DOE/WIPP-069

WASTE ACCEPTANCE CRITERIA FOR THE WASTE ISOLATION PILOT PLANT

Revision 7

November 8, 1999

U.S. Department of Energy
Carlsbad Area Office

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This document supersedes draft revision 6 of DOE/WIPP-069

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Revision 7

November 8, 1999

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CHANGE HISTORY

DOE/WIPP-069, Revision 7, November 1999

Revision 7 of the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* supersedes draft revision 6 and differs significantly from it. Draft revision 6 was prepared to align with revision 1 of the *Transuranic Waste Characterization Quality Assurance Program Plan* (QAPP). With the recent issuance of the Hazardous Waste Facility Permit by the New Mexico Environment Department (NMED), it was decided to cancel the QAPP and have the generator/storage sites work directly with the Waste Analysis Plan (WAP) of the permit. This decision effectively voided revision 6 of the WAC.

Because the Waste Isolation Pilot Plant (WIPP) is presently not permitted by NMED to dispose of remote-handled (RH) transuranic (TRU) waste, this WAC covers contact-handled (CH)-TRU waste only. An RH Waste Analysis Plan (WAP) and associated RH-WAC addressing this type of waste are being prepared by the Carlsbad Area Office (CAO) and will be issued as separate documents. In addition, a companion document to this CH-WAC is also being prepared to provide guidance to the sites about how to demonstrate compliance.

Major changes to the WAC are as follows:

- All references to RH-TRU waste acceptance criteria for transportation and disposal have been deleted; hence, all waste acceptance criteria addressed in this document are specific to CH-TRU waste.

- All references to the QAPP have been deleted.

- The CH-WAC has been modified, as necessary, to reflect the language contained in the WIPP Final Hazardous Waste Permit issued by the NMED.

- Transuranic Package Transporter Model II (TRUPACT-II) requirements are summarized as transportation safety requirements. These requirements have been updated to align with changes in the Safety Analysis Report for the TRUPACT-II Shipping Package (TRUPACT-II SARP), revision 17.

- The TRU Waste Certification Statement has been removed.

- A new subsection entitled "Radionuclide Composition" has been added to the Radiological Properties sections. "Thermal Power Criteria" has been deleted from the Radiological Properties section and the 10 kW per acre repository limit has been consolidated into the Decay Heat subsections.

- The TRUPACT-II Payload Container and the Payload Assembly Transportation Certification Documents have been removed from the CH-WAC. Refer to the TRUPACT-II SARP for examples of these documents and instructions for their completion.

- The summary table has been reformatted and relocated to section 3.1.

- The WIPP Waste Information System (WWIS) Data Dictionary has been removed. Refer to the WWIS User's Manual for an updated data dictionary and additional details regarding data input.

- The format of section 3 has been changed. The “Environmental Compliance Requirements” subsection has been subdivided into the “WIPP Hazardous Waste Facility Permit Requirements”, the “Compliance Certification Decision Requirements”, and the “Land Withdrawal Act (LWA) Requirements.” Applicable “acceptance criteria” are identified, and a brief description of the "compliance methods" is provided in table 3.1.

- The use of alternative shipping category notation for payload container transport has been incorporated. A method for mixing payload containers of different shipping categories within a single TRUPACT-II has been incorporated. Refer to section 3.6.1.

- A new appendix to address the requirements for radioassay has been added.

- The Waste Stream Profile Form and the instructions for its completion have been removed. Refer to the WAP in the final Hazardous Waste Facility Permit for a copy of the form.

- PE-Ci limits for 55-gallon drums overpacked in an SWB or a TDOP have been lowered to 1,100 PE-Ci.

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LIST OF ACRONYMS AND ABBREVIATIONS

AEA	Atomic Energy Act
AK	acceptable knowledge
AMAD	activity median aerodynamic diameter
ASTM	American Society for Testing and Materials
CAO	Carlsbad Area Office
CCA	*Compliance Certification Application*
CFR	*Code of Federal Regulations*
CH	contact-handled (waste)
CH-WAC	contact-handled waste acceptance criteria
CPR	cellulose, plastic, and rubber
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FGE	fissile gram equivalent
ICP-MS	inductively coupled plasma–mass spectrometry
LCS	laboratory control sample
LDR	Land Disposal Restriction
LWA	Land Withdrawal Act
MOC	management and operating contractor
MS	matrix spike
MSD	matrix spike duplicate
nCi/g	nanocuries per gram
NDA	nondestructive assay
NIST	National Institute of Standards and Technology
NMED	New Mexico Environment Department
NRC	U.S. Nuclear Regulatory Commission
NTWP	National Transuranic Waste Program
PATCD	Payload Assembly Transportation Certification Document
PCB	polychlorinated biphenyl
PCTCD	Payload Container Transportation Certification Document
PDP	performance demonstration program
PE-Ci	plutonium-239 equivalent curies

QA	quality assurance
QAO	quality assurance objective
QAPD	*Quality Assurance Program Document*
QAPjP	quality assurance project plan
QAPP	*TRU Waste Characterization Quality Assurance Program Plan*
QC	quality control
RC	radiochemistry
RCRA	Resource Conservation and Recovery Act
RH	remote-handled (waste)
%R	percent recovery
RPD	relative percent difference
RSD	relative standard deviation
SAR	*Waste Isolation Pilot Plant Safety Analysis Report*
SARP	*Safety Analysis Report for the TRUPACT-II Shipping Package*
SWB	standard waste box
TDOP	ten-drum overpack
TMU	total measurement uncertainty
TRAMPAC	*TRUPACT-II Authorized Methods for Payload Control*
TRU	transuranic
TRUCON	TRUPACT-II content (codes)
TRUPACT-II	Transuranic Package Transporter-Model II
UHWM	uniform hazardous waste manifest
VOC	volatile organic compound
WAP	Waste Analysis Plan
WIPP	Waste Isolation Pilot Plant
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 that contact-handled transuranic (CH-TRU) waste must meet before it can be transported to and managed and disposed of at the Waste Isolation Pilot Plant (WIPP). These criteria serve as the U.S. Department of Energy's (DOE) primary directive for ensuring that TRU waste is managed and disposed of in a manner that protects worker and public health and safety and the environment.

The authorization basis of WIPP includes the U.S. Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act (reference 1) and the Land Withdrawal Act (LWA; reference 2). Included in this document are the requirements and associated criteria imposed by these acts, as well as the Resource Conservation and Recovery Act (RCRA), on the TRU waste destined for disposal at WIPP.

The DOE TRU waste sites must certify all TRU waste containers to the criteria identified in this CH-WAC. As shown in figure 1.0, the flow-down of applicable requirements to the CH-WAC is traceable to several higher-tier documents, including the WIPP operational safety requirements derived from the WIPP Technical Safety Requirements (reference 3) and the WIPP Safety Analysis Report (reference 4), the transportation requirements for CH-TRU wastes derived from the Safety Analysis Report for the TRUPACT-II Shipping Package (TRUPACT-II SARP; reference 5), the WIPP LWA (reference 2), the WIPP Hazardous Waste Facility Permit (reference 6), and the Title 40 Code of Federal Regulations (CFR) § 191/194 compliance certification decision (reference 7). The solid arrows shown in figure 1.0 represent the flow-down of all applicable container-based requirements. The two dotted arrows shown in figure 1.0 represent the flow-down of summary level requirements only; i.e., the sites must reference the regulatory source documents from the U.S. Nuclear Regulatory Commission (NRC) and the New Mexico Environment Department (NMED) for a comprehensive and detailed listing of the requirements.

This CH-WAC does not address the subject of waste characterization relating to a determination of whether the waste is hazardous; rather, the sites are referred to the WAP contained in the WIPP Hazardous Waste Facility Permit for details of the sampling and analysis protocols to be used in determining the physical and chemical properties of the waste. Requirements and associated criteria pertaining to a determination of the radiological properties of the waste, however, are addressed in appendix A of this document. The collective information obtained from waste characterization records and acceptable knowledge (AK) documentation serves as the basis for sites to certify that their TRU waste satisfies the WIPP waste acceptance criteria listed herein. This CH-WAC does address the characterization requirements associated with radioassay in appendix A.

Section 2.0 of this document identifies the responsible organizations and associated activities for ensuring that the CH-TRU waste is managed in a manner that protects

worker and public health and safety and the environment. Section 3.0 lists the requirements and acceptance criteria for the physical, chemical, and radiological properties of the waste as well as the properties of the container itself. These requirements are partitioned according to their source; i.e., they are identified as having originated from either the WIPP operations and safety requirements, transportation safety requirements, the Hazardous Waste Facility Permit, the compliance certification decision, or the LWA.

Section 4.0 summarizes the quality assurance (QA) requirements relating to waste characterization, certification, and transportation. TRU waste sites must develop and implement a QA program that meets all applicable requirements of the Carlsbad Area Office (CAO) *Quality Assurance Program Document* (QAPD; reference 8). Characterization of CH-TRU waste must be in accordance with the performance requirements of the WAP and implemented in accordance with a site- specific quality assurance project plan (QAPjP). Certification of containers for shipment in the TRUPACT-II shall be performed under a written QA program that provides confidence for both the shipper and the receiver that the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC; reference 9) requirements have been met.

The appendices provide supplemental information relating to radioassay (appendix A) and radiotoxic inhalation hazard analyses (appendix B). A glossary is provided in appendix C.

The CH-WAC is a controlled document. Revised/changed pages will be supplied either by hard copy or electronically to all holders of controlled copies. The most current version of the CH-WAC is available for downloading from the CAO Web Page at http://www.wipp.carlsbad.nm.us/library/wac/chwac.pdf.

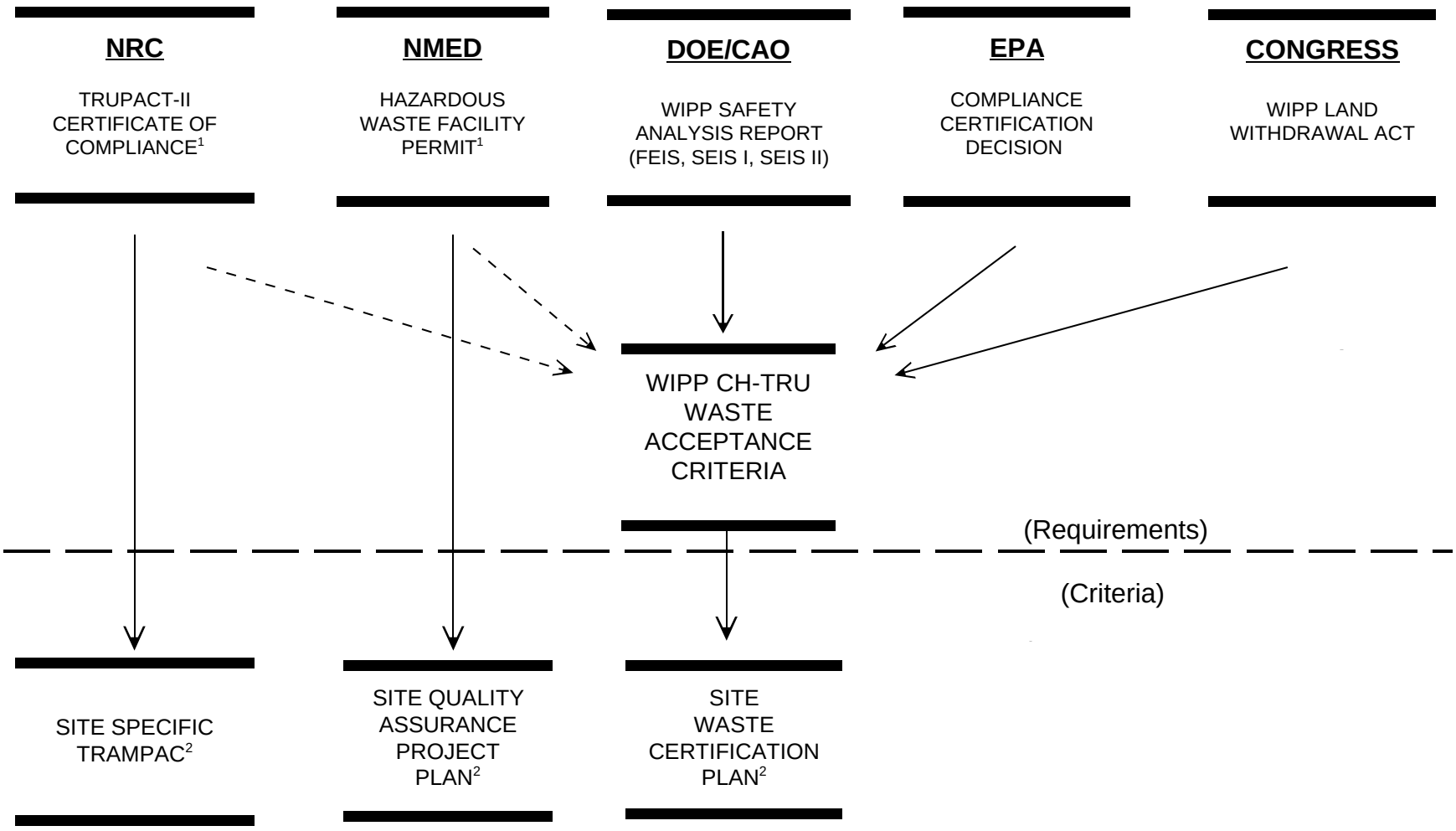

Figure 1.0 Regulatory Basis of CH-TRU Waste Acceptance Criteria

Note 1: The TRUPACT-II SARP and the WIPP Hazardous Waste Facility Permit provide detailed requirements. This CH-WAC only provides an overview of these requirements.

