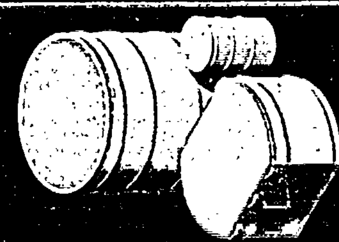
May 2004

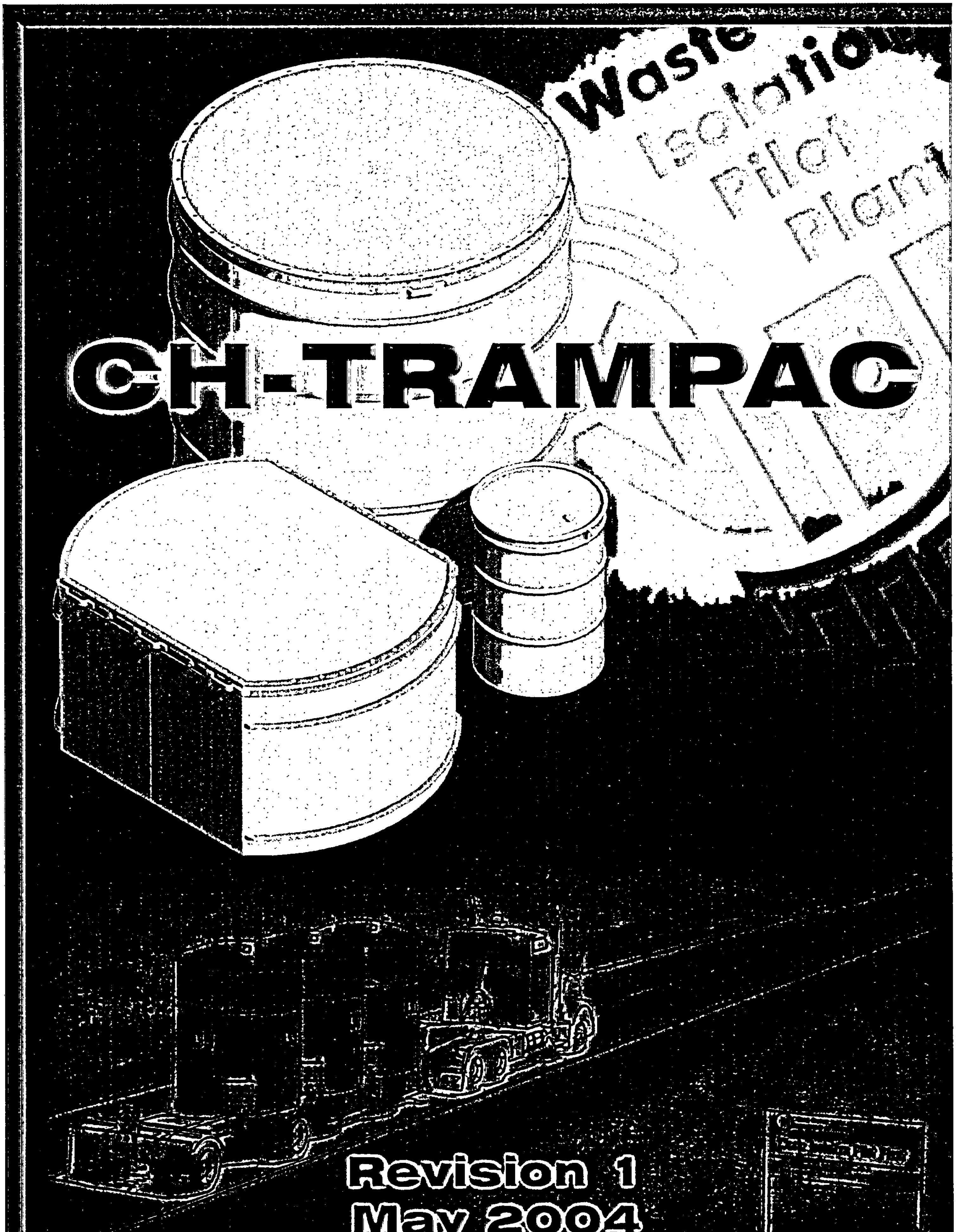
Attachment E2

Revised Pages for Revision 1 (May 2004) of the Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC)

