRU Waste”). • Modifications to Figure 1.0 and Tables 1, 2, 3, 4, 5, A-1, A-3, and A-4. • A temporary suspension of receipt and processing of RH waste when containerized in either transport or facility casks. • A temporary delay in the shipment from SRS to WIPP of dilute and dispose PuO using CCOs. • Allowance for the receipt and processing of RH waste when containerized in a shielded container. • Incorporation into Appendix A the use of figure of merit assessments used as an alternative for replicate gamma ray measurements using far field measurements. • Addition into Appendix A the methodologies for performing dose-to-curie and gravimetric/dimensional measurements. • Addition of fissile equivalent mass for uranium into Table A-1.

REVISION NUMBER	DATE ISSUED	DESCRIPTION OF CHANGES
		• Title change of Table A-3. • Updates to the list of definitions in Appendix C. • Changes to titles and text in Appendices A, F, G, and I. • Text changes and the addition of Figure H-1 in Appendix H. • Additions and deletions in the list of acronyms. • Typographical error corrections and updates to the internet links.
11	11-04-2022	• Updated phone and fax numbers for the Office of Scientific and Technical Information and the fax number for the National Technical Information Service. • Deleted the following text in Section 3.2.1, third bullet: "Waste packaged in CCOs that contain combustibles are excluded from shipment to the WIPP, excluding radiological control materials and packaging materials normally used to load these containers (References 4, Sections 3.3.2.3, and 3.6)." • Modified Table 1, the Non-Machine Compacted Waste section, 55-gallon drum configured as a CCO; added text that states: "Limited to ≤ 2,000 g of plastics" and "for additional special waste container geometry/material requirements refer to Supplement to Table 1, *CCO Material Requirements.*" • Modified Table 1, the Non-Machine Compacted Waste section, POCs (i.e., a Standard, S100, S200, and S300); added text that states: "Be/BeO shall be mechanically/chemically bound to the fissile material." • Modified Table 1, the Machine Compacted Waste section; added two new rows to the end of the table: 55-gallon drum configured as a POC (i.e., a Standard, S100, S200, and S300) and 55-gallon drum configured as a CCO. • For the new row in Table 1, listed as 55-gallon drum configured as a POC (i.e., a Standard, S100, S200, and S300); added text as follows: "Limited to ≤ 33.9 kg of plastics." • For the new row in Table 1, listed as 55-gallon drum configured as a POC (i.e., a Standard, S100, S200, and S300); listed the FGE Limit as "≤ 200."

REVISION NUMBER	DATE ISSUED	DESCRIPTION OF CHANGES
		• For the new row in Table 1, listed as 55-gallon drum configured as a CCO; added text as follows: "Limited to ≤ 2,000 g of plastics." • For the new row in Table 1, listed as 55-gallon drum configured as a CCO; added text as follows: "for additional special waste container geometry/material requirements refer to Supplement to Table 1, *CCO Material Requirements.*" • For the new row in Table 1, listed 55-gallon drum configured as a CCO; listed the FGE Limit as "≤ 380." • Deleted original footnote 1 from Table 1. • Added new footnote 1 to POC waste container type: "POCs can contain combustibles provided the UltraTech 9424S filter is installed in the 55-gallon drum 3/4-inch lid opening per manufacturer's specifications. POCs containing combustibles, packaged with the UltraTech 9424S filter as described in this note, are considered compliant with the WAC." • Added Supplement to Table 1*, CCO Material Requirements*, to describe three options available for CCOs. Based on container contents, boron carbide may be required to address post-closure criticality safety. • Modified the CCO row within Table 5; deleted "Direct-loaded – all approved waste forms except CCOs containing combustibles other than radiological control materials and packaging materials normally used to load these containers." • Modified the CCO row within Table 5; deleted the PE-Ci Limit "≤ 1,800." • Modified the CCO row within Table 5; added the following text: "Direct-loaded – only with approved CCO-S packaging configuration." • Modified the CCO row within Table 5; the PE-Ci Limit for the CCO-S configuration is limited to "≤ 24." • Modified the CCO row within Table 5; added the following text: "Direct-loaded – only with approved CCO-EDP packaging configuration." • Modified the CCO row within Table 5; the PE-Ci Limit for the CCO-EDP configuration is limited to "≤ 120." • Clarified footnote 1 of Table 5; changed the language to the following: "For payload containers that exceed

REVISION NUMBER	DATE ISSUED	DESCRIPTION OF CHANGES
		the PE-Ci limit, disposal options include either repackaging the waste, or petitioning the DOE/CBFO for an alternative determination of WAC compliance based on an approved safety analysis of the PE-Ci limit exceedance." • Clarified footnote 2 as follows: "POCs can be loaded up to 1,800 PE-Ci per container with an assembly limit of 1,800 PE-Ci. The CCO-S and CCO-EDP processes are described in Reference 4, the WIPP Documented Safety Analysis, Chapter 2, Section 2.6.2.12*, Criticality Control Overpack* and Chapter 3, Section 3.3.2.3 (2), entitled *WIPP WAC.*" • Added two references (Reference 52 and 53) to Section 5.0 as the basis for criticality safety within CCOs. • In Appendix C, Glossary, added definitions of CCO-EDP and CCO-S, as defined in the DSA, Revision 8a. • Global editorial corrections and updates.

LIST OF ACRONYMS AND ABBREVIATIONS

AK	acceptable knowledge
AKA	acceptable knowledge assessment
ALARA	as low as reasonably achievable
AMAD	activity median aerodynamic diameter
AMWTP	Advanced Mixed Waste Treatment Project
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
Be/BeO	beryllium/beryllium oxide
BoK	Basis of Knowledge
CBFO	Carlsbad Field Office
CCC	criticality control container
CCE	Chemical Compatibility Evaluation
CCO	criticality control overpack
CCO-EDP	CCO prepared using the Enhanced Dilution Process
CCO-S	CCO prepared using the Sandia Process
CCP	Central Characterization Program
CFR	Code of Federal Regulations
CH	contact-handled
CH-TRAMPAC	Contact-Handled Transuranic Waste Authorized Methods for Payload Control
Ci	curie
cm^2	square centimeter
CoC	Certificate of Compliance
CPR	cellulose, plastic, and rubber
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
dpm	disintegrations per minute
DQO	data quality objective
DSA	Documented Safety Analysis
DTC	dose-to-curie
EPA	U.S. Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FEM	fissile equivalent mass
FGE	fissile gram equivalent
FOM	figure of merit

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

g/cm^3	gram per cubic centimeter
GSTR	Generator Site Technical Review
ICP-MS	inductively coupled plasma-mass spectrometry
IWMDL	Interface Waste Management Documents List
keV	kiloelectron volt
kg	kilogram
LCS	laboratory control sample
LLD	lower limit of detection
LWA	Land Withdrawal Act
m^3	cubic meters
M&O	management and operating
MCNP	Monte Carlo N-Particle
MDA	minimum detectable activity
MOA	Memorandum of Agreement
mrem/hr	milliroentgen equivalent man per hour
MS	matrix spike
MSD	matrix spike duplicate
MSDS	Material Safety Data Sheet
nCi	nanocuries
nCi/g	nanocuries per gram
NDA	nondestructive assay
NEPA	National Environmental Policy Act
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NRC	U.S. Nuclear Regulatory Commission
NTP	National TRU Program
OJT	on-the-job training
PCB	polychlorinated biphenyl
PE-Ci	Plutonium-239 equivalent curie
Permit	WIPP Hazardous Waste Facility Permit
POC	pipe overpack container
ppm	parts per million
QA	quality assurance
QAO	quality assurance objective
QAPD	Quality Assurance Program Document
QAPjP	Quality Assurance Project Plan
QC	quality control

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

%R	percent recovery
RC	radiochemistry
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
rem/hr	roentgen equivalent man per hour
RGN	reactivity group number
RH	remote-handled
RH-TRAMPAC	Remote-Handled Transuranic Waste Authorized Methods for Payload Control
RPD	relative percent difference
RSD	relative standard deviation
SAR	Safety Analysis Report
SCG	Summary Category Group
SDS	Safety Data Sheets
SEIS	Supplemental Environmental Impact Statement
SLB2	standard large box 2
SME	subject matter expert
SNM	special nuclear material
SPM	Site Project Manager
SWB	standard waste box
TDOP	ten-drum overpack
TMU	total measurement uncertainty
TRAMPAC	Transuranic Waste Authorized Methods for Payload Control
TRU	transuranic
TRUCON	TRU waste content
TRUPACT-II	Transuranic Package Transporter-II
TRUPACT-III	Transuranic Package Transporter-III
TSDF	Treatment, Storage, and Disposal Facility
VE	visual examination
WAC	Waste Acceptance Criteria
WAP	Waste Analysis Plan
WCP	WIPP Certified Program
WDS	Waste Data System
WIPP	Waste Isolation Pilot Plant
WMC	Waste Matrix Code
WSPF	Waste Stream Profile Form
WWIS	WIPP Waste Information System

1.0 INTRODUCTION

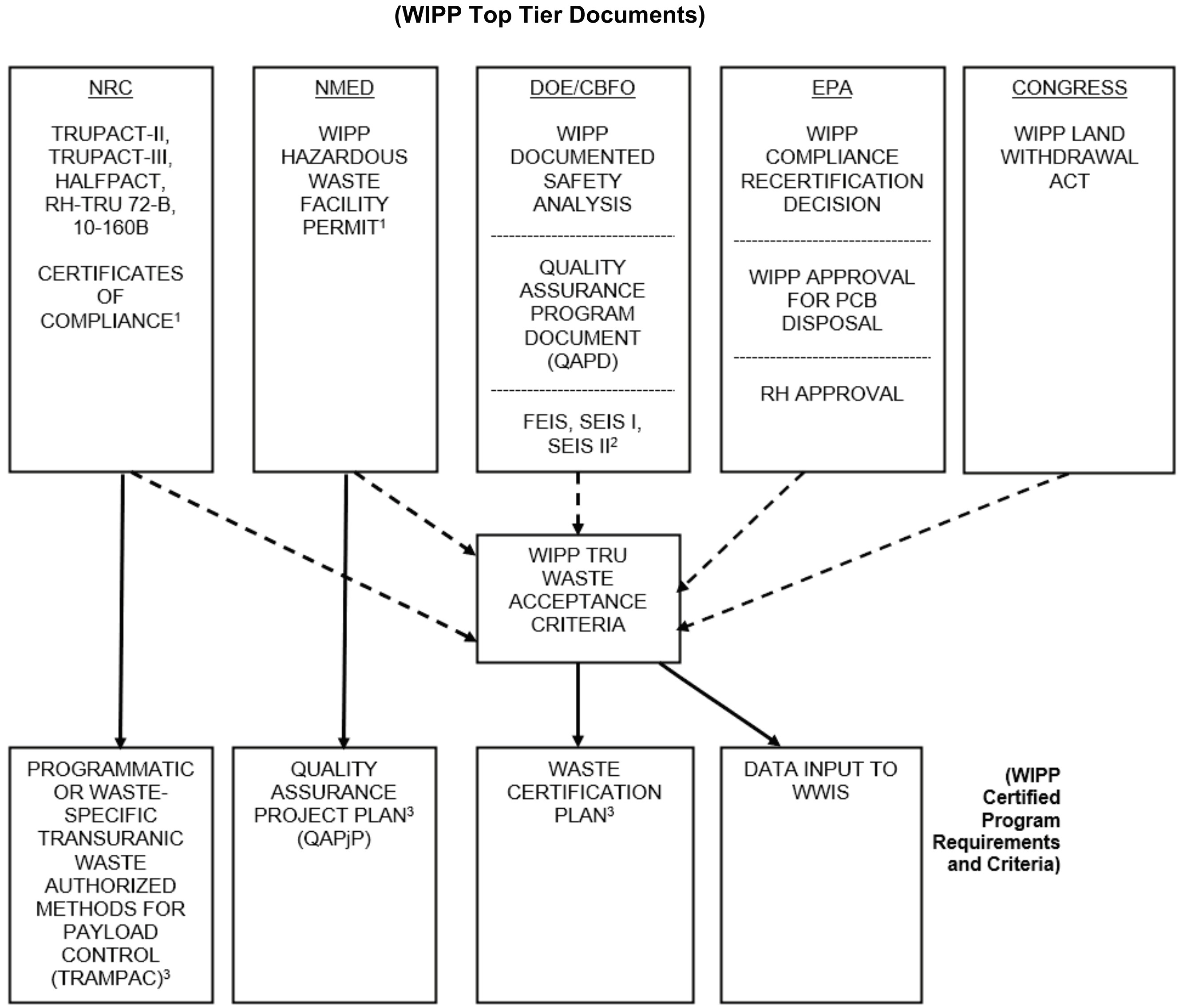
The purpose of this document is to summarize the waste acceptance criteria (WAC) applicable to the transportation, storage, and disposal of contact-handled (CH) and remote-handled (RH) transuranic (TRU) waste at the Waste Isolation Pilot Plant (WIPP). These criteria serve as the U.S. Department of Energy's (DOE's) primary directive for ensuring that CH-TRU and RH-TRU waste is managed and disposed of in a manner that protects human health and safety and the environment.

The WIPP authorization basis for the disposal of CH-TRU and RH-TRU waste includes the DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Reference 1) and the WIPP Land Withdrawal Act (LWA; Reference 2). Included in this document are the requirements and associated criteria imposed by these acts and the Resource Conservation and Recovery Act (RCRA; Reference 3), as amended, on the TRU waste destined for disposal at the WIPP.

The WIPP Certified Programs (WCPs) must certify CH-TRU and RH-TRU waste payload containers to the waste acceptance criteria identified in this document. As shown in Figure 1.0, Regulatory Basis of TRU Waste Acceptance Criteria, the flow-down of applicable requirements to the WAC is traceable to several higher-tier documents, including the WIPP safety requirements taken from the WIPP Documented Safety Analysis (DSA; Reference 4); the transportation requirements for CH wastes derived from the Transuranic Package Transporter-II (TRUPACT-II), Transuranic Package Transporter-III (TRUPACT-III), and HalfPACT Certificates of Compliance (References 5, 6, and 7); the transportation requirements for RH wastes derived from the RH-TRU 72-B and 10-160B Certificates of Compliance (References 8 and 9); the WIPP LWA (Reference 2); the WIPP Hazardous Waste Facility Permit (Permit; Reference 10); the U.S. Environmental Protection Agency's (EPA's) Compliance Recertification Decision and approval for polychlorinated biphenyls (PCBs) disposal (References 11, 12, 13, 14, 15, and 16); and the EPA's letter of approval of the DOE's RH-TRU Waste Characterization Program (Reference 17). The dotted arrows shown in Figure 1.0 represent the flow-down of summary-level requirements from top-tier WIPP program documents. The solid arrows represent the flow-down of individual payload container-based requirements that serve to identify the most restrictive overlapping conditions, limitations, and prohibitions relating to the physical, chemical, and radiological attributes of the waste as well as the properties of the applicable payload containers.

This WAC does not address the subject of waste characterization relating to a determination of whether the waste is hazardous; rather, the WCPs are referred to the Waste Analysis Plan (WAP) contained in the Permit (Reference 10) for details of the protocols to be used in determining compliance with the required physical and chemical properties of the waste. Requirements and associated criteria pertaining to a determination of the radiological properties of TRU waste, however, are addressed in Appendix A.

Figure 1.0 Regulatory Basis of TRU Waste Acceptance Criteria



1 The TRAMPACs as referenced by the TRUPACT-II, TRUPACT-III, HalfPACT, and RH-TRU 72-B Certificates of Compliance, the Safety Analysis Report as referenced by the 10-160B Certificate of Compliance (CoC), and the Permit provide detailed requirements. This WAC provides only an overview of these requirements.
2 Final Environmental Impact Statement (FEIS), Supplemental Environmental Impact Statement (SEIS).
3 All work performed by the WCPs for the Carlsbad Field Office (CBFO) must be performed under an approved Quality Assurance (QA) program. The programmatic or waste-specific Transuranic Waste Authorized Methods for Payload Control (TRAMPAC) can be a separate document or can be embodied in the WCPs' waste certification plans. The 10-160B Safety Analysis Report (SAR) does not require the preparation of a programmatic or waste-specific TRAMPAC. Instead, acceptable methods for payload compliance for the 10-160B package are implemented by a U.S. Nuclear Regulatory Commission (NRC) approved site-specific Appendix to the 10-160B SAR.

The collective information obtained from waste characterization records and acceptable knowledge (AK) serves as the basis for the WCPs to certify that the TRU waste satisfies the WIPP waste acceptance criteria listed herein.

Section 2.0 of this document identifies the responsible organizations and associated activities for ensuring that the TRU waste is managed in a manner that protects human health and safety and the environment.

Section 3.0 identifies the authorization basis of the TRU waste requirements and lists the associated waste acceptance criteria relating to the physical, chemical, and radiological attributes of the waste, as well as the properties of the applicable payload containers and packages.

Section 4.0 summarizes the QA requirements relating to waste characterization, certification, and transportation. Prior to achieving WIPP certification, CBFO designated TRU waste programs must develop and implement a QA program that meets all applicable requirements of the CBFO *Quality Assurance Program Document* (QAPD; Reference 19). Characterization of TRU waste must be in accordance with the performance requirements of the WIPP WAP and the WAC, and implemented in accordance with a WCP Quality Assurance Project Plan (QAPjP). Certification of payload containers for shipment in the TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, or 10-160B shall be performed under a CBFO-approved QA program that provides confidence for both the shipper and the receiver that the requirements for the transportation system have been met.

The appendices to this WAC provide supplemental information relating to radiological characterization (Appendix A, Radiological Characterization Requirements for Transuranic Waste) and radiotoxic inhalation hazard analyses (Appendix B, ^{239}Pu Equivalent Activity). Appendix C, Glossary, provides definitions for terms used in this document. Appendix D, Payload Container Integrity Checklist, addresses the visual inspection requirements and compliance criteria for determining if CH-TRU and RH-TRU payload containers meet the criteria of Section 3.2.1. Appendix E, Payload Management of TRU Alpha Activity Concentration, describes the policy and implementation methods for the payload management of TRU alpha activity concentration when overpacking waste containers. Appendix F, Radiography Requirements for Transuranic Waste for EPA Compliance, and Appendix G, Visual Examination Requirements for Transuranic Waste for EPA Compliance, provide the radiography and visual examination (VE) requirements relating to the EPA's physical characterization requirements for CH-TRU waste. Appendix H, Enhanced Acceptable Knowledge, discusses the new activities and process enhancements relating to the collection, verification, and validation of AK. Appendix I, Certified Waste Pre-Shipment Compliance Actions, lists actions that all currently certified waste containers in the complex, as well as those containers continuing to be certified, will undergo prior to shipment.

This WAC is a controlled document. The current revision of the WAC may be downloaded from the CBFO Web Page at http://www.wipp.energy.gov/library/wac/WAC.pdf.

This Internet link is provided for informational purposes only and may change without prior public notification.

2.0 RESPONSIBILITIES

This section identifies the responsibilities of organizations that develop and approve this WAC and of those that oversee the implementation of the requirements defined herein. The responsibilities of the organizations to which these requirements apply are also identified in this section (Reference 4, Chapter 18).

2.1 DOE Headquarters

Provides policy, guidance, and oversight for DOE Environmental Management sites, facilities, and operations.

2.2 DOE Carlsbad Field Office (CBFO)

The CBFO is responsible for administration of the WIPP Management and Operating (M&O) Contract and managing the National TRU Program (NTP) for the DOE. The CBFO is responsible for the day-to-day management and direction of strategic planning and related activities associated with the characterization, certification, transportation, and disposal of defense generated TRU waste. The CBFO holds the applicable permits, certifications, and records of decision necessary for the operation and closure of the WIPP facility.

The CBFO assists the DOE sites in resolving issues about the management of TRU waste as requested. The CBFO provides policy and oversight direction for WCP activities related to certification of waste for transportation to and disposal at the WIPP. Other CBFO responsibilities include, but are not limited to, the following:

- Ensuring that the WCPs prepare implementation plans, procedures, and documentation to meet the requirements and criteria in the WAC
- Reviewing and approving WCP waste certification plans, QA plans, QAPjPs, programmatic or waste-specific TRAMPACs, and implementing procedures to ensure adequate flow-down of the WIPP's top-tier requirements, including changes to those documents
- Overseeing activities associated with the
  - repackaging and treatment of TRU waste to determine accuracy of AK and compliance with the Basis of Knowledge (BoK) document (DOE/WIPP-17-3589)
  - characterization and certification of TRU waste
  - proper use of approved transportation packaging
  - receipt, management, and disposal of TRU waste at the WIPP

- Initiating Memorandum of Agreements (MOAs) with the DOE sites regarding mutual interface and agreed-upon requirements (including TRU waste repackaging and treatment), including provisions in MOAs for the CBFO and the WIPP M&O contractor oversight of DOE site waste repackaging and treatment activities performed for WIPP acceptability

- Providing a fleet of NRC-approved Type B transportation packagings for shipment of TRU waste from the DOE sites to the WIPP

- Ensuring that TRU waste accepted for management and disposal at the WIPP complies with the Permit, applicable laws, and regulations as described in this WAC

- Initiating, reviewing, and approving proposed revisions to this WAC to ensure that environmental impacts associated with any revision are bounded by existing WIPP National Environmental Policy Act (NEPA) documentation, including the Final Environmental Impact Statement (Reference 20) and related supplements I (Reference 21) and II (Reference 22)

- Performing certification audits and surveillances

- Performing Generator Site Technical Reviews (GSTRs) jointly but independently from the WIPP M&O contractor

- Reviewing and approving waste confirmation activities performed by the WIPP M&O contractor

- Granting and/or rescinding transportation and waste certification authority to WCPs

2.3 DOE Sites

Manage TRU waste, including its generation, packaging, repackaging, and treatment, in accordance with site-specific M&O contracts and DOE Orders, and implement conditions agreed to in MOAs between the CBFO Manager and the DOE site. Transfer waste to the WCP for characterization and certification.

2.3.1 DOE Field Elements

Each DOE Field Element at the DOE sites is responsible for overseeing the management of the site TRU waste program in compliance with established CBFO requirements, policies, and guidelines, and for providing liaison between the CBFO and the M&O contractors.

2.3.2 WIPP Management and Operating (M&O) Contractor

The WIPP M&O Contractor is responsible for the day-to-day management and planning required for the safe disposal of defense generated TRU waste at the WIPP. Related key activities include:

- Verification that each container is part of an approved waste stream with the Enhanced Acceptable Knowledge process (see Appendix H of this WAC) prior to authorizing shipment in the Waste Data System (WDS).
- Review of approved Waste Stream Profile Forms (WSPFs) to verify the information provided is complete and accurate, and that the waste stream complies with the WAP (Permit Attachment C) and the WAC prior to authorization for shipment (see Appendix C for the definition of a waste stream).
- Verification of the Permit requirement for confirmation of certified waste prior to shipment to the WIPP from the DOE sites.
- Review (no less frequently than annually) of material at risk for waste certified for future shipment to the WIPP to provide conservative, unmitigated consequences in the safety analysis.
- Management of the Central Characterization Program (CCP) for the CBFO NTP.
- Performance of GSTRs, which are reviews of DOE sites' implementation of WIPP requirements (excluding DOE activities that are reviewed and evaluated by designated CBFO NTP personnel). These reviews are stand-alone reviews/evaluations independent of those performed by other organizations (e.g., CBFO Quality Assurance/CBFO Technical Assistance Contractor, WCPs, DOE-Headquarters, etc.). These programmatic reviews examine and evaluate generator sites' TRU waste activities up-stream (i.e., prior to presenting the waste to the Certified Programs).