Note 2: All work performed by the site for the CAO must be performed under an approved QA program.

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2.0 RESPONSIBILITIES

This section identifies the responsibilities of organizations that develop and approve the WIPP CH-WAC and of those that oversee the implementation of the requirements defined herein. The responsibilities of the organizations to which these CH-WAC apply are also identified in this section.

2.1 DOE Headquarters

The Assistant Secretary for Environmental Management (EM-1) provides policy and guidance for DOE environmental management sites, facilities, and operations.

2.2 DOE Carlsbad Area Office

The Carlsbad Area Office (CAO) 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 TRU waste. The CAO assists the sites in resolving issues about the management of TRU waste as requested. The CAO provides policy direction for and oversight of TRU waste program activities related to certification of waste for disposal at WIPP at participating DOE TRU waste sites. Within the CAO, these responsibilities are assigned to the National Transuranic Waste Program (NTWP). The CAO is responsible for

- Ensuring that the sites prepare implementation documentation and programs to meet the requirements and criteria in the CH-WAC

- Overseeing all CH-WAC activities associated with the

  - Characterization and certification of TRU waste
  - Proper use of approved transportation packaging
  - Receipt, management, and disposal of TRU waste in WIPP

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

- Ensuring that all TRU waste accepted for management and disposal at WIPP complies with the WIPP Hazardous Waste Facility Permit, applicable laws, regulations, and this CH-WAC

- Reviewing proposed revisions to the CH-WAC to ensure that environmental impacts associated with any revision are bounded by existing WIPP National Environmental Policy Act documentation

- Reviewing and approving the site's waste certification plan

- Reviewing and approving the site-specific QAPjP and TRAMPAC
- Reviewing and approving this CH-WAC and subsequent revisions

2.3 DOE Field Elements

Each DOE Field Element is responsible for overseeing the management of the site TRU waste program in compliance with established NTWP requirements, policies, and guidelines, and for providing liaison between the CAO and the management and operating contractors (MOC) at DOE facilities participating in the NTWP.

2.4 TRU Waste Generator/Storage Sites

Each participating site is responsible for developing and implementing site-specific TRU waste program documents (plans) that address applicable requirements and criteria pertaining to packaging, characterization, and certification of each defense TRU waste container to be shipped to WIPP. Each site shall prepare a waste certification plan. Methods of compliance with each requirement and associated criterion to be implemented at the site shall be described or specifically referenced and shall include procedural and administrative controls. Sites will certify that each CH-TRU waste container meets the criteria contained in table 3.1.

3.0 WIPP WASTE ACCEPTANCE REQUIREMENTS AND CRITERIA

The requirements and associated criteria for acceptance of defense CH-TRU waste at WIPP for disposal are identified in this CH-WAC. The CH-WAC requirements are derived from several source documents: the WIPP Safety Analysis Report (reference 4), the TRUPACT-II SARP (reference 5), the TRUPACT-II Certificate of Compliance (reference 10), the WIPP LWA (reference 2), the WIPP Hazardous Waste Facility Permit (reference 6), and the Criteria for the certification and recertification of the WIPP (reference 7). Definitions of terms used in this CH-WAC are included in appendix C.

3.1 Summary of WIPP Waste Acceptance Criteria

The purpose of section 3.0 is to present the requirements that must be met before TRU waste can be transported to and managed and disposed of at WIPP. The requirements and associated criteria are organized under six major headings: Container Properties, Radiological Properties, Physical Properties, Chemical Properties, Gas Generation Properties, and Data Package Contents. Table 3.1 provides a summary of the waste acceptance criteria and compliance methods for each waste attribute that must be managed at WIPP. Only wastes from a properly characterized and approved waste stream can be certified as meeting the requirements and associated criteria contained in this CH-WAC. Any waste container from a waste stream that has not been preceded by an appropriate certified Waste Stream Profile Form (WSPF) is not acceptable at WIPP (reference 6, section II.C.3.k).

Site-specific plans and procedures shall contain details of the processes, controls, techniques, tests, and other actions to be applied to each TRU payload container, waste stream, and shipment. Methods of compliance with each requirement shall be described and the specific procedure cited. These 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 CH-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 WIPP is certified to meet the CH-WAC by the responsible site certifying official(s).

Sites shall transmit required characterization, certification, and shipping data to WIPP using the WIPP Waste Information System (WWIS). The WWIS has electronic and edit/limit checks to ensure that the data representing the waste containers are in compliance with this CH-WAC. Before shipping TRU waste containers from a WIPP-accepted waste stream, the site shall transmit the required waste certification and shipment data to WIPP. Sites may periodically be requested to transmit container radiography reports or other data to WIPP. WIPP will not accept any waste container shipments for disposal if the waste container information has not been correctly submitted and approved for shipment by the Data Administrator. The WWIS User's Manual (reference 11) provides the information needed by TRU waste sites to perform

tasks associated with transmittal of the waste container characterization, certification, and shipment information to WIPP.

Sites will be notified of revisions to external regulatory requirements by CAO. Revisions of requirements in referenced documents not controlled by the DOE (but by, for example, the U.S. Environmental Protection Agency [EPA], NRC, or NMED) shall have precedence over the values specified here if more restrictive. These changes will be incorporated in future revisions of the CH-WAC.

Table 3.1
Summary of CH-TRU Waste Acceptance Criteria and Compliance Methods

WASTE ATTRIBUTES	WASTE ACCEPTANCE CRITERIA	COMPLIANCE METHODS
3.2 Container Properties		
Payload container description 3.2.1	U.S. Department of Transportation (DOT) Type A or Equivalent • 55-gallon drums (direct fill or containing a pipe component) • Standard waste boxes (SWBs) • Ten-drum overpacks (TDOPs)	Site procurement specifications and QA acceptance reports, or manufacturers' fabrication documentation and records demonstrating equivalency with DOT Type A requirements, or visual certification of manufacturer's stamp, or testing records showing compliance with 49 CFR § 173.461, or comparison to technical criteria/industry standards. Records of visual inspection to verify container integrity.
Container weight and center of gravity 3.2.2	• DOT Type A or equivalent limits • TRUPACT-II limits from the SARP (appendix 1.3.7, section 2.3.1.1)	Record of loaded container/assembly weights. (Weighing individual containers and totaling is acceptable.)
Removable surface contamination 3.2.3	For individual containers, payload assemblies, and packagings - • <20 dpm/100 cm^2 for alpha • <200 dpm/100 cm^2 for beta-gamma	Records of surface contamination surveys taken on individual containers prior to release from a radiological contamination area. Records of surface contamination surveys taken on TRUPACT-IIs prior to shipment.
Container identification/ marking 3.2.4	• Bar code label consisting of the site identification and a unique container identification number • Shipping category	Visual inspection at time of shipment.
Dunnage 3.2.5	• Empty 55-gallon drums • Empty SWB	Labeled "EMPTY" or "DUNNAGE", and applicable WWIS data reported.
Filter vents 3.2.6	• Payload containers vented using filter(s) that meet the WIPP Hazardous Waste Facility Permit and the TRUPACT-II SARP, appendix 1.3.5 specification	Records of visual inspection. Site procurement specifications and QA acceptance reports, or manufacturers' fabrication documentation.

WASTE ATTRIBUTES	WASTE ACCEPTANCE CRITERIA	COMPLIANCE METHODS
3.3 Radiological Properties		
Radionuclide composition 3.3.1	• Assay measurements • Quantification of ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs*	Records of assay data and AK documentation
Fissile material quantity (^{239}Pu fissile gram equivalent [FGE]) 3.3.2	• ≤200 g/55-gallon drum (direct fill or containing a pipe component) • ≤325 g/SWB • ≤325 g/TDOP • ≤325 g/TRUPACT-II • ≤2800 g/TRUPACT-II (fourteen 55-gallon drums each containing one pipe component)	Records of assay data and AK documentation, and records of calculations using isotopic composition, specific activity of the isotopes, and measured assay values to determine ^{239}Pu FGE.
TRU alpha activity concentration 3.3.3	• >100 nCi of alpha-emitting TRU isotopes per gram of waste.	Records of assay data and AK documentation and records of calculations showing concentrations of the total TRU radionuclides in the waste matrix.
^{239}Pu equivalent activity (PE-Ci) 3.3.4	<u>Untreated waste</u> • ≤80 PE-Ci/55-gallon drum • ≤130 PE-Ci/SWB • ≤130 PE-Ci/TDOP • ≤1,100 PE-Ci/55-gallon drum overpacked in a 85-gallon drum, or SWB, or TDOP • ≤1,100 PE-Ci/SWB overpacked in a TDOP • ≤1,800 PE-Ci/55-gallon drum containing a pipe component <u>Solidified/vitrified waste</u> • ≤1,800 PE-Ci/55-gallon drum	Records of assay data and AK documentation and records of conversion and calculations using appendix B
Radiation dose rate 3.3.5	• ≤200 mrem/h at the surface of the payload container and the TRUPACT-II. • ≤10 mrem/h at 2 m	Measurements shall be made on each CH-TRU waste container with instruments calibrated using sources traceable to a national standard. The results of these measurements shall be reported to WIPP before shipment using the WWIS.
3.4 Physical Properties		
Liquids 3.4.1	Free liquid • <1 volume percent of external container • <1 inch or 2.5 cm in bottom of internal containers	AK documentation, radiography, visual examination, and/or packaging records will be used to determine the presence of free liquids and to ensure that the quantity of liquid satisfies the acceptance criteria.
Sealed containers 3.4.2	• No sealed containers greater than 4 liters	AK documentation, radiography, visual examination, and/or packaging records.

WASTE ATTRIBUTES	WASTE ACCEPTANCE CRITERIA	COMPLIANCE METHODS
3.5 Chemical Properties		
Pyrophoric materials 3.5.1	• <1% radionuclide pyrophorics • No nonradionuclide pyrophorics	AK documentation and records of procedures, processes, or evidence that shows no presence of pyrophorics or treatment to eliminate the characteristic
Hazardous waste 3.5.2	• Characterization is in accordance with approved site-specific QAPjP as defined in the WIPP WAP • Limited to RCRA hazardous waste codes listed in table 3.5.2.	AK documentation and approved WSPF, and records showing types and quantities of hazardous constituents, and CAO-approved QAPjPs
Chemical compatibility 3.5.3	• No chemicals or materials that are incompatible	AK documentation and approved TRUPACT-II TRUCON content code
Explosives, corrosives, and compressed gases 3.5.4	• No explosives, corrosives, or compressed gases	Site policies/procedures prohibiting these items AK documentation, radiography, visual examination, and/or packaging records
Headspace gas volatile organic compound (VOC) concentrations 3.5.5	• Every container will be headspace gas sampled.	Waste characterization records showing container headspace gas VOC concentrations Data transmittal to WWIS
Polychlorinated biphenyl concentration 3.5.6	• <50 ppm	AK documentation and/or records of sampling and analysis
Asbestos 3.5.7	• Sites shall identify wastes containing asbestos	AK documentation and/or records of sampling and analysis including visual examination Sites that need to dispose of asbestos contaminated TRU waste should contact the Waste Certification Manager at the CAO for guidance.