CH-TRAMPAC

Revision 1
May 2004

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Revision 1
May 2004

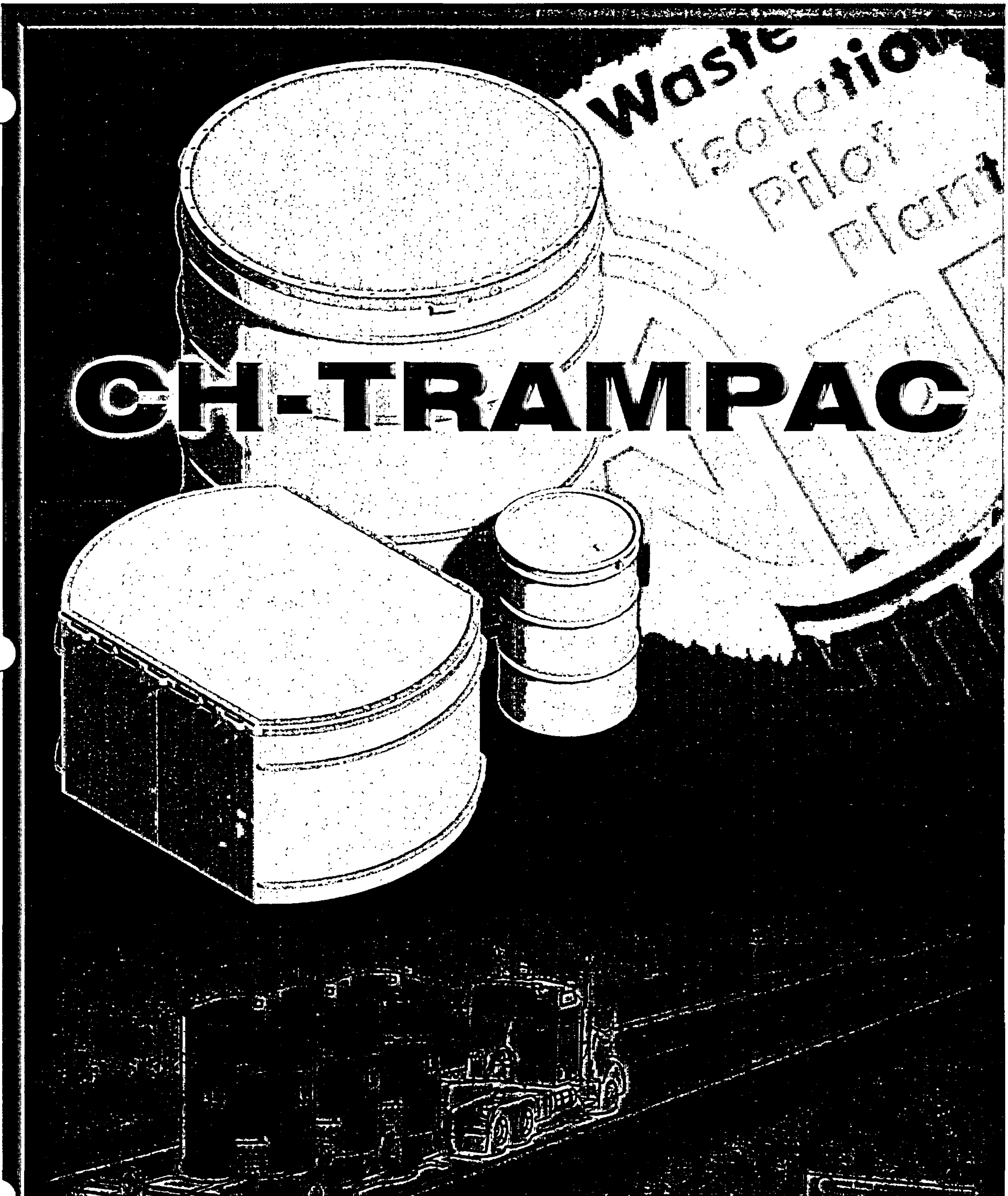
CH-TRAMPAC
Revision 1
May 2004

TABLE OF CONTENTS

TABLE OF CONTENTS *(Continued)*

TABLE OF CONTENTS *(Continued)*

TABLE OF CONTENTS *(Continued)*

TABLE OF CONTENTS *(Continued)*

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

1.0 INTRODUCTION

The Contact-Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC) is the governing document for shipments in the Transuranic Package Transporter-II (TRUPACT-II) and HalfPACT packagings. All users of the TRUPACT-II and the HalfPACT shall comply with all payload requirements outlined in this document, using one or more of the methods described. Supporting information for the limits and compliance methods defined in this document is contained in the CH-TRU Payload Appendices.

1.1 Scope

The TRUPACT-II and the HalfPACT have been developed as Type B packagings to provide a safe means of transporting contact-handled (CH) transuranic (TRU) wastes and other authorized payloads such as tritium-contaminated materials. The shipment of tritium-contaminated waste shall be as described in Appendix 6.11 of the CH-TRU Payload Appendices. The shipment of Content Code LA 154 from Los Alamos National Laboratory shall be as described in Appendix 6.12 of the CH-TRU Payload Appendices. The shipment of waste packaging configurations with a single unvented heat-sealed bag layer in addition to other layers of confinement shall be as described in Appendix 6.13 of the CH-TRU Payload Appendices. Both packagings consist of an outer containment assembly (OCA), an inner containment vessel (ICV), and two aluminum honeycomb spacer assemblies, with the HalfPACT being a shorter version of the TRUPACT-II. The CH-TRAMPAC defines the authorized contents for both packagings. The defined payload is, for the most part, independent of packaging. Information that is specific to the TRUPACT-II or the HalfPACT packaging is identified as such within the CH-TRAMPAC.

1.2 Purpose

The purposes of the CH-TRAMPAC are to:

- Define the applicable requirements for a payload to be transported in the TRUPACT-II or HalfPACT packaging
- Describe the acceptable methods of compliance that shall be used to prepare and characterize the CH-TRU materials or other payload materials prior to transport in a TRUPACT-II or HalfPACT packaging
- Identify the quality assurance (QA) program that shall be applied to these methods.

1.3 Requirements

Requirements are established to ensure compliance of the payload with the transportation parameters of the TRUPACT-II and HalfPACT packagings. The CH-TRAMPAC defines payload requirements under the following categories:

- Container and Physical Properties (Chapter 2.0)
- Nuclear Properties (Chapter 3.0)

- Chemical Properties (Chapter 4.0)
- Gas Generation (Chapter 5.0)
- Payload Assembly (Chapter 6.0)
- Quality Assurance (Chapter 7.0).