  The GSTR Program ensures that necessary and sufficient processes and procedures are in place and implemented to assure WIPP WAC compliant waste containers. Cognizant personnel from the WIPP M&O Contractor and CBFO NTP also complete programmatic reviews/assessments of the sufficiency and implementation of the DOE sites' TRU waste treatment, packaging, and management processes with regard to their required performance to assure WIPP WAC implementation.

  The GSTR also provides the detail on DOE sites' programs and program implementation (including changes to existing procedures and processes) to assure that any deficiencies are detected and noncompliant shipments are avoided.

2.4 WIPP Certified Programs (CCP by site and contractor for the Idaho Advanced Mixed Waste Treatment Project [AMWTP])

Each WCP is responsible for developing and implementing CBFO-approved TRU waste program plans and procedures that address applicable WIPP top-tier requirements and the WIPP waste acceptance criteria for packaging, characterizing, and certifying defense TRU waste for WIPP disposal. The CCP is responsible for developing and implementing programmatic or waste-specific TRAMPACs and procedures for certifying and shipping TRU waste to the WIPP. Methods of compliance with each requirement and associated criterion to be implemented by the WCPs shall be described or specifically referenced and shall include procedural and administrative controls consistent with the CBFO QAPD (Reference 19). The WCPs are required to submit these program plans and procedures to the CBFO for review and approval prior to their implementation. The WCPs will certify that each TRU waste payload container meets the waste acceptance criteria contained in this document prior to shipment.

3.0 WASTE ACCEPTANCE REQUIREMENTS AND CRITERIA FOR TRU WASTE

The requirements and associated criteria for acceptance of defense TRU waste at the WIPP for disposal are identified in this WAC. The acceptance criteria of this WAC describe the controlling (i.e., the most restrictive) requirements to be used by the DOE sites in preparing their waste for transportation to and disposal at the WIPP. In some instances, the acceptance criteria and regulatory requirements are synonymous. The WAC requirements are taken from several source documents including, but not limited to, the WIPP DSA (Reference 4), the TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, and 10-160B Certificates of Compliance (References 5, 6, 7, 8, and 9), the WIPP LWA (Reference 2), the Permit (Reference 10), the Compliance Recertification Decision (Reference 11), the Initial Report for PCB Disposal Authorization (Reference 12), the EPA letter of approval to land dispose non-liquid PCBs at the WIPP (References 13 and 14), the Revision to the Record of Decision for the DOE's WIPP Disposal Phase and associated WIPP NEPA database (References 15 and 16), and the EPA's letter of approval of the DOE's RH-TRU Waste Characterization Program (Reference 17). Terms used in this WAC are defined in Appendix C.

For each of the TRU waste acceptance requirements flowed down by WIPP's regulating agencies, there are some requirements that are derived from dual sources. In those instances, the most restrictive waste acceptance requirement is adopted. Overall, these waste acceptance requirements address the acceptable physical, chemical, and radiological properties of the TRU and TRU-mixed waste, in addition to the varying types of payload containers authorized for receipt at the WIPP. The properties of the packagings (TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, and 10-160B) used in shipping the TRU waste to the WIPP, however, are referenced but not addressed by this WAC. The reader should review the 10-160B Safety Analysis Report for Packaging for detailed packaging requirements (Reference 40).

When implementing this WAC, WCPs should refer to these source documents, 40 Code of Federal Regulations (CFR) §194.8 and §194.24, and other WIPP program documents, including Performance Demonstration Program Plans and the CBFO QAPD, as applicable, for information pertinent to the DOE system of controls, including compilation of enhanced AK discussed in Appendix H.

3.1 Summary of the WIPP Authorization Basis

The purpose of Section 3.0 and related appendices is to present the requirements and associated criteria that must be met for TRU waste to be transported to, managed at, and disposed of at the WIPP. The requirements and associated criteria are organized under five major headings: Container Properties, Radiological Properties, Physical Properties, Chemical Properties, and Data Package Contents. Only TRU waste from a properly characterized and approved waste stream may be certified as meeting the requirements and associated criteria contained in this WAC. Any waste container from a waste stream that has not been preceded by an appropriate certified and approved WSPF is not acceptable at the WIPP (Reference 10, Part 2, Section 2.3.3.10; Reference 4, Chapter 18).

WCPs' plans and procedures shall contain details of the processes, controls, techniques, tests, and other actions to be applied to each TRU waste payload container, waste stream, and shipment. Methods of compliance with each requirement shall be described and the specific procedure cited. These methods of compliance shall include procedural controls, administrative controls, and waste generation process controls. The QA requirements applicable to waste characterization, certification, and transportation are addressed in various sections of this WAC and are briefly summarized in Section 4.0. The data resulting from the implementation of the plans and procedures will form the basis for verifying that TRU waste to be sent to the WIPP is certified to meet the WAC by the responsible WCP certifying official(s).

WCPs shall transmit required waste characterization, certification, and shipping data to the WIPP Waste Information System (WWIS) database using the WDS. The WWIS is an electronic database and is a subsystem of the WDS. The WDS is equipped with edit/limit checks to verify that the data representing the waste payload containers are in compliance with this WAC. Before shipping TRU waste payload containers from a WIPP-accepted waste stream, the WCP shall transmit the required waste characterization, certification, and shipping data via WDS to the WWIS database. WCPs may periodically be requested to transmit payload container radiography reports or other data to the WIPP. The WIPP will not accept any waste shipments for disposal if the waste payload container information has not been correctly submitted and approved for shipment by the WWIS Data Administrator. The Waste Data System User's Manual (Reference 23) provides the information needed by WCPs to perform tasks associated with transmittal of the payload container's characterization, certification, and shipment information to the WIPP.

The DOE sites will be notified of revisions to external regulatory requirements by the CBFO. Revisions of requirements in referenced documents not controlled by the DOE (but by, for example, the EPA, NRC, or New Mexico Environment Department [NMED]) shall have precedence over the values specified here if they are more restrictive. These changes will be incorporated in future revisions of this WAC.

3.1.1 DOE Operations and Safety Requirements for the WIPP

The WIPP DSA (Reference 4) addresses TRU waste handling and emplacement operations. The waste accepted for emplacement at the WIPP must conform to the WAC to meet the DSA. The DSA documents the safety analyses that develop and evaluate the adequacy of the WIPP safety basis necessary to ensure the safety of workers, the public, and the environment from the hazards posed by the WIPP's waste receiving, handling, and emplacement operations. The DSA establishes and evaluates the adequacy of the safety basis in response to plant normal and abnormal operations and postulated accident conditions.

3.1.2 NRC Transportation Safety Requirements

Acceptable methods for payload compliance are defined in the TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, and 10-160B Certificates of Compliance

(References 5, 6, 7, 8, and 9) and implemented by the Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC), TRUPACT-III TRAMPAC, Remote-Handled Transuranic Waste Authorized Methods for Payload Control (RH-TRAMPAC), and 10-160B SAR (References 24, 25, 40, and 41). For shipments to the WIPP using the TRUPACT-II, TRUPACT-III, HalfPACT, or RH-TRU 72-B packaging, each WCP must prepare a programmatic or waste-specific TRAMPAC describing how it will ensure compliance with each payload parameter. The programmatic or waste-specific TRAMPAC shall contain sufficient detail to allow the CBFO reviewers to adequately understand and evaluate the compliance methodology for each payload parameter. For shipments to the WIPP using the 10-160B packaging, each WCP must prepare a site-specific appendix to the 10-160B SAR for approval by the NRC. To satisfy the requirement for compatibility with a programmatic or waste-specific TRAMPAC, the appendix shall contain sufficient detail to allow the CBFO reviewers to adequately understand and evaluate the compliance methodology for each payload parameter.

WCPs shall have a packaging QA program that defines the QA activities that apply to the use of NRC-approved transportation packagings equivalent to Title 10 CFR, Part 71, Subpart H (Reference 26).

3.1.3 NMED Hazardous Waste Facility Permit Requirements

TRU waste is classified as TRU-mixed waste if it contains hazardous constituents regulated under the New Mexico Hazardous Waste Act (Reference 27). Only TRU and TRU-mixed wastes that have been characterized in accordance with the WIPP WAP and that meet the Treatment, Storage, and Disposal Facility (TSDF) waste acceptance criteria as presented in the Permit, Part 2, Section 2.3.3., will be accepted at the WIPP facility for disposal in the permitted underground hazardous waste disposal unit.

Prior to disposal, each participating WCP shall develop and implement a QAPjP that addresses all the applicable requirements specified in the WIPP WAP. In accordance with the Permit Attachment C5 of the WAP, the QAPjP will include the qualitative or quantitative criteria for determining whether the waste characterization programs are being satisfactorily performed. All WCPs' QAPjPs will be reviewed and approved by the CBFO.

3.1.4 EPA Requirements

3.1.4.1 EPA Compliance Recertification Decision

Title 40 CFR §194.24(c) states that the DOE shall specify the limiting values for waste components to be emplaced in the repository (Reference 28). The EPA's Compliance Recertification Decision (Reference 11) identifies the repository limits for several waste components, including free water, metals, and cellulose, plastic, and rubber (CPR). Although the Recertification does not specify limiting values for the activities and masses of specific radionuclides, it identifies the listed values for a number of radionuclides that are considered in the Performance Assessment. To demonstrate that the cumulative total activities of the specified radionuclides (^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs) are consistent with the levels used for the Performance Assessment and the Recertification, reporting and tracking of the specified radionuclides is necessary (see Appendix A). TRU waste payload containers shall contain more than 100 nanocuries (nCi) of alpha-emitting TRU isotopes per gram of waste with half-lives greater than 20 years, as specified in Section 3.3.3 of this WAC.

The repository limit for free water is a maximum of 1,684 cubic meters (m^3) and is met by the observable liquid criterion specified in Section 3.4.1 of this WAC. The limit for ferrous metals is a minimum of 2×10^7 kilograms (kg). This limit will be met in the total repository inventory by the metals that constitute the payload containers alone; thus, the WIPP tracks the number and type of payload containers emplaced in the repository as reported to the WWIS database by the WCPs (see Section 3.2.1 of this WAC). The repository limit for CPR is a maximum of 2.2×10^7 kg. WCPs are required to estimate the CPR weights and report these estimates to the WWIS database on a payload container basis as required by Section 3.6.1 of this WAC.

WCPs must quantify and report the activities and masses of specific radionuclides for the purpose of tracking the total radionuclide inventory of the repository as specified in Section 3.3.1 of this WAC. The presence or absence of these specific radionuclides is determined from AK, radiological characterization, computations, or a combination thereof in accordance with Appendix A of this WAC. The results of this determination are reported to the WWIS database on a payload container basis.

The methods used to quantify the above waste components for purposes of EPA compliance are discussed in Appendices A, F, and G.

3.1.4.2 EPA Approval for PCB Disposal

PCB-contaminated TRU and PCB-contaminated TRU waste mixed with a hazardous waste, including PCB remediation waste, PCB articles, and PCB bulk product waste may be stored and disposed at the WIPP (References 12, 13, 14, 15, and 16).

Waste streams identified as containing PCBs shall be brought to the attention of the CBFO so that a determination can be made as to their acceptability at the WIPP.

3.1.5 WIPP Land Withdrawal Act Requirements

The term “WIPP” means the Waste Isolation Pilot Plant project authorized under Section 213 of the DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164; 93 Stat. 1259, 1265) to demonstrate the safe disposal of radioactive waste materials generated by atomic energy defense activities (Reference 1). Hence, by law, the WIPP can accept only radioactive waste generated by atomic energy defense activities of the United States (Reference 2, Section 2[19]).

The DOE and its predecessor agencies were engaged in a broad range of activities that fall under the heading of atomic energy defense activities. A TRU waste is eligible for disposal at the WIPP if it has been generated in whole or in part by one or more of the following functions (References 29 and 30):

- naval reactors development
- weapons activities, including defense inertial confinement fusion
- verification and control technology
- defense nuclear materials production
- defense nuclear waste and materials by-products management
- defense nuclear materials security and safeguards and security investigations
- defense research and development

Using AK, the DOE sites must determine that each waste stream to be disposed of at the WIPP is "defense" TRU waste.

High-level radioactive waste or spent nuclear fuel shall neither be transported, emplaced, nor disposed of at the WIPP (Reference 2, Section 12). Also, no TRU waste may be transported by or for the DOE to or from the WIPP except in packages (1) the design of which has been certified by the NRC, and (2) that have been determined by the NRC to satisfy its QA requirements (Reference 2, Section 16[a]).

3.2 Container Properties

3.2.1 Description

Acceptance Criterion for CH-TRU Waste. Each payload container shall be assigned a TRU waste content (TRUCON) code and a payload shipping category (References 24 and 25, Section 5.1). Each of the below listed authorized payload container types shall have one or more filter vents or equivalent venting mechanisms approved by the CBFO. See Section 3.2.7 and Reference 41. Authorized payload container types (References 24 and 25, Section 2.1.1) include a:

- 55-gallon drum.

- 55-gallon drum containing a pipe component (commonly referred to as a pipe overpack container [POC]).

- 55-gallon drum containing a criticality control container (commonly referred to as a criticality control overpack [CCO]).

- 85-gallon drum, either direct-loaded or containing one 55-gallon drum. The term “85-gallon drum” includes 75- to 88-gallon drums.

- 100-gallon drum.

- shielded container containing a 30-gallon inner steel drum.

- standard large box 2 (SLB2), either direct-loaded or containing various individual containers (4 × 4 × 7-foot boxes and 5 × 5 × 8-foot boxes as well as other containers of smaller sizes).

- standard waste box (SWB), either direct-loaded, containing up to four 55-gallon drums, up to three 85-gallon drums, up to two 100-gallon drums, or one bin.

- ten-drum overpack (TDOP), either direct-loaded, containing up to ten 55-gallon drums, up to six 85-gallon drums, or one SWB.

Acceptance Criterion for RH-TRU Waste. Each payload container shall be assigned a TRUCON code (Reference 41, Section 1.5.1). The only payload containers authorized for receipt of RH-TRU waste in the RH bay of the Waste Handling Building at the WIPP include RH-TRU waste canisters shipped in RH-TRU 72-B packaging and 55-gallon drums shipped in 10-160B packaging (References 9 and 41, Section 2.1.1).

The RH-TRU waste canister shall comply with the specifications in the RH-TRAMPAC (Reference 41).

Under the current revision of the WIPP DSA, the disposal of RH waste containerized in either a transport or facility RH-TRU waste canister is not authorized. However, the disposal of RH waste is authorized when direct-loaded into a 30-gallon steel drum and containerized into a shielded container, thereby allowing it to be handled as CH-TRU waste but inventoried as RH-TRU waste.

Acceptance Criterion for CH-TRU and RH-TRU Waste. Both CH-TRU and RH-TRU waste payload containers shall:

- meet U.S. Department of Transportation (DOT) Specification 7A, Type A, packaging requirements delineated in 49 CFR §173.465 (Reference 4, Section 2.3.2; Reference 10, Attachment A1, Section A1-1b).

- be made of steel and be in good and unimpaired condition prior to shipment from the DOE sites. To demonstrate compliance with the requirement that payload containers be in good and unimpaired condition, the exterior of all payload containers shall undergo 100% visual inspection prior to loading into an authorized package. The results of this visual inspection shall be documented using the Payload Container Integrity Checklist contained in Appendix D. A payload container in good and unimpaired condition, 1) does not have significant rusting, 2) is of sound structural integrity, and 3) does not show signs of leakage. Significant rusting is a readily observable loss of metal due to oxidation (e.g., flaking, bubbling, or pitting) that causes degradation of the payload container's structural integrity. Rusting that causes discoloration of the payload container surface or consists of minor flaking is not considered significant. A payload container is not of sound structural integrity if it has breaches or significant denting or deformation. Breaching is defined as a penetration in the payload container that exposes the internals of the container.

Significant denting or deformation is defined as damage to the payload container that results in creasing, cracking, or gouging of the metal, or damage that affects payload container closure. Dents or deformations that do not result in creasing, cracking, or gouging or affect payload container closure are not considered significant.

- be reported to the WWIS database referencing the number and types of payload containers planned for shipment to the WIPP.

3.2.2 Weight Limits and Center of Gravity

Acceptance Criterion for CH-TRU Waste. See the CH-TRAMPAC for weight limits and center of gravity requirements (Reference 24). See the TRUPACT-III TRAMPAC for applicable weight limits (Reference 25).

Acceptance Criterion for RH-TRU Waste. Each payload container shall comply with the following maximum (gross) weight limit (References 41, 49, and 50):

- Removable Lid Canister – 4,240 lbs
- Fixed (Welded) Lid Canister (55-gallon drums) – 5,980 lbs
- Fixed (Welded) Lid Canister (direct-loaded) – 5,250 lbs
- NS15 Neutron Shielded Canister – 3,100 lbs
- NS30 Neutron Shielded Canister – 3,100 lbs
- 55-gallon drum – 1,000 lbs (453.59 kg)

Also see the 10-160B packaging CoC for applicable weight limits (Reference 9).

3.2.3 Assembly Configurations

Acceptance Criterion for CH-TRU Waste. See the CH-TRAMPAC and TRUPACT-III TRAMPAC for payload assembly configuration requirements (References 24 and 25).

Acceptance Criterion for RH-TRU Waste. See the RH-TRAMPAC and/or 10-160B packaging CoC for applicable assembly configuration requirements (References 41 and 9).

3.2.4 Removable Surface Contamination

Acceptance Criterion for TRU Waste. Removable surface contamination on CH-TRU and RH-TRU waste payload containers, payload assemblies, and packagings shall not exceed 20 disintegrations per minute (dpm)/100 square centimeters (cm^2) alpha and 200 dpm/100 cm^2 beta-gamma (Reference 10, Attachment A1, Section A1-1d[2]; References 31 and 32). The fixing of surface contamination to meet these criteria is not allowed by the WIPP in accordance with best management practices for ensuring worker radiation dose as low as reasonably achievable (ALARA).

3.2.5 Identification/Labeling

Acceptance Criterion for TRU Waste. Each payload container shall be labeled with a unique payload container identification number (Reference 24, Section 2.4; Reference 25, Section 2.3; and Reference 41, Section 2.3) using bar code labels permanently attached in conspicuous locations. The unique payload container identification number shall include a DOE site identifier as a prefix (Reference 23, Page 41).

The payload container identification number shall be in medium to low density Code 39 bar code symbology as required by American National Standards Institute (ANSI) Standard ANSI/AIM BC1-1995 (Reference 33) in characters at least 1-inch high and alphanumeric characters at least ½-inch high in the case of 55-, 85-, and 100-gallon drums or shielded containers.

In the case of a canister, the characters composing the identification number shall be at least 2 inches high and of a color contrasting with their background. A minimum of three canister identification numbers shall be placed at approximately equal intervals around the circumference of the canister and within 18 inches of the top of the canister. Any exception to these canister identification/labeling requirements is subject to the CBFO’s review and approval.

A minimum of three bar code identification labels shall be placed at approximately equal intervals around the circumference of the drum or shielded container (120 degrees for three labels, 90 degrees for four labels, etc.) so that at least one label is clearly visible when the drums or shielded containers are assembled into a payload (i.e., a label must be visible after slip sheets and wrapping are applied). In the case of SWBs, bar code labels are required on the flat sides of the SWBs (Reference 34). For TDOPs and SLB2s, a minimum of one bar code is required.

Payload containers shall be marked "Caution Radioactive Material" using a yellow and magenta label as specified in 10 CFR Part 835 (Reference 32). Those payload containers whose contents are also RCRA-regulated (mixed-TRU) shall be additionally marked "Hazardous Waste" as specified in 40 CFR §262.32 (Reference 35). For TRU and TRU-mixed wastes containing PCBs, the payload containers shall be marked in accordance with 40 CFR §761.40 (Reference 14). Additionally, DOT Type B packages (i.e., the TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, and 10-160B) containing PCBs must be properly marked in accordance with the EPA Conditions of Approval and 40 CFR §761.40 (References 13 and 14).

If an empty 55-, 85-, 100-gallon drum or shielded container is used as dunnage to complete a payload configuration, the dunnage container shall be labeled with the following information:

- Unique payload container identification number
- “EMPTY” or “DUNNAGE”

If a seven-pack of only dunnage 55-gallon drums, a four-pack of only dunnage 85-gallon drums, a three-pack of only dunnage 100-gallon drums, or a dunnage SWB is used in the TRUPACT-II, the container(s) shall be labeled only “EMPTY” or “DUNNAGE,” and the unique container identification number label is not required for these containers (Reference 24, Section 2.4.1). The same requirement applies to a five-drum carriage of dunnage 55-gallon drums used in the 10-160B.

3.2.6 Dunnage

Acceptance Criterion for TRU Waste. See the CH-TRAMPAC and the 10-160B packaging CoC for dunnage requirements (References 24 and 9, respectively).

To maximize the efficiency of disposal operations at the WIPP, the use of dunnage should be minimized. In the event the use of dunnage cannot be avoided, the preferred practice for maximizing the efficiency of waste handling and the utilization of disposal room capacity is to ship them in assemblies (e.g., a seven-pack assembly of dunnage 55-gallon drums for loading into a TRUPACT-II and a five-pack assembly of dunnage 55-gallon drums for loading into a 10-160B).

3.2.7 Filter Vents

Acceptance Criterion for TRU Waste. Containers that have been stored in an unvented condition (i.e., no filter and/or unpunctured liner) shall be aspirated for a specific length of time to ensure equilibration of any gases that may have accumulated in the closed payload container (References 24 and 25, Section 5.3.1).

Each payload container shall have one or more filter vents or equivalent venting mechanisms (References 24, Section 2.5.1; Reference 25, Section 2.4.1; and Reference 41, Section 2.4.1; Reference 10, Attachment A1, Section A1-1b[1]). These filter vents shall meet the specifications of the Permit, CH-TRAMPAC, TRUPACT-III TRAMPAC, and RH-TRAMPAC as applicable. The model number of each filter vent or combination of filter vents installed on a payload container shall be reported to the WWIS database (Reference 47).

3.3 Radiological Properties

With respect to the required radiological properties identified within this section, the associated radionuclides can be divided into two distinct groups.

The first group includes the activities and masses of the ten WIPP-tracked radionuclides (i.e., ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs). This set of radionuclides is regulated by the EPA in accordance with 40 CFR Parts 191 and 194 (References 36 and 28). Estimates of their activities and masses shall be derived from a system of controls certified by the CBFO that includes AK, computations, measurements, sampling, etc. (Reference 37, Appendix TRU Waste).