WASTE ATTRIBUTES	WASTE ACCEPTANCE CRITERIA	COMPLIANCE METHODS
3.6 Gas Generation Properties		
Payload shipping category 3.6.1	All payload containers in a TRUPACT-II shall belong to the same shipping category.	Assigned shipping category and approved content code
Decay heat 3.6.2	• ≤Decay heat limit for the authorized shipping category • ≤40 W per TRUPACT-II	Records of assay data or AK documentation and records of conversion to wattage and calculations showing compliance
Test category waste 3.6.3	• Steady-state hydrogen gas generation release rate is less than or equal to the rate specified in the TRUPACT-II SARP, appendix 1.3.7	Records of gas generation testing/sampling
Flammable VOCs 3.6.4	• ≤500 ppm total in the headspace of any payload container	AK documentation and/or headspace gas sampling and analysis
Venting and aspiration 3.6.5	• Retrievably stored drums that have been stored in an unvented condition shall be aspirated before shipment for a length of time greater than or equal to time shown in the TRUPACT-II SARP	Records showing aspiration time is met
3.7 Data Package Contents		
Characterization and certification data 3.7.1	• WSPF and accompanying characterization data summary report • Waste container data imported to the WWIS	Generation, submittal, and approval of data prior to shipment
Shipping data 3.7.2	• Uniform hazardous waste manifest (UHWM)(1) or bill of lading • Land disposal restriction (LDR) notification(1) • Payload Assembly Transportation Certification Document (PATCD) and Payload Container Transportation Certification Document (PCTCD)	UHWM and LDR notification generated PATCD and PCTCD on file

NOTES:
(1) Applies only to shipments of RCRA hazardous waste.

*Am - Americium, Cs - Cesium, Pu - Plutonium, Sr - Strontium, U - Uranium

3.1.1 DOE Operations and Safety Requirements for WIPP

The WIPP Safety Analysis Report (SAR; reference 4) addresses CH-TRU waste handling and emplacement operations. The waste accepted for emplacement in the WIPP must conform to the CH-WAC. The SAR documents the safety analyses that develop and evaluate the adequacy of the WIPP safety bases necessary to ensure the safety of workers, the public, and the environment from the hazards posed by WIPP waste receiving, handling, and emplacement operations. The SAR establishes and evaluates the adequacy of the safety bases in response to plant normal and abnormal operations and postulated accident conditions. In addition to the requirements found in the WIPP SAR, requirements from best practices and operational experience are also listed in this section.

3.1.2 NRC Transportation Safety Requirements for the TRUPACT-II

Acceptable methods for payload compliance are defined in the TRUPACT-II SARP, appendix 1.3.7 (TRAMPAC). For shipments to WIPP, each site must prepare a site-specific TRAMPAC describing how it will ensure compliance with each payload parameter. This technical plan shall contain sufficient detail to allow reviewers to adequately understand and evaluate the compliance methodology for each payload parameter.

Sites shall have a packaging QA program that defines the QA activities that apply to the use of NRC-approved transportation packagings in accordance with 10 CFR § 71, subpart H.

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 RCRA. Only TRU mixed waste and TRU waste that have been characterized in accordance with the WAP and that meet the treatment, storage, and disposal facility waste acceptance criteria as presented in permit conditions II.C.3.a through II.C.3.k of the WIPP Hazardous Waste Facility Permit will be accepted at the WIPP facility for disposal in the permitted underground hazardous waste disposal unit.

Prior to disposal, each participating site shall develop and implement a QAPjP that addresses all the applicable requirements specified in the WIPP WAP. In accordance with attachment B5 of the WIPP WAP, the QAPjP will include the qualitative or quantitative criteria for making a hazardous waste determination. All site QAPjPs will be reviewed and approved by the CAO.

3.1.4 EPA Compliance Certification Decision Requirements

Title 40 CFR § 194.24(c) states that the DOE shall specify the limiting values for waste components to be emplaced in the repository. Appendix WCL (Waste Component Limits) of the Compliance Certification Application (CCA; reference 12) identifies the specific waste components that are associated with the waste proposed for disposal at WIPP. Because the sensitivity analysis (appendix SA of the CCA) shows that disposal system performance is not sensitive to most properties of the emplaced waste, only repository limits for free water; metals; and cellulose, plastic, and rubber (CPR) have been established.

The repository limit for free water is a maximum of 1685 m^3 and is met by the free liquid criterion (section 3.4.1 of this CH-WAC), which limits to 1% by volume the amount of free liquid in any one waste container.

The limits for metals are a minimum of 2×10^7 kg for ferrous metals and 2×10^3 kg for nonferrous metals. These limits will be met in the total repository inventory by the metals that constitute the waste containers alone; thus, WIPP tracks and reports the number and type of containers emplaced as reported in the WIPP Waste Information System (WWIS), as required by section 3.2.1 of this CH-WAC.

The repository limit for CPR is a maximum of 2×10^7 kg. Sites are required to estimate the weight of CPR and report this estimate in the WWIS on a container basis.

Lastly, waste generators must quantify and report the activity values of each of the following radionuclides for purposes of tracking the inventory curie content: ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs. The presence or absence of these radionuclides is determined using AK documentation and radioassay in accordance with appendix A of this CH-WAC. The results of this determination are reported in the WWIS on a container basis.

3.1.5 Land Withdrawal Act Requirements

By law, WIPP can accept only radioactive waste generated by atomic energy defense activities of the United States (reference 2). These activities include the manufacture and research of nuclear weapons and the operation of naval reactors (reference 13).

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 WIPP if it has been generated in whole or in part by one or more of the following functions (reference 14):

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

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

3.1.6 Acceptance Criteria

The acceptance criteria of this CH-WAC describe the controlling (i.e., the most restrictive) requirements to be used by the sites. In some cases the acceptance criteria and regulatory requirements are synonymous.

3.2 Container Properties

3.2.1 Payload Container Description

Operations and Safety Requirements. Waste containers shall be noncombustible and meet DOT Type A packaging requirements. WIPP-acceptable waste containers include 55-gallon drums (direct fill or containing a pipe component), 85-gallon drum overpacks, SWBs, and TDOPs. (Reference 3, section 5.9.12)

Transportation Safety Requirements for the TRUPACT-II. Only the following payload containers are authorized for shipment in the TRUPACT-II: 55-gallon drums (direct fill or containing a pipe component), SWBs, and TDOPs. All containers transported within the TRUPACT-II shall comply with the specifications in the TRUPACT-II SARP. The maximum number of containers per TRUPACT authorized packaging configurations are provided in table 3.2.1. (Reference 5, appendix 1.3.3, section 2.1.1)

Table 3.2.1
Maximum Number of Containers per TRUPACT-II and Authorized Packaging Configurations

14	55-Gallon drums
14	55-Gallon drums, each containing one pipe component
2	SWBs
2	SWBs, each containing one bin
2	SWBs, each containing up to four 55-gallon drums
1	TDOP
1	TDOP containing up to 10 55-gallon drums
1	TDOP containing up to six 85-gallon drums (each 85-gallon drum containing one 55-gallon drum)
1	TDOP containing one SWB
1	TDOP containing one bin within an SWB
1	TDOP containing up to four 55-gallon drums within a SWB

Hazardous Waste Facility Permit Requirements. Acceptable waste containers for disposal are limited to 55-gallon drums, SWBs, TDOPs, and 85-gallon drum overpacks (reference 6, module IV, section IV.C.1). These containers must meet the requirements for DOT Specification 7A regulations (reference 6, attachment M1, section M1-1b). Waste containers will be made of steel and be in good condition prior to shipment from the generator sites (reference 6, attachment M1, section M1-1b).

Compliance Certification Decision Requirements. Generator sites will report number and types of containers in the WWIS. (Reference 11, appendices [Waste Characterization Analysis and Waste Component Limits])

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Payload containers must be steel DOT Type A or equivalent 55-gallon drums, SWBs, or TDOPs in good condition.

3.2.2 Container Weight and Center of Gravity

Operations and Safety Requirements. Individual payload container weights shall be limited to the weight capacities that meet DOT Type A requirements. (Reference 4, section 4.2.1.1.1)

Transportation Safety Requirements for the TRUPACT-II. Each payload container, payload assembly, and loaded TRUPACT-II shall comply with the weight limits shown in table 3.2.2. Weight calculations for the payload assembly must include measurement error. The total weight of the top seven drums or SWB of the payload assembly shall be less than or equal to the total weight of the bottom seven drums or SWBs. The total weight of the top five drums in a TDOP shall be less than or equal to the total weight of the bottom five drums. The scale calibration shall be in accordance with National Institute of Standards and Technology (NIST) Handbook 44 or equivalent. (Reference 5, appendix 1.3.7, section 2.3.1)

Table 3.2.2
TRUPACT-II Container/Assembly Weights

Container	Maximum Gross Weight (lbs.)
55-Gallon drum	≤1,000*
SWB	≤4,000
TDOP	≤6,700
Six-inch-diameter pipe component in a 55-gallon drum	≤328
Twelve-inch-diameter pipe component in a 55-gallon drum	≤547
Payload assembly of fourteen 55-gallon drums	≤7,265
Payload assembly of two SWBs	≤7,265
TRUPACT-II	≤19,250
Truck (tractor/trailer)	≤80,000

* Must meet restrictions in DOT Specification 7A.

Note: 85-Gallon overpacks are acceptable at WIPP as overpacks but are not authorized for transport in TRUPACT-II as individual payload containers.

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Payload containers shall meet both TRUPACT-II and DOT Type A weight limits (from DOT Specification 7A requirements) for individual containers. Assemblies shall meet TRUPACT-II requirements.

3.2.3 Removable Surface Contamination

Operations and Safety Requirements. Removable surface contamination on CH-TRU waste payload containers, container assemblies, or packagings shall not exceed the values in 10 CFR § 835 appendix D (reference 15). The fixing of surface contamination to meet this criterion is not allowed (reference 3, section 5.9.12).

Transportation Safety Requirements for the TRUPACT-II. No requirements.

Hazardous Waste Facility Permit Requirements. Containers will be free of surface contamination above DOE limits. (Reference 6, attachment M1, section M1-1b) The free release limit is defined by DOE Orders as alpha contamination less than 20 dpm and beta-gamma contamination less than 200 dpm. (Reference 6, attachment M1, section M1-1d[2])

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. The degree of removable surface contamination for each CH-TRU waste container and TRUPACT-II must be measured using site procedures before shipment to WIPP. The results of these surveys must be documented, transmitted to WIPP using the WWIS, and must be less than the values of 20 dpm/100 cm^2 alpha or 200 dpm/100 cm^2 beta-gamma.

3.2.4 Container Identification/Labeling

Operations and Safety Requirements. Each CH-TRU waste container shall be uniquely identified by means of bar code labels permanently attached in conspicuous locations. The container identification number shall be in medium to low density Code 39 bar code symbology as required by MIL-STD-1189B (reference 16) in characters at least one inch high and alphanumeric characters at least one-half inch high. The bar code identification labels shall be placed at three locations about 120 degrees apart so that at least one label is clearly visible when drums are assembled into a seven-pack (i.e., a label must be visible after slip sheets and wrapping are applied). Bar code labels are required on the flat sides of SWBs.

All waste containers shall be marked "Caution Radioactive Material" using a yellow and magenta label as specified in 10 CFR § 835. Those waste containers whose contents are also RCRA regulated (mixed-TRU) shall be additionally marked "Hazardous Waste" as specified in 40 CFR § 262.32 (reference 17).

Transportation Safety Requirements for the TRUPACT-II. Each CH-TRU waste payload container shall be marked with a unique container identification number and the "shipping category" after verification of all payload parameters. (Reference 5, section 2.4.1)

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. CH-TRU waste containers shall be labeled with a barcode label consisting of the site identification and a unique container identification number. CH-TRU waste containers shall also be marked with the "shipping category." The container identification number and the shipping category may be on the same label(s).