1.4 Methods of Compliance

This document describes allowable methods to be used for determining compliance with each payload requirement and the controls imposed on the use of each method. Each generator or storage site shall select and implement a single method, or a combination of methods, to ensure that the payload is compliant with each requirement and is qualified for shipment. These methods shall be delineated in a programmatic or waste-specific data TRU Waste Authorized Methods for Payload Control (TRAMPAC).

Each shipper shall document and demonstrate compliance with the CH-TRAMPAC by one of the following methods:

- A programmatic TRAMPAC, which defines the process in which payload compliance is met, will be prepared by the shipper and approved by the U.S. Department of Energy (DOE) Carlsbad Field Office (CBFO). Implementing procedures of the TRAMPAC will be reviewed by the DOE-CBFO for completeness and compliance as part of the audit process.

  Compliance with transportation requirements applies to the following two categories of waste:

  1. Waste Generated Under a Formal Certification Program. Payload containers in this category (designated "100 Series") are characterized individually based on process knowledge and visual examination at the time of waste generation. For sites using a set of site/equipment-specific procedures for payload control for compliance, an independent verification of compliance must be performed prior to transport for no less than 10 percent of the 100 Series payload containers transported from each site per year. This independent verification may consist of a second operator verifying the container contents or waste records during the waste generation process or radiography.

  2. Waste Generated Prior to Site Implementation of a Formal Certification Program. Payload containers in this category (designated "200 Series") are characterized based on process knowledge. An independent verification of compliance shall be performed prior to transport for 200 Series waste using a statistical sampling program comprised of the methods identified in this section (visual examination, radiography, measurement, etc.).

- For small quantity shipments, a waste-specific data TRAMPAC will be prepared by the shipper and approved by the DOE-CBFO. The waste data are evaluated against the requirements in this document. A small quantity shipment may be made by any waste generator who does not have a DOE-CBFO approved programmatic TRAMPAC or a waste generator with a limited number of containers not addressed within their programmatic TRAMPAC.

A summary of the methods of compliance that shall be used for TRUPACT-II and HalfPACT payload control is provided in the following sections.

1.4.1 Visual Examination

Visual examination at the time of waste generation may be used to qualify waste for transport (e.g., 100 Series waste). The operator(s) of a waste generating area shall visually examine the physical form of the waste according to site/equipment-specific procedures and remove all prohibited waste forms prior to placement in the payload container. Observation of the waste generation process by an independent operator may be used as an independent verification of compliance prior to closure of the payload container. Visual examination under a sampling program may be used as independent verification (e.g., to verify the absence of prohibited items in 200 Series waste).

1.4.2 Visual Inspection

Visual inspection may be used to evaluate compliance with specific restrictions (e.g., visual inspection of payload container type, marking, etc.). Visual inspection by a second operator may be considered independent verification.

1.4.3 Radiography

Radiography, or equivalent nondestructive examination techniques, may be used as an independent verification to qualify waste for transport after the payload container is closed (e.g., to nondestructively examine the physical form of the waste and to verify the absence of prohibited waste forms). A radiography system normally consists of an X-ray-producing device, an imaging system, an enclosure for radiation protection, a waste container handling system, an audio/video recording system, and an operator control and data acquisition station. Some variation within a given nondestructive examination system will exist between sites. Site/equipment-specific QA and quality control (QC) procedures ensure that radiography system operator(s) are properly trained and qualified. Appendix 5.1 of the CH-TRU Payload Appendices describes typical real-time radiography procedures.

Other radiographic methods must meet the same performance objectives for real-time radiography (i.e., to nondestructively examine the physical form of the waste and to verify the absence of prohibited items in a payload container) and must be controlled by procedures similar to those described in Appendix 5.1 of the CH-TRU Payload Appendices for real-time radiography.

1.4.4 Records and Database Information

Information obtained from existing site records and/or databases or knowledge of process may be used to qualify waste for transport (e.g., as a basis for reporting the absence of prohibited waste forms within waste containers). This information may be verified using radiography (Section 1.4.3) and/or a waste sampling program (Section 1.4.6).

1.4.5 Administrative and Procurement Controls

Site-specific administrative and procurement controls may be used to show that the payload container contents are monitored and controlled and to demonstrate the absence of prohibited items.

1.4.6 Sampling Programs

Sampling programs comprised of the statistical application of other methods identified in this section may be used as an independent verification of compliance (e.g., for 200 Series waste). A site-specific statistical sampling program designed to address all payload requirements needing verification is recommended. Appendix 5.3 of the CH-TRU Payload Appendices describes previous sampling programs at the DOE sites.

1.4.7 Measurement

Direct measurement or evaluation based on analysis using the direct measurement may be used to qualify waste (e.g., direct measurement of the weight or analysis of assay data to determine decay heat).

1.5 CH-TRUCON Document

The CH-TRU Waste Content Codes (CH-TRUCON) document[1] is a catalog of TRUPACT-II and HalfPACT authorized contents and a description of the methods utilized to demonstrate compliance with the CH-TRAMPAC.