The second group, which may overlap with the first group, includes any other radionuclides contributing to the radiological properties of the waste including ^{239}Pu fissile gram equivalent (FGE), ^{235}U fissile equivalent mass (FEM), TRU alpha activity concentration, plutonium-239 equivalent curies (PE-Ci), decay heat of the payload container, and the average RH activity concentration per liter per canister. This set of radiological data is regulated both by the NRC as specified in the CH-TRAMPAC, the TRUPACT-III TRAMPAC, and the RH-TRAMPAC (References 24, 25, and 41) and by the CBFO as summarized by the WIPP DSA (Reference 4). Total activity will be quantified and tracked by the WWIS to ensure compliance with the WIPP LWA limits for RH-TRU waste, including limiting its activity to ≤ 23 curies per liter per canister (averaged over the volume of the canister), limiting total disposed RH-TRU waste activity to ≤ 5.1 million curies, and limiting surface dose rates of canisters to ≤ 1,000 roentgen equivalent man per hour (rem/hr) (Reference 2, Section 7).

Appendix A of this document provides the methods and requirements by which to characterize the radiological composition of TRU waste in addition to the remaining radiological properties listed above. However, for AK taken from Safeguards and Security measurements, the source and method from which the data were generated, including the basis for the reliability of the data, shall be submitted to, and approved by, the CBFO prior to use. PE-Ci quantities shall be calculated for each payload container in accordance with Appendix B.

3.3.1 Radionuclide Composition

Acceptance Criterion. The activities and masses of ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs shall be established on a payload container basis for purposes of tracking their contributions to the total WIPP radionuclide inventory (Reference 37, Appendix TRU Waste). The estimated activities and masses, including their associated total measurement uncertainties (TMUs), expressed in terms of one standard deviation, for these ten radionuclides shall be reported to the WWIS database on a payload container basis. For any of these ten radionuclides whose presence can be substantiated from AK, direct measurement, computations, or a combination thereof, and whose measured data are reported as being below the lower limit of detection (LLD) or the minimum detectable activity (MDA) for that radionuclide, the WCP shall report the character string "< LLD" to the WWIS database for the activity and mass of that radionuclide; otherwise a value of zero shall be reported. Quantitative estimates for either the LLD or MDA shall not be used when calculating related radiological properties of the waste, such as TRU alpha activity concentration, ^{239}Pu FGE, decay heat, and ^{239}Pu equivalent activity. See Appendix A, Section A.3, of this document for information pertaining to the development and application of LLD or MDA.

Other radionuclides in addition to the ten WIPP-tracked radionuclides (i.e., ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs) that collectively contribute to 95% of the total radiological hazard for the payload container based on the A_2 values given in

49 CFR §173.435 shall be reported on the TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, or 10-160B bill of lading or manifest in accordance with 49 CFR §172.203 and 49 CFR §173.433 (References 38 and 39). The activities and masses of these other radionuclides shall also be reported to the WWIS database along with their associated TMU, expressed in terms of one standard deviation for each waste container.

Other radiological properties of the waste that may also require quantification include the ^{239}Pu FGE, ^{235}U FEM, PE-Ci, TRU alpha activity concentration, radiation dose equivalent rate, decay heat, and RH average concentration.

3.3.2 ^{239}Pu Fissile Gram Equivalent

Acceptance Criterion for CH-TRU Waste. For each payload container, the sum of ^{239}Pu FGE plus two times its associated TMU, expressed in terms of one standard deviation, shall comply with the limits in Table 1 (Reference 4, Section 6.4.2; References 24 and 25, Section 3.1.1). The values calculated for ^{239}Pu FGE and its associated TMU (expressed in terms of one standard deviation) shall be reported to the WWIS database for each payload container. See the CH-TRAMPAC and TRUPACT-III TRAMPAC for ^{239}Pu FGE limits applicable to the TRUPACT-II, TRUPACT-III, and HalfPACT packages (References 24 and 25).

Table 1 ^{239}Pu FGE Limits for CH-TRU Waste Payload Containers

Waste Container Type	Be/BeO Limits	Special Waste Container Geometry/Material Requirements	^{239}Pu FGE Limit
Non-Machine Compacted Waste			
55- (excluding POCs and CCOs), 85-, and 100-gallon drums	≤ 1% by weight of the waste	None	≤ 200
55-gallon drum configured as a POC(1) (i.e., a Standard, S100, S200, and S300)	≤ 1% by weight of the waste	None	≤ 200
55-gallon drum configured as a CCO	≤ 1% by weight of the waste	Limited to ≤ 2,000 g of plastics. For additional special waste container geometry/material requirements refer to Supplement to Table 1, *CCO Material Requirements (References 52, 53)*.	≤ 380
Shielded Container	≤ 1% by weight of the waste	None	≤ 200
SLB2	≤ 1% by weight of the waste	None	≤ 325

Table 1 239Pu FGE Limits for CH-TRU Waste Payload Containers (continued)

Waste Container Type	Be/BeO Limits	Special Waste Container Geometry/Material Requirements	^{239}Pu FGE Limit
SWB	≤ 1% by weight of the waste	None	≤ 325
TDOP	≤ 1% by weight of the waste	None	≤ 325
55- (excluding POCs and CCOs), 85-, and 100-gallon drums	> 1% by weight of the waste up to 100 kg	None	≤ 100
SWB	> 1% by weight of the waste	None	≤ 100
TDOP	> 1% by weight of the waste	None	≤ 100
POCs(1) (i.e., a Standard, S100, S200, and S300)	> 1% by weight of the waste	Beryllium/beryllium oxide (Be/BeO) shall be mechanically/chemically bound to the fissile material.	≤ 140
Machine Compacted Waste			
55- (excluding POCs and CCOs), 85-, and 100-gallon drums	≤ 1% by weight of the waste	Partially compacted waste.	≤ 200
55- (excluding POCs and CCOs), 85-, and 100-gallon drums	≤ 1% by weight of the waste	Fully compacted waste without design vertical spacing.(2)	≤ 170
55- (excluding POCs and CCOs), 85-, and 100-gallon drums	≤ 1% by weight of the waste	Fully compacted waste with design vertical spacing.(2) The dimensions of the payload containers (e.g., 100-gallon drums) ensure a minimum 0.5-inch separation between their compacted waste contents and other axially adjacent payload containers.	≤ 200

Table 1 239Pu FGE Limits for CH-TRU Waste Payload Containers (continued)

Waste Container Type	Be/BeO Limits	Special Waste Container Geometry/Material Requirements	^{239}Pu FGE Limit
Shielded Container	≤ 1% by weight of the waste	Fully compacted waste directly loaded into a vented 30-gallon inner steel drum.	≤ 200
SWB/TDOP	≤ 1% by weight of the waste	Fully compacted waste with design vertical spacing.(2) Contains one 100-gallon drum having a minimum top and bottom design spacing of 0.75 and 0.50 inches, respectively, with a 16-gauge drum outer lid and bottom and an inner/recessed 16-gauge steel lid.	≤ 250
SWB/TDOP	≤ 1% by weight of the waste	Fully compacted waste with design vertical spacing.(2) Containing one 55-, 85-, or 100-gallon drum whose design vertical spacing ensures a minimum of 0.5-inches between drum contents and the exterior top and bottom of the drum (e.g., a recessed lid) with no loose material or other drums of waste loaded in the SWB/TDOP.	≤ 200
SWB/TDOP	≤ 1% by weight of the waste	Partially compacted waste. Containing one 55-, 85-, or 100-gallon drum with no loose material or other drums of waste loaded in the SWB/TDOP.	≤ 200
SWB/TDOP	≤ 1% by weight of the waste	Fully compacted waste without limitation on inner configuration.	≤ 185
55-gallon drum configured as a POC(1) (i.e., a Standard, S100, S200, and S300)	≤ 1% by weight of the waste	Limited to ≤ 33.9 kg of plastics.	≤ 200
55-gallon drum configured as a CCO	≤ 1% by weight of the waste	Limited to ≤ 2,000 g of plastics. For additional special waste container geometry/material requirements refer to Supplement to Table 1, *CCO Material Requirements (References 52, 53)*.	≤ 380

(1) POCs can contain combustibles provided the UltraTech 9424S filter is installed in the 55-gallon drum 3/4-inch lid opening per manufacturer's specifications. POCs containing combustibles, packaged with the UltraTech 9424S filter as described in this note, are considered compliant with the WAC.
(2) Design vertical spacing requirements for axially stacked drums containing fully compacted waste can be credited to the design of the drum's top and bottom rolled rims. The requirement was set at the largest value of 0.5 inches for all cases for consistency.

Supplement to Table 1, CCO Material Requirements (References 52, 53)

Option (1)	Boron Carbide (B_4C) (2) (g)	Hydrogenous Content (3) (g)	Miscellaneous Filler (4) (g)
A	≥ 10	≤ 2,800	—
B	—	≤ 1,300	—
C	—	≤ 1,500	≥ 6×FGE

Notes:
(1) Waste packaged in each CCO shall adhere to the limits defined in Table 1 in addition to those specified under Options A, B, or C.
(2) The B_4C shall be well mixed with the ^{239}Pu FGE and remain so during transportation, storage, and handling operations. The B_4C mass is based on the natural abundance of ^{10}B (i.e., 19.9 wt.% ^{10}B). The B_4C mass requirement shall apply to (a) each criticality control container (CCC) that contains directly loaded TRU waste with ^{239}Pu FGE, or (b) any convenience containers used to load a CCC that contain ^{239}Pu FGE. For example, if a CCC is directly loaded with TRU waste containing ^{239}Pu FGE and also loaded with two cans containing ^{239}Pu FGE, the directly-loaded TRU waste in the CCC and each can in the CCC must include at least 10 g of well mixed B_4C.
(3) The mass of hydrogenous content within the CCC shall include the mass of any organic material (e.g., mass of plastic, cellulose, foam) and the mass of water associated with any inorganic material (e.g., mass of adsorbed water on zeolite, water of hydration in concrete and clay, or water in hydrate such as hydrated metal ion).
(4) Only the non-hydrogenous portion of the miscellaneous filler mass that is well mixed with the ^{239}Pu FGE mass shall meet the miscellaneous filler mass requirement. The miscellaneous filler shall remain well mixed with ^{239}Pu FGE during transportation, storage, and handling operations. If several convenience containers are used to load a CCC, then each convenience container shall independently meet the miscellaneous filler criteria. For example, if a CCC is loaded with two convenience containers, where the first has 100 ^{239}Pu FGE and the second has 280 ^{239}Pu FGE, at least 600 g and 1,680 g of miscellaneous filler shall be within each respective convenience container.

Acceptance Criterion for RH-TRU Waste. Each canister must comply with the limits in either Table 2 or Table 4 or meet the fissile material exemption of 10 CFR §71.15. In the case of Table 2, the sum of the ^{239}Pu FGE plus two times its associated TMU, expressed in terms of one standard deviation, shall comply with the applicable limits in Table 2. In the case of Table 4, the ^{235}U FEM weight percentage plus two times its associated TMU, with TMU expressed in terms of one standard deviation, shall comply with the applicable limit in Table 4 (Reference 41).

See the 10-160B packaging CoC for applicable package requirements (Reference 9) and Table 3 for associated drum requirements.

The values calculated for ^{239}Pu FGE or ^{235}U FEM and their associated TMUs (expressed in terms of one standard deviation) shall be reported to the WWIS database for each payload container.

Table 2 ^{239}Pu FGE Limits for a Canister Shipped in an RH-TRU 72-B Package

Payload Contents	^{239}Pu FGE Limit (Removable/Welded Lid Canister)	^{239}Pu FGE Limit (Neutron Shielded Canister)
Non-Machine Compacted Waste		
Be/BeO limited to ≤ 1% by weight of the waste	≤ 315	≤ 245
Be/BeO limited to ≤ 1% by weight of the waste including credit taken for ≥ 5 g of ^{240}Pu Poisoning*	≤ 325	≤ 245
Be/BeO limited to ≤ 1% by weight of the waste including credit taken for ≥ 15 g of ^{240}Pu Poisoning*	≤ 350	≤ 245
Be/BeO limited to ≤ 1% by weight of the waste including credit taken for ≥ 25 g of ^{240}Pu Poisoning*	≤ 370	≤ 245
Be/BeO > 1% by weight of the waste and is chemically or mechanically bound to the fissile material	≤ 305	Unauthorized
Be/BeO > 1% by weight of the waste and is not chemically or mechanically bound to the fissile material	≤ 100	Unauthorized
Machine Compacted Waste (compaction density not limited)		
Be/BeO limited to ≤ 1% by weight of the waste	≤ 245	≤ 245

* The minimum ^{240}Pu content for the RH-TRU waste canister shall be determined after the subtraction of two times the error.

Table 3 ^{239}Pu FGE Limits for Drums Shipped in a 10-160B Package

Payload Contents	^{239}Pu FGE Limit
Non-Machine Compacted Waste	
30- or 55-gallon drum (Be/Graphite limited to ≤ 1% by weight of the waste)	≤ 200
30- or 55-gallon drum (Be/Graphite > 1% by weight of the waste)	≤ 100
30- or 55-gallon drum (unlimited Graphite with Be mass ≤ 1% by weight of the waste)	≤ 120
Machine Compacted Waste (compaction density not limited)	
55-gallon drum (Be/Graphite limited to ≤ 1% of the weight of the waste)	≤ 170
55-gallon drum (Be/Graphite limited ≤ 1% of the weight of the waste) with 1-inch design spacing maintained between drum content and exterior top and bottom)	≤ 200

Table 4 ^{235}U FEM Limit for a Canister Shipped in an RH-TRU 72-B Package

Payload Contents	Fissile Limit per RH-TRU Waste Canister (wt% U-235 FEM)	Fissile Limit per Neutron Shielded Canister (wt% U-235 FEM)
Non-machine compacted primarily uranium with particle/lump size characteristic dimensions all less than 0.039 inches and/or greater than 2.36 inches	≤ 0.96	N/A
Non-machine compacted primarily uranium with particle/lump size characteristic dimensions of any size up to a total contents net weight of 3,100 pounds	≤ 0.84	N/A

3.3.3 TRU Alpha Activity Concentration

Acceptance Criterion for TRU Waste. TRU waste payload containers shall contain more than 100 nCi of alpha-emitting TRU isotopes per gram of waste with half-lives greater than 20 years (Reference 2, Section 2 [18]). Without taking into consideration the TMU, the TRU alpha activity concentration for a payload container is determined by dividing the TRU alpha activity of the waste by the weight of the waste.

The weight of the waste is the weight of the material placed into the payload container (i.e., the net weight of the container). The weight of the waste is typically determined by subtracting the tare weight of the payload container (including the weight of the rigid liner and any shielding external from the waste, if applicable) from the gross weight of the payload container. In the event waste containers (e.g., 55-gallon drums) that have been radioassayed are overpacked in a payload container (e.g., in an SWB), WCPs shall sum the individual TRU alpha activity values of the individual waste containers and divide by the sum of the individual net waste weights (i.e., less container, shielding, and liner weights as appropriate) to determine the activity per gram for the payload container. Waste containers selected for payload management shall comply with the policy for the management of TRU alpha activity concentration (see Appendix E). Loading a 55-gallon pipe overpack with cans is considered direct loading, not overpacking, for the purposes of calculating the weight of the container. The TRU alpha activity concentration shall be reported to the WWIS database; however, there are no reporting requirements for its associated TMU (Reference 17; Reference 37, Chapter 4, Section 4.3.2).

3.3.4 ^{239}Pu Equivalent Activity

Acceptance Criterion for TRU Waste. PE-Ci limits are shown in Tables 5 and 6. PE-Ci quantities shall be calculated for each payload container (see Appendix B) and reported to the WWIS database (Reference 4, Section 3.4.1.2, and Table 3.4-1). There are no reporting requirements for the associated TMU.

Table 5 PE-Ci Limits for CH-TRU Waste Payload Containers

Payload Container	Packing Configuration	PE-Ci Limit (1)
55-, 85-, and 100-gallon drum	Direct-loaded – all approved waste forms	≤ 80
Shielded Container	Direct-loaded – vented 30-gallon inner steel drum – all approved waste forms	≤ 80
CCO	Direct-loaded – only with approved CCO-S packaging configuration(2)	≤ 24 (2)
	Direct-loaded – only with approved CCO-EDP packaging configuration(2)	≤ 120 (2)
SLB2	Direct-loaded – all approved waste forms	≤ 560
SWB	Direct-loaded (or a bin) – all approved waste forms	≤ 560
TDOP	Direct-loaded – all approved waste forms	≤ 560
85-gallon drum	Overpacking an undamaged 55-gallon drum – all approved waste forms(3)	≤ 1,100
SWB, TDOP	Overpacking an assembly of undamaged 55- or 85-gallon drums with no single payload container within the assembly exceeding 1,100 PE-Ci – all approved waste forms(3)	≤ 1,200
TDOP	Overpacking an undamaged SWB – all approved waste forms(3)	≤ 1,200
POCs (Standard, S100, S200, and S300)	Direct-loaded – all approved waste forms	≤ 1,800 (2)
All	Solidified/vitrified waste (PE-Ci limit of 1,800 is per payload container assembly, as applicable)	≤ 1,800

Notes:
(1) For payload containers that exceed the PE-Ci limit, disposal options include either repackaging the waste, or petitioning the DOE/CBFO for an alternative determination of WAC compliance based on an approved safety analysis of the PE-Ci limit exceedance.
(2) POCs can be loaded up to 1,800 PE-Ci per container with an assembly limit of 1,800 PE-Ci. The CCO using the Sandia Process (CCO-S) and CCO using the Enhanced Dilution Process (CCO-EDP) are described in Reference 4, the WIPP Documented Safety Analysis, Chapter 2, Section 2.6.2.12*, Criticality Control Overpack*, and Chapter 3, Section 3.3.2.3 (2), entitled *WIPP WAC.*
(3) An undamaged container provides an additional barrier should a breach occur in the overpack. When overpacking one or more damaged waste containers, direct-loaded PE-Ci limits apply.

Table 6 PE-Ci Limits for RH-TRU Waste Payload Containers

Payload Container	Packing Configuration	PE-Ci Limit
RH-TRU Waste Canister	All approved waste forms other than solidified/vitrified waste	≤ 240
55-Gallon Drum (shipped in a 10-160B)		≤ 80
RH-TRU Waste Canister	Solidified/vitrified waste	≤ 1,800
55-Gallon Drum (shipped in a 10-160B)		

3.3.5 Radiation Dose Equivalent Rate

<u>Acceptance Criterion for CH-TRU Waste</u>. The external radiation dose equivalent rate of individual payload containers shall be ≤ 200 milliroentgen equivalent man per hour (mrem/hr) at the surface with the exception of the S100 and S300 pipe overpacks, which are limited to ≤179 mrem/hr and ≤ 155 mrem/hr, respectively, at the surface (References 24 and 25, Section 3.2). Internal payload container shielding shall not be used to meet these criteria, except for authorized shielded payload container configurations such as 55-gallon drums containing a pipe component, 55-gallon drums containing a criticality control container, or a shielded container. In the case of payload containers (e.g., the SLB2) that meet the radiation dose equivalent rate requirement of 200 mrem/hr, however, additional payload container shielding beyond that identified as an integral component may be used to shield to levels that are ALARA.

In special instances where the use of internal shielding is necessitated, the WCP can petition the CBFO for an alternative determination of disposition using the WIPP's Unreviewed Safety Question Determination and Suspect Container Response Program.

Total dose equivalent rate and the neutron contribution to the total dose equivalent rate shall be reported for each payload container to the WWIS database.

See the CH-TRAMPAC and TRUPACT-III TRAMPAC for associated package requirements (References 24 and 25).

<u>Acceptance Criterion for RH-TRU Waste</u>. The external radiation dose equivalent rate of individual payload containers shall be ≥200 mrem/hr, but ≤1,000 rem/hr at the surface (Reference 2, Sections 2 and 7). Containers whose dose equivalent rate is ≥ 200 mrem/hr but placed into a payload container with a resultant dose equivalent rate of < 200 mrem/hr can be shipped and counted as RH-TRU waste (Reference 2, Section 16).

Total dose equivalent rate and the neutron contribution to the total dose equivalent rate shall be reported for each payload container to the WWIS database.

3.3.6 Decay Heat

Acceptance Criterion for TRU Waste. See the CH-TRAMPAC, TRUPACT-III TRAMPAC, RH-TRAMPAC, and 10-160B packaging CoC for applicable decay heat requirements (References 24, 25, 41, and 9, respectively). Wastes with Content Code 154 are excluded from shipment to the WIPP thereby mitigating potential deflagrations associated with high decay heat waste (Reference 4, Section 3.3.2.3).

3.3.7 Average Activity Concentration

Acceptance Criterion for RH-TRU Waste. Remote-handled TRU waste received at the WIPP shall not exceed 23 curies per liter maximum activity level averaged over the volume of the payload container (Reference 2, Section 7).

3.4 Physical Properties

3.4.1 Observable Liquid

Acceptance Criterion for TRU Waste. Liquid waste is not acceptable at the WIPP. Liquid in the quantities delineated below is acceptable.

- Observable liquid shall be less than 1 percent by volume of the outermost container at the time of radiography or VE (Reference 10). The limit of “less than 1 percent” is taken from packaging requirements (References 24, 25, and 41) and is more restrictive than the limit of “no more than 1 percent” in the Permit.
- Internal containers with more than 60 milliliters or 3 percent by volume observable liquid, whichever is greater, are prohibited (Reference 10).
- Containers with Hazardous Waste Number U134 assigned shall have no observable liquid (Reference 10).
- Overpacking the outermost container that was examined during radiography or VE or redistributing untreated liquid within the container shall not be used to meet the liquid volume limits (Reference 10).
- The disposal of free-flowing PCB liquids (i.e., observable liquids) is prohibited except that incidental liquids such as, but not limited to, rainwater, groundwater, condensate, leachate, load separation and dust control liquid, are allowed in PCB/TRU and PCB/TRU mixed bulk product waste containers less than 1 percent by volume of the outermost container at the time of radiography or VE (Reference 13).

For WCPs that use VE, the detection of any liquid in non-transparent internal containers, detected from shaking the internal container, will be handled by assuming that the internal container is filled with liquid and adding this volume to the total liquid in the container being characterized using VE (Reference 10, Attachment C, Section C-3b; Reference 37, Appendix TRU Waste).

3.4.2 Sealed Containers

Acceptance Criterion for TRU Waste. Sealed containers that are greater than 4 liters (nominal) are prohibited except for solid inorganic waste packaged in a metal container (Reference 24, Section 2.8.1; Reference 25, Section 2.7.1; Reference 41, Section 2.7.1).

3.4.3 Physical Form

Acceptance Criterion for RH-TRU Waste. Debris waste (Summary Category Group [SCG] S5000) shall be reported to the WWIS database as plastic using the volume of the waste container multiplied by the maximum loading density of plastic (620 kg/m^3) up to the net weight of the waste. Soils and gravel (SCG S4000) shall be reported to the WWIS database as the net weight of the waste with the waste material parameter type of “soil.” Homogeneous solids (SCG S3000) shall be reported to the WWIS database as the net weight of the waste with the waste material parameter type appropriate to the waste (e.g., solidified inorganic material, solidified organic material, cement). Debris waste included in containers of SCG S3000 or SCG S4000 waste shall be reported to the WWIS database as plastic with an estimated weight. For all summary category groups, plastic packaging (e.g., drum liners) will also be reported to the WWIS database as packaging (Reference 17, Pages 29 and 43).