3.2.5 Dunnage

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. Empty drums or SWBs must be used as dunnage to complete a 14-drum or two-SWB configuration. Dunnage containers shall have open vent ports (i.e., not filtered or plugged). (Reference 5, appendix 1.3.7, section 2.2)

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Empty drums used as dunnage to complete a seven-pack of waste drums in a shipment to WIPP shall be labeled "EMPTY" or "DUNNAGE" and have container marking as described in section 3.2.4, as appropriate. Refer to the WWIS User's Manual (reference 11) for data transmittal requirements applicable to dunnage containers that are part of a waste container payload assembly.

If a seven-pack of empty drums or an SWB is shipped as dunnage to fill a TRUPACT-II, label the drums/SWB "EMPTY" or "DUNNAGE," but do not label them with container ID numbers.

To maximize the shipping efficiency of the TRUPACT-II, the use of dunnage drums should be minimized. In the event the use of dunnage drums 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 multiples of seven (i.e., seven-packs). The use of dunnage drums is reviewed and approved concurrently with the review and approval of shipment assemblies by the WWIS Data Administrator on a case-by-case basis.

3.2.6 Filter Vents

Operations and Safety Requirements. All waste containers to be shipped to the WIPP facility shall be vented with one or more filter vents. (Reference 3, section 5.9.12)

Transportation Safety Requirements for the TRUPACT-II. CH-TRU waste payload containers, including overpacks, shall have one or more filter vents. Filter vents must meet the specifications described in appendix 1.3.7 of the TRUPACT-II SARP. (Reference 5, appendix 1.3.7, section 2.5)

Hazardous Waste Facility Permit Requirements. Containers are to be vented through individual carbon composite particulate filters or filters with equivalent VOC dispersion characteristics, allowing any gases that are generated by radiolytic and microbial processes within a waste container to escape, thereby preventing over pressurization or development of conditions within the container that would lead to the development of ignitable, corrosive, reactive, or other characteristic wastes (reference 6, attachment B, section B-1c). A filtered vent (as described in section M1-1d[1]) will be installed in the drum lid to prevent the escape of any radioactive particulates and to eliminate any potential of pressurization (reference 6, attachment M1, section M1-1b).

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Filters must meet both the TRUPACT-II requirements for minimum hydrogen diffusivity and RCRA requirements for VOC dispersion. The only currently approved filters are manufactured by Nuclear Filters Technologies and include NUCFIL-012, -013, and -020. If two or more filters are used to vent a waste container, the model number of each filter must be reported to WIPP using the appropriate comment field in the WWIS.

3.3 Radiological Properties

3.3.1 Radionuclide Composition

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. The DOT requires shipping papers that accompany the transport of hazardous materials to include a description of those radionuclides that constitute 95 percent or more of the activity. See section 3.7.1 for additional shipping data requirements. (49 CFR §172.203 and 173.433)

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. For CH-TRU waste, waste generators must quantify and report each of the following radionuclides for purposes of

tracking the inventory curie content: ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs. (Reference 12, appendix WCL)

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. The radionuclide composition which comprises 95 percent or more of the activity must be reported in the WWIS for each waste container .

3.3.2 Fissile Material Quantity (^{239}Pu Fissile Gram Equivalents)

Operations and Safety Requirements. The limits for fissile material quantity, in terms of ^{239}Pu FGEs, are shown in table 3.3.2. (Reference 3, sections 5.9.11 and 5.9.12)

Table 3.3.2
Nuclear Criticality Safety Limits

Payload Container Type	^{239}Pu FGE Limit
55-gallon drum	$\leq$ 200
SWB	$\leq$ 325
TDOP	$\leq$ 325

Transportation Safety Requirements for the TRUPACT-II. A payload container shall be acceptable for transport only if the ^{239}Pu FGE plus two times the measurement error is less than or equal to 200 g for a drum, 200 g for a pipe component, 325 g for an SWB, or 325 g for a TDOP. (Reference 5, appendix 1.3.7, section 3.1)

A TRUPACT-II shall be acceptable for transport only if the ^{239}Pu FGE plus two times the measurement error is less than or equal to 325 g for a payload of fourteen 55-gallon drums, two SWBs, or one TDOP. A TRUPACT-II shall be acceptable for transport only if the ^{239}Pu FGE plus two times the measurement error is less than or equal to 2,800 g for a payload of fourteen 55-gallon drums containing pipe components. (Reference 5, appendix 1.3.7, section 3.1)

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. The ^{239}Pu FGE of the radionuclides in each waste container shall be reported to WIPP using the WWIS. Payload containers must meet both the TRUPACT-II and the WIPP repository requirements for criticality.

The total ^{239}Pu FGE for a TRUPACT-II payload shall be calculated and recorded in the PATCD.

3.3.3 TRU Alpha Activity Concentration

Operations and Safety Requirements. TRU waste containers to be disposed of at WIPP shall contain more than 100 nCi of alpha-emitting TRU isotopes per gram of waste (Reference 3, section 5.9.12).

Transportation Safety Requirements for the TRUPACT-II. No requirements.

Hazardous Waste Facility Permit Requirements. WIPP is a facility for the management, storage, and disposal of TRU mixed waste. (Reference 6, attachment A, section A-2)

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. TRU waste containers to be disposed of at WIPP 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[20])

Acceptance Criteria. The TRU alpha activity concentration in the waste must be greater than 100 nCi/g with half-lives greater than 20 years. The tare weight of the waste containers (including the rigid liner and any added shielding) shall be subtracted before performing the calculation to obtain TRU alpha activity concentration.

3.3.4 ^{239}Pu Equivalent Activity

Operations and Safety Requirements. The PE-Ci limits for CH-TRU waste containers are listed in table 3.3.4. (Reference 3, section 5.9.12)

Table 3.3.4
WIPP PE-Ci Limits for CH TRU Waste

Packaging Configuration	^{239}Pu PE-Ci Limit
55-gallon drum containing untreated waste - direct packaged	≤80
55-gallon drum containing untreated waste - overpacked in a SWB, or 85-gallon drum, or TDOP	≤1,100
55-gallon drum containing a pipe component	≤1,800
55-gallon drum containing solidified/vitrified waste	≤1,800
SWB containing untreated waste - direct packaged	≤130
SWB containing untreated waste - overpacked in a TDOP	≤1,100
TDOP containing untreated waste - direct loaded	≤130

Transportation Safety Requirements for the TRUPACT-II. No requirements.

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. PE-Ci quantities shall be calculated for each container in accordance with appendix B and reported to WIPP using the WWIS. Limits are shown in table 3.3.4.

3.3.5 Radiation Dose Rate

WIPP Operations and Safety Requirements. CH-TRU waste containers shall not exceed 2 mSv/h or 200 mrem/h on contact (beta + gamma + neutron). (Reference 3, section 5.9.12)

Transportation Safety Requirements for the TRUPACT-II. The external radiation dose rates of individual payload containers and the loaded TRUPACT-II shall be $\leq$200 mrem/h at the surface and $\leq$10 mrem/h at 2 m. Payload containers that meet the radiation dose rate requirements may be shielded to as low as reasonably achievable. Internal payload container shielding shall not be used to meet these requirements, except for the pipe component configuration. (Reference 5, appendix 1.3.7, section 3.2)

Hazardous Waste Facility Permit Requirements. Only contact-handled TRU mixed waste is permitted for storage or disposal at the WIPP facility. (Reference 6, attachment A, section A-2) Contact-handled TRU mixed waste means transuranic mixed waste with a surface dose rate not greater than 200 mrem/h. (Reference 6, module I, section I.D.1) Remote-handled TRU mixed waste is not acceptable at WIPP. (Reference 6, module II, section II.C.3.h)

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. The external radiation dose rates of individual payload containers and the loaded TRUPACT-II shall be $\leq$200 mrem/h at the surface and $\leq$10 mrem/h at 2 m. Neutron contributions to the total payload container dose rate shall be reported separately in the WWIS.

3.4 Physical Properties

3.4.1 Liquids

Operations and Safety Requirements. Liquid waste will not be accepted for disposal at WIPP. Only residual liquids in well-drained internal containers are allowed.
The aggregate amount of residual liquid is limited to less than 1 volume percent of the external container. (Reference 3, section 5.9.12)

Transportation Safety Requirements for the TRUPACT-II. Liquid waste is prohibited in the payload containers, except for residual amounts in well-drained containers. The aggregate volume of residual liquid in a payload container shall be less than 1 percent (volume) of the payload container. (Reference 5, appendix 1.3.7, section 2.6)

Hazardous Waste Facility Permit Requirements. Liquid waste is not acceptable at WIPP. Waste shall contain as little residual liquid as is reasonably achievable by pouring, pumping, and/or aspirating, and internal containers shall contain less than 1 inch or 2.5 cm of liquid in the bottom of the container. Total residual liquid in any payload container (e.g., 55-gallon drum, SWB, etc.) may not exceed 1 percent volume of that container. (Reference 6, module II, section II.C.3.a) For generator/storage sites that choose to use visual examination in lieu of radiography, the detection of any liquid waste in nontransparent inner containers, detected from shaking the container, will be handled by assuming that the container is filled with liquid and adding this volume to the total liquid in the payload container (e.g., 55-gallon drum or SWB). (Reference 6, attachment B, section B-3c)

Compliance Certification Decision Requirements. The maximum value of free water that can be emplaced with the waste in the repository is 1,685 m^3 based on a 1 volume percent limit per waste container. Hence, the volume of residual free liquids in payload containers shall on average be less than or equal to 1 volume percent of the payload container. (Reference 12, appendix WCL)

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. The aggregate volume of residual liquid in a payload container shall be less than 1 percent (volume) of the payload container. Internal containers shall contain less than 1 inch or 2.5 cm of liquid in the bottom of the containers.

3.4.2 Sealed Containers

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. Sealed containers greater than 4 L are prohibited except for Waste Material Type II.2 packaged in a metal container. Containers greater than 4 L, except for those packaging Waste Material Type II.2, shall not be sealed or shall be fitted with a filter vent. (Reference 5, appendix 1.3.7, section 2.8.1)

Hazardous Waste Facility Permit Requirements. All waste containers with unvented rigid containers greater than 4 L shall be subject to innermost layer of containment sampling or shall be vented prior to initiating drum age and equilibrium criteria. (Reference 6, attachment B1, section B1-1a)

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Payload containers shall be verified to be free of sealed containers greater than 4 L.

3.5 Chemical Properties

3.5.1 Pyrophoric Materials

Operations and Safety Requirements. Pyrophoric materials, other than radionuclides, shall be rendered safe by mixing them with chemically stable materials (e.g., concrete, glass) or shall be processed to remove their hazardous properties. Radionuclides in pyrophoric form are limited to less than one percent by weight of the CH-TRU waste in any container, and these shall be generally dispersed in the waste. (Reference 3, section 5.9.12)

Transportation Safety Requirements for the TRUPACT-II. Pyrophoric radioactive materials shall be present only in small residual amounts (<1 percent by weight) in payload containers. Radioactive pyrophorics 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 CH-TRU waste payload container. (Reference 5, appendix 1.3.7, section 4.1)

Hazardous Waste Facility Permit Requirements. Non-radionuclide pyrophoric materials, such as elemental potassium, are not acceptable at WIPP. (Reference 6, module II, section II.C.3.b)

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Pyrophoric radioactive materials shall be present only in small residual amounts (<1 percent by weight) in payload containers. CH-TRU waste streams that are expected to contain any metallic radionuclides are to be treated (oxidized) to eliminate as much of the potential pyrophorics as possible before being placed in containers for shipment to WIPP. A validated process (i.e., one that has been proven by test or analysis) that converts pyrophoric compounds to a nonpyrophoric form may be used to meet this criterion.

3.5.2 Hazardous Waste

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. No requirements.

Hazardous Waste Facility Permit Requirements. Hazardous wastes not occurring as co-contaminants with TRU wastes (non-mixed hazardous wastes) are not acceptable at WIPP. Each CH-TRU mixed waste container shall be assigned one or more EPA hazardous waste codes as appropriate. Only EPA hazardous waste codes listed as allowable in the Hazardous Waste Facility Permit and specified in table 3.5.2 below may be managed at WIPP. Wastes exhibiting the characteristic of ignitability, corrosivity, or reactivity (EPA hazardous waste numbers of D001, D002, or D003) are not acceptable at WIPP. (Reference 6, module II, section II.C.3.g) In the context of this CH-WAC, hazardous waste codes are synonymous with hazardous waste numbers. (Reference 6, module II, sections II.C.3.c and II.C.4)

Sites are required to make a hazardous waste determination in accordance with applicable requirements of the WAP (reference 6, attachment B) and the Waste Characterization Sampling Methods (reference 6, attachment B1). Any waste container which has not undergone either radiographic or visual examination is not acceptable at WIPP (reference 6, module II, section II.C.3.j).