1.5.1 Required Elements

Each content code within the CH-TRUCON document must contain the following elements:

CONTENT CODE: Identifies the two-letter site abbreviation that designates the physical location of the waste and the three-digit code that designates waste generation relative to implementation of a formal certification program and the physical and chemical form of the waste. Content code identifiers are defined in the CH-TRUCON (Tables 3 and 4).

CONTENT DESCRIPTION: Identifies the physical form of the waste (e.g., describing whether it is inorganic or organic, solidified or solid). This is similar to the waste material type titles in Section 5.1.

STORAGE SITE: Provides the location of the waste, if the location is different than the generating site. If the generating site and storage site are the same, this section is not required to be included in the content code.

[1] U.S. Department of Energy (DOE), "CH-TRU Waste Content Codes (CH-TRUCON)," current revision, DOE/WIPP-3194, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

GENERATING SITE: Provides the location of waste generation.

WASTE DESCRIPTION: Provides basic information regarding the nature and/or main components of the waste.

GENERATING SOURCE(S): Lists processes and/or buildings at each site that generate the waste in each content code.

WASTE FORM: Provides more detailed information on the waste contents, how the waste is processed, and/or specific information about the chemistry of constituents.

WASTE PACKAGING: Describes, in detail, techniques necessary for waste packaging in a given content code. This includes a description of the waste confinement layers, the number of layers of confinement used in packaging waste, and the mechanism for bag, can, or container closure.

ASSAY: Describes the types of radioactive materials measurement techniques or other methods utilized to obtain fissile material content and decay heat values for a particular content code.

FREE LIQUIDS: Describes the procedures used by the sites to ensure that the limits imposed on free liquids (<1% by volume) are met for each content code.

EXPLOSIVES/COMPRESSED GASES: Identifies the methods used to preclude the presence of explosives or compressed gases, except for incidental aerosol cans.

PYROPHORICS: Describes the controls in place at each site to ensure that nonradioactive pyrophoric materials in TRU waste are excluded, reacted to render nonreactive, or are immobilized prior to placement in waste.

CORROSIVES: Describes the controls in place to ensure that corrosive materials in TRU waste either are not present or are neutralized or immobilized prior to placement in a payload container.

CHEMICAL COMPATIBILITY: Describes the controls in place to ensure chemical compatibility for the waste contents and the TRUPACT-II or HalfPACT packaging. All chemicals/materials in the waste for a specific content code are restricted to the allowable chemical lists (Tables 4.3-1 through 4.3-8) and the 5% limit on total materials not listed as specified in Section 4.3.

PAYLOAD CONTAINER VENTING AND ASPIRATION: Details how payload containers that have been stored in an unvented condition (i.e., no filter and/or unpunctured liner) will be aspirated to ensure equilibration of any gases that may have accumulated in the closed container. This procedure is required only for unvented waste.

ADDITIONAL CRITERIA: Provides details on how the waste qualifies for shipment by meeting additional transport requirements (e.g., venting payload containers and liners).

SHIPPING CATEGORY: Shipping categories based on the above parameters for each content code are summarized in the CH-TRUCON (Table 2).

MAXIMUM ALLOWABLE WATTAGE: The maximum allowable wattage limit for each shipping category is determined in accordance with Section 5.2.3.

1.5.2 Use and Approval

All containers must have a content code approved by the Waste Isolation Pilot Plant (WIPP) CH-TRU Payload Engineer to be eligible for shipment. Any site requiring the transportation of TRU waste in the TRUPACT-II or HalfPACT that is not described in an approved content code must request the revision or addition of a content code by submitting a request in writing to the WIPP CH-TRU Payload Engineer.

The WIPP CH-TRU Payload Engineer has the authority to approve a content code request only if compliance with the transportation requirements of the CH-TRAMPAC document can be demonstrated. Any submittal not meeting the requirements of the CH-TRAMPAC shall not be approved for inclusion in the CH-TRUCON document or be used as the basis for a shipment in the TRUPACT-II or HalfPACT. The WIPP CH-TRU Payload Engineer does not have the authority to change the transportation requirements for the TRUPACT-II or the HalfPACT as specified in the CH-TRAMPAC document without approval from the U.S. Nuclear Regulatory Commission (NRC).

Requests for revisions to content codes shall be submitted to the WIPP CH-TRU Payload Engineer and may include the following:

- Minor revisions to the content code descriptions (e.g., changes to buildings or sources generating the waste)
- Changes to method(s) used to characterize the waste (e.g., the use of an alternate approved assay method)
- Changes to the packaging descriptions (e.g., the use of a different number of bag layers)
- Addition of a new authorized waste form from a given site (e.g., shipment of filter waste)
- Minor revisions to the chemical list for a specific content code.

The process for requesting a content code addition or revision is as follows:

1. The site prepares in writing a request containing sufficient information to satisfy all of the necessary elements identified in Section 1.5.1. If the request is for a content code revision, only the revised elements require preparation and documentation. The site shall ensure that the information submitted in the form of a content code addition

or revision accurately describes the waste and waste generating processes based on site knowledge.

2. The site submits the request (e.g., draft content code or revised content code elements) in writing to the WIPP CH-TRU Payload Engineer for review.