3.5 Chemical Properties

3.5.1 Pyrophoric Materials

Acceptance Criterion for TRU Waste. Radioactive pyrophoric materials shall be present only in small residual amounts (≤1 percent by weight) in payload containers and shall be generally dispersed in the waste in accordance with best management practices for ensuring worker protection. Radioactive pyrophorics in concentrations greater than 1 percent by weight and all nonradioactive pyrophorics shall be reacted (or oxidized) and/or otherwise rendered nonreactive prior to placement in the payload container (References 24, 25, and 41, Section 4.1.1).

Nonradionuclide pyrophoric materials are not acceptable at the WIPP (Reference 4, Section 11.4.1; Reference 10, Attachment C, Section C-1c; Reference 10, Part 2, Section 2.3.3.2).

3.5.2 Hazardous Waste

Acceptance Criterion for TRU Waste. Hazardous wastes not occurring as co-contaminants with TRU wastes (non-mixed hazardous wastes) are not acceptable at the WIPP. Each CH-TRU mixed waste container shall be assigned one or more hazardous waste numbers as appropriate. Only the EPA hazardous waste numbers listed as allowable in the Hazardous Waste Facility Permit may be managed at the WIPP. Some of the waste may also be identified by unique state hazardous waste codes. These wastes are acceptable at the WIPP as long as the TSDF waste acceptance criteria are met (Reference 10, Attachment C, Section C-1b; Reference 10, Part 2, Section 2.3.3.3). Wastes exhibiting the characteristic of ignitability, corrosivity, or reactivity (EPA hazardous waste numbers of D001, D002, or D003) are not acceptable at the WIPP (Reference 10, Attachment C, Section C-1c; Reference 10, Part 2, Sections 2.3.3.3, 2.3.3.7, and 2.3.4).

3.5.3 Chemical Compatibility

Acceptance Criterion for TRU Waste. TRU waste containing incompatible materials or materials incompatible with payload container and packaging materials, shipping container materials, other wastes, repository backfill, or seal and panel closure materials are not acceptable for transport in the TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, or 10-160B packagings or for disposal at the WIPP. Chemical constituents shall conform to the lists of allowable materials in Tables 4.3-1 through 4.3-8 of the CH-TRAMPAC, Tables 4.3-1 through 4.3-7 of the TRUPACT-III TRAMPAC, and Table 4.3.1 of the RH-TRAMPAC, as applicable. Other chemicals or materials not identified in these tables are, in general, present as trace quantities; i.e., materials that occur individually in the waste in quantities less than 1 weight percent. The total quantity of these trace materials is restricted to less than 5 weight percent total (Reference 10, Attachment C, Section C-1c; Reference 10, Part 2, Section 2.3.3.4; References 24, 25, and 41, Section 4.3.1; and Appendix 4.10.0 of the 10-160B SAR). See Appendix H.3 of this document.

3.5.4 Explosives, Corrosives, and Compressed Gases

Acceptance Criterion for TRU Waste. Waste shall contain no explosives, corrosives, or compressed gases (pressurized containers) (Reference 10, Attachment C, Section C-1c; Reference 10, Part 2, Sections 2.3.3.5 and 2.3.3.7; References 24, 25, and 41, Section 4.2.1).

3.5.5 Headspace Gas Concentrations

Acceptance Criterion. The headspace gas of payload containers shall be determined in accordance with a programmatic or waste-specific TRAMPAC (References 24 and 25, Section 5.2.1), as required.

3.5.6 Polychlorinated Biphenyls

Acceptance Criterion for TRU Waste. For TRU and TRU-mixed wastes containing PCBs meeting the conditions of approval in Reference 13, the payload container data entered into the WWIS database shall include the earliest date of waste generation (i.e., the date of removal from service for disposal), the date of waste certification for disposal, and the date the waste was sent to the WIPP for disposal (Reference 13, Section III.D.4). Additionally, the estimated weight of the PCBs in kilograms (as recorded on the uniform hazardous waste manifest), and a description of the type of

PCB waste (e.g., PCB remediation waste, PCB bulk product waste, etc.) shall be entered into the WWIS database (References 14, §761.207(a)(2) and §761.180). Hanford, Idaho National Laboratory, Savannah River Site, Oak Ridge National Laboratory, Knolls Atomic Power Laboratory, and Los Alamos National Laboratory are authorized to ship their TRU and TRU-mixed wastes containing PCBs to the WIPP (References 15 and 16).

Other sites in the DOE complex may also identify some TRU waste that contains PCBs during the process of characterizing their TRU waste for disposal at the WIPP. Subject to NEPA review, as appropriate, the CBFO will make a determination regarding the acceptability of waste from these DOE sites at the WIPP.

3.6 Data Package Contents

3.6.1 Characterization and Certification Data

Acceptance Criterion for TRU Waste. WCPs shall prepare a WSPF for each waste stream. Each WSPF shall be approved by the Permittees prior to the first shipment of that waste stream. Characterization and certification information for each payload container shall be submitted to the WWIS database and approved by the Data Administrator. WCPs are required to estimate the CPR weights and report these estimates to the WWIS database on a payload container basis. In the case of RH-TRU debris waste, estimates of CPR weights using radiography are calculated differently from CH-TRU debris waste, as discussed in Appendix F. Any payload container from a waste stream that has not been preceded by an appropriate certified WSPF is not acceptable at the WIPP (Reference 10, Part 2, Section 2.3.3.10).

3.6.2 Shipping Data

Acceptance Criterion for TRU Waste. WCPs shall prepare either a bill of lading or a uniform hazardous waste manifest for TRU waste shipments as required by the transportation requirements. The land disposal restriction notification for TRU mixed waste shipments shall state that the waste is not prohibited from land disposal (Reference 10, Attachment C, Section C-5b(2)).

4.0 QUALITY ASSURANCE REQUIREMENTS

Quality assurance is an integral part of TRU waste characterization, certification, and transportation activities. This section defines the QA program requirements that provide confidence that TRU waste characterization, certification, and transportation activities will be performed satisfactorily by each participating WCP. The QA requirements applicable to the WIPP are addressed in the CBFO QAPD (Reference 19).

Each WCP shall be responsible for developing, documenting, and implementing site-specific QA plans that address the elements of the CBFO QAPD that apply to their TRU waste program. Specifically, WCPs shall develop QA plans that govern TRU waste characterization, certification, and transportation activities. These site-specific QA plans shall be submitted to the CBFO for approval. TRU wastes may not be characterized, certified, or shipped to the WIPP before the CBFO's approval of these QA plans. The CBFO and the M&O Contractor will conduct audits and surveillances to ensure that the WCPs are in compliance with their approved site-specific QA plans.

4.1 Waste Characterization Quality Assurance Requirements

WCPs are responsible for describing required QA and quality control (QC) activities applicable to TRU waste characterization in site-specific QA documentation. All analytical laboratories analyzing the WIPP waste characterization samples for the WCPs shall have established documented QA/QC programs.

Waste characterization data collected prior to the implementation of a QA program pursuant to 40 CFR §194.22(a)(1) may only be qualified in accordance with an alternate methodology that is approved by the CBFO and employs one or more of the following methods:

- peer review in accordance with NUREG-1297 (Reference 51),
- corroborating data,
- confirmatory testing (i.e., testing made on a representative sub-population of payload containers within a waste stream), or
- demonstration of the equivalence of an alternate QA program (as described in Reference 19, Section 5.4).

Examples of corroborating data include, but are not limited to, data from a related waste source or from a different time period of generation, a related CH or RH waste source, a similar waste process generated at a different site or facility, a similar source material, and data that establishes the efficacy of a mathematical model.

The data quality objectives (DQOs) are qualitative and quantitative statements that specify the WIPP program technical and quality objectives; they are determined through the DQO process (Reference 42). The DQOs for waste characterization activities relating to the physical and chemical properties of the waste, in conjunction with the nondestructive examination methods of radiography and VE, are contained in the WAP of the Permit (Reference 10, Attachments C-3 and C-4). The DQOs for radiological characterization of TRU waste are given in Appendix A of this document.

Quality assurance objectives (QAOs) are data characteristics used to determine whether the quality of the waste characterization data collected is acceptable (10 CFR §194.22). The following QAOs are used throughout this document:

- Data precision – A measure of the mutual agreement between comparable data gathered or developed under similar conditions expressed in terms of a standard deviation.
- Data accuracy – The degree to which data agree with an accepted reference or true value.
- Data representativeness – The degree to which data accurately and precisely represent a characteristic of a population, a parameter, variations at a sampling point, or environmental conditions.
- Data completeness – A measure of the amount of valid data obtained compared to the amount that was expected.
- Data comparability – A measure of the confidence with which one data set can be compared to another.

Although QAOs are used to assess the quality of analytical data, both quantitative and qualitative, they may not all be applicable to certain waste characterization methodologies.

Corrective action reports applicable to WAP requirements shall be resolved prior to waste shipment (Reference 10, Attachment C-6).

4.2 Waste Certification Quality Assurance Requirements

Participating WCPs shall develop and implement a site-specific QA plan for waste certification that describes the required QA and QC activities applicable to the certification of TRU waste to the WAC. Site-specific QA plans must comply with the requirements of the CBFO QAPD (Reference 19).

4.3 Waste Transportation Quality Assurance Requirements

The QA requirements for the transportation of TRU waste involve two elements: compliance with payload control requirements and compliance with usage requirements, as applicable.

The QA requirements for payload control compliance are derived from the CH-TRAMPAC, TRUPACT-III TRAMPAC, RH-TRAMPAC, and the 10-160B CoC

(References 24, 25, 41, and 9, respectively). The QA requirements for compliance with usage requirements are derived from 10 CFR Part 71 and 49 CFR Part 173 (References 26 and 39), the Certificates of Compliance, DOE Orders 460.1 and 460.2 (References 43 and 44), the CH Packaging Program Guidance (Reference 45), and the RH Packaging Program Guidance (Reference 46).

Participating WCPs shall develop and implement site-specific QA plans that comply with these requirements. WCPs are responsible for describing the QA and QC activities applicable to the specific parameters of the transportation packaging methods for payload control. WCPs shall develop and implement a transportation packaging QA program that defines the QA and QC activities applicable to usage of the transportation systems, as applicable. The use, operation, and maintenance of the transportation systems by the user are conducted under a QA program approved by the appropriate DOE field offices. This program controls the use of the NRC-certified packaging and shall comply with the CH Packaging Program Guidance (Reference 45) and RH Packaging Program Guidance (Reference 46), as applicable.

5.0 REFERENCES

NOTE: The current revision of these reference documents is applicable. The Internet links are provided for informational purposes only and may change without prior public notification.

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Appendix A

Radiological Characterization Requirements for Transuranic Waste

A.1 INTRODUCTION

The WIPP requires radiological characterization data for TRU waste to:

- track the WIPP radionuclide inventory, by radionuclide activity and mass, for those radionuclide inventories listed in Section 3.3.1,
- demonstrate that each payload container disposed of at the WIPP contains TRU waste as specified in Section 3.3.3, and
- verify that applicable transportation and facility limits on individual payload containers and assemblies specified in Sections 3.3.2 to 3.3.7.

Radiological characterization methods, such as nondestructive assay (NDA), dose-to-curie (DTC), radiochemistry (RC), gravimetric or dimensional measurements in conjunction with modeling, and AK serve to quantify at least one of the more prevalent radionuclides known to be present in the waste. For the radioassay processes, NDA is a non-invasive technique relying on a measurement or series of measurements of emitted radiations from the waste container which are then correlated through calibrations or dynamic efficiency to provide a measure of the radionuclides present in the waste. Typical examples of NDA methodologies include gamma spectroscopy, passive/active neutron measurements, DTC, and calorimetry. Radiochemistry is an invasive technique relying on direct sampling and analysis to identify the radionuclides present. Gravimetric and dimensional techniques utilize weight and dimensional measurements. The DTC techniques are also non-invasive and use an externally measured gamma or neutron dose rate correlated by modeling to the emitting radionuclide or radionuclides. Depending on the method applied, the remaining radionuclides present in the waste in reportable quantities will then be identified by direct measurement, through AK of radionuclide ratios as discussed in Section A.2, sampling and analysis, or process knowledge derivation (i.e., modeling). The subsequently determined radionuclide ratios are then used to quantify radionuclides based on the measured value of the prevalent radionuclide. The application of these processes and techniques will be described in greater detail in later sections of this appendix. The dual utilization of any of the above-mentioned radiological characterization methods or other developed alternative methods for the characterization of either CH-TRU or RH-TRU waste is allowed if technically justified and approved by the CBFO.

Each WCP must technically justify that the AK, radiological characterization methods, instruments, and procedures used:

- are appropriate for the specific waste stream and waste content code descriptions being assayed, and
- will result in unbiased values for the cumulative activity and mass of the WIPP radionuclide inventory.

Data collected prior to the implementation of a quality assurance program pursuant to 40 CFR §194.22(a)(1) may only be qualified in accordance with an alternate methodology that is approved by the CBFO and employs one or more of the methods described in Section 4.1 (Waste Characterization Quality Assurance Requirements).

Proposals for alternative approaches to the identification and quantification of radionuclides for radiological characterization purposes (e.g., quantification of radionuclide ratios using AK on a waste stream basis) must be submitted to the CBFO for review and approval. The CBFO will report such proposals to the EPA for consideration prior to issuing approval.

Controlled changes to related plans or procedures shall be managed through the document control process that complies with the CBFO QAPD. The WCP's Site Project Manager (SPM) and the Site QA Manager shall review all such changes, including all planned and in-process changes, and report to the CBFO those changes that could impact compliance with the criteria in this document. The SPM shall ensure that WCP-approved changes to related plans or procedures affecting either the performance criteria or data quality of certified systems/processes are not used in the development of waste certification data prior to the CBFO's review and approval. Related testing, calibration, and training performed in accordance with these WCP-approved changes, however, are not precluded from being conducted prior to the CBFO's review and approval (Memorandum from CBFO to Distribution, CBFO:NTP:RMK:VW:02-2734:UFC:5822, July 29, 2002).

A.2 RADIONUCLIDE RATIOS

Establishing radionuclide ratios for use in quantifying radionuclides is performed by direct measurement of a representative sub-population of containers using WIPP-certified systems, or through AK, sampling and analysis, or process knowledge derivation (i.e., modeling). WCPs may opt to qualify AK as permitted by 40 CFR §194.22(b) by performing confirmatory testing on a representative sub-population of payload containers within a waste stream using WIPP-certified radioassay systems. When a WCP performs direct measurements of radionuclide ratios, it is expected that a representative sub-population of payload containers within a waste stream will be measured, with the understanding that, in some cases, valid data may not be obtainable for certain containers for technical reasons (e.g., lack of sufficient signal or poor counting statistics). All such instances will be documented and appropriately dispositioned by the measurement facility. For those few waste containers for which direct measurement does not yield useable radionuclide ratio information, AK or sampling or modeling may be used.

A.2.1 Methods for Confirmation of Radionuclide Ratio AK

A.2.1.1 Radioassay Determinations

As a minimum, to confirm existing AK data, it is necessary to compare ratios of the two most prevalent radionuclides in the radionuclide mix. For weapons and reactor grade plutonium, these are typically ^{239}Pu and ^{240}Pu by weight. For heat source waste, the predominant radionuclides are typically ^{238}Pu and ^{239}Pu by weight. Measured radionuclide ratios for ^{241}Am may confirm existing AK by waste stream. However, due to the fluctuation of ^{241}Am in certain waste streams or the age of the waste material, it may become necessary to measure ^{239}Pu to ^{241}Am radionuclide ratios on all containers in that waste stream.

^{241}Am is the daughter of ^{241}Pu, which decays with a half-life of about 14 years. If the time since the chemical separation of the plutonium is known, the quantity of measured ^{241}Am can be used to calculate the quantity of ^{241}Pu. This assumes there was no ^{241}Am in the waste just after the chemical separation and that no ^{241}Am was added to or removed from the waste during the time since the separation. Since ^{241}Am is an indirect measurement of ^{241}Pu, it could be compared (by ratio) to any plutonium isotope (^{239}Pu or ^{240}Pu) associated with weapons and reactor grade plutonium.

For weapons grade and reactor grade waste, radionuclide ratio values for ^{238}Pu can be assumed to be valid in AK data if the values for ^{239}Pu and ^{240}Pu have been confirmed. Because ^{242}Pu cannot typically be measured using NDA methods, the contribution of ^{242}Pu radionuclide ratio is calculated by correlation techniques.

For some of the DOE sites that were involved primarily in weapons production, the fissile isotopes ^{235}U and ^{233}U and the fissionable isotope ^{238}U may not have been measured when the transuranic waste was originally assayed (i.e., using non-WIPP-certified systems), primarily because the plutonium isotopes were the radionuclides of interest to the DOE site. However, other forms of AK may be available. If so, then the AK can be confirmed by data generated on a WIPP-certified system. If valid AK does not exist, then the data generated on a WIPP-certified system can only be used to detect or calculate ^{238}U, ^{235}U, and ^{233}U or to confirm their absence. Because ^{234}U cannot be measured using NDA methods, the radionuclide ratios for ^{234}U may be calculated from the ^{235}U enrichment. Values, or lack thereof, for ^{137}Cs can be confirmed by the data generated on a WIPP-certified system. This is typically done by measuring ^{137}Cs directly, or by comparing the NDA measured ^{241}Am 662 kiloelectron volt (keV) peak to the other ^{241}Am peaks (e.g., the 125 keV or 721 keV peaks) to determine if the 662 keV peak's intensity is consistent with the expected ^{241}Am intensity. A disproportionate higher response for the 662 keV peak relative to the other ^{241}Am peaks may indicate the presence of ^{137}Cs. ^{90}Sr may be calculated from the value for ^{137}Cs and AK. If detected, a waste container's concentration of ^{137}Cs can be used to derive a value of ^{90}Sr through the application of the appropriate scaling factor(s). All scaling factors used will be technically sound and based on known, documented relationships or correlations. The data report for the waste containers for which the ^{90}Sr value is derived in this manner shall reflect the use of a scaling factor(s) and provide sufficient documentation to enable its independent calculation. Finally, the gamma spectra must be carefully examined for significant presence of other radionuclides to ensure compliance with transportation requirements. Data obtained for radionuclides other than the WIPP-tracked radionuclides presented above are required to address confounding radionuclide issues (i.e., masking) with regard to NDA. When RC is used for confirmation instead of NDA, less reliance on calculated radionuclides is required.

Each WCP must technically justify that the techniques used to confirm the absence or the ratio of non-measurable radionuclides are valid for the particular radioassay method used to confirm AK.

A.2.1.2 Dose-to-Curie Determinations

The curie content of waste containers can be derived based on an external gamma and/or neutron dose rate measurement. This process, referred to as DTC, can be used to establish radionuclide activity, total activity, and activity per container, when used in conjunction with scaling factors.

The DTC method requires a dose rate measurement of the waste container to derive the quantity of either the primary gamma or neutron-emitting radionuclide(s) in the container. The activities of the remaining radionuclides in the waste are then derived by the use of conversion factors, commonly termed "scaling factors." The dose rate measurement shall be made using a calibrated instrument at a defined spatial location external to the container. The correlations to convert from a gamma or neutron dose rate to a radionuclide content in curies are derived from radiation transport modeling using shielding computer programs such as MicroShield or Monte Carlo N-Particle (MCNP) transport code. The external dose rate can be correlated to the total activity of the primary gamma or neutron-emitting radionuclides in the container by taking into account such factors as matrix and container geometry. The activities of the other radionuclides in the waste are calculated using scaling factors which correlate to the primary radionuclides determined from the dose rate measurement.

Scaling factors can be developed from modeling, sampling and analysis, process information, and/or other forms of AK. For some wastes, the scaling factors can be calculated based on fuel characteristics and computer modeling (from a program such as ORIGEN). Representative sampling and analysis may also be used to derive scaling factors. Another alternative is to use process inventory information to develop scaling factors. The scaling factor development should consider potential partitioning of the key gamma radionuclide and the scaled radionuclides in the process operations and the disposition of the waste. For example, ^{137}Cs may be separated from the actinides by fuel examination activities involving water where the ^{137}Cs would be more soluble in water than the actinides. The radionuclide scaling factor derivation shall be documented.

When using a computer code, such as ORIGEN, for production and depletion modeling and calculations during irradiation and radioactive decay, the following requirements apply:

- The computer codes to be used shall be controlled under an appropriate software quality assurance program that tracks the installation and use of the codes, and requires comprehensive verification and validation prior to use.

- Calculations shall be performed using methods, including computer programs, which account for the pre-irradiation composition of the fuel or target used to produce the TRU radionuclides, the exposure of this fuel or target during irradiation, and the change in radionuclide activities following irradiation.

- The appropriate cross-sections shall be used or generated for each irradiation condition.
- The fuel or target exposure history shall be used in the radionuclide generation and depletion calculation. Different irradiation times and decay times from multiple irradiation materials in the generation of the waste shall be accounted for in the analyses.

The DTC radiological characterization shall document the following as applicable:

- The detector's gamma or neutron response function (e.g., mrem/hr) shall be consistent with that used in the calculation of the dose rate.
- The number of measurements to be made at equally spaced polar positions about the container.
- The average value of the measurements shall be used for the DTC conversion calculation of radionuclides in the container.
- The DTC correlation shall be developed as a function of the waste density for each radionuclide contributing to 95% of the measured dose rate. A determination of the waste density requires that the fill height of each container be known.
- The DTC correlation shall consider the waste type (i.e., metal, concrete, or organic) and waste height effects (other than its effect on density), if such parameters are determined to be significant.
- The DTC correlation shall include the shielding effect of the container wall(s) and shall account for any significant scatter from shield walls adjacent to the container being measured.
- The dose rate per unit activity outside a container shall be calculated through straightforward shielding analysis techniques. These techniques include discrete ordinates, Monte Carlo, and point-kernel methods that have been implemented in numerous computer programs. Some of the more common programs implementing these methods are MCNP and MicroShield.
- The DTC correlation shall be used with the measured dose rate to estimate the activity in the waste container of the primary gamma radionuclide that is the basis of the scaling factor.

- The DTC determinations of radionuclides present in a waste container shall be decayed for all radionuclides with half-lives of approximately 30 years or less to correct from the time of the scaling factor development to the time of shipment.

The following QAOs are applied for the DTC method:

- Precision – Not applicable.
- Accuracy – Accuracy is achieved through the use of standardized and benchmarked radiation transport computer codes such as MCNP or MicroShield.
- Representativeness – Representativeness of the DTC correlation is achieved through the use of an appropriate model of the actual physical drum dose rate configuration. Representativeness is demonstrated through the documentation and independent review of the DTC correlation.
- Completeness – Completeness of the DTC correlation is achieved by basing it on calculations that span the full range of important parameter values (such as density, source location, waste composition, etc.) that are expected to be encountered with the actual TRU waste containers.
- Comparability – Not applicable.

Specific procedural steps for conducting the radiation survey of the exterior of the waste container for the purpose of DTC measurements shall be developed.

A.2.1.3 Determination of Radionuclide Concentrations in Waste by Radiochemistry

For waste streams that have reasonably homogeneous characteristics of radionuclide concentrations and density, such as soil and sludge, sampling and analysis may be used to derive the radionuclide concentrations of the radionuclides required for characterization. A representative number of samples may be needed to demonstrate the homogeneity of the waste stream and to derive the average concentrations of the radionuclides of interest. The radiochemistry data shall be analyzed to determine average concentrations. The variability in the data shall be used to determine uncertainties in the average concentrations. Acceptable Knowledge information may be required to support the conclusion that a particular waste stream is homogeneous. If adequate AK information is available, modeling may be used to develop the concentration of radionuclides that are not separately measured in standard radiological characterization techniques.