Table 3.5.2
WIPP-Acceptable RCRA Hazardous Waste Codes

D004	D019	D034	F002
D005	D021	D035	F003
D006	D022	D036	F004
D007	D026	D037	F005
D008	D027	D038	F006
D009	D028	D039	F007
D010	D029	D040	F009
D011	D030	D043	P015
D018	D032	F001	------

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Each individual waste payload container must come from a waste stream documented using an approved WSPF. These forms identify the proper hazardous waste codes as well as the absence of corrosive, reactive, and ignitable characteristics. After CAO approval of the WSPF, RCRA hazardous waste codes for each CH mixed waste container must be reported to WIPP using the WWIS.

3.5.3 Chemical Compatibility

Operations and Safety Requirements. CH-TRU mixed waste shall contain no chemicals that would cause adverse reactions with other payload containers during

handling or disposal. Waste streams identified as containing incompatible materials or materials incompatible with waste containers cannot be shipped to WIPP unless they are treated to remove the incompatibility. (Reference 3, section 5.9.12)

Transportation Safety Requirements for the TRUPACT-II. Chemical constituents in a waste container shall conform to the allowable chemical lists in the TRUPACT-II SARP, appendix 1.3.7, tables 4-1 through 4-6. Total trace chemicals/materials within a waste container are limited to a total of less than 5 weight percent. (Reference 5, appendix 1.3.7, section 4.4)

Hazardous Waste Facility Permit Requirements. Wastes incompatible with backfill, seal and panel closure materials, container and packaging materials, shipping container materials, or other wastes are not acceptable at WIPP. (Reference 6, module II, section II.C.3.d)

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Only wastes that have been shown to meet the approved TRUPACT-II chemical lists in the SARP are acceptable at WIPP.

3.5.4 Explosives, Corrosives, and Compressed Gases

Operations and Safety Requirements. CH-TRU waste shall contain no explosives, corrosives, or compressed gases. (Reference 3, section 5.9.12)

Transportation Safety Requirements for the TRUPACT-II. Explosives, corrosives, and pressurized containers are prohibited from the payload. (Reference 5, appendix 1.3.7, section 4.2).

Hazardous Waste Facility Permit Requirements. Wastes containing explosives or compressed gases are not acceptable at WIPP (reference 6, section II.C.3.e). Wastes exhibiting the characteristic of corrosivity are not acceptable at WIPP (reference 6, module II, section II.C.3.g).

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. CH-TRU waste shall contain no explosives, corrosives, or compressed gases. If corrosives, pressurized containers, or explosive materials are found to be present, they must be physically removed, neutralized, or treated to render them inert such that a violent reaction is not possible.

3.5.5 Headspace Gas VOC Concentrations

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. No requirements.

Hazardous Waste Facility Permit Requirements. Any waste container which has not undergone headspace gas sampling and analysis to determine VOC concentrations is not acceptable at WIPP. (Reference 6, module II, section II.C.3.i)

Sites are required to characterize their waste in accordance with the WAP (reference 6, attachment B) and the Waste Characterization Sampling Methods (reference 6, attachment B1).

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. All waste containers shall be headspace gas sampled and analyzed in accordance with an approved site-specific QAPjP, as defined in the WAP. Required QAOs for headspace gas analysis are specified in the WIPP Hazardous Waste Facility Permit. (Reference 6, permit attachment B3)

3.5.6 Polychlorinated Biphenyl Concentration

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. No requirements.

Hazardous Waste Facility Permit Requirements. Wastes with polychlorinated biphenyl (PCB) concentrations equal to or greater than 50 ppm are not acceptable at WIPP. (Reference 6, module II, section II.C.3.f)

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Wastes determined by either AK or sampling and analysis to have a PCB concentration greater than or equal to 50 ppm are prohibited.

3.5.7 Asbestos

Operations and Safety Requirements. The NMED regards asbestos-contaminated TRU waste as a special waste for which the WIPP must be designated a special waste disposal facility (20 NMAC 9.1.700).

Transportation Safety Requirements for the TRUPACT-II. No requirements.

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Those sites that need to dispose of asbestos-contaminated TRU waste should contact the CAO Waste Certification Manager for guidance.

3.6 Gas Generation Properties

3.6.1 Payload Shipping Category

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. Each payload container shall be assigned a payload shipping category that is included in an approved content code in the TRUCON document. Two payload shipping category notations are available: (1) alpha-numeric and (2) numeric. Either notation may be used by a shipping site. (Reference 5, appendix 1.3.7, section 5.1)

All CH-TRU waste payload containers shipped in a single TRUPACT-II shall be assigned the same shipping category or the same waste type (I, II, III, or IV) having different bounding g-values and resistances, provided that the decay heat limit for all payload containers within the payload is conservatively assumed to be the same as that of the payload container with the lowest decay heat limit. (Reference 5, appendix 1.3.7, section 6.0)

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Payload containers shall be assigned an approved shipping category.

3.6.2 Decay Heat

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. The decay heat within each payload container plus the measurement error shall be less than or equal to the decay heat limit specified in table 5-6 of appendix 1.3.7 in the TRUPACT-II SARP for each authorized payload shipping category. The total decay heat from all containers in a TRUPACT-II shall be less than 40 W. (Reference 5, appendix 1.3.7, section 5.2)

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Decay heat for each payload container plus the measurement error shall be less than or equal to the limits of the assigned shipping category. The value of the decay heat shall be recorded on the PCTCD.

3.6.3 Test Category Waste

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. A payload container can be placed in the test category when the decay heat loading exceeds the limit set for the shipping category or when the payload container does not have a characterized bounding g-value. (Reference 5, appendix 1.3.7, section 5.3)

For a payload container in the test category to be qualified for transport, its steady-state hydrogen gas generation release rate must be equivalent to the rate for the analytical categories and shall not exceed the limit specified in the TRUPACT-II SARP, appendix 1.3.7, tables 5-6 and 5-7.

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Test category containers shall be tested to determine if the limits on hydrogen gas generation and flammable organics in the headspace are met. Data from the testing shall be recorded on the PCTCD for test category waste.

3.6.4 Flammable VOCs

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. The total concentration of potentially flammable VOCs shall be limited to 500 ppm in the headspace of a payload container. (Reference 5, Appendix 1.3.7, section 5.4)

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. For content codes that identify potentially flammable VOCs as part of the waste, approved waste generation procedures shall be used to ensure that the total concentration is ≤500 ppm in the headspace of each payload container. If an upper limit cannot be established for the amount of potentially flammable VOCs in a content code or if the theoretical limit of 500 ppm is exceeded, a gas sampling program shall be implemented. For content codes that do not contain any flammable VOCs, there are no sampling requirements. (Reference 5, appendix 1.3.7, section 5.4.2)

3.6.5 Venting and Aspiration

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. TRU waste drums and containers that have been stored in an unvented condition (i.e., no filter installed and rigid liner not punctured) shall be aspirated for a specific length of time to ensure equilibration of any gases that may have accumulated in the closed containers prior to shipment. (Reference 5, appendix 1.3.7, section 5.5)

Hazardous Waste Facility Permit Requirements. No requirements.

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Records showing aspiration time is met.

3.7 Data Package Contents

3.7.1 Characterization and Certification Data

Operations and Safety Requirements. A data package with certification shall be transmitted prior to shipment. (Reference 3, section 5.9.12)

Transportation Safety Requirements for the TRUPACT-II. No requirements

Hazardous Waste Facility Permit Requirements. Data summary reports, waste stream characterization summary reports, and WSPFs resulting from waste characterization activities shall be transmitted to the Permittees, reviewed for completeness, and screened for acceptance prior to loading any TRU mixed waste into the TRUPACT-II (reference 6, attachment B). The WSPF is provided in the WAP (reference 6, attachment B, section B-4b[1]). Data submittal will be complete for each container prior to TRU mixed waste shipment (reference 6, attachment B, section B-4b[1]). Only those waste containers that pass all Phase II waste screening determinations will be emplaced at WIPP (reference 6, attachment B, section B-4b[2]).

Compliance Certification Decision Requirements. For CH-TRU waste, waste generators must quantify and report each of the following radionuclides for purposes of

tracking the inventory curie content: ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U ^{90}Sr, and ^{137}Cs. (Reference 12, appendix WCL)

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Sites shall prepare a WSPF for each waste stream. Characterization and certification information for each payload container shall be submitted to the WWIS and approved by the Data Administrator. Any waste container from a waste stream that has not been preceded by an appropriate certified WSPF is not acceptable at WIPP.

3.7.2 Shipping Data

Operations and Safety Requirements. No requirements.

Transportation Safety Requirements for the TRUPACT-II. The site transportation certification official shall complete the PCTCDs and authorize the TRUPACT-II package for shipment by completing and signing the TRUPACT-II PATCD. The shipping records shall be maintained by the shipper for a minimum period of three years. (Reference 5, appendix 1.3.7, section 6.2)

The DOT requires shipping papers that accompany the transport of hazardous materials to include a description of the hazardous material including those radionuclides that constitute at least 95 percent of the activity (49 CFR § 172.203 [reference 18]).

Hazardous Waste Facility Permit Requirements. Sites shall prepare a UHWM and an LDR notification. (Reference 6, attachment B, section B-4b(2))

Compliance Certification Decision Requirements. No requirements.

Land Withdrawal Act Requirements. No requirements.

Acceptance Criteria. Sites shall prepare a bill of lading and a UHWM for CH-TRU waste shipments. The LDR notification for CH-TRU mixed waste shipments shall state that the waste is not prohibited from land disposal. For shipment in TRUPACT-II, a PATCD and PCTCD shall be prepared for containers and assemblies. For each waste container, the radionuclide composition constituting at least 95 percent of the activity shall be reported to WIPP using the WWIS. The radionuclides listed on the manifest must match those listed in the WWIS.

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4.0 QUALITY ASSURANCE REQUIREMENTS

Quality assurance is an integral part of TRU waste characterization, certification, transportation, and operation 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 site. The QA requirements applicable to WIPP are addressed in the CAO QAPD (reference 8).

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

4.1 Waste Characterization Quality Assurance Requirements

Sites 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 WIPP waste characterization samples for the TRU waste sites shall have established, documented QA/QC programs.

Data quality objectives are qualitative and quantitative statements that specify WIPP program technical and quality objectives; they are determined through the data quality objective process (reference 19). The data quality objectives for waste characterization activities relating to the physical and chemical properties of the waste are contained in the WAP of the WIPP Hazardous Waste Facility Permit (reference 6, attachment B3). The NDA QAOs are given in appendix A of this document.

Any payload containers with unresolved discrepancies associated with hazardous waste characterization will not be managed or disposed of at WIPP until the discrepancies are resolved (reference 6, attachment B4, section B4-4). Corrective action reports applicable to WAP requirements shall be resolved prior to waste shipment (reference 6, attachment B6, section B6-4).

4.2 Waste Certification QA Requirements

Participating sites 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 CH-WAC. Site-specific QA plans must comply with the requirements of the CAO QAPD.

4.3 Waste Transportation QA Requirements

Quality assurance requirements for the transportation of TRU waste involve two elements: compliance with TRUPACT-II payload control requirements and compliance with TRUPACT-II usage requirements. The QA requirements for payload control compliance are derived from the certificate of compliance for the TRUPACT-II issued by the NRC (reference 10). The certificate of compliance references the TRAMPAC (reference 9). The QA requirements for compliance with TRUPACT-II usage requirements are derived from 10 CFR § 71, 49 CFR § 173 (references 20, 21), the TRUPACT-II certificate of compliance (reference 10), DOE Orders 460.1 and 460.2 (references 22, 23), and the CAO TRUPACT-II Operating and Maintenance Instructions Manual (reference 24). Participating sites shall develop and implement site-specific QA plans that comply with these requirements. Sites are responsible for describing the QA and QC activities applicable to the specific parameters of the transportation packaging SARP methods for payload control in a site-specific TRAMPAC. Sites shall develop and implement a transportation packaging QA program that defines the QA and QC activities applicable to usage of the TRUPACT-II. This program controls the use of the NRC-certified packaging (TRUPACT-II) and shall comply with the CAO TRUPACT-II Operating and Maintenance Instructions Manual.