3. The WIPP CH-TRU Payload Engineer shall review the submittal for completeness and satisfactory demonstration of compliance with all the transportation requirements of the CH-TRAMPAC. As part of this review, the WIPP CH-TRU Payload Engineer's responsibilities may include a review to ensure that each of the previously identified elements is complete, the calculation or verification of new payload shipping categories to accommodate changes in packaging configurations using the Numeric Payload Shipping Category Worksheet (Tables 2.2-1 through 2.2-4 in Appendix 2.2 of the CH-TRU Payload Appendices), and the analysis of compliance with the list of allowable materials (for new waste forms or for changes in chemical composition) pursuant to Section 4.3. The WIPP CH-TRU Payload Engineer shall not approve any submittal that does not demonstrate compliance with every transportation requirement for the TRUPACT-II and HalfPACT.

4. Upon completion of the review, the WIPP CH-TRU Payload Engineer shall send formal written notification to the site indicating the status of the request. If the request is denied, the WIPP CH-TRU Payload Engineer shall indicate in the notification the reason why the request was not accepted and shall identify which elements of the submittal are incomplete or out of compliance.

5. If the request is approved, a site may begin using the new or revised content code once official written notification is received from the WIPP CH-TRU Payload Engineer. Sites may not use proposed content code additions or revisions to make shipments in the TRUPACT-II or HalfPACT prior to receipt of written notification from the WIPP CH-TRU Payload Engineer.

6. The WIPP CH-TRU Payload Engineer shall record all approved content code additions or revisions in the CH-TRUCON document. The current revision of the CH-TRUCON document shall be available to sites.

1.6 Compliance Program

1.6.1 Transportation Certification Official

The site Transportation Certification Official is responsible for administratively verifying the compliance of payload containers and the payload assembly with all transportation requirements. The site Transportation Certification Official shall approve by signature on the transportation certification documents every payload for transport.

1.6.2 DOE-CBFO

The DOE-CBFO is responsible for the performance of compliance verification audits, which are conducted prior to the first shipment and periodically thereafter to evaluate TRUPACT-II and HalfPACT payload compliance. Audit activities include document review and interview of site operators on a job-function basis relative to meeting the applicable criteria. Where specific technical ability is required (e.g., chemical compatibility, isotopic inventory, and assay), technical experts are included on the audit team. DOE-CBFO will grant or deny waste transportation authorization based on objective evidence of the audit and the recommendation of the audit team's report. Compliance verification audits are not required at sites that document compliance by preparing waste-specific data packages that are reviewed and approved by the DOE-CBFO.

1.7 Quality Assurance

The QA requirements applicable to the use of the TRUPACT-II and HalfPACT packagings are defined by Title 10, Code of Federal Regulations (CFR), Part 71 (10 CFR 71), Subpart H. The use and maintenance of the TRUPACT-II and the HalfPACT by the user are conducted under a QA program approved by the appropriate DOE field office. The compliance of a payload to be transported in the TRUPACT-II or the HalfPACT is determined by the user under a QA program approved by the DOE-CBFO (see Chapter 7.0).

2.0 CONTAINER AND PHYSICAL PROPERTIES REQUIREMENTS

2.1 Authorized Payload Containers

2.1.1 Requirements

Payload containers transported within the TRUPACT-II or HalfPACT shall comply with the specifications in Section 2.9.

The list of authorized payload containers and the associated maximum number of containers allowed in a TRUPACT-II and HalfPACT payload are summarized in Table 2.1-1

Table 2.1-1 — Authorized Payload Containers

Payload Container	Maximum Number Allowed in Payload	
	TRUPACT-II	HalfPACT
55-Gallon Drum	14	7
Standard Pipe Overpack[a]	14	7
S100 Pipe Overpack	14	7
S200 Pipe Overpack	14	7
S300 Pipe Overpack	14	7
85-Gallon Drum[b]	8	4
100-Gallon Drum	6	3
Standard Waste Box (SWB)	2	1
Ten-Drum Overpack (TDOP)	1	NA

[a]Standard pipe overpacks must be assembled into seven-packs of 6-inch standard pipe overpacks or 12-inch standard pipe overpacks only.
[b]The term "85-gallon drum" in this document includes 75- to 88-gallon drums.
NA = Not applicable.

2.1.2 Methods of Compliance and Verification

Compliance shall be by one, or a combination, of the following methods:

- Visual inspection to the specifications of Section 2.9.
- Administrative and procurement controls demonstrating that payload containers have been procured to the specifications of Section 2.9.

In addition to meeting the specifications of Section 2.9 at the time of procurement, the integrity of the payload container shall be visually inspected prior to transport to ensure that payload container is in good and unimpaired condition (e.g., no significant rusting and is of sound structural integrity). Compliance shall be documented in accordance with site-specific procedures prior to shipment.

2.2 Dunnage

2.2.1 Requirements

A shipper shall use empty 55-, 85-, or 100-gallon drums or an SWB as dunnage to complete a payload configuration if too few loaded payload containers are available that meet transportation requirements. The dunnage container(s) must meet the specifications of Section 2.9 with the exception that dunnage containers shall have at least one open vent port (i.e., not filtered or plugged).

Dunnage containers shall be marked in accordance with Section 2.4.

2.2.2 Methods of Compliance and Verification

Compliance shall be verified through visual inspection and documented prior to shipment.

2.7 Sharp or Heavy Objects

2.7.1 Requirements

Sharp or heavy objects in the waste shall be blocked, braced, or suitably packaged as necessary to provide puncture protection for the payload containers packaging these objects.