If the radionuclide concentration data are to be used in the characterization of the homogeneous waste, then requirements of Section A.4.3 shall be followed. Existing sampling and analytical data may be used, if the data can be qualified in accordance with the requirements of Section A.2.2.2.

A.2.1.4 Gravimetric or Dimensional Measurements

For unique waste streams where the activity within a waste stream is identified as discreet pieces of irradiated materials, such as fuel specimens or target test specimens, gravimetric or dimensional measurements may be used to establish the activity content of the waste container or to confirm AK information for the same measurements. In the gravimetric method, each piece of the irradiated material placed into the waste container shall be weighed to determine the total mass of the irradiated materials in the container. In the dimensional measurement method, measurements of length, width, and thickness are used for a volumetric determination. Coupling of the volumetric determination with AK information on the density and composition of the irradiated material allows for the calculation of the mass of the discreet piece. Information from the AK record may be used to establish such items as cladding thickness or pellet diameter.

The mass measurements shall be coupled with information on the radionuclide activity distributions within each piece to establish the total TRU activity, total activity, and total individual radionuclide activities per waste container. The radionuclide activity distributions may be developed from modeling, process information, and/or other forms of AK. The modeling includes the development of the radionuclide distributions from calculations based on fuel characteristics and computer modeling (from a program such as ORIGEN) as discussed in Section A.2.1.2.

Gravimetric systems that provide data for the characterization of waste shall be controlled under formal measurement control programs.

Any gravimetric technique used for TRU waste shall be performed in accordance with calibration and operating procedures that have been submitted to and approved by the CBFO.

The following QAOs apply to the VE operator when performing gravimetric or dimensional measurements:

- Precision – Measurement equipment shall be maintained according to manufacturer’s recommendation. Balance shall be calibrated and maintained according to manufacturer’s recommendation.

- Accuracy – Balance readout shall be 2 percent of the check weight. The length measurement shall be 0.1 of an inch verified by a second operator.

- Representativeness – Not applicable.

- Completeness – Every quantity of fuel or test specimen loaded into the container is measured.

- Comparability – Not applicable.

A.2.2 Acceptable Knowledge Documentation

The use of AK information concerning the radiological composition of a waste stream will be documented either in the AK Summary Report for the waste characterization of the waste stream or in another controlled document approved by the SPM. Should this information be contained in AK package(s) prepared to meet other general waste characterization requirements, it need not be duplicated in other controlled documents that address the radiological properties of the waste stream. However, all relevant information, as discussed in the following sections, must be included in the AK record.

A.2.2.1 Required Elements

This section identifies the required radiological information that each TRU waste site or WCP measurement facility must maintain for a waste stream. A TRU waste site or WCP waste characterization facility may use AK to delineate the distribution of the 10 WIPP-tracked radioisotopes within a TRU waste stream and the presence or absence of isotopes. The type and quantity of supporting documentation may vary by waste stream and shall be compiled in a written record that shall include a summary identifying all sources of information used to delineate the waste stream's radionuclide distribution. The basis and rationale for the delineation shall be clearly summarized in an AK report and traceable to referenced documents. Assumptions made in this delineation shall be identified. The following information shall be included as part of the AK written record:

- map of the DOE site with the areas and facilities involved in TRU-mixed waste generation, treatment, and storage identified
- facility mission description as related to radionuclide-bearing materials and their management (e.g., routine weapons production, fuel research and development, and experimental processes)
- description of the specific DOE site locations (such as the area or building) and operations relative to the radionuclide composition of the TRU wastes they generated (e.g., plutonium recovery, weapons fabrication, pyrochemical operations, and waste incineration)
- waste identification or categorization schemes used at the facility relevant to the waste material's radionuclide distribution (e.g., the use of codes that correlate to a specific radionuclide distribution, and a description of the radionuclide composition of each waste stream)
- information regarding the waste's physical and chemical composition that could affect the radionuclide distribution (e.g., processes used to remove ingrown ^{241}Am or alter its expected contribution based solely on radioactive decay kinetics)

- statement of all numerical adjustments applied to derive the material's radionuclide distribution (e.g., scaling factors, decay/ingrowth corrections, and secular equilibrium considerations)

- specification of the radionuclide ratios for the 10 WIPP-tracked radionuclides (^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs) and, if applicable, other radionuclides that contribute to 95% of the total radiological hazard of a waste stream, waste stream subpopulation, or container based on the A_2 values given in 49 CFR §173.435.

A.2.2.2 Supplemental Acceptable Knowledge Information

Each DOE site or WCP measurement facility shall obtain supplemental AK information, dependent on availability. The amount and type of this information cannot be mandated, but WCPs shall collect information as appropriate to support their contention regarding the waste's radionuclide distribution. This information will be used to compile the waste's AK written record. Supplemental AK documentation that may be used includes, but is not limited to, information from the following sources:

- Safeguards & Security, Materials Control & Accountability, and other nuclear materials control systems or programs and the data they generated

- reports of nuclear safety or criticality, or accidents/excursions involving the use of special nuclear material (SNM) or nuclear material

- waste packaging, waste disposal, building or nuclear material management area logs or inventory records, and DOE site databases that provide information on SNM or nuclear materials

- test plans, research project reports, or laboratory notebooks that describe the radionuclide content of materials used in experiments

- information from DOE site personnel (e.g., documented interviews)

- historical analytical data relevant to the radionuclide distribution of the waste stream

A.2.2.3 Discrepancy Resolution

If there is a discrepancy between AK information related to radionuclide ratios or composition, the WCP will evaluate the sources of the discrepancy to determine if the discrepant information is credible. Information that is not credible or information that is limited in its applicability to WIPP characterization will be identified as such and the reasons for dismissing it will be justified in writing. Limitations concerning the information will be documented in the AK record and summarized in the AK report. In the event that the discrepancy cannot be resolved, the WCP will perform direct measurements for the impacted population of containers. If discrepancies result in a change to the original determinations, the AK summary will be updated.

A.3 DATA QUALITY OBJECTIVES

The DQOs for WIPP certifiable radiological characterization data are established in Section 3.3 of this WAC. They are summarized below in Table A-1 as they apply to individual payload containers.

Table A-1 Data Quality Objectives for Radiological Characterization

Requirement	DQO	Confidence(1)
TRU alpha activity concentration(2) > 100 nCi/g(3)	A > LLD	N/A
^{239}Pu Fissile mass ≤ FGE limit	^{239}Pu FGE + $2\sigma_{TMU}$(FGE) ≤ FGE limit	97.5%
^{235}U FEM	^{235}U FEM + $2\sigma_{TMU}$ ≤ $L_{TRAMPAC}$(4) limit	97.5%
Decay heat ≤ TRAMPAC(4) limit	DH + $1\sigma_{TMU}$(DH) ≤ $L_{TRAMPAC}$(4)	84%

Notes:
(1) Confidence means the statistical level of confidence that the limit is exceeded or not exceeded depending on the requirements of the individual DQOs. The confidence is derived from the specified DQOs which assume contributions to TMU are normally distributed.
(2) TRU waste determinations shall be in accordance with the policy for the management of TRU alpha activity concentration when overpacking waste containers (see Appendix E).
(3) nCI/g = nanocuries per gram.
(4) TRAMPAC includes limits from the CH-TRAMPAC, the RH-TRAMPAC, and the TRUPACT-III TRAMPAC.

There are no stipulated DQOs for PE-Ci or individual radionuclide activities (except as they impact the requirements listed above). However, at a minimum, radioassay programs must be capable of identifying, measuring, and reporting the presence or absence of:

- the ten radionuclides identified in Section 3.3.1 for tracking of the WIPP radionuclide inventory (see Section A.2.1),
- ^{235}U, in order to calculate FGE or FEM, as required in Section 3.3.2 for compliance with transportation requirements, and
- other radionuclides whose presence contributes to 95% of the radioactive hazard, as specified in Section 3.3.1, for compliance with transportation requirements.

In support of the above requirements, each WCP must evaluate, document, and technically justify the following determinations:

Lower Limit of Detection and Minimum Detectable Activity: The LLD for each radioassay system, except for DTC, must be determined. Instruments performing TRU/low-level waste discrimination measurements must have an LLD of 100 nCi/g or less. Site-specific environmental background and container-specific interferences must be factored into LLD and MDA determinations. The LLD and MDA are similarly defined as that level of radioactivity which, if present, yields a measured value greater than the critical level with a 95% probability, where the critical level is defined as that value which measurements of the background will exceed with 5% probability. The LLD is expressed as a concentration (the activity divided by the waste mass) while the MDA is expressed in units of activity. In general, the term MDA is used to describe the statistically derived activity below which the true activity of an individual radionuclide in a sample cannot be determined. It therefore represents the highest activity of a particular radionuclide that may probably be in a sample within the statistical bounds of the conditions under which the measurement was made. Because the MDA is a measurement-based parameter, it is not feasible to calculate MDAs for radionuclides that are not determined primarily by measurement (e.g., ^{90}Sr). In such cases, the WCP shall derive the equivalent of an MDA; i.e., a reporting threshold for a radionuclide(s), when it is technically justified. This value may be based on decay kinetics, scaling factors, or other scientifically based relationships, and must be adequately documented in WCP records. For purposes of reporting radionuclide data to the WWIS database, this value will be the equivalent of an MDA. References A3 and A4 provide information in developing the MDA.

Total Measurement Uncertainty: The method used to calculate the TMU for the quantities in Table A-1 must be documented and technically justified for each CBFO-certified radiological characterization system. Compliance with this requirement will be evaluated in reviews of the TMU documentation package for each assay system by the CBFO. General guidance for determining the TMU is provided in References A5 and A6.

Calibration Documents/Procedures and Frequencies: Calibration documents/procedures shall be developed for calibrating each radioassay measurement system, except for DTC, before initial use. Calibrations may be performed by using either physical standards or accepted calculational models and methods. During calibration or re-calibration, system correction factors shall be established and algorithms adjusted such that the value of percent recovery (%R) is set equal to 100%; i.e., the system is calibrated or modeled to reflect 100% recovery. The matrix/source surrogate waste combination(s) used for initial calibrations, as well as the calculational models and methods, shall be described in a calibration plan or detector characterization report and will be representative, as appropriate, of the:

- activity range(s), gram loading(s), photon energy range(s), and
- relevant waste matrix characteristics (e.g., densities, moderator content, applicable matrix correction, and container size) planned for measurement by the system.

Calibration(s) shall be performed in accordance with consensus standards, when such standards exist. If consensus standards are not used, full documentation of the calibration technique must be provided to and approved by the CBFO prior to performing WIPP-related assays. Primary calibration standards shall be obtained from suppliers maintaining a nationally accredited measurement program. When primary standards are not available, the standards used shall be correlated with primary standards obtained from a nationally accredited measurement program. Neutron-emitting standards proposed as surrogates for ^{238}Pu or ^{240}Pu (e.g., ^{252}Cf) may be used for calibration if their equivalence is clearly documented. In addition, recent technology advancements have expanded the ability to mathematically model the physical principles involved with neutron and gamma-ray transport and measurement. This modeling allows the development of computational methods for system calibrations.

Gamma modeling methods are described in American Society for Testing and Materials (ASTM) C1726, *Standard Guide for Use of Modeling for Passive Gamma Measurements* (Reference A7). The modeling and methodology must be clearly documented. For calorimetry, calibration shall be performed in accordance with Reference A8.

Calibration Verification: Notwithstanding the need to calibrate individual components for replacement, changes, or adjustments (e.g., energy calibration of a detector), verification of the radioassay measurement system's calibration shall be performed after any one of the following occurs:

- major system repairs and/or modifications
- replacement of the measurement system's components; e.g., detector, neutron generator, or supporting electronic components that have the capacity to affect data
- significant changes to the system's software
- relocation of the system
- failure of measurement quality controls not assignable to external activities or events

Calibration verification shall consist of demonstrating that the affected operating system modality (whether gamma, passive neutron, or active neutron) is within the range of acceptable operation. Secondary standards or sources can be used for the calibration verification if their responses have been correlated with primary calibration standards. These secondary standards or sources may either be a single source or a collection of sources in a geometrically stable configuration and matrix, with suitably long-lived radionuclides. These may be used to confirm proper operation when compared to a previously collected baseline set of measurements that have demonstrated the reproducibility of response for the source(s) and configuration. If a verification of the measurement system's calibration or other test demonstrates that the system's response has significantly changed, a re-calibration of the system shall be performed. A calibration verification does not need to be performed at initial equipment setup when a calibration confirmation is being performed.

Calibration Confirmation: In order to confirm that the calibration of a modality (e.g., a gamma efficiency curve) of an NDA system was correctly established, the accuracy and precision of the system are determined after each calibration or re-calibration. Accuracy and precision for fixed geometry systems are determined by performing replicate measurements of an appropriate surrogate matrix selected from within the expected operating range of the calibration being confirmed. For example, a calibration involving a lead-lined waste drum would most appropriately employ a surrogate lead-lined drum while a POC configuration would more appropriately employ a POC surrogate. In the typical case of a gamma detection system, a minimally interfering matrix, such as a light combustible matrix container, might be considered. If a geometrically consistent surrogate is not available, then the justification of the surrogate container selected shall be documented. Calibration confirmation replicate measurements shall be performed on containers of the same nominal size as those in which actual waste is assayed and according to approved waste assay procedures. The number of replicate measurements to be performed shall be documented and technically justified. The replicate measurements shall be performed using nationally recognized standards, or certified standards derived from nationally recognized standards that span the expected operating range of the system. The standards used to calculate accuracy shall not be the same as those used for the system calibration.

Alternatively, for gamma systems using segmented gamma scanning techniques, an Efficiency Curve Calibration may be used as described in Reference A9, *Standard Test Method for Nondestructive Assay of Special Nuclear Material in Low Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning*, ASTM C1133. This type of calibration is based on an energy range over which the efficiency response is defined. This allows calibration for gamma-emitting radionuclides without a specific mass or activity loading limitation for the establishment of the calibration range. For an NDA system using the Efficiency Curve Calibration, the calibration and operating ranges are only limited by geometry, equipment, system performance, and the ability to interpret the acquired gamma spectra. Similarly, modeling methodologies accuracy is confirmed by observing a single measurement’s computed activity from several gamma rays of different energies emitted from the same radionuclide, as described in Reference A7, *Standard Guide for Use of Modeling for Passive Gamma Measurements*, ASTM C1726.

Figure of merit (FOM) assessments may be used as validation of far field measurement techniques where the efficiency is dynamically generated during each measurement. The FOM assessment shall, as applicable to far field measurement techniques, involve techniques in confirming that the modeled efficiencies used for nuclide quantification are internally consistent. Using radionuclides that emit multiple gamma energy lines allows for efficiency accuracy confirmation to be performed by evaluating the consistency of each line activity calculated via that efficiency.

Accuracy is reported as percent recovery (%R). Accuracy shall be 100% ± 10%. The justification for accuracy outside of the 90% – 110% range will be documented. For gamma systems, the accuracy shall be calculated for each useable gamma energy line over the calibration range. The accuracy for each line shall be 100% ± 10%. The justification for not using certain gamma lines due to matrix density, filter density, or attenuation will be documented. Precision is reported as percent relative standard deviation (%RSD). The %RSD shall not exceed the values listed in Table A-2 for the corresponding number of replicate measurements in a non-interfering matrix.

Table A-2 Upper Limits for %RSD vs. Number of Replicates

Number of Replicates	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Max %RSD*	1.8	6.6	10.0	12.3	14.0	15.2	16.2	17.1	17.7	18.3	18.8	19.3	19.7	20.0

* The values listed are derived from the measured standard deviation of the replicate measurements using

$$\frac{s}{\mu} \bullet 100\% < \sqrt{\frac{(0.292)^2 \bullet \chi^2_{0.05,n-1}}{n-1}} \bullet 100\%$$

where *s* is the measured standard deviation, n is the number of replicates, *μ* is the true value,

is the critical value for the upper 5% tail of a one-sided chi-squared distribution with n –1 degrees of freedom, and 0.292 corresponds to a 95% upper confidence bound on the true system precision limit of 29.2%.

Measurement facilities may develop alternate limits for accuracy and precision subject to approval by the CBFO prior to certification of waste.

A.4 QUALITY CONTROL

To ensure that data of known and documented quality are generated, each participating measurement facility shall implement a documented facility QA program. Any radiological characterization technique used for TRU waste must be performed in accordance with calibration and operating procedures that have been written, approved, and controlled by the WCP or testing facility. Laboratory procedures must contain applicable quality controls. Facility QA programs shall specify qualitative and quantitative acceptance criteria for the QC checks of this program and corrective action measures to be taken when these criteria are not satisfied.

A.4.1 General Requirements

Radiological Characterization Training: Only appropriately trained and qualified personnel shall be allowed to perform radiological characterization and data validation/review. Standardized training requirements for radiological characterization personnel shall be based upon existing industry standardized training requirements (e.g., ASTM C1490, *Standard Guide for Selection, Training and Qualification of Nondestructive Assay (NDA) Personnel* [Reference A10], and ANSI N15.54, *Radiometric Calorimeters – Measurement Control Program* [Reference A8]) and shall meet the specifications in the CBFO QAPD. Requalification of radioassay personnel shall be based upon evidence of continued satisfactory performance and must be performed at least every two years.

Software QC Requirements: All computer programs and revisions thereof used for radioassay shall meet the applicable requirements in Section 6.0 of the CBFO QAPD (Reference A2).

Comparison Programs: WCPs using radioassay systems shall participate in any relevant measurement comparison program(s) sponsored or approved by the CBFO. Such programs may be conducted as part of the NDA performance demonstration program (References A11 and A12), or through other third parties (Reference: WIPP Compliance Recertification Application, including Annual Reports to the EPA).

A.4.2 NDA QC Requirements

The NDA QC requirements identified in various ASTM and ANSI standards (References A7, A8, A9, A13, A14, A15, and A16), and NRC standard practices and guidelines (Reference A17) as referenced in this appendix are recommended for use at all testing facilities. Some specific QC requirements are:

Background Measurements: Background measurements must be performed and recorded once per operational day, unless otherwise approved by the CBFO. Contributions to background due to radiation from nearby radiation-producing equipment, standards, or wastes must be carefully controlled or more frequent background checks must be performed. For calorimeters, basepower or baseline measurements shall be conducted at a frequency determined by each WCP and approved by the CBFO.

Instrument Performance Measurements: Performance checks on calibrated and operable gamma and neutron NDA instruments must be performed and recorded once per operational day. Performance checks shall include efficiency checks (when applicable), matrix correction checks and, for spectrometric instruments, peak position, and resolution checks. If daily performance checks result in data that are outside the acceptable ranges specified in Table A-3, then the cause of the failure will be evaluated and the required responses in Table A-3 shall be followed. If the failure is the result of outside influences such as surrounding waste container movement, mis-positioning of waste containers, failure to initiate container rotation, etc., then the system performance check shall be repeated after the source of failure is rectified and documented. Acceptability of performance check data may be based on either statistically determined limits (Warning or Action limits) derived from a suitable population of data or on a technically determined (i.e., non-statistical) assignment of acceptable boundary limits (Above and Below flags). Above and Below boundary limits should mirror the Action category and follow the identified required response. The basis of the applicability range or assigned boundaries must be documented.

Containers and sources used for performance checks must be constructed in such a way that the surrogate waste characteristics and geometries do not change over time.

Radioactive sources should be long-lived, easy to position relative to the detector(s), and of sufficient radioactivity to obtain good results with relatively short count times, preferably with count times equivalent to normal container assay times.

Performance checks for calorimetry shall be performed with electrical and/or heat standards traceable to a nationally accredited measurement program at a frequency determined by each WCP, consistent with Reference A18. This information is specified in WCP operating procedures and approved by the CBFO.

Data Checks: Background (for calorimetry: baseline or base power) and performance measurements shall be reviewed and evaluated at least weekly to determine continued acceptability of the assay system and to monitor performance for biases and trends.

Table A-3 Performance Control Limits

Category	Acceptability Range(1), (2)	Required Response
Acceptable Range	$\lvert Data \rvert \leq 2\sigma$	No action required.
Warning Range	$2\sigma < \lvert Data \rvert \leq 3\sigma$	The performance check standard shall be rerun no more than two times. If the rerun performance check(s) result in data within ± 2σ, then the additional performance checks shall be documented and work may continue. If the system does not fall within ± 2σ after two rerun performance checks, then the required response for the Action Range shall be followed.
Action Range	$\lvert Data \rvert > 3\sigma$ Or exceeds Above or Below Boundary Limits	Work shall stop and the occurrence shall be documented and appropriately dispositioned (e.g., corrective action by operator or initiation of a nonconformance report). The radioassay system shall be removed from service pending successful resolution of all necessary actions, and all assays performed since the last acceptable performance check are suspect, pending satisfactory resolution. Recalibration or calibration verification is required prior to returning the system back to service.

Notes:
(1) Reference A16, Nondestructive Assay Measurement Control and Assurance, ANSI N15.36.
(2) The standard deviation σ is only based on the reproducibility of the data check measurements themselves. This is not TMU.

A.4.3 Radiochemistry QC Requirements

Radiochemistry analysis requirements shall be specified in the sampling plan. Any radiochemistry method may be used as long as it meets the DQOs in Section A-3. Only laboratories that have been evaluated, approved, and included on the WCP's qualified supplier list shall be used. The sample plan shall include the specification of radiochemical methods for specific isotopes and the radionuclides to be reported. Analysis shall be performed in accordance with the following:

- The samples shall be analyzed using radiochemistry, including alpha spectroscopy, gamma spectroscopy, or other appropriate methods to determine the relative activity levels of specified radionuclides. Mass spectrometry should be considered for the measurement of isotopes that are not separated in normal radiochemistry techniques.

- The minimum detectible activity levels and measurement uncertainty shall be recorded for each sample.

- It may not be possible to measure activities for each of the reportable radionuclides by sampling. Some radionuclide activities may be less than the estimated minimum detectable concentration. In such cases, analyses may be used to derive scaling factors to augment the sample results.

- The test result for each sample must be associated with a specific lot, batch number, or container.

The QAOs listed in Table A-4 present laboratory control requirements that must be met unless the laboratory has an established QA program with alternative QAOs that provide acceptable analytical quality control.

Table A-4 Quality Control Requirements for Radiochemistry

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action
Laboratory control samples (LCS)	One per analytical batch	75% to 125%R (recovery)	See Laboratory Control Sample(1)
Method blank	One per analytical batch	Site-specific statistical control limits	See Method Blanks(2)
Laboratory duplicate	One per analytical batch	RPD (relative percent difference) ≤ 40, or laboratory precision criteria	See Laboratory Duplicate(3)
Matrix spike (MS)	One per analytical batch for ICP-MS, as required by the test performed	50 to 150%R or laboratory method criteria	See Matrix Spike and Matrix Spike Duplicate(4)
Matrix spike duplicate (MSD)	One per analytical batch, as required by the test performed	50 to 150%R, RPD ≤ 40, or laboratory method criteria	See Matrix Spike and Matrix Spike Duplicate(4)
Radioisotopic tracers	Every sample	Site-specific statistical control limits	See Radioisotopic Tracer(5)

Notes:

(1) Laboratory Control Sample: An LCS is analyzed at least once per analytical batch. If a solid matrix with established control limits is used as the LCS, the established limits may be used for the acceptance criteria. The control limits shall meet the criteria in Table A-3.