5.0 REFERENCES

NOTE: *The current revision of these reference documents is applicable.*

1. Public Law 96-164, 93 Stat. 1259. National Security and Military Applications of Nuclear Energy Authorization Act of 1980, Section 213(a).

2. Public Law 102-579, 106 Stat. 4777 (as amended by Public Law 104-201). Waste Isolation Pilot Plant Land Withdrawal Act.

3. U.S. Department of Energy. *Waste Isolation Pilot Plant Technical Safety Requirements.* DOE/WIPP - 95-2125. Carlsbad, New Mexico, Waste Isolation Pilot Plant, U.S. Department of Energy.

4. U.S. Department of Energy. *Waste Isolation Pilot Plant Safety Analysis Report.* DOE/WIPP-95-2065. Carlsbad, New Mexico, Waste Isolation Pilot Plant, U.S. Department of Energy.

5. U.S. Nuclear Regulatory Commission. *Safety Analysis Report for the TRUPACT-II Shipping Package.* NRC Docket No. 71-9218. Washington, D.C., Office of Regulatory Procedures, U.S. Nuclear Regulatory Commission.

6. New Mexico Environment Department. *Waste Isolation Pilot Plant Hazardous Waste Facility Permit.* NM4890139088-TSDF, Santa Fe, New Mexico.

7. 63 FR 27353. "Criteria for the certification and recertification of the Waste Isolation Pilot Plant's compliance with the disposal regulations: certification decision: EPA final rule." *Federal Register* 63: 27353-27406. Radiation Protection Division, Washington, D.C.

8. U.S. Department of Energy. *Quality Assurance Program Document.* CAO-94-1012. Carlsbad, New Mexico, Carlsbad Area Office, U.S. Department of Energy.

9. U.S. Nuclear Regulatory Commission. *Safety Analysis Report for the TRUPACT-II for Packaging (SARP, Appendix 1.3.7, TRUPACT-II Authorized Methods for Payload Control).* Washington, D.C., Office of Regulatory Procedures, U.S. Nuclear Regulatory Commission.

10. U.S. Nuclear Regulatory Commission. *Certificate of Compliance.* NRC Docket No. 71-9218. Washington, D.C., Office of Regulatory Procedures, U.S. Nuclear Regulatory Commission.

11. U.S. Department of Energy. *WIPP Waste Information System User's Manual for Use by Shippers/Generators.* DOE/CAO-97-2273. Carlsbad, New Mexico, Carlsbad Area Office, U.S. Department of Energy.

12. U.S. Department of Energy. *Title 40 CFR § 191, Compliance Certification Application for the Waste Isolation Pilot Plant.* DOE/CAO-1996-2184, Carlsbad, New Mexico.

13. 42 U.S.C. 2011 et seq. Atomic Energy Act of 1954 (AEA).

14. 42 U.S.C 10141. Nuclear Waste Policy Act of 1982.

15. Title 10 CFR § 835. "Occupational radiation protection." Code of Federal Regulations, Washington, D.C., Office of the Federal Register, National Archives and Records Administration.

16. U.S. Department of Defense. *Standard Department of Defense Bar Code Symbology.* MIL-STD-1189B.

17. Title 40 CFR § 262. "Standards applicable to generators of hazardous waste." *Code of Federal Regulations,* Washington, D.C., Office of the Federal Register, National Archives and Records Administration.

18. Title 49 CFR § 172. "Shipping papers: additional description requirements." *Code of Federal Regulations,* Washington, D.C., Office of the Federal Register, National Archives and Records Administration.

19. U.S. Environmental Protection Agency. *Guidance for the Data Quality Objectives Process*. EPA-QA/G-4, Washington, DC, Quality Assurance Management Staff, U.S. Environmental Protection Agency.

20. Title 10 CFR § 71. "Packaging and transportation of radioactive material." *Code of Federal Regulations,* Washington, D.C., Office of the Federal Register, National Archives and Records Administration.

21. Title 49 CFR § 173. "Shippers–General requirements for shipping and packaging." *Code of Federal Regulations,* Washington, D.C., Office of the Federal Register, National Archives and Records Administration.

22. U.S. Department of Energy. *Packaging and Transportation Safety.* DOE Order 460.1. Washington, D.C.

23. U.S. Department of Energy. *Departmental Materials Transportation and Packaging Management.* DOE Order 460.2. Washington, D.C.

24. U.S. Department of Energy. CAO TRUPACT-II Operating and Maintenance Instructions, DOE/WIPP-93-1001. Carlsbad, New Mexico, Waste Isolation Pilot Plant, U.S. Department of Energy.

APPENDIX A

Radioassay Requirements for Contact-handled Transuranic Waste

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A.1 Introduction

Radioassay techniques are used to determine the radionuclide content of waste. Radioassay methods include both nondestructive and destructive techniques. The term "radioassay" includes all types of assay techniques. Nondestructive assay (NDA) refers only to nonintrusive assay techniques, whereas radiochemistry (RC) is used to refer to destructive assay techniques.

A list of NDA methods or techniques is included in section A-3. NDA techniques allow an item to be assayed without altering its physical or chemical form. Common NDA techniques rely on detection of either gamma rays or neutrons. NDA is performed on a waste container basis.

RC is the radiochemical analysis of a representative sample collected from the waste. The sample is then physically and/or chemically processed for subsequent analysis by standard radioactivity counting methods. When sites are using RC methods, they must perform them in compliance with established method-specific procedures, including demonstration of compliance with QAOs for precision, accuracy, completeness, comparability, and representativeness.

RC is most often used to quantify the radioisotopic content of well-mixed samples of waste from homogeneous waste streams (sludges or solidified liquids) for which, because of large quantities of hydrogen and a dense matrix, neither neutron nor gamma NDA techniques are as accurate.

Several regulations and criteria that apply to WIPP require radionuclide data:

- The quantities of radionuclides listed in section 3.3.1 must be tabulated in a cumulative WIPP emplacement inventory.

- The activity concentration of TRU radionuclides present in every waste container (nCi/g) must be determined to demonstrate that the waste meets the definition for TRU waste.

- Values for total alpha radioactivity and activities of individual radionuclides for individual containers are required to determine compliance with limits placed on individual containers for FGEs, PE-Ci, and decay heat.

For each CH-TRU waste container, the quantity of each specific radionuclide listed in section 3.3.1 must be reported. Trace radionuclides (less than 5 percent of the total activity) need not be reported, so long as 95 percent of the total container radioactivity is accounted for. In the event that waste containers that have been radioassayed are overpacked (e.g., in an SWB), sum the individual activity values and divide by the net waste weight (total less container, shielding, and liner weights) to determine the activity per gram.

Currently used NDA techniques often do not directly identify and quantify all the individual radionuclides present in TRU waste. Instead they typically measure a few

key radionuclides, which are then used to calculate quantities of unmeasured radionuclides by use of isotopic ratios. These ratios can be provided by AK of isotopic ratios, by direct measurements using relative gamma spectrum analysis, or by RC techniques. AK provided for non-hazardous waste must meet the WAP requirements for hazardous waste.

NDA measurements taken previously may be used without additional assays provided the data are traceable and of sufficient quality to meet current quality requirements.

A.2 Quality Assurance Objectives

Each site shall demonstrate and technically justify that the radioassay techniques used are appropriate for the specific waste stream and TRUCON waste type being assayed. The QAOs for radioassay are summarized in table A-1. The NDA QAOs have been established for precision and accuracy. Sites shall demonstrate that the QAOs can be achieved for each radioassay system over the applicable ranges of measurement. The QAOs must be demonstrated on containers of the same nominal size as those in which the waste is assayed.

QAO's for representativeness and completeness are not applicable to NDA since every container is subject to radioassay. However, representativeness and completeness do apply to RC. For RC analysis of waste samples, representativeness shall be achieved by the collection of unbiased samples. If analysis of representative samples is planned by the site for characterization of a waste stream, the site shall document the basis for the statistical sampling strategy and the selection of waste containers for sampling.

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 radioassay data are those that were obtained when the laboratory or testing facility demonstrated that the instrumentation and method were in control.

Table A-1
Quality Assurance Objectives for Radioassay

Range of Waste Activity in α-Curies[a]	Nominal Compliance Point α-Curies[a] (g WG Pu)[b]	Precision[c] (%RSD)	Accuracy[d] (%R)
0 to 0.02	0.008 (0.1)	≤ 20	70-130
>0.02 to 0.2	0.08 (1.0)	≤ 15	70-130
>0.2 to 2.0	0.8 (10)	≤10	70-130
> 2.0	12.8 (160)	≤ 5	70-130

[a] Applicable range of TRU activity to which the QAOs apply, units are curies of alpha-emitting TRU isotopes with half-lives greater than 20 years.

[b] The nominal activity (or weight of Pu) used to demonstrate that QAOs can be achieved for the corresponding range in column 1. Values in parentheses are the approximate equivalent weights of weapons grade plutonium (WG Pu) 15 years after purification; for purposes of demonstrating QAOs, "nominal" means within ±50 percent, except for the highest range, where "nominal" means ±25 percent.

[c] ± One standard deviation based on 15 replicate measurements of a noninterfering matrix. The calculated standard deviation is compared with the mean measured value of the QAO source to obtain the %RSD.

[d] Percent recovery (%R) determined from the ratio of measured to known values based on the average of 15 replicate measurements of a noninterfering matrix.

Precision. Sites shall demonstrate compliance with the QAO for precision by replicate processing of the appropriate-size mock waste container containing the quantities of TRU isotopes indicated in table A-1 for each range for which the measurement system is to be qualified. PDP standards and drums may be used after their characteristics have been published in a PDP test cycle report, if their use will not interfere with the PDP. The QAO radioactivity shall be distributed in a non-interfering matrix and shall not be one of the standards used to calibrate the counting system. A total of 15 replicate counts shall be obtained; the waste container shall be removed from the measurement system and reinserted between measurements. The calculated standard deviation of these measurements is compared with the mean measured value of the QAO source to obtain the %RSD.

Accuracy. Sites shall demonstrate compliance with the QAO for accuracy by replicate processing of a mock waste container of the appropriate size which contains the quantities of TRU isotopes indicated in table A-1 for each range for which the measurement system is to be qualified. This activity shall be in the form of a verification standard; that is, it shall be characterized as well as the calibration standards but it may not be one of the calibration standards and shall not be derived from or calibrated against one of the calibration standards. PDP standards and drums may be used after their characteristics have been published in a PDP test cycle report if their use will not

interfere with the PDP. The activity shall be distributed in a non-interfering matrix. A total of 15 replicate counts shall be obtained; the waste container shall be removed from the measurement system and reinserted between measurements. The accuracy shall be computed as the mean %R of the known value.

The minimum detectable concentration (MDC) for each assay method must be determined. In addition to being a function of the particular instrument and assay method, the MDC is also dependent on the radiation background, characteristics of the waste type being measured, and other factors. The MDC is defined here as that radioactivity concentration which, if present, yields a measured value greater than the critical level with 95% probability, where the critical level is defined as that value which measurements of the background will exceed with 5% probability.

Typically, a baseline detection limit is first determined by performing 15 replicate measurements on a surrogate drum with a matrix containing no added activity. Using the measured variance of background thus obtained, the appropriate equations in references A1 or A2 can then be used to calculate the baseline detection limit. To obtain the MDC for the actual waste drums, this detection limit may then need to be adjusted to account for interferences from different matrix conditions or radiation backgrounds that occur in the waste drums. Sites may use alternate methods of determining the MDC as long as they use the definition described in the preceding paragraph. It is recommended that the MDCs for an assay method be documented as a function of the interfering characteristics (e.g., MDC versus background level, matrix attenuation, drum weight, etc.) if feasible.

Only measured values greater than the minimum detectable concentration are valid for TRU waste determinations. Wastes can only be sent to WIPP when the measured TRU alpha activity concentration in the waste container is greater than 100 nCi/g and when the measured value is greater than the minimum detectable concentration. Effectively, this means that instruments performing TRU/low-level waste discrimination measurements must have an MDC of 100 nCi/g or less.