2.7.2 Methods of Compliance and Verification

Compliance shall be by one, or a combination, of the following methods:

- Review of records and database information, which may include knowledge of process
- Radiography
- Visual examination
- Sampling program.

2.8 Sealed Containers

2.8.1 Requirements

Sealed containers that are greater than 4 liters (nominal) are restricted as specified below except for Waste Material Type II.2 packaged in a metal container; Waste Material Type II.2 does not generate any flammable gas when packaged in metal cans (see Appendix 3.2 of the CH-TRU Payload Appendices). Retrievably stored payload containers with incidental rigid sealed containers greater than 4 liters (nominal) and less than or equal to 5 gallons (nominal) shall be overpacked in a configuration authorized in Section 2.9. Sealed containers that are greater than 5 gallons (nominal) in size (except for metal cans packaging Waste Material Type II.2) are prohibited.

The allowance for the incidental presence of sealed containers up to five gallons is specified to address ALARA issues associated with the removal of such sealed containers from retrievably stored payload containers. While sealed containers may have been used at a site, they are not primary components of the waste generated. Production and maintenance activities may have generated sealed containers incidental to the primary waste generation processes.

As an example, waste information from a site data set of approximately 7,000 55-gallon drums indicates the presence of sealed container(s) greater than 4 liters (nominal) in approximately 7 percent of the waste. Of this 7 percent inventory, site radiography data suggests that the majority (60 to 70 percent) of sealed containers are only slightly larger than 4 liters in size (carboy containers). The remaining inventory of sealed containers is less than or equal to five gallons in size and consists of metal buckets with crimped lids that are taped around the circumference and plastic bottles with screw top lids. Remediation efforts to date have involved the removal and inspection of these sealed containers. The results of this remediation show that the sealed containers have been stored safely and that the contents of the sealed containers are not pressurized, indicating that the sealed containers are low gas generators and have gas communication with the atmosphere outside of the sealed container. The containers (carboy containers, metal buckets, and plastic bottles) are not designed to withstand pressure or gas accumulation.

In terms of flammable gas generation analysis, the analysis presented in Section 5.0 accounts for all of the radioactive material in the payload container, including that present in any sealed container. The methodology also assumes that all of the radioactive material is in the same inner layer.

In addition, any unlikely gas release from the sealed container will not contribute to a pressure spike in a payload container (e.g., 55-gallon drum), given the maximum size of the sealed container (5 gallons [18.9 liters]), the volume of a payload container containing a sealed container (e.g., the volume of a 55-gallon drum is 208 liters, with waste materials and a significant void volume), and the gas release properties of the payload container filter (flow rate of 35 milliliters/minute at 1 inch of water [0.656 mole/minute/atmosphere]). Instead, the payload container will equilibrate to easily accommodate any gas release from an internal sealed container up to five gallons in size.

2.8.2 Methods of Compliance and Verification

Compliance shall be by one, or a combination, of the following methods:

- Review of records and database information, which may include knowledge of process
- Radiography
- Visual examination
- Sampling program.

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3.0 NUCLEAR PROPERTIES REQUIREMENTS

The nuclear properties requirements outlined in this section require a knowledge of isotopic composition and quantity of fissile material. The four major product material isotopic compositions are:

1. Weapons-grade plutonium (Pu) (primarily Pu-239)
2. Fuel-grade plutonium (primarily Pu-239)
3. Heat-source plutonium (primarily Pu-238)
4. Other TRU isotopes.

Site process areas usually only handle product materials of specific isotopic composition (e.g., weapons-grade plutonium has the following composition: 93.83% Pu-239, 5.82% Pu-240, 0.34% Pu-241, 0.02% Pu-242, 0.01% Pu-238). Therefore, the isotopic composition in the waste from specific process areas remains constant since product isotopic composition is closely controlled to meet production isotopic specification requirements.

3.1 Nuclear Criticality

3.1.1 Requirements

A payload container shall be acceptable for transport only if the Pu-239 fissile gram equivalent (FGE) plus two times the measurement error (i.e., two standard deviations) is less than or equal to the following limits:

Drums
- 200 grams for a 55-, 85-, or 100-gallon drum, except for drums containing greater than 1% by weight beryllium (Be) or beryllium oxide (BeO)
- 100 grams for a 55-, 85-, or 100-gallon drum containing greater than 1% by weight Be or BeO
- 55-, 85-, or 100-gallon drums containing greater than 1% by weight Be or BeO and machine-compacted waste are not shippable

SWBs and TDOPs
- 325 grams for an SWB or TDOP, except for SWBs or TDOPs containing greater than 1% by weight Be or BeO or machine-compacted waste
- 100 grams for an SWB or TDOP containing greater than 1% by weight Be or BeO
- 250 grams for an SWB or TDOP containing machine-compacted waste
- SWBs or TDOPs containing greater than 1% by weight Be or BeO and machine-compacted waste are not shippable

Pipe Overpacks
- 200 grams for a standard pipe overpack, S100 pipe overpack, S200 pipe overpack, or S300 pipe overpack. Pipe overpacks containing machine-compacted waste are not shippable.

Note: If a payload container will be overpacked, FGE limits apply only to the outermost payload container of the overpacked configuration.