(2) Method Blanks: A method blank is analyzed at least once per analytical batch. It contains all reagents in proportions equal to those in the samples and is carried through the analytical procedure to identify if contamination is present. Acceptance criteria for method blanks are established for each site. If they are expressed as statistical control limits, they shall meet the requirements in Table A-3.

(3) Laboratory Duplicate: A laboratory duplicate is analyzed at least once per analytical batch. A laboratory duplicate is a separate aliquot from the same field sample carried through the entire analytical procedure. The RPD or laboratory precision data between duplicate results are compared.

(4) Matrix Spike and Matrix Spike Duplicate: Duplicate MSs on individual field samples are performed for inductively coupled plasma-mass spectrometry (ICP-MS) analysis at a minimum frequency of one pair (MS plus MSD) per analytical batch. The MSDs are preferred for any analytical procedure not using radioactive tracers. The MS and MSD results are acceptable if the criteria given above for percent recovery and RPD are met.

(5) Radioisotopic Tracer: Some methods require that all samples, blanks, LCSs, and laboratory duplicates be spiked with radioisotopic tracers to determine chemical recoveries, counting efficiencies, or a combination thereof. Acceptance criteria for method blanks are established for each site. If they are expressed as statistical control limits, they shall meet the requirements in Table A-3.

Completeness of RC data shall be expressed as the ratio of the number of samples that are analyzed with valid results to the total number of samples that are submitted for analysis, expressed as a percent. Acceptable RC data shall be obtained for 90 percent of the samples acquired for waste characterization. Valid results for RC data are those that were obtained when the laboratory or testing facility demonstrated that the instrumentation and method were in control.

Representativeness of RC data shall be achieved by the collection of unbiased samples.

A.5 DATA MANAGEMENT

A.5.1 Data Review and Validation

All radiological characterization data must be reviewed and approved by qualified personnel prior to being reported. At a minimum, the data must be reviewed by a technical reviewer and approved by the SPM. The validation process includes verification that the applicable quality controls specified in Section A.4 have been met.

A.5.2 Data Reporting

Radiological characterization data must be reported to the WCP project office on a testing batch basis. A batch is defined, for the purpose of the program, as a suite of waste containers or samples undergoing radiological characterization using the same testing equipment. For NDA, the WCP shall specify the size of the batch as needed, without regard to waste matrix. For RC, a testing batch shall not exceed 20 waste containers without regard to waste matrix, as is consistent with industry practice.

Each radiological characterization testing facility is required to submit batch data reports for each batch to the WCP project office on standard forms (either hard copy or electronic equivalent), as provided in approved documentation. These batch data reports shall consist of the following:

- testing facility name, testing batch number, container numbers included in that testing batch, and signature release by the SPM
- table of contents
- background and performance data or control charts for the relevant time period
- data validation per the CBFO QAPD (Reference A2, Section 5.3.2), and as described in site procedures
- separate testing report sheet(s) for each container in the testing batch that includes:
  - title "Radioassay Data Sheet"
  - method used for radiological characterization (i.e., procedure identification)
  - date of radiological characterization
  - activities and/or masses of individual radioisotopes present and their associated TMUs (curies and/or grams)
  - operator signature/date
  - reviewer signature/date

Other radiological properties to be documented for each CH-TRU and RH-TRU waste container, as applicable, include:

- decay heat expressed in watts and its associated TMU
- ^{239}Pu FGE expressed in grams and its associated TMU
- TRU alpha activity concentration expressed in curies per gram
- ^{239}Pu equivalent activity expressed in curies
- average RH-TRU waste activity concentration per canister expressed in curies per liter, and
- ^{235}U FEM for RH-TRU waste expressed in grams and its associated TMU

These calculated quantities shall be included in the batch data report or other QA record or database.

When TMU is reported differently on the testing report sheet than in the WWIS database, the method of expressing TMU shall be specified on the testing report sheet or associated procedures/QAPjP. In the case of radiochemical analyses, the batch data report shall also include the QC sample results.

A.5.3 Data and Records Retention

The following nonpermanent records shall be maintained at the radiological characterization facilities or shall be forwarded to the WCP project office for maintenance, and shall be documented and retrievable by batch number, in accordance with the CBFO QAPD:

- testing batch reports
- all raw data, including instrument readouts, calculation records, and radiological characterization QC results
- all instrument calibration reports, as applicable

A.6 QUALITY CHARACTERISTICS ASSESSMENT

Per 40 CFR §194.22(c), there are five “quality characteristics” that must be assessed. These quality characteristics and the method by which they are assessed are described in the following sections.

A.6.1 Data Accuracy

Per 40 CFR §194.22(c)(1), *Data Accuracy* is defined as "the degree to which data agree with an acceptable reference or true value." For NDA methods, this quality characteristic is reported as %R and is met and maintained as described in Section A.3. For RC methods, this quality characteristic is met and maintained through the requirements specified in Table A-4 of Section A.4.3. See References A11 and A12 for application of this quality characteristic in formulating the scoring criteria for data generated by the performance demonstration program. Specifically, Appendix D, Section D.1 of these references gives the definitions of limits, bounds, and point estimates as they relate to NDA measurement systems and the relationship between accuracy, bias, and %R.

A.6.2 Data Precision

Per 40 CFR §194.22(c)(2), *Data Precision* is defined as "a measure of the mutual agreement between comparable data gathered or developed under similar conditions expressed in terms of standard deviation." For NDA methods, except for DTC, this quality characteristic is met and maintained as described in Section A.3. For RC methods, this quality characteristic is met and maintained through the requirements specified in Table A-4 of Section A.4.3.

A.6.3 Data Representativeness

Per 40 CFR §194.22(c)(3), *Data Representativeness* is defined as "the degree to which data can accurately and precisely represent a characteristic of a population, a parameter, variations at a sampling point, or environmental conditions." For NDA and RC methods, this quality characteristic for the waste stream is met and maintained through 100% measurement confirmation on a payload container basis. For NDA, since the entire waste container is subjected to measurement, representativeness pertaining to the actual measurement is not applicable. However, since a sample is physically removed from the container for RC measurements and must be representative of the waste within the container, Section A.4.3 provides the criteria for representativeness for the actual sample itself.

A.6.4 Data Completeness

Per 40 CFR §194.22(c)(4), *Data Completeness* is defined as "a measure of the amount of valid data obtained compared to the amount that was expected." For NDA methods, this quality characteristic is met and maintained by requiring 100% valid results. Any results indicating the NDA measurement was invalid require re-measurement. For RC methods, this quality characteristic is met and maintained through the requirements specified in Section A.4.3.

A.6.5 Data Comparability

Per 40 CFR §194.22(c)(5), *Data Comparability* is defined as "a measure of confidence with which one data set can be compared to another." For NDA and RC methods, this quality characteristic is addressed by ensuring that all data are produced under the same system of controls. These controls apply to all aspects of the data generation process, including procurement of analytical instruments, calibration and operation of assay equipment according to industry standards, preparation and use of standardized instrument and data review procedures, and training of equipment operators and technical/data review personnel to the CBFO QAPD, as specified in Section A.4.1. All NDA and RC systems and methods are approved by the CBFO prior to use in generating waste characterization data. Additionally, comparison of measured data with AK derived or based values, as applicable, provides a means to assess comparability on a waste stream basis. Although no specific confidence level is specified, these controls provide comparability among all data generated under this program. WCPs using radioassay systems shall participate in measurement comparison programs as specified in Section A.4.1.

A.7 REFERENCES

Note: The current revisions of these reference documents are applicable. The Internet links are provided for informational purposes only and may change without prior public notification.

A1. U.S. Nuclear Regulatory Commission. *Peer Review for High-Level Nuclear Waste Repositories,* NUREG-1297, Washington D.C., Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission.

A2. U.S. Department of Energy. *Quality Assurance Program Document*, DOE/CBFO-94-1012. Carlsbad, New Mexico, Carlsbad Field Office, U.S. Department of Energy. (http://wipp.energy.gov/documents-library-by-title.asp)

A3. Currie, Lloyd A., 1968. *Limits for Qualitative Detection and Quantitative Determination*. *Anal.Chem.* 40: 586-93.

A4. U.S. Environmental Protection Agency, 1980. *Upgrading Environmental Radiation Data.* EPA 520/1-80-012, Washington D.C., Office of Radiation Programs, U.S. Environmental Protection Agency.

A5. K. C. Smith, R. A. Stroud, K. L. Coop, and J. F. Bresson. 1998. *Total Measurement Uncertainty Assessment for Transuranic Waste Shipments to the Waste Isolation Pilot Plant*. Proceedings of the 6th Nondestructive Assay Waste Characterization Conference, Salt Lake City, Utah, Nov. 17-19, 1998, pp. 21-37.

A6. K. L. Coop, J. F. Bresson, M. E. Doherty, B. M. Gillespie, and D. R. Davidson. *Standardized Total Measurement Uncertainty Reporting for WIPP*. Nondestructive Assay Interface Working Group, Salt Lake City, Utah, May 22, 2000.

A7. American Society for Testing and Materials. *Standard Guide for Use of Modeling* *for Passive Gamma Measurements*. ASTM C1726, Annual Book of ASTM Standards, Philadelphia, Pennsylvania, American Society for Testing and Materials.

A8. American National Standards Institute. *Radiometric Calorimeters – Measurement Control Program*, ANSI N15.54, American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

A9. American Society for Testing and Materials. *Standard Test Method for Nondestructive Assay of Special Nuclear Material in Low Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning*. ASTM C1133, Annual Book of ASTM Standards, Philadelphia, Pennsylvania, American Society for Testing and Materials.

A10. American Society for Testing and Materials. *Standard Guide for Selection, Training and Qualification of Nondestructive Assay (NDA) Personnel*, ASTM C1490, Annual Book of ASTM Standards, Philadelphia, Pennsylvania, American Society for Testing and Materials.

A11. U.S. Department of Energy. *Performance Demonstration Program Plan for Nondestructive Assay of Boxed Wastes for the TRU Waste Characterization Program*, DOE/CBFO-01-1006. Carlsbad, New Mexico, Carlsbad Field Office, U.S. Department of Energy. (http://www.wipp.energy.gov/Documents_NTP.htm)

A12. U.S. Department of Energy. *Performance Demonstration Program Plan for Nondestructive Assay of Drummed Wastes for the TRU Waste Characterization Program*, DOE/CBFO-01-1005. Carlsbad, New Mexico, Carlsbad Field Office, U.S. Department of Energy. (http://www.wipp.energy.gov/Documents_NTP.htm)

A13. American Society for Testing and Materials. *Standard Test Method for Determination of Plutonium Isotopic Composition by Gamma-Ray Spectrometry*. ASTM C1030, Annual Book of ASTM Standards, Philadelphia, Pennsylvania, American Society for Testing and Materials.

A14. American Society for Testing and Materials. *Standard Test Method for Nondestructive Assay of Nuclear Material in Scrap and Waste by Passive-Active Neutron Counting Using a 252Cf Shuffler*. ASTM C1316, Philadelphia, Pennsylvania, American Society for Testing and Materials.

A15. American Society for Testing and Materials. *Standard Test Method for Nondestructive Assay of Plutonium, Tritium and 241 Am by Calorimetric Assay*. ASTM C1458, Annual Book of ASTM Standards, Philadelphia, Pennsylvania, American Society for Testing and Materials.

A16. American National Standards Institute. *Nondestructive Assay Measurement Control and Assurance*, ANSI N15.36. American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

A17. U.S. Nuclear Regulatory Commission. 1984. *Nondestructive Assay of Special Nuclear Material Contained in Scrap and Waste.* Regulatory Guide 5.11, Washington, DC, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission.

A18. American National Standards Institute. *Plutonium-Bearing Solids Calibration Techniques for Calorimetric Assay.* ANSI N15.22-1987, American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

Appendix B

^{239}Pu Equivalent Activity

The concept of ^{239}Pu equivalent activity is intended to eliminate the dependency of radiological analyses on specific knowledge of the radionuclide composition of a TRU waste stream. A unique radionuclide composition and/or distribution is associated with most TRU waste streams at each DOE site. By normalizing all radionuclides to a common radiotoxic hazard index, radiological analyses that are essentially independent of these variations can be conducted for the WIPP facility. ^{239}Pu, as a common component of most defense TRU wastes, was selected as the radionuclide to which the radiotoxic hazard of other TRU radionuclides could be indexed.

Modeled operational releases from the WIPP facility, including both routine and accident-related, are airborne. There are no known significant liquid release pathways during the operational phase of the facility. This, and the fact that TRU radionuclides primarily represent inhalation hazards, allows a valid relationship to be established, which normalizes the inhalation hazard of a TRU radionuclide to that of ^{239}Pu for the purpose of the WIPP radiological analyses. In effect, the radiological dose consequences of an airborne release of a quantity of TRU radioactivity with a known radionuclide distribution will be essentially identical to that of a release of that material expressed in terms of a quantity of ^{239}Pu. To obtain this correlation, the 50-year effective whole-body dose commitment or dose conversion factor for a unit intake of each radionuclide will be used.

For a known radioactivity quantity and radionuclide distribution, the ^{239}Pu equivalent activity is determined using radionuclide-specific weighting factors. The ^{239}Pu equivalent activity (AM) can be characterized by

$$\mathrm{AM} = \sum_{i=1}^{K} A_i / WF_i$$

where K is the number of TRU[1] radionuclides, Ai is the activity of radionuclide i, and WFi is the PE-Ci weighting factor for radionuclide i.

WF_i is further defined as the ratio

$$WF_i = E_o / E_i$$

where E_o (rem/µCi) is the 50-year effective whole-body dose commitment due to the inhalation of ^{239}Pu particulates with a 1.0 µm activity median aerodynamic diameter (AMAD) and a weekly pulmonary clearance class, and E_i (rem/µCi) is the 50-year effective whole-body dose commitment due to the inhalation of radionuclide (i) particulates with a 1.0 µm AMAD and the pulmonary clearance class resulting in the

[1] TRU as designated in this equation refers to any radionuclide with an atomic number greater than 92 and including ^{233}U.

highest 50-year effective whole-body dose commitment. Weighting factors calculated in this manner are presented in Table B-1 for radionuclides typically present in CH-TRU waste. If other TRU radionuclides are determined to be present in the payload container, their weighting factors can be obtained from the values of E_o and E_i contained in DOE/EH-0071 (Reference B1).

Table B-1 PE-Ci Weighting Factors for Selected Radionuclides

Radionuclide	Pulmonary Clearance Class*	Weighting Factor
^{233}U	Y	3.9
^{237}Np	W	1.0
^{236}Pu	W	3.2
^{238}Pu	W	1.1
^{239}Pu	W	1.0
^{240}Pu	W	1.0
^{241}Pu	W	51.0
^{242}Pu	W	1.1
^{241}Am	W	1.0
^{243}Am	W	1.0
^{242}Cm	W	30.0
^{244}Cm	W	1.9
^{252}Cf	Y	3.9

* (W) Weekly, (Y) Yearly

REFERENCE

B1. U.S. Department of Energy. *Internal Dose Conversion Factors for Calculation of Dose to the Public,* DOE/EH-0071, July 1988.

Appendix C

Glossary

10-160B Packaging – An NRC-certified Type B transportation packaging used for transportation of TRU wastes.

Acceptable knowledge – Any information about the process used to generate waste, material inputs to the process, and the time period during which the waste was generated, as well as data resulting from the analysis of waste, conducted prior to or separate from the waste certification process authorized by the EPA's Certification Decision, to show compliance with Condition 3 of the certification decision (Appendix A of this part) (40 CFR §194.2 and §194.67).

Activity – A measure of the rate at which a material emits nuclear radiation, usually given in terms of the number of nuclear disintegrations occurring in a given length of time. The common unit of activity is the curie, which amounts to 37 billion (3.7×10^{10}), disintegrations per second. The International Standard unit of activity is the becquerel and is equal to one disintegration per second.

Administrative controls – Provisions relating to organization and management, procedures, record keeping, assessment, and reporting necessary to ensure the safe operation of the facility.

Atomic energy defense activities – Activities of the Secretary of Energy (and predecessor agencies) performed in whole or in part in carrying out any of the following functions: naval reactors development; weapons activities, including defense inertial confinement fusion; verification and control technology; defense nuclear material production; defense nuclear waste and materials by-product management; defense nuclear materials security investigations; and defense research and development.

Authorization basis – Those aspects of the facility design and operational requirements relied upon by the DOE to authorize the operation of nuclear facilities and processes.

Characterization – Sampling, monitoring, and analysis (whether by review of AK, nondestructive examination, NDA, or RC) to identify and quantify the constituents of a waste material.

Chemical compatibility – Assessing the properties of chemicals in a payload container (> 1 weight percent); there must be no adverse safety or health hazards produced as a result of any mixtures that occur.

Completeness – The percentage of measurements made that are judged to be valid measurements. The completeness goal is to generate a sufficient amount of valid data based on program needs. Valid results for radioassay and radiography data are those that were obtained when the laboratory or testing facility demonstrated that the instrumentation and method were in control; that is, that all calibration, verification, interference, and zero matrix checks met acceptance criteria.

Compressed gas – Compressed gases are those materials defined as such by 49 CFR Part 173, Subpart G.

Contact-handled transuranic waste – Transuranic waste with a surface dose equivalent rate not greater than 200 millirem per hour (Reference 2, Section 2[3]).

Contact-handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC) – The governing document for shipments in the Transuranic Package Transporter-II (TRUPACT-II) and HalfPACT packagings (Reference 24, Section 1).

Content code – A uniform system applied to waste forms to group those with similar characteristics for purposes of shipment in the TRUPACT-II, TRUPACT-III, HalfPACT, and RH-TRU 72-B packagings.

Corrosive/Corrosivity – A solid waste exhibits corrosivity if a sample of the waste is either aqueous and has a pH ≤ 2 or ≥ 12.5, or it is a liquid and corrodes steel at a rate > 6.35 mm (0.250 inch) per year at a test temperature of 55°C (130°F) (40 CFR §261.22).

Criticality Control Overpack – A packaging configuration consisting of a steel 55-gallon drum containing a vented criticality control container confinement vessel that is centrally positioned within the drum by laminated plywood dunnage (Reference 48, Section 4.6).

Criticality Control Overpack – Enhanced Dilution Process (CCO-EDP) – In the EDP process, free-flowing plutonium oxide powder is added to blend cans containing an adulterant mixture (whose composition is non-radioactive and chemically stable). A neutron absorber is added to the blend. The blend can is closed, placed in a shielding container, and compressed in a glovebox using a hydraulic compression system. The shielding container with the inner compacted blend can is bagged out in a low-density polyethylene plastic bag and placed into an outer can and closed. Two outer slip-lid cans containing shielded, compacted blend cans may be placed in a criticality control container (CCC) which is bolted shut and then placed in 55-gallon drum; i.e., CCO (DSA, Reference 4).

Criticality Control Overpack – Sandia (CCO-S) – A small percentage of CCO drums shipped to WIPP from the Savannah River Site and other generator sites will follow the packaging configuration tested at Sandia National Laboratories. In the Sandia tests, the primary canister (can) was filled with a surrogate material and closed. The primary canister was placed inside a plastic bag-out bag. The plastic bag-out bag with the loaded primary canister is enclosed within a larger secondary canister. Two secondary canisters may be placed inside the CCC. The CCC is bolted shut and placed inside a CCO designated as CCO-S (DSA, Reference 4).

Curie – A unit of activity equal to 37 billion (3.7×10^{10}) disintegrations per second.

Disposal – Permanent isolation of TRU waste from the accessible environment with no intent of recovery, whether or not such isolation permits the recovery of such waste (Reference 2, Section 2[5]).

Dose conversion factor – A numerical factor used in converting radionuclide uptake (curies) in the body to the resultant radiation dose (rem).

Dose equivalent rate – The radiation dose equivalent delivered per unit time (e.g., rem per hour).

Drum – Includes 55-gallon, 85-gallon, and 100-gallon drums as described in the CH-TRAMPAC and the Permit.

Far field measurement – A measurement where the maximum dimensions of both the container and detector are negligible compared with their separation.

Figure of merit – A numerical quantity based on one or more characteristics of an assay system used to determine the performance effectiveness for an application.

Fissile gram equivalent – An isotopic mass of radionuclide normalized to ^{239}Pu.

Fissile material – Any material consisting of or containing one or more radionuclides that can undergo neutron-induced fission with neutrons of essentially zero kinetic energy (e.g., thermal neutrons), such as ^{233}U, ^{235}U, and ^{239}Pu.

Fully compacted waste – Waste that has been mechanically compacted such that the distribution and form of polyethylene in the waste exceeds 0.646 gram per cubic centimeter (g/cm^3); i.e., 70% of the theoretical full density of polyethylene (0.923 g/cm^3).

HalfPACT – An NRC-certified Type B transportation packaging used for transportation of CH-TRU wastes.

Hazardous waste – Those wastes that are designated hazardous by the EPA's (or state's) regulations. For a detailed description, see 40 CFR §261.3. Hazardous wastes are listed in 20.4.1 New Mexico Administrative Code (NMAC), subpart II (40 CFR Part 261), and/or exhibit one of the four characteristics in 20.4.1 NMAC, subpart II (40 CFR Part 261) (i.e., ignitability, corrosivity, reactivity, and toxicity).

Headspace – The total contained volume of a container minus the volume occupied by the waste material.

Headspace gas – The gas within the headspace of a container.

Internal container – A container inside the outermost container examined during radiography or VE. Drum liners, liner bags, plastic bags used for contamination control, capillary-type lab ware, and debris not designed to hold liquid at the time of original waste packaging are not internal containers (Reference 10, Part 1, Section 1.5.17).

Lower Limit of Detection – The level of radioactivity which, if present, will yield a measured value greater than the critical limit with a 95% probability. The critical limit is defined as that value which measurements of the background will exceed with a 5% probability.

Machine-compacted waste – Waste whose volume has been reduced using a mechanical process.

Minimum detectable activity – The minimum detectable activity is the smallest amount of radioactivity in a sample that can be detected with a 5% probability of erroneously detecting radioactivity, when in fact none was present (Type I error) and also, a 5% probability of not detecting radioactivity, when in fact it is present (Type II error).

Nondestructive Assay – A general term for a number of techniques, such as gamma spectroscopy, passive/active neutron measurement, DTC, and calorimetry. These techniques provide information on the radionuclide content of waste and sometimes on its spatial distribution inside containers (Reference 18).

Observable liquid – Liquid that is observable using radiography or VE as specified in Permit Attachment C, Waste Analysis Plan (Reference 10, Part 1, Section 1.5.18).

Overpack – A container put around another container. There are two types of overpacks, those containing damaged inner containers and those containing undamaged inner containers. An undamaged inner container is one that meets the U.S. DOT Specification 7A, Type A, requirements as discussed in Section 3.2.1 of the WAC.