The method used to calculate the total measurement uncertainty (TMU) must be documented by each site. The TMU is used in a variety of calculations; however, it is not added to the assay value for the purpose of determining whether a container is classified as TRU waste. There is no numerical limit for TMU, but it must be properly calculated and documented. The TMU shall be determined in accordance with section A.7 of this appendix.

A.3 Methods Requirements

Any radioassay method may be used to assay TRU waste, provided that it is demonstrated that the assay method meets the requirements of the applicable QAOs and the TRUPACT-II SARP, appendix 1.3.7, Section 3.0. If more than one method is applied, it is recommended that they be tested for comparability of results.

NDA Methods Requirements. Various NDA assay methods (table A-2) are available subject to achieving the applicable QAOs. The list is neither complete nor limiting and is simply intended to illustrate the breadth of choices.

Table A-2
Typical NDA Methods

Types of Measurements	Methods
Gamma-ray measurements	High resolution spectroscopy (intrinsic germanium) Transmission corrected gamma-ray measurements - Segmented gamma-ray scanner - Computed tomographic gamma-ray scanner
Passive neutron measurements	Shielded neutron assay probe totals counter Passive neutron coincidence counter Advanced matrix corrected passive neutron counter High efficiency neutron counter
Calorimetric assay	Combination of heat flow calorimetry and gamma-ray spectrometry
Passive/active neutron measurements	Am-Li source-driven coincidence counter Californium delayed-neutron counter (shuffler) Neutron generator differential die-away counter Combined thermal/epithermal neutron counter

For NDA, the assay procedures cited in various American Society for Testing and Materials (ASTM) standards (references A3-A5) and NRC standard practices and guidelines (reference A6) as referenced in this appendix are recommended for use at all testing facilities. These procedures specify the use of NIST-traceable calibration standards, compatible equipment and equipment setup, record keeping, equipment maintenance, and safe operation of the equipment.

RC Methods Requirements. Any RC method may be used as long as the assay results meet the QAOs. Each laboratory used for TRU waste assay by RC shall demonstrate that the analytical methods are appropriate to assay the specific wastes for which they are proposed. Typical RC methods include:

- High resolution gamma spectrometry
- Gas proportional counting
- Liquid scintillation counting
- Alpha spectrometry
- Inductively coupled plasma–mass spectroscopy (ICP-MS)
- Fluorimetry

These methods must contain the following general provisions:

- Assay standards must be prepared and used as indicated in the standard test methods.

- The waste matrix should consist of an essentially uniform distribution of the radionuclides throughout. The sample taken from the waste must be sampled, weighed, and handled in a manner that ensures that it is representative and traceable to its specific waste batch or waste container.

- The waste must have been thoroughly mixed before assay samples are collected.

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

- All methods will be preceded by radiochemical separation and/or preparation for measurement

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. 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.

It shall be the responsibility of the facility QA officer to monitor and document procedure performance, including the analysis of QC samples. A nonconformance report must be initiated and resolved if the reported QC measurements do not meet the acceptance criteria. The facility QA officer and technical supervisor shall have the responsibility to implement corrective actions when acceptable procedure performance is not met.

Any radioassay technique used for TRU waste must be performed in accordance with calibration and operating procedures that have been written, approved, and controlled by the site.

Laboratory procedures must contain applicable quality controls. Table A-3 presents a list of laboratory control procedures that must be performed by laboratories involved in the TRU waste RC process.

Table A-3
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	See Laboratory Control Sample[a]
Method blank	One per analytical batch	Site-specific statistical control limits	See Method Blanks[b]
Laboratory duplicate	One per analytical batch	RPD (relative percent difference) $\leq$40, or project-specific requirements	See Laboratory Duplicate[c]
Matrix spike (MS)	One per analytical batch for ICP-MS	50 to 150%R	See Matrix Spike and Matrix Spike Duplicate[d]
Matrix spike duplicate (MSD)	One per analytical batch	50 to 150%R RPD $\leq$40, or project-specific requirements	See Matrix Spike and Matrix Spike Duplicate[d]
Radioiostopic tracers	Every sample	Site-specific statistical control limits	See Radioiostopic Tracer[e]

[a]**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. If LCS recoveries do not meet acceptance criteria, a non-conformance report is prepared and corrective action is initiated to determine the cause of the problem. Associated samples are qualified in the data report.

[b]**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. The acceptance criteria for method blanks are established by each site; they may be expressed as statistical control limits. Criteria may be absolute values, multiples of background variation, fractions of activity concentrations observed in samples, or other appropriate units. When results outside the criteria are obtained, a non-conformance report is prepared and corrective action is initiated to determine the cause of the problem. Associated samples are qualified in the data report.

[c]**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 between duplicate results is compared with the criteria; if the RPD between duplicate results does not meet the criteria, a non-conformance report is prepared and corrective action is initiated to determine the cause of the problem. Associated sample results are qualified in the data report.

[d]**Matrix Spike and Matrix Spike Duplicate**. Duplicate MSs on individual field samples are performed for 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. Sample data associated with non-compliant MS and MSD results are qualified in the data report.

[e]**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. The acceptance criteria for method blanks are established by each site; they may be expressed as statistical control limits. When yields outside the criteria are obtained, a non-conformance report is prepared and corrective action is initiated to determine the cause of the problem. Associated samples are qualified in the data report.

Background Measurements. Background measurements, when necessary, shall be performed daily, unless otherwise specified by radioassay system procedures.

Instrument Performance Checks. Performance checks for calorimetry should be performed at frequencies consistent with applicable consensus standards. Performance

checks on other NDA instruments shall be performed daily on calibrated and operable radioassay systems before use on that day; additional checks at other times may be advisable. Radioactive sources used for these checks are not required to be NIST traceable; however, they 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. Performance checks shall include efficiency checks and, for spectrometric instruments, energy calibration and resolution checks.

Control Charts. Background measurements and performance checks shall be plotted on applicable control charts to demonstrate continued acceptability of the assay system. If performance checks result in data that are outside the acceptable range, the radioassay system shall be removed from service pending completion of corrective actions, and all assays performed since the last acceptable performance check are suspect, pending satisfactory resolution.

Replicate Assays. For NDA, replicate assays shall be performed once per testing batch (defined as no more than 20 containers) or once per week, whichever is more frequent, except for calorimetric assay, where replicate assays shall be performed once per testing batch (defined as no more than 20 containers), or once per month, whichever is more frequent.

Comparison Programs. Sites using radioassay systems shall participate in any relevant measurement comparison program(s) sponsored or approved by the NTWP team leader. Such programs may be conducted as part of the NDA PDP (reference A7) or through other third parties.

Radioassay Operator Training. Only trained personnel shall be allowed to perform radioassays. Standardized training requirements for radioassay operators shall be based upon existing industry standard training requirements. Requalification of operators shall be based upon evidence of continued satisfactory performance and must be performed at least every two years.

A.5 Calibration Procedures and Frequencies

Each radioassay measurement system shall be calibrated before initial use and the calibration verified on at least one matrix/source combination at least annually. The same source/matrix combination should not be used repeatedly to satisfy the latter requirement. The CAO will consider circumstances where this may not be necessary on a case by case basis. Calibration methods are specific to the type of radioassay system being calibrated. It is recommended that calibrations be performed in accordance with consensus standards, when applicable consensus standards are available. For calorimetric assay, reference A8 should be used. If consensus standards are not used, full documentation of the calibration technique must be provided. All calibrations shall be performed as prescribed in written calibration procedures at frequencies to be determined by and specified in the procedures. Recalibrations shall occur after major repairs or if a verification of the calibration demonstrates that it has significantly changed after relocation of the system.

Primary calibration standards shall be obtained from NIST, the New Brunswick Laboratory, or suppliers maintaining measurement systems and standards traceable to NIST. When primary standards are not available, the standards used shall be cross-calibrated with primary standards obtained from the above sources. PDP standards and drums may **not** be used for calibrations since the calibration sources must be independent from sources used for verification measurements (i.e., the PDP). The range of applicability of system calibrations must be specified in site procedures. This shall include both the range of radioactivity loadings and the waste types or relevant waste matrix characteristics (e.g., densities, moderator content) for which the calibrations are valid.

A.6 Software Requirements

All computer programs and revisions thereof used for radioassay shall be documented, verified, and validated as required by the QAPD (reference A9). Verification shall include both verification of the algorithm used and test runs of the program comparing the program output to true values. Test runs shall exercise all default and boundary values of parameters. Performance of software controlling the measurement process and analyzing data shall be demonstrated and documented in accordance with ASME NQA-1, element 11, supplement 11S-2 (reference A10) and NQA-2, part 2.7 (reference A11). Performance may be demonstrated by the use of test problems and/or in the context of testing the performance of the measurement system with QC samples. Software testing must cover the full range of expected applications of the system.

Documentation of computer programs shall include, at a minimum:

Program name
Revision number
Revision date
Author(s)
Program application
Programming language (including version numbers of all compilers, linkers, etc.)
Operating system
Required hardware
Descriptions of algorithms used
User's manual
Listing of code
Examples of input and output forms
Results of test cases
Copies of external data files
Lists of default parameters
Records of review and approval

Site procedures for radioassay systems must contain all necessary instructions for the operation of computerized systems.

Radioassay data may be reduced using computer software that is specifically designed for the particular method used. This software must be identified in site procedures. Algorithms associated with each system shall be described in either site-specific or instrument-specific technical documentation; data outputs shall be collected and retained. Data should be electronically transferred whenever possible.

A.7 Total Measurement Uncertainty

Total measurement uncertainty quantifies the potential error in measurements taken by an assay system on a waste container within the waste stream. An NDA measurement of a waste container may deviate from the true value as a result of bias, random error, or a combination of the two. The TMU is composed of bias and random errors and is typically expressed as an interval extending below and above the measured value. The TMU is used to determine whether the radioactivity of individual waste containers may exceed specific criteria (e.g., the drum shipping limit of 200 FGEs). Each site may develop its own methodology for estimating TMU according to the principles described in this appendix. While there is no maximum TMU prescribed, it is generally advantageous to both WIPP and the sites for NDA measurement facilities to reduce measurement uncertainties to the lowest practical level.

Initial calibrations are typically performed using noninterfering waste matrices. However, random error and bias should also be evaluated using simulated waste. Mock-up drums representing site-specific waste characteristics may be constructed for this purpose, or existing test drums may be used. These test drums are used to estimate random errors and biases associated with inhomogeneous matrices and nonuniform source distributions over the expected range of radioactivity.

Calculations for TMU may incorporate data from similar assay systems, computational models (e.g., Monte Carlo simulation techniques), data from the measurements themselves (e.g., counting statistics), or data from experiments. In general, uncertainties due to random error, matrix effects, and nonuniform source distribution are expected to be the chief contributors to TMU; however, all of the following should be considered, as appropriate (reference A12):

- Random error
- Calibration uncertainties
- Nonuniform source distribution
- Self-shielding
- Self-absorption
- Attenuation
- Instrument-specific effects
- Inhomogeneous matrix effects
- Incorrect isotopic ratio assumption
- Gamma and neutron interfering materials
- Neutron multiplication

Random Errors. Random errors are deviations of individual measurements taken over time on a waste container from the average measurement for a waste container.

For radioassay, counting statistics are generally the largest contributor to random error. Other factors contributing to random error are environmental (e.g., humidity, atmospheric pressure), instrumental (e.g., detector gain fluctuations), or container effects (e.g., movement of container contents). Over many measurements, random errors tend to cancel out. Random errors are estimated by taking replicate measurements of real or mocked-up waste drums, selected as representative of a waste stream or waste type, over the expected range of radioactivity.

Bias. The bias of an NDA system is defined as the ratio of an averaged measurement to the true value for the waste container. If the ratio differs from 1, the system is biased with respect to that waste container. Biases occur due to the impossibility of calibrating the system perfectly for every waste container within a waste stream. Factors contributing to bias vary according to the waste type and radioassay method. Examples include matrix heterogeneity; impurities in the matrix that absorb, moderate, attenuate, or multiply radioactive emissions; nonuniform source distribution; and unexpected isotopic composition.

Sites must document how the individual elements contributing to TMU were determined and how they are combined to calculate the total TMU. The TMU must be correctly calculated and adequately documented. Compliance with these requirements will be evaluated in reviews of the TMU package for each assay system by an NDA technical specialist with assistance, as needed, from other CAO audit team members who have technical and practical proficiency in gamma and neutron assay techniques, statistics, TRU waste characteristics, and applicable regulatory requirements.