A TRUPACT-II or HalfPACT shall be acceptable for transport only if the Pu-239 FGE plus two times the measurement error (i.e., two standard deviations) is less than or equal to the following limits:

No Credit for Pu-240 Poisoning

Drums

- 325 grams for a payload of 55-, 85-, or 100-gallon drums, except for payloads containing greater than 1% by weight Be or BeO. If a 55-, 85-, or 100-gallon drum contains machine-compacted waste in the form of "puck" drums, one of the following conditions must be met:
  - The packing fraction of puck drum contents shall not be greater than 70%, the minimum combined thickness of steel separating the fissile masses in two axially adjacent overpack drums shall be 0.12 inch, and, for TRUPACT-II payloads, the payload assembly shall utilize a polyethylene slipsheet and reinforcing plate, each with a nominal thickness of 0.15 in., that axially separate the top and bottom tier of payload containers, or
  - One compacted puck drum spacer shall be used in the bottom of each drum packaging the puck drums as per the specifications in Appendix 1.3.1 of the TRUPACT-II SAR and Appendix 1.3.1 of the HalfPACT SAR and, for TRUPACT-II payloads, the payload assembly shall utilize a polyethylene slipsheet and reinforcing plate, each with a nominal thickness of 0.15 in., that axially separate the top and bottom tier of payload containers.

  Compliance with these conditions shall be documented in site-specific documents.
- 250 grams for a payload of 55-, 85-, or 100-gallon drums containing less than or equal to 1% by weight Be or BeO and machine-compacted waste (i.e., not meeting one of the above conditions)
- 100 grams for a payload of 55-, 85-, or 100-gallon drums containing greater than 1% by weight Be or BeO

SWBs and TDOPs

- 325 grams for a payload of SWB(s) or a TDOP, except for payloads containing greater than 1% by weight Be or BeO
- 250 grams for a payload of SWB(s) or TDOP containing less than or equal to 1% by weight Be or BeO and machine-compacted waste
- 100 grams for a payload of SWB(s) or a TDOP containing greater than 1% by weight Be or BeO

Pipe Overpacks

- 2,800 grams per TRUPACT-II or 1,400 grams per HalfPACT for a payload of standard pipe overpacks, S100 pipe overpacks, S200 pipe overpacks, or S300 pipe overpacks.

A payload composed of both 55-gallon drums and standard pipe overpack payload containers shall be acceptable for transport only if the Pu-239 FGE plus two times the measurement error (i.e., two standard deviations) is less than or equal to the applicable 55-gallon drum payload limit.

If payload containers with different properties (e.g., machine-compacted and non-machine-compacted waste) are assembled in the same payload, the most-restrictive payload container and payload assembly limits and requirements shall apply to all payload containers.

Table 3.1-1 presents a summary of the FGE limits for payload containers and payloads.

Credit for Pu-240 Poisoning

- For payloads of 55-, 85-, or 100-gallon drums, or SWB(s) without machine-compacted waste containing less than or equal to 1% by weight Be or BeO, the package limits specified in Table 3.1-1 apply. The minimum Pu-240 content for the payload shall be determined after the subtraction of two times the error.

Table 3.1-1 — Summary of FGE Limits

FGE Limits with No Credit for Pu-240 Poisoning				
Contents	**Payload Container**	**Fissile Limit per Payload Container (Pu-239 FGE)[a]**	**Fissile Limit per TRUPACT-II Package (Pu-239 FGE)**	**Fissile Limit per HalfPACT Package (Pu-239 FGE)**
Not machine compacted with ≤ 1% by weight Be/BeO	Drum	200	325	325
	Pipe Overpack	200	2,800	1,400
	SWB	325	325	325
	TDOP	325	325	325
Not machine compacted with > 1% by weight Be/BeO	Drum	100	100	100
	Pipe Overpack	200	2,800	1,400
	SWB	100	100	100
	TDOP	100	100	100
Machine compacted with ≤ 1% by weight Be/BeO	Drum	200	250	250
	Pipe Overpack	Unauthorized	Unauthorized	Unauthorized
	SWB	250	250	250
	TDOP	250	250	250
Machine compacted with controls[b] and ≤ 1% by weight Be/BeO	Drum	200	325	325
	Pipe Overpack	Unauthorized	Unauthorized	Unauthorized
	SWB	Unauthorized	Unauthorized	Unauthorized
	TDOP	Unauthorized	Unauthorized	Unauthorized
Machine compacted with > 1% by weight Be/BeO	Drum	Unauthorized	Unauthorized	Unauthorized
	Pipe Overpack	Unauthorized	Unauthorized	Unauthorized
	SWB	Unauthorized	Unauthorized	Unauthorized
	TDOP	Unauthorized	Unauthorized	Unauthorized

FGE Limits with Credit for Pu-240 Poisoning		
Contents	**Minimum Pu-240 Content in Payload (grams)**	**Fissile Material Limit per Package (Pu-239 FGE)**
Not machine compacted with ≤ 1% by weight Be/BeO in drums or SWB(s)	5	340
	15	360
	25	380

[a] The FGE limit given applies to the payload container regardless of Pu-240 content in the package.

[b] The contents shall be machine-compacted waste in the form of "puck" drums and meeting the conditions specified in Section 3.1.1

3.2 Radiation Dose Rates

3.2.1 Requirements

The external radiation surface dose rate of an individual payload container shall be less than or equal to the limits specified in Table 3.2-1.