Package – (1) A packaging plus its contents. (2) The reusable Type B shipping container (e.g., TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, or 10-160B), loaded with TRU waste payload containers, which has been prepared for shipment in accordance with the package QA program. (3) In the regulations governing the transportation of radioactive materials, the packaging, together with its radioactive contents, as presented for transport.

Packaging – The reusable Type B shipping container for transport of TRU waste payload containers (e.g., TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, or 10-160B).

Packaging quality assurance program – A WCP document that defines the quality assurance and quality control activities applicable to usage of the NRC-approved packaging. This program shall meet the requirements of 10 CFR Part 71, Subpart H.

Partially compacted waste – Waste that has been mechanically compacted such that the distribution and form of polyethylene in the waste does not exceed 0.646 g/cm^3; i.e., 70% of the theoretical full density of polyethylene (0.923 g/cm^3).

Payload assembly – An assembly of payload containers qualified for transport in a TRUPACT-II, HalfPACT, or 10-160B.

Payload container – The outermost container (e.g., a drum, shielded container, SLB2, SWB, TDOP, or canister) for TRU waste material that is placed in a reusable Type B shipping container (e.g., a TRUPACT-II, TRUPACT-III, HalfPACT, RH-TRU 72-B, or 10-160B) for transport.

PCB bulk product waste – Waste derived from manufactured products containing PCBs in a non-liquid state, at any concentration where the concentration at the time of designation for disposal was ≥ 50 parts per million (ppm) PCBs. PCB bulk product waste does not include PCBs or PCB items regulated for disposal under §761.60(a) through (c), §761.61, §761.63, or §761.64 (References 13 and 40 CFR §761.3).

Pipe overpack – A packaging configuration consisting of a vented cylindrical pipe component surrounded by dunnage within a vented 55-gallon drum with a rigid polyethylene liner and vented lid.

Plutonium-239 equivalent activity – An equivalent radiotoxic hazard of a radionuclide normalized to ^{239}Pu.

Precision – A measure of mutual agreement among individual measurements of the same property made under prescribed similar conditions, often expressed as a standard deviation or relative percent difference.

Pyrophoric – A pyrophoric solid is any solid material, other than one classified as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily, and when ignited burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water reactive materials (10 CFR §61.2).

Radioassay – Methods used to identify and quantify radionuclides in TRU waste. Radioassay includes NDA and RC.

Radiography – A nondestructive testing method that uses X-rays to inspect and determine the physical form of waste.

Radionuclide – A nuclide that emits radiation by spontaneous transformation.

Remote-handled transuranic waste – Transuranic waste with a surface dose equivalent rate of 200 millirem per hour or greater (Reference 2, Section 2[12]).

Remote-handled Transuranic Waste Authorized Methods for Payload Control (RH-TRAMPAC) – The governing document for shipments in the RH-TRU 72-B packaging (Reference 41, Section 1).

RH-TRU Waste Canister (fixed and removable lid) – Container that is transported in the RH-TRU 72-B Cask.

RH-TRU 72-B Packaging – An NRC-certified Type B transportation packaging used for transportation of RH-TRU wastes.

Shielded container – A metal payload container authorized for use within the HalfPACT packaging, that has been tested by the DOE to meet DOT Specification 7A Type A requirements. It is approximately the same size as a standard 55-gallon drum, contains an inner steel drum, and incorporates a nominal one-inch layer of lead lining to shield waste forms with high gamma energies. Although the shielded container is managed during handling, shipment, storage, and disposal as a CH payload container, the waste contained in a shielded container is characterized and inventoried in the WWIS database as RH waste.

Shipper – A TRU waste site that releases an NRC-approved package to a carrier for shipment to the WIPP.

Shipping category – A shipping category is defined by the following parameters: chemical composition of the waste (waste type), gas generation potential of the waste material type (quantified by the g-value for hydrogen), and gas release resistance (type of payload container and type and maximum number of confinement layers used).

Sites – Department of Energy TRU waste generator or storage sites.

Standard large box 2 – A specialized metal payload container with a top-loading and a bottom-loading option for use within the TRUPACT-III packaging, that has been tested by the DOE to meet DOT Specification 7A Type A requirements.

Standard waste box – A metal payload container authorized for use within the TRUPACT-II and HalfPACT packaging, that has been tested by the DOE to meet DOT Specification 7A Type A requirements.

Summary category group – Used to segregate TRU-mixed wastes into broad groups having similar physical forms. The summary category groups include homogeneous solids (S3000) that are at least 50 percent by volume solid process residues, soil/gravel (S4000) that is at least 50 percent by volume soil/gravel, and debris (S5000) that is at least 50 percent by volume materials that meet the criteria specified in 20.4.1.800 NMAC (incorporating 40 CFR §268.2(g)). Categorization is based on the summary category group constituting the greatest volume of waste for a waste stream (Reference 10, Attachment C).

Ten-drum overpack – A metal payload container authorized for use within the TRUPACT-II packaging, that has been tested by the DOE to meet DOT Specification 7A Type A requirements.

Trace chemicals/materials – Chemicals/materials that occur individually in the waste in quantities less than 1 weight percent. The total quantity of chemicals/materials not listed as allowed materials for a given waste material type in any payload container is restricted to less than 5 weight percent (References 24 and 25, Section 4.3.1; Reference 41, Section 4.3.1).

TRU isotope – An isotope of any element having an atomic number greater than uranium (i.e., 92).

TRU waste – Waste containing more than 100 nCi of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years, except for (1) high-level radioactive waste, (2) waste that the Secretary has determined, with the concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations, or (3) waste that the NRC has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61 (Reference 2, Section 2[18]).

TRU-mixed waste – TRU waste that is also a hazardous waste as defined by the Hazardous Waste Act and 20.4.1.200 NMAC (incorporating 40 CFR §261.3) (Reference 10, Part 1, Section 1.5.7).

TRUPACT-II – An NRC-certified Type B transportation packaging used for transportation of CH-TRU wastes.

TRUPACT-III – An NRC-certified Type B transportation packaging used for transportation of CH-TRU wastes in the SLB2 container.

TRUPACT-III Transuranic Waste Authorized Methods for Payload Control (TRUPACT-III TRAMPAC) – The governing document for shipments in the TRUPACT-III packaging (Reference 25, Section 1).

Verification – The act of authenticating or formally asserting the truth that a process, item, data set, or service is, in fact, that which is claimed. Data verification is the process used to confirm that all review and validation procedures have been completed.

Waste Acceptance Criteria – Constraints (limits) on the physical, chemical, and radiological properties of TRU waste and its packaging as determined by the WIPP's authorization basis requirements. TRU waste will not be approved for shipment to and disposal at the WIPP until it has been certified as meeting these criteria. Waste acceptance criteria ensure that TRU waste is managed and disposed of in a manner that protects human health and safety and the environment.

Waste Analysis Plan – The Waste Analysis Plan includes test methods, details of planned waste analysis for complying with the general waste analysis requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.13), a description of the waste shipment screening and verification process, and a description of the QA/QC program. WCPs are required to implement the applicable requirements of the WAP.

Waste certification – Formal and documented declaration by WCPs that waste has been characterized and meets the requirements of the WIPP WAC.

Waste characterization – The process of determining that TRU waste meets the requirements of the WAC by the acceptable performance of the activities defined by the CBFO-approved WCP plans.

Waste matrix code – A DOE-developed coding system for grouping waste streams that have similar matrix constituents, especially for treatment objectives. This coding system allows waste streams within the DOE TRU waste system that have similar physical and chemical waste form properties to be categorized together (Transuranic Waste Baseline Inventory Report, DOE/CAO-95-1121).

Waste stream – A waste stream is waste materials that have common physical form, that contain similar hazardous constituents, and that are generated from a single CH or RH process or activity (Reference 10, Attachment C).

WIPP Certified Program (includes CCP by site and the contractor for the AMWTP)
A program that has undergone initial certification and once per year recertification audits conducted by the CBFO to verify the adequacy of procedures reflecting program requirements (compliance), implementation of the procedures (procedure adherence), and the effectiveness of the procedures (desired result) (Reference 4, Chapter 18, Section 18.4).

WIPP Waste Information System – A computerized data management system used by the WIPP to gather, store, and process information pertaining to CH-TRU and RH-TRU waste destined for or disposed of at the WIPP. The WWIS database is a subsystem of the WDS (Reference 23, Waste Data System Definitions).

Appendix D

Payload Container Integrity Checklist

The operator is to visually examine 100% of the payload container exterior to determine if the payload container meets the criteria of Section 3.2.1. At a minimum, WCPs shall incorporate the questions and criteria contained in the following checklist into applicable procedures. This payload container inspection shall be performed and documented as a part of the loading process. Any "YES" answer on the inspection checklist will result in the operator discontinuing the inspection, marking the payload container as unacceptable for shipment, and removal of the payload container from the shippable inventory. Before the rejected container can be shipped, it must undergo appropriate corrective actions (e.g., evaluation, repackaging, overpacking, etc.), as applicable. All containers must have an acceptable and complete inspection checklist documenting that it meets the DOT 7A criteria.

Table D-1 Payload Container Inspection Checklist (Example)

Container Examination		Discussion of Criteria	Compliance	
			Yes	No
1.	Is the payload container obviously degraded?	Obviously degraded means clearly visible and potentially significant defects in the payload container or payload container surface.		
2.	Is there evidence that the payload container is, or has been, pressurized?	Pressurization can be indicated by a fairly uniform expansion of the sidewalls, bottom or top. Past pressurization can be indicated by a notable outward deflection of the bottom or top. Verify that the payload container is not warped.		
3.	Is there any potentially significant rust or corrosion such that wall thinning, pin holes, or breaches are likely or the load bearing capacity is suspect?	Rust shall be assessed in terms of its type, extent, and location. Pitting, pocking, flaking, or dark coloration characterizes potentially significant rust or corrosion. This includes the extent of the payload container surface area covered, thickness, and if it occurs in large flakes or built-up (caked) areas. Rusted payload containers may not be accepted if: • Rust is present in caked layers or deposits • Rust is present in the form of deep metal flaking, or built-up areas of corrosion products In addition, the location of rust should be noted; for example, on a drum: top lid; filter region; locking chine; top one-third, above the second rolling hoop; middle one-third, between the first and second rolling hoops; bottom one-third, below the second rolling hoop; and on the bottom.		

Container Examination		Discussion of Criteria	Compliance	
			Yes	No
		Payload containers may still be considered acceptable if the signs of rust show up as: • Some discoloration on the payload container • If rubbed would produce fine grit or dust or minor flaking (such that wall thinning does not occur)		
4.	Are any of the following apparent? • wall thinning • pin holes • breaches	Wall thinning, pin holes, and breaches can be a result of rust/corrosion (see discussion for #3).		
5.	Are there any split seams, tears, obvious holes, punctures (of any size), creases, broken welds, or cracks?	Payload containers with obvious leaks, holes or openings, cracks, deep crevices, creases, tears, broken welds, sharp edges or pits, are either breached or on the verge of being breached. Verify that there is no warpage that could cause the container to be unstable or prevent it from fitting properly in the applicable package.		
6.	Is the load-bearing capacity suspect?	The load-bearing capacity could be reduced for excessive rust (see discussion for #3), wall thinning (see discussion for #4), breaches, cracks, creases, broken welds, etc. (see discussion for #5).		
7.	Is the payload container improperly closed?	Inspect the fastener and fastener ring (chine) if applicable for damage or excessive corrosion. Check the alignment of the fastener to ensure that it is in firm contact around the entire lid and the payload container will not open during transportation.		
8.	Are there any dents, scrapes, or scratches that make the payload container's structural integrity questionable or prevent the top and bottom surfaces from being parallel?	Deep gouges, scratches, or abrasions over wide areas are not acceptable. If top and bottom surfaces are not parallel, this would indicate that the container is warped. Dents should be less than ¼ inch deep by 3 inches long and between ½ inch and 6 inches wide. All other dents must be examined to determine impact of structural integrity.		

Container Examination		Discussion of Criteria	Compliance	
			Yes	No
9.	Is there discoloration which would indicate leakage or other evidence of leakage of material from the payload container?	Examine the payload container regions near vents, top lid fittings, bottom fittings, welds, seams, and intersections of one or more metal sheets or plates. Payload containers must be rejected if evidence of leakage is present.		
10.	Is the payload container bulged?	For the purposes of this examination, bulging is indicated by: • A fairly uniform expansion of the sidewalls, bottom, or top (e.g., in the case of a drum, either the top or bottom surface protrudes beyond the planar surface of the top or bottom ring, • A protrusion of the side wall (e.g., in the case of a drum, beyond a line connecting the peaks of the surrounding rolling hoops or a line between a surrounding rolling hoop and the bottom or top ring), or • Expansion of the sidewall (e.g., in the case of a drum, such that it deforms any portion of a rolling hoop).		

REFERENCES

D1. INEEL Engineering Design File. "Waste Container Integrity Evaluation for Storage," EDF-RWMC-705, September 25, 1996. Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID.

D2. Title 49 CFR Part 173, Subpart 475. "Quality Control Requirements Prior to Each Shipment of Class 7 (Radioactive) Materials." *Code of Federal Regulations,* Washington, D.C., Office of the Federal Register, National Archives and Records Administration. (https://www.law.cornell.edu/cfr/text/49/173.475)

D3. DOE/RL-96-57, Section 2.5.5. "Test & Evaluation Document for the U.S. Department of Transportation Specification 7A Type A Packaging." (Formerly WHC-EP-0558). (https://rampac.energy.gov/docs/default-source/default-document-library/doe-rl- 96-57-volume-2-rev-0-d.pdf?sfvrsn=2)

Appendix E

Payload Management of TRU Alpha Activity Concentration

E.1 SCOPE

The policies and methods for the management of TRU alpha activity concentration within each TRU waste payload container disposed of at the WIPP are set out below. They are based on the definition of TRU waste in the WIPP LWA, Public Law 102-579. The WIPP LWA defines TRU waste as:

"…waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years…" (Sec. 2[18])

This appendix pertains specifically to the payload management of TRU alpha activity concentration of waste containers selected for overpacking.

E.2 POLICIES

The National TRU Waste Program has established the following policies for managing TRU alpha activity concentration in compliance with the WIPP LWA (References E1, E2, and E3):

- The TRU alpha activity concentration limit for TRU waste (> 100 nCi/g) applies to the TRU waste stream as a whole.
- Waste containers belonging to a TRU waste stream may vary in their TRU alpha activity concentration, some containing > 100 nCi/g and some containing ≤ 100 nCi/g. Using process knowledge in combination with radioassay measurements to determine the presence of transuranic isotopes within the waste stream, WCPs define a TRU waste stream based on its potential to include waste containers with a TRU alpha activity concentration in excess of 100 nCi/g.
- Waste containers belonging to the same TRU waste stream may be overpacked into a payload container (e.g., SWB or TDOP) provided the TRU alpha activity concentration of the payload container exceeds 100 nCi/g.

E.3 PREREQUISITES FOR IMPLEMENTATION

- Each waste container selected for payload management must be part of the TRU waste stream identified in the AK Summary Report for that waste stream (References E2 and E3).
- WCPs shall submit to the CBFO, for its review and approval, applicable plans and procedures for making TRU waste determinations based on payload management practices that involve the overpacking of waste containers (Reference E2).

- The CBFO will notify the EPA of DOE sites seeking such authorization prior to the CBFO's approval of a WCP to manage TRU alpha activity concentration using payload management. The WIPP will not accept payload managed waste for disposal until the EPA has received notice (Reference E3).

E.4 IMPLEMENTATION AND PRACTICE

- Each TRU waste stream selected for payload management must include in its AK Summary Report an estimate of the total waste volume and the percentage of the waste volume that is above and below 100 nCi/g. (It should be noted that this information, although based on the best available AK information, is preliminary and subject to the performance of WIPP certified radiological characterization processes and cannot and will not be used as a measure of AK accuracy) (Reference E3).

- Each waste container selected for payload management must contain at least one TRU isotope (e.g., ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, etc.) whose activity exceeds the LLD of the radioassay system used to characterize the waste (References E2 and E3). The applicability of LLD will vary from system to system and may be on a container basis. Sections 3.3.1 and A.3 of this document provide the applicable requirements for determining and reporting LLDs.

- Each waste container selected for payload management may only be overpacked into a payload container with other waste containers from the same TRU waste stream.

- The TRU alpha activity concentration of the payload container is determined according to Section 3.3.3 of this document.

E.5 REFERENCES

E1. Public Law 102-579, 106 Stat. 4777, 1992 (as amended by Public Law 104-201, 1996). Waste Isolation Pilot Plant Land Withdrawal Act. (http://www.wipp.energy.gov/library/cra/baselinetool/documents/regulatory%20tools/10%20WIPPLWA1996.pdf)

E2. Letter to Mr. Frank Marcinowski (Director, Office of Radiation and Indoor Air, U.S. Environmental Protection Agency) from Dr. Ines R. Triay (Manager, Carlsbad Field Office, U.S. Department of Energy), August 4, 2003.

E3. Letter to Dr. Ines R. Triay (Manager, Carlsbad Field Office, U.S. Department of Energy) from Mr. Frank Marcinowski (Director, Office of Radiation and Indoor Air, U.S. Environmental Protection Agency), August 8, 2003.

Appendix F

Radiography Requirements for Transuranic Waste for EPA Compliance

F.1 RADIOGRAPHY REQUIREMENTS FOR TRU WASTE

Radiography aids in the examination and identification of containerized waste. All activities required to achieve radiography objectives shall be described in WCP documents. These documents shall include instructions specific to the radiography systems used at the DOE site. This appendix applies to radiography of TRU waste, including both CH-TRU and RH-TRU waste.

A radiography system (e.g., real-time radiography or digital radiography/computed tomography) normally consists of an X-ray producing device, an imaging system, an enclosure for radiation protection, a waste container handling system, an audio/video recording system, and an operator control and data acquisition station. Although these six components are required, it is expected there will be some variation within a given component between DOE sites. The radiography system shall have controls or an equivalent process which allow the operator to control image quality. On some radiography systems, it should be possible to vary the voltage to provide an optimum degree of penetration through the waste.

To perform radiography, the waste container is scanned while the operator views the video monitor. An audio/video recording shall be made of the waste container scan and is maintained as a non-permanent record. An approved radiography data form shall also be completed to document the summary category group and waste matrix code (WMC), to verify there are no prohibited items, including observable liquid in excess of the waste acceptance criteria limit, and to identify waste components, including packaging materials, for the purposes of assigning waste material parameters to the container's contents.

An inventory of waste items and packaging materials is compiled, and the items on the inventory are sorted and combined by waste material parameter. For CH-TRU waste, the estimated waste material parameter weights should be determined using the inventory in combination with a standard weight look-up table and reported to the WWIS database. For RH-TRU waste, waste material parameter weight estimates are not required.

Containers whose contents prevent full examination during radiography shall be subject to VE. If AK for the waste stream suggests that VE would provide no additional relevant information for that container, the reason(s) for the inability to perform full identification shall be recorded on the radiography data form with the supporting AK referenced.

For containers which contain classified shapes and undergo radiography, the radiography recording shall be considered classified information. The radiography data forms will not contain classified information.

Existing radiography data collected prior to the implementation of a quality assurance program pursuant to 40 CFR §194.22(a)(1) may only be qualified in accordance with an alternate methodology that is approved by the CBFO and employs one or more of the methods described in Section 4.1 (Waste Characterization Quality Assurance Requirements).

F.2 RADIOGRAPHY TRAINING

The radiography system involves qualitative and semiquantitative evaluations of visual displays. Operator training and experience are the most important considerations for assuring quality controls in regard to the operation of the radiography system and for interpretation and disposition of radiography results. Only trained and qualified radiography operators shall be allowed to operate radiography equipment.

Standardized training and qualification requirements for radiography operators shall be based upon existing industry standard training requirements and shall comply with the training and qualification requirements of this waste acceptance criteria document and the CBFO QAPD.

The WCP shall develop a training program that provides radiography operators with both formal and on-the-job training (OJT). At each TRU waste site, the WCP radiography operators shall be instructed in the AK description of TRU waste, specific waste generating practices, typical packaging configurations, and associated waste material parameters expected to be found in each WMC at the DOE site. The OJT and apprenticeship shall be conducted by an experienced, qualified radiography operator prior to qualification of the training candidate. The WCP training programs shall be site-specific due to differences in equipment, waste configurations, and the level of waste characterization efforts. For example, certain DOE sites use digital radiography equipment, which is more sensitive than real-time radiography equipment. In addition, the particular physical forms and packaging configurations at each DOE site will vary; therefore, radiography operators shall be trained on the types of waste that are generated, stored, or characterized at that particular DOE site.

The training program shall contain the following elements:

- Project Requirements
- State and Federal Regulations
- Basic Principles of Radiography
- Radiographic Image Quality
- Radiographic Scanning Techniques
- Application Techniques
- Radiography of Waste Forms
- Standards, Codes, and Procedures for Radiography
- Site-Specific Instruction

The training program shall also contain OJT, which addresses:

- System Operation
- Identification of Packaging Configurations
- Identification of Waste Material Parameters
- Weight and Volume Estimation
- Identification of Prohibited Items

Radiography training containers shall contain items common to waste streams currently or expected to be characterized at the DOE site.

Radiography training containers will be examined using the same processes and procedures as those used for examining TRU and TRU-mixed waste. The procedures may be modified as necessary to allow use with the training containers. The examination criteria for training containers will be the same as for actual waste containers. The pass/fail criteria for the examination will be consistent with the original qualification criteria. Contents of the training containers will reflect the waste stream description of one or more of the waste streams currently or expected to be examined at the DOE site. Training containers will be reconfigured prior to being examined. Training container examinations shall be performed by each operator semiannually (approximately every six months).

The audio/video recording and data form shall then be reviewed by a subject matter expert (SME) or real-time radiography supervisor to ensure that operators' interpretations remain consistent and accurate. Imaging system characteristics shall be verified on a routine basis.

Qualifications of radiography operators shall, at a minimum, encompass the following requirements:

- Successfully pass a comprehensive exam with a score of 80% or greater based upon training enabling objectives. The comprehensive exam will address all of the radiography operations, documentation, characterization, and procedural elements stipulated in this WAC.

- Perform a training container examination in the presence of an appointed WCP radiography SME. The person will be an experienced radiography operator who is also qualified as an OJT trainer.

Requalifications of operators are based on evidence of continued satisfactory performance (primarily SME or audio/video recording reviews), and shall be done at least every two years. Unsatisfactory performance will result in disqualification. Satisfactory operator performance is defined as the acceptable identification of prohibited items, including observable liquid in excess of the waste acceptance criteria limit, the estimation of waste material parameter weights as evaluated by the SME, and a score of $\geq$ 80% on the comprehensive written exam. Retraining and demonstration of satisfactory performance are required before a disqualified operator is again allowed to operate the radiography system.

In summary, the operator qualification process is as follows:

- Initial qualification
  - Includes formal and OJT training. An SME will provide oversight of the OJT and apprenticeship to ensure satisfactory knowledge and practical performance.
  - Successful examination of a training container in the presence of an SME.
  - Successfully pass a comprehensive written exam with a score of 80% or greater.
- Semiannual continuing education refresher training
  - Successful examination of a training container in the presence of an SME or an audio/video recording review by a supervisor.
- Biennial requalification (every two years)
  - Successful examination of a training container in the presence of an SME or an audio/video recording review by a supervisor.
  - Successfully pass a comprehensive written exam with a score of 80% or greater.