A.8 Data Management

The results of radioassay for each waste container must be documented and available to the data user. Requirements for radioassay data validation and reporting are presented below.

Data Validation

All radioassay data must be reviewed and approved by qualified personnel prior to being reported. The validation process includes verification that the QAOs in table A-1 have been met. The demonstration that QAOs have been met for specific measurement systems need only be made for the ranges in table A-1 for which the measurement system will actually be used.

Data Reporting

The results of radioassay must be documented and available to data users. Radioassay testing facilities must retain raw data in sufficient detail and with adequate support documentation to repeat all calculations as necessary. If activities of isotopes other than the nominal isotopes of interest are detected by an actual waste measurement, the activity of each of these isotopes must be reported as part of the waste assay for that container.

Radioassay testing data must be reported to the site project office on a testing batch basis. Batches are defined, for the purpose of the program, as a suite of waste containers undergoing radioassay using the same testing equipment. A testing batch can be up to 20 waste containers without regard to waste matrix.

Each radioassay testing facility is required to submit testing batch data reports for each testing batch to the site project office on approved standard forms (or electronic equivalent). Site-specific documentation must include example forms (or electronic equivalent) that will be used for reporting. Radioassay testing batch data reports shall consist of the following:

Testing facility name, testing batch number, drum numbers included in that testing batch, and signature releases of radioassay testing personnel as described in section B3-10 of the WAP.

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Background and performance check data or control charts for the relevant time period.

Data review checklists for each testing batch verifying that the data generation level review as described in section B3-10 of the WAP has taken place.

Separate testing report sheet(s) for each sample in the testing batch that includes

- Title "Radioassay Data Sheet"
- Method used for NDA (i.e., procedure identification)
- TRUCON code, Item Description Code, matrix parameter category, as applicable
- Date of NDA examination
- Total ^{239}Pu FGEs (g) and associated uncertainty
- Total alpha activity and associated uncertainty (curies)
- TRU activity and associated uncertainty (nCi/g)
- Listing of individual radioisotopes present (curies) and associated uncertainty (curies)
- Thermal power and associated uncertainty (W)
- QC replicate (yes/no)
- Operator signature/date
- Reviewer signature/date

All associated uncertainties shall be reported at the 95-percent confidence level. In all cases, the total uncertainties in the assay must be calculated as described in section A.7. A form containing all the information specified above must be completed and signed. In addition, radioassay-testing facilities located on sites shall maintain the following items in their files, documented and retrievable by testing batch number:

- All raw data, including instrument readouts, calculation records, and radioassay QC results
- All instrument calibration reports, as applicable

Contract radioassay testing facilities shall forward these items along with testing batch data reports to the site project office for storage in site project files. As with batch data reports, these items may be submitted in electronic format.

References for Appendix A

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A6. 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.

A7. U.S. Department of Energy. *Performance Demonstration Program Plan for Nondestructive Assay for the TRU Waste Characterization Program.* DOE/CAO-95-1045, Current Revision. Carlsbad, New Mexico, Carlsbad Area Office, U.S. Department of Energy.

A8. American National Standard for Nuclear Materials. *Plutonium-Bearing Solids Calibration Techniques for Calorimetric Assay.* ANSI N15.22-1987

A9. U.S. Department of Energy. *Quality Assurance Program Document.* CAO-94-1012. Carlsbad, New Mexico, Carlsbad Area Office, U.S. Department of Energy.

A10. ASME NQA-1-1989. *Quality Assurance Program Requirements for Nuclear Facilities.*

A11. ASME NQA-2a-1990 addenda, Part 2.7 *Quality Assurance Requirements of Computer Software for Nuclear Facility Applications.*

A12. Smith, K. C., 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, Nov. 17-19, 1998, pp.21-37.

APPENDIX B

^{239}Pu Equivalent Activity

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The concept of ^{239}Pu equivalent activity (PE-Ci) 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 generator/storage 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.

Operational releases from the WIPP facility, including both routine and accident-related, are airborne. There are no 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, A_i is the activity of radionuclide i, and WF_i 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 highest 50-year effective whole-body dose commitment.

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

The values of E_o and E_i may be obtained from DOE/EH-0071 (reference B1). Weighting factors calculated in this manner are presented in table B-1 for selected radionuclides of interest.

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

Radionuclide	Pulmonary Clearance Class[a]	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

[a](W) Weekly, (Y) Yearly

Reference for Appendix B

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

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Acceptable knowledge - Knowledge used for waste characterization, which is based on the materials and processes used to generate a waste. Acceptable knowledge includes information about the physical form of the waste, the base materials composing the waste (especially hazardous and radioactive materials), and the process that generated the waste. Acceptable knowledge is used to define waste streams, assign summary categories, assign EPA hazardous waste numbers, estimate the weight fraction of CRP, and estimate isotopic ratios.

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.

Americium - A TRU element resulting from the beta decay of ^{241}Pu. Symbol is Am.

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 DOE to authorize the operation of nuclear facilities and processes.

Characterization - Sampling, monitoring, and analysis—whether by review of AK, nondestructive examination, NDA, RC, headspace gas analysis, or chemical analysis of the volatile or semi-volatile organic compounds or metals—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 which 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 analytical, 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. Valid samples are those collected and submitted for analysis that were representative and met all preservation requirements upon arrival at the laboratory.

Compressed gas - Compressed gases are those materials defined as such by 49 CFR § 173, subpart G.

Contact-handled transuranic waste - Transuranic waste with a surface dose rate not greater than 200 mem/h. The container itself provides sufficient protection, and no extra shielding is required.

Content code - A uniform system applied to waste forms to group those with similar characteristics for purposes of shipment in the TRUPACT-II. The content code is not to be confused with the item description code.

Corrosive/Corrosivity - A solid waste exhibits corrosivity if a sample of the waste is either aqueous and has a pH $\leq$2 or $\geq$ 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° (130°F). (40 CFR §261.22)

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, subsection 5).

DOE Field Element - The first line DOE field element that carries the organizational responsibility for (1) managing and executing assigned programs, (2) directing contractors who conduct the programs, and (3) ensuring that environment, safety, and health are integral parts of each program.

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

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

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

Fissile material - Any material consisting of or containing one or more fissile radionuclides such as ^{233}U, ^{235}U, and ^{239}Pu. Fissile materials are classified according to the controls needed to provide nuclear criticality safety during transportation, as provided in 49 CFR § 173.455. Certain exclusions are provided in 49 CFR § 173.453.

Free liquid - (1) A liquid that readily separates from the solid portion of a waste under ambient temperature and pressure. (2) Liquid that is not sorbed into a host material such that it could spill or drain from its container.

g-value - The number of hydrogen molecules generated per 100 electron volts of energy absorbed.

Hazardous waste - Those wastes which are designated hazardous by EPA (or state) regulations. For a detailed description, see 40 CFR § 261.3. Hazardous wastes are listed in 20 NMAC 4.1, subpart II (40 CFR § 261) and/or exhibit one of the four characteristics in 20 NMAC 4.1, subpart II (40 CFR § 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.

Mixed waste - Radioactive waste (as defined by the AEA) that contains hazardous constituents listed in 40 CFR § 261, subpart D (Lists of Hazardous Wastes) or that exhibits any of the hazardous waste characteristics identified in 40 CFR 261, subpart C (Characteristics of Hazardous Waste) (i.e., waste that contains both radioactive and hazardous components, as defined by the AEA and the RCRA).

Overpack - A payload container placed around another container to control contamination or to enclose a damaged container. The term 85-gallon drum is used to refer to 79-, 83-, and 85-gallon drums when used to overpack 55-gallon drums.

Package - (1) A packaging plus its contents. (2) The reusable Type B shipping container (i.e., TRUPACT-II) 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 - (1) For radioactive material, the assembly of components necessary to ensure compliance with the packaging requirements of 40 CFR § 173.40, subpart I. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The conveyances, tie-down system, and auxiliary equipment may sometimes be designated as part of the packaging. (2) The reusable Type B shipping container for transport of TRU waste payload containers (i.e., TRUPACT-II). (3) A shipping container without its contents.

Packaging quality assurance program - A site-specific 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 § 71, subpart H.

Payload container - The outermost container for TRU waste material that is placed in a reusable Type B shipping container (i.e., TRUPACT-II) for transport.

Payload container assembly - An assembly of payload containers, such as a seven-pack of drums, that is intended to be handled and emplaced as a single unit.

Pipe component - 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 - A metallic radioactive element used as a nuclear fuel to produce radioactive nuclides for research and as the fissile agent in nuclear weapons. The symbol is Pu.

Plutonium equivalent curie (PE-Ci) - 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 - Materials that may ignite spontaneously in air or that emit sparks when scratched or struck, especially with materials such as steel. A flammable solid that, under transport conditions, might cause fires through friction or retained heat or that can be ignited readily and, when ignited, burns vigorously and persistently so as to create a serious transportation hazard. Included in the pyrophoric definition are spontaneously combustible materials, water reactive materials, and oxidizers. Examples of nonradioactive pyrophorics are organic peroxides, sodium metal, and chlorates.

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 - TRU waste that requires shielding in addition to that provided by the container to protect people nearby from radiation exposure, where the external surface dose rate at the outer surface of the container exceeds 200 mrem per hour but is less than 1000 rem per hour.

Residual liquid - Liquids in quantities of less than 1 volume percent of the waste container that result from liquid residues remaining in well-drained internal containers, condensation of moisture, and liquid separation resulting from sludge/resin setting.

Shipper - A TRU waste generator/storage site that releases a TRUPACT-II to a carrier for shipment.

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/storage sites.

Standard waste box - A payload container designed and manufactured in accordance with WIPP Engineering Specification E-I-343, authorized for use with TRUPACT-II transportation packages, that has been tested by DOE to meet DOT Specification 7A Type A requirements.

Ten-drum overpack - A metal payload container (73 inches high and 72 inches in outside diameter), authorized for use within the TRUPACT-II packaging, that has been tested by DOE to meet DOT Specification 7A Type A requirements.

Transuranic 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 § 61. (Reference 2, section 2, subsection 18)

TRUCON content codes - (1) The document containing a description of the waste stream, waste form, and package configuration for each waste content code authorized for shipment in TRUPACT-II containers. (2) A type of shorthand representation of the chemical content and physical waste form of generator waste streams for use in the transportation safety analyses.

TRU mixed waste - TRU waste that is also a hazardous waste as defined by the Hazardous Waste Act and 20 NMAC 4.1.200 (incorporating 40 CFR § 261.3). (Reference 6, module I, section I.D.6)

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

TRUPACT-II Authorized Methods for Payload Control - (1) The acceptance criteria for TRUPACT-II, covering U.S. DOT requirements for waste transportation. This document lists the authorized methods for meeting the TRUPACT-II payload requirements. (2) A site-specific document describing the activities applicable to the TRUPACT-II methods for payload control compliance defined in the Certificate of Compliance for the TRUPACT-II issued by the NRC. (3) The TRAMPAC is chapter 1.3.7, section 13 of the TRUPACT-II SARP. The SARP designates the responsibility to the NTWP for ensuring that TRUPACT-II users comply with the TRUPACT-II SARP and Certificate of Compliance.

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.

Volatile organic compounds - For the purposes of the TRU waste program, those RCRA-regulated VOCs listed in the WAP and any additional compounds tentatively identified by VOC analytical procedures used to satisfy program requirements (i.e., any compound containing carbon and hydrogen with any other element that has a vapor pressure of 77.6 mL of mercury (1.5 psia) or greater under actual storage conditions).

Waste acceptance criteria - Constraints (limits) on the physical, chemical, and radiological properties of TRU waste and its packaging as determined by 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 are imposed to ensure the health and safety of both workers and the public in addition to the protection of the environment.

Waste analysis plan - The waste analysis plan includes test methods, details of planned waste sampling and analysis, a description of the waste shipment screening and verification process, and a description of the QA/QC program. Sites are required to implement the applicable requirements of the WAP. (Reference 6, attachment B)

Waste characterization - The process of determining that TRU waste meets the requirements of the WAC by the acceptable performance of the activities defined by site-specific, CAO-approved plans outlined in table 2.4.

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

Waste stream - A waste stream is waste material generated from a single process or from an activity which is similar in material, physical form, and hazardous constituents (reference 6, attachment B).