Successful examination of a training container is defined as the acceptable verification of the WMC and identification of prohibited items, including observable liquid in excess of waste acceptance criteria limits, the assignment of waste items to waste material parameters, and their estimated weights, as evaluated by a radiography SME.

F.3 QUALITY CONTROL

Independent replicate scans and replicate observations of the video output of the radiography process shall be performed under uniform conditions and procedures. Independent replicate scans shall be performed on one waste container per day or once per testing batch, whichever is less frequent. Independent observation of one scan (not the replicate scan) shall be made once per day or once per testing batch, whichever is less frequent. The replicate scan and the independent observation scan must be performed by a qualified radiography operator other than the individual who performed the first examination. A testing batch is a suite of waste containers undergoing radiography using the same testing equipment. A testing batch can be up to 20 waste containers without regard to waste matrix.

Oversight functions include periodic audio/video recording reviews of accepted waste containers by a qualified radiography operator other than the operator who dispositioned the waste container. The results of this independent verification shall be made available to the radiography operator.

F.4 DATA REVIEW AND VALIDATION

A testing batch data report for data validation and QA purposes is required when radiography is used to characterize waste. A testing batch data report (or equivalent) includes data pertaining to radiography for up to 20 waste containers or samples.

All measurement data must be reviewed and approved by qualified personnel prior to being reported. Reviews shall meet the requirements of the CBFO QAPD. At a minimum, the data must be reviewed by an independent technical reviewer and approved by the SPM. This review shall be performed by an individual other than the data generator who is qualified to have performed the initial work. The independent technical reviewer shall verify, at a minimum, the following information:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used (verification of procedure and revision).
- Data were reported in the proper units and correct number of significant figures.
- Calculations have been verified by a valid calculation program, a spot check of verified calculation programs, and/or 100 percent check of all hand calculations.
- Values that are not verifiable to within rounding or significant difference discrepancies must be rectified prior to completion of independent technical review.
- The data have been reviewed for transcription errors.
- The testing QA documentation for batch data reports is complete and includes, as applicable, raw data, calculation records, calibration records (or references to an available calibration package), list of containers in the batch, and QC sample results. Corrective action will be taken to ensure that all batch data reports are complete and include all necessary raw data prior to completion of the independent technical review.
- QC sample results are within established control limits and, if not, the data have been appropriately dispositioned using the nonconformance process.
- Radiography tapes have been reviewed (independent observation) on a waste container basis at a minimum of once per testing batch or once per day of operation, whichever is less frequent.

- There is no indication of prohibited items in the container, including observable liquid in excess of the waste acceptance criteria limit, and the physical form matches the WMC.

- The appropriate QAOs have been met as defined in the Permit (Reference 10, Attachment C3-2a).

All data must be approved by the SPM. The SPM shall verify, at a minimum, the following information:

- Data generation-level independent technical review, validation, and verification have been performed as evidenced by the completed review checklists and appropriate signature release. Batch data review checklists are complete.

- Batch data reports are complete and data are properly reported (e.g., data are reported in the correct units and with the correct number of significant figures).

- Data meet all applicable QAOs.

The SPM shall provide a SPM Summary and a Data Validation Summary for each batch data report. These reports may be combined and shall consist of a detailed checklist documenting that the batch has been adequately reviewed and that the data meet program objectives.

To ensure that data of known and documented quality are generated, each participating measurement facility shall implement a documented facility QA program. Facility QA programs shall specify qualitative and quantitative acceptance criteria for the QC checks of this program, and corrective actions to be taken when these criteria are not satisfied. Only appropriately trained and qualified personnel shall be allowed to perform data validation/review.

Appendix G

Visual Examination Requirements for Transuranic Waste for EPA Compliance

G.1 VISUAL EXAMINATION REQUIREMENTS FOR TRU WASTE

This appendix applies to VE requirements for TRU waste, including both CH-TRU and RH-TRU waste.

TRU waste container contents may be verified directly by performing VE on the waste container contents. The VE may also be performed during packaging or repackaging of waste.

The VE does not require audio/video recordings of the examination if the VE is documented on a data form and certified with signatures from two qualified VE operators. If the second operator cannot verify the descriptions of the first operator, corrective actions will be taken in accordance with the established QA program.

The results of VE shall be documented on VE data forms and reported to the WWIS database. The VE shall confirm that the physical form of the waste stream is consistent with the assigned AK summary category group of either S3000 (homogeneous solids), S4000 (soils and gravel), or S5000 (debris). The VE shall describe all contents of a waste container by clearly identifying all discernible waste items, packing materials, and waste material parameters in the waste container. Estimated or measured weights of the identified contents shall be determined for CH-TRU waste. For RH-TRU waste, however, Section 3.4.3 of the WAC specifies an alternate methodology for estimating and reporting weights of the physical form to the WWIS database.

The VE video/audio recordings of containers that contain classified shapes shall be considered classified information. The VE data forms will not contain classified information.

Existing VE data collected prior to the implementation of a quality assurance program pursuant to 40 CFR §194.22(a)(1) may only be qualified in accordance with an alternate methodology that is approved by the CBFO and employs one or more of the methods described in Section 4.1 (Waste Characterization Quality Assurance Requirements).

G.2 VISUAL EXAMINATION TRAINING

The VE shall consist of a semiquantitative and qualitative evaluation of the waste container contents and may be recorded on audio/video recording media. Standardized training for VE shall be developed to include both formal classroom training and OJT. Personnel performing VE shall be instructed in the specific waste generating processes, typical packaging configurations, and the waste material parameters expected to be found in each WMC at the DOE site. The OJT and apprenticeship shall be conducted by an operator experienced and qualified in VE prior to qualification of the candidate. The WCP training shall be site-specific to include the various waste configurations at the DOE site. For example, the particular physical forms and packaging configurations at each DOE site will vary, so operators shall be trained on types of waste that are generated, stored, or characterized at that particular DOE site. The VE operators need only be trained to the physical forms and packaging configurations used on the waste stream that they are examining and packaging. The VE personnel shall be requalified once every two years.

Training shall address the following required elements:

- Project Requirements
- State and Federal Regulations
- Application Techniques
- Site-Specific Instruction

Training shall also include OJT that addresses:

- Identification of Packaging Configurations
- Identification of Waste Material Parameters
- Weight and Volume Estimation
- Identification of Prohibited Items, including Observable Liquid in Excess of the Waste Acceptance Criteria Limit

Each VE facility shall designate one or more VE experts. The VE expert shall be familiar with the waste generating processes that have taken place at the DOE site and will also be familiar with all types of waste being characterized at that site. The VE expert shall be responsible for the overall direction and implementation of the VE at that facility. The VE expert shall receive training in the same elements as the VE personnel, including both formal training and OJT. Qualification of a VE expert shall be based on familiarity with waste generating processes, familiarity with the types of waste being characterized, and meeting the training requirements discussed above. Consistent with other VE personnel, the VE expert shall be requalified once every two years. WCP documents shall specify the selection, qualification, and training requirements for the VE expert.

G.3 METHOD

The VE recorded on video/audio media shall meet the following minimum requirements:

- The video/audio media shall record the waste packaging event for the container such that all waste items placed into the container are recorded in sufficient detail and shall contain an inventory of waste items in sufficient detail that another trained VE operator can identify the associated waste material parameters.

- The video/audio media shall capture the waste container identification number.

- The personnel loading the waste container shall be identified on the video/audio media or on packaging records traceable to the loading of the waste container.

- The date of loading of the waste container will be recorded on the video/audio media or on packaging records traceable to the loading of the waste container.

The VE performed using two operators shall meet the following minimum requirements:

- At least two WCP personnel who witnessed the packaging of the waste shall approve the data forms or packaging records attesting to the contents of the waste container.
- The data forms or packaging records shall contain an inventory of waste items in sufficient detail that a trained VE operator can identify the associated waste material parameters.
- The container identification number shall be recorded on the data forms or packaging records.

A description of the waste container contents shall be recorded on a VE data form. The description shall clearly identify all waste material parameters and provide enough information to estimate weights of waste material parameters. In cases where bags are not opened, a brief written description of the contents of the bags shall contain an estimate of the amount of each waste type in the bags. The written records of VE shall be supplemented with the audio/videotape recording, if applicable.

In some instances, RH-TRU waste will be contained in opaque containers and not all items will be visible to the operator (e.g., sealed paint cans or 5-gallon buckets). If these containers are not opened during VE, source documents must be available in the AK record that allow the operator to identify the contents of the closed containers.

G.4 DATA REVIEW AND VALIDATION

A testing batch data report for data validation and QA purposes is required when VE is used to characterize waste. A testing batch data report (or equivalent) includes data pertaining to VE for up to 20 waste containers or samples.

All measurement data must be reviewed and approved by qualified personnel prior to being reported. Reviews shall meet the requirements of the CBFO QAPD. At a minimum, the data must be reviewed by an independent technical reviewer and approved by the SPM. This review shall be performed by an individual other than the data generator who is qualified to have performed the initial work. The independent technical reviewer shall verify, at a minimum, the following information:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used (verification of procedure and revision).
- Data were reported in the proper units and correct number of significant figures.
- Calculations have been verified by a valid calculation program, a spot check of verified calculation programs, and/or 100 percent check of all hand calculations.

- Values that are not verifiable to within rounding or significant difference discrepancies must be rectified prior to completion of independent technical review.

- The data have been reviewed for transcription errors.

- The testing QA documentation for batch data reports is complete and includes, as applicable, raw data, calculation records, and list of containers in the batch. Corrective action will be taken to ensure that all batch data reports are complete and include all necessary raw data prior to completion of the independent technical review.

- There is no indication of prohibited items in the container, including observable liquid in excess of the waste acceptance criteria limit, and the physical form of the waste matches the WMC.

- The appropriate QAOs have been met as defined in the Permit (Reference 10, Attachment C3-2b).

All data must be approved by the SPM. The SPM shall verify, at a minimum, the following information:

- Data generation-level independent technical review, validation, and verification have been performed as evidenced by the completed review checklists and appropriate signature release. Batch data review checklists are complete.

- Batch data reports are complete and data are properly reported (e.g., data are reported in the correct units and with the correct number of significant figures).

- Data meet all applicable QAOs.

The SPM shall provide a SPM Summary and a Data Validation Summary for each batch data report. These reports may be combined and shall consist of a detailed checklist documenting that the batch has been adequately reviewed and that the data meet program objectives.

To ensure that data of known and documented quality are generated, each participating measurement facility shall implement a documented facility QA program. Facility QA programs shall specify qualitative and quantitative acceptance criteria for the QC checks of this program, and corrective actions to be taken when these criteria are not satisfied. Only appropriately trained and qualified personnel shall be allowed to perform data validation/review.

Appendix H

Enhanced Acceptable Knowledge

H.1 INTRODUCTION

After the 2014 radiological release event, several new activities and process enhancements were established. One of these enhancements was to provide additional controls over the collection, verification, and validation of AK, thus resulting in a more robust AK program referred to as Enhanced Acceptable Knowledge (Reference 4, Chapter 18.4.2.1). Use of these newly established controls by the WCPs is expected to ensure the receipt of WIPP WAC compliant waste containers.

H.2 INTERFACE WASTE MANAGEMENT DOCUMENTS LIST (IWMDL)

The IWMDL is a part of the Enhanced Acceptable Knowledge processes to be performed to ensure that the AK documentation is adequate, current, and accurately reflects the waste stream description in the AK Summary Report relating to waste management. The IWMDL is used to assess active waste management practices for containers currently being generated or repackaged by assessing on-going packaging, repackaging, and remediation activities. Containers packaged prior to the implementation of an IWMDL shall be assessed using the acceptable knowledge assessment (AKA) process described in H.5.

The purpose of IWMDL process is to identify generator documents associated with current TRU waste management and packaging to be reviewed before TRU waste stream payload containers are added to an active, proposed, or preliminary waste stream. The IWMDL assessment must include:

- Collection, review, and compilation of the list (IWMDL) of the generator site procedures, plans, and reports controlling waste management, waste generation, waste treatment, waste packaging, waste repackaging, waste remediation, waste stream delineation, and waste characterization (e.g., inspection and testing) activities for each TRU waste stream.

- Establishment of lines of communication with generator points of contact and/or SMEs directly involved with the generation, characterization, and management activities for each waste stream.

- Review and maintenance of the IWMDL to include any new or revised documents. The IWMDL, including changes to the list, will be approved by the WCP. Changes to procedures on the list will be evaluated by the WCP.

- Verification of the procedures that affect waste management and packaging related to the physical and chemical composition of waste stream containers.

Procedure verification will include the review of waste management and packaging activities performed under the procedures listed on the IWMDL. Verification of a procedure (both for the initial procedure and subsequent revisions) is to ensure an understanding of the implementation of procedural steps/processes which can potentially affect the physical and chemical properties of the waste (i.e., compatibility, reactivity, ignitability, or corrosivity). This verification shall be done by one or more of the following methods, as appropriate: observation of implementation, table top review, a cold run review of applicable procedural steps, briefings and/or discussions with SMEs/operators, or something deemed equivalent to these methods of verification. The verification must be clearly documented, as well as any equivalent method justifications. Subsequent revisions to documents on the list will be reviewed by the AK expert prior to adding affected containers to the waste stream.

H.3 CERTIFIED PROGRAM ENHANCED CHEMICAL COMPATIBILITY EVALUATION

As part of the process for characterizing and certifying TRU waste for disposal at the WIPP, it is necessary to consider the range of possible chemical combinations that could occur in each waste stream. Potential adverse chemical reactions (e.g., generation of heat, fire, explosion, or toxic fumes) that stem from combining potentially incompatible chemicals must be evaluated to support safe and compliant waste management. To expand upon this evaluation, chemical compatibility has been enhanced to require formal documentation and generation of a chemical compatibility evaluation (CCE) for the waste stream, or sub-population of the waste stream, as needed. The CCEs are documented by the WCPs using procedural requirements based on the method described in the 1980 EPA method EPA-600/2-80-076, “A Method for Determining the Compatibility of Hazardous Wastes” (EPA Method). The CCE will document and communicate the evaluation including the conclusions. Chemical compatibility evaluations concluding the potential for chemical incompatibility will provide the basis for placing an administrative hold on the affected waste via issuance of a nonconformance report. Those CCEs concluding the potential for chemical incompatibility are provided to the CBFO for information only. The CCEs concluding that the waste is acceptable are provided to the CBFO for formal review and approval.

The following methodology shall be applied to determine the chemical compatibility of the constituents in the waste stream:

- Chemical/material quantity estimations are based on a review of the AK source documents collected and are conservative approximations. A qualitative evaluation, based on the use of the given chemical/material as described in the AK source documents, is made in the absence of quantitative information (e.g., analytical data, mass balance information, procedural recipes). When the available AK data are inconclusive, the more conservative quantity is assigned.

- A determination of which “trace” chemicals and materials are present in insignificant quantities.

- Based on the specific chemicals/materials use and management described in the AK record, assess the “trace” chemicals/materials to determine those that are insignificant and do not require additional evaluation and document the justification and assumptions for this determination in the CCE. The justification(s) for this determination for each chemical and material may include, but are not limited to, the following examples:

- Chemicals/materials included only in historical waste already emplaced at the WIPP.
- Chemicals/materials that have been segregated from the waste stream resulting in only incidental insignificant contamination.
- Process chemicals and products introduced in such minute quantities (e.g., drops of indicators and dilute analytical standard solutions) that they would result in only insignificant waste contamination.
- Chemicals present in the waste stream in low ppm concentrations based on analytical or other characterization data.
- Process chemicals that are reacted or consumed during use (e.g., experiment oxidants, reductants, and buffers). The AK expert must consider the use of excess reagents in these instances.

- Assignment of Reactivity Group Numbers (RGNs) to chemicals and materials of concern will be coordinated with the Payload Engineer Team responsible for RGN assignment during TRUCON code development. The Payload Engineer Team is responsible for maintaining the List of RGNs for Chemicals/Materials in the TRU Waste Inventory (Master RGN List). The Master RGN List will be updated as chemicals and materials are evaluated during the development of the CCEs.
- The primary focus of this evaluation is to assess potential reactions between dominant and minor constituents. However, some trace components could produce significant exothermic reactions, even in small quantities, without the proper actions being taken to mitigate the hazards associated with these compounds. For this reason, all trace chemicals that could not be determined to be insignificant must be evaluated for compatibility regardless of concentration.
- For compound(s) that cannot be found in the EPA Method, coordination with the Payload Engineer Team to assign the most appropriate RGN(s) based on its chemical class (functional group) or reactive properties based on review of chemical literature, material safety data sheets (MSDSs), safety data sheets (SDSs), or industry documentation and reports is required.
- For inorganic chemicals or materials determined to be non-reactive compounds that are not listed in the EPA Method or in the Master RGN List, the RGNs will be determined to be not applicable (NA) and the justification for this determination must be documented in the CCE.

- For purposes of the CCE, “incompatible” refers to chemicals and materials that when mixed can lead to adverse hazardous chemical reactions described in 40 CFR 264.17(b) (General Requirements for Ignitable, Reactive, or Incompatible Wastes) and the 1980 EPA method. Thus, compatible chemicals and materials (including those referred to as non-reactive in this evaluation) may react slowly over time, and even generate heat, but will not lead to unanticipated or disastrous effects such as (1) generate extreme heat or pressure, fire or explosions, or violent reactions; (2) produce uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health or the environment; (3) produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosions; (4) damage the structural integrity of the device or facility; (5) through other like means threaten human health or the environment.

H.4 BASIS OF KNOWLEDGE FOR EVALUATING OXIDIZING CHEMICALS IN TRU WASTE

The BoK document (DOE/WIPP-17-3589) has been provided by the CBFO and shall be implemented in conjunction with the AK procedures of the WCPs. The BoK document specifies when waste with oxidizing chemicals is acceptable as is, or when treatment will be required, along with the treatment that must be performed.

H.5 CERTIFIED PROGRAM ACCEPTABLE KNOWLEDGE ASSESSMENTS

To ensure that the AK documentation relating to the management of potentially reactive, corrosive, ignitable, and incompatible TRU waste materials is adequate, current, and accurately described in existing AK Summary Reports, AKAs will be performed for waste containers packaged and/or waste stream containers to be characterized prior to the implementation of the IWMDL (see Figure H-1 titled “Combined AKA and IWMDL Flow Chart”). New AK Summary Reports and the supporting documentation must address all of the evaluation parameters described in this section or an AKA must be performed and include:

- The review of the existing AK documentation associated with the historic and current waste management activities up to the implementation of the IWMDL relating specifically to TRU waste generation, packaging, treatment, remediation, and characterization, focusing on the use of absorbents, immobilization products, and neutralization reagents for the waste stream.

- The review of existing AK for the special testing and management activities associated with suspect materials included in each waste stream.

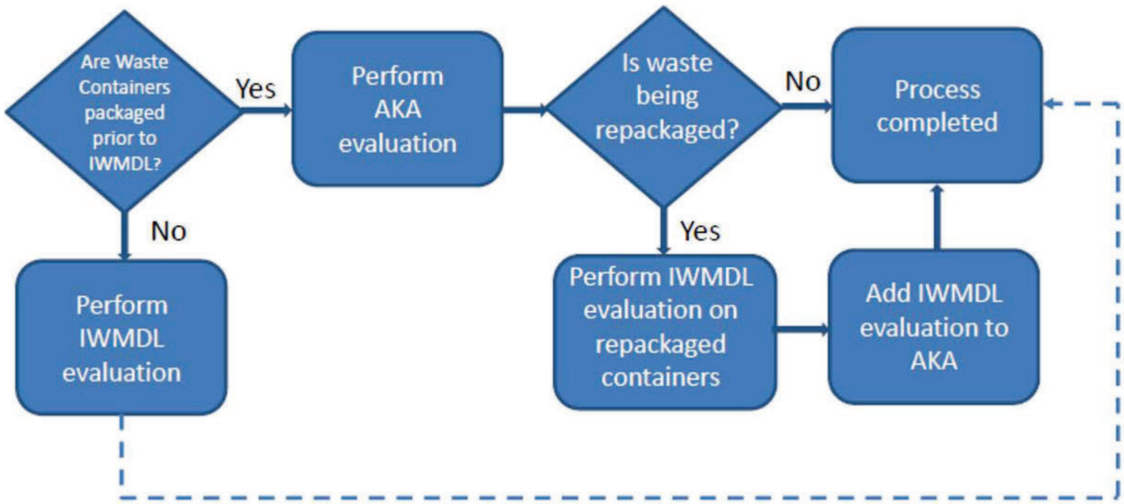
- An assessment of revisions of waste management and packaging procedures bounded by the inventory to identify any relevant changes associated with these activities described in the AK Summary Report.

- The AKA document includes the following, as applicable:

  - AK records associated with commercial products used (e.g., MSDSs, SDSs, and other manufacturer's information),
  - Waste stream summary (brief description of the waste stream and generating activities),
  - Historic waste management practices,
  - Current waste management practices,
  - Waste remediation and repackaging practices,
  - Absorbent, immobilization, and neutralization reagents,
  - Container-specific documentation collected and reviewed,
  - New and revised AK source documents,
  - AKA conclusions, assumptions, and limitations, and
  - List of containers bounded by the evaluation.

- The AKA will be reviewed by the CCP Management Representative or designated generator site Points of Contact or SMEs for the accuracy and completeness of practices and procedures under their purview controlling the generation and management (e.g., waste repackaging, remediation, treatment) of the subject waste containers described by the AKA.

Figure H-1 Combined AKA and IWMDL Flow Chart



H.6 AK BRIEFINGS

AK briefing updates by the AK expert and/or SPM to waste management personnel and operators involved in the generation, treatment, remediation, characterization (physical, chemical, and/or radiological properties), or packaging of waste are required by Paragraph 31 of the Settlement Agreement and Stipulated Final Order, dated January 22, 2016, HWB 14-21 [CO], March 18, 2016. These briefing updates are required after the issuing or changing of AK Summary Reports or Item Description Codes.

Appendix I

Certified Waste Pre-Shipment Compliance Actions

All currently certified waste containers in the complex, as well as those containers continuing to be certified, will undergo the following prior to shipment:

- Certified Programs will implement an enhanced AK process, including an enhanced CCE for the waste streams or waste stream sub-populations, and submit to the CBFO for review.
- Certified Programs will implement the BoK document in the AK process for evaluating oxidizing chemicals in TRU waste streams to determine acceptability or need for treatment.
- The CBFO will concur with enhanced CCE and implementation of the BoK for the evaluated waste stream.
- The CBFO will approve waste streams with acceptable enhanced CCE documentation provided by the WIPP Certified Programs.
- The WIPP M&O Contractor Payload Engineers will evaluate TRUCON codes to ensure compliance with the enhanced CCE.
- The WIPP M&O Contractor will implement an additional check in the WDS verifying enhanced AK data have been collected for each payload container before shipment.
- The WIPP M&O Contractor will obtain written approval from the CBFO prior to release of waste streams for shipment.
- The WIPP M&O Contractor will verify each container requested is part of a CBFO-approved waste stream and authorizes shipment in WDS.