Table 3.2-1 — Maximum Surface Dose Rate Limits

Payload Container	Maximum Surface Dose (mrem/hr)
55-Gallon Drum	200
Standard Pipe Overpack	200
S100 Pipe Overpack	179
S200 Pipe Overpack	200
S300 Pipe Overpack	155
85-Gallon Drum	200
100-Gallon Drum	200
SWB	200
TDOP	200

The external radiation dose rates of the TRUPACT-II and the HalfPACT shall be less than or equal to 200 millirem per hour (mrem/hr) at the surface and less than or equal to 10 mrem/hr at 2 meters.

Additional payload container shielding, beyond that identified in Section 2.9 as an integral component of the payload container, shall be subject to the following restrictions. Payload containers that meet the above radiation dose rate requirements without shielding may be shielded to levels that are *as-low-as-reasonably-achievable* (ALARA). In addition, internal shielding may be used to meet the above requirement if shown to be fixed in location and configuration during normal conditions of transport. In addition, any reconfiguration under hypothetical accident conditions must be shown to be such that the post-accident dose rate shall not exceed 1 rem/hr at 1 meter from the surface of the package.

3.2.2 Methods of Compliance and Verification

The payload container surface dose rate shall be measured and compliance with the applicable limit recorded on the PCTCD or OPCTCD (see Section 6.2.1). Measurements shall be made with instruments traceable to a national standard. The dose rate for the TRUPACT-II and HalfPACT at the surface and at 2 meters shall be measured and compliance determined and documented in accordance with site procedures.

If supplemental shielding is used to meet the surface dose rate limits, the following methods must be used to demonstrate compliance:

(a) The structural response of the internal shield, to the extent utilized to provide distance and material attenuation of the source term, shall be verified through analysis and/or test with respect to the conditions of 10 CFR 71.71(c)(7) and 10 CFR 71.73(c)(1).

(b) The configuration of the shield in both the normal conditions of transport and hypothetical accident conditions scenarios, as determined in (a) above, shall be evaluated through analysis and/or test to establish the maximum neutron and/or gamma source term allowed to ensure that the package dose rate requirements of 10 CFR 71.47 and 10 CFR 71.51(a) are met.

(c) The analyses and/or tests conducted to satisfy the requirements of (a) and (b) above shall be performed under a 10 CFR 71 Subpart H equivalent QA program. The internal shield shall have been constructed under a shipping or generator site QA program and the resulting fabrication documentation shall be reviewed for compliance with the shield configuration evaluated in (a) above under a 10 CFR 71 Subpart H equivalent QA program.

Compliance with the above requirements shall be documented in each applicable case for submittal to the CH-TRU Payload Engineer, who will direct the review and evaluation of the request. Written approval is required before internal shielding may be used to meet the radiation dose rate requirement.

3.3 Activity Limits

3.3.1 Requirements

The TRUPACT-II and HalfPACT are limited to a maximum total activity of 406 curies (Ci) when packaging payloads of either S100 or S300 pipe overpacks. The S100 and S300 pipe overpack payloads are limited to sealed neutron sources in the forms specified in Table 3.3-1. Each payload shall be acceptable for shipment only if the determined activity plus the error (i.e., one standard deviation) meets this limit.

Table 3.3-1. Sealed Source Forms for S100 and S300 Pipe Overpacks

^{241}Am Be	^{238}Pu O	^{239}Pu Li	^{241}Am
^{238}Pu Be	^{239}Pu O	^{238}Pu B	^{238}Pu
^{239}Pu Be	^{244}Cm O	^{239}Pu F	^{239}Pu
^{241}Am O	^{241}Am Li	^{238}Pu ^{13}C	^{244}Cm

The contents of each S200 pipe overpack are limited to the radionuclides and associated activities listed in Table 3.3-2 for both the S200-A and S200-B shield insert configurations. Each S200 pipe overpack shall be acceptable for shipment only if the determined activity plus the error (i.e., one standard deviation) meets the applicable limit.

No activity limits exist for 55-gallon drums, standard pipe overpacks, 85-gallon drums, 100-gallon drums, SWBs, or TDOPs.

3.3.2 Methods of Compliance and Verification

Compliance with the activity requirements is similar to the compliance methodology described in Section 3.1.2.

The total activity plus the error (i.e., one standard deviation) for a payload of S100 or S300 pipe overpacks shall be calculated and compared to the limit (406 Ci).

For each S200 pipe overpack, the sum of "partial fractions" for any combination of radionuclides present in the waste must be less than or equal to one. The limits for individual radionuclides are specified in Table 3.3-2.

No activity limits exist for 55-gallon drums, standard pipe overpacks, 85-gallon drums, 100-gallon drums, SWBs, or TDOPs.

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4.0 CHEMICAL PROPERTIES REQUIREMENTS

4.1 Pyrophoric Materials

A pyrophoric (solid) is defined as:

> Any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.[1]

Examples of pyrophoric radionuclides are metallic plutonium and americium. Examples of nonradioactive pyrophorics, or materials/wastes that may cause a pyrophoric-type event, are organic peroxides, sodium metal, and chlorates.

All waste generating sites administratively control the procurement, distribution, use, and disposal of nonradioactive pyrophoric materials. In general, pyrophoric materials are not permitted in TRU process areas. The quantity of pyrophoric materials that does enter any process is strictly limited and controlled by site safety considerations.

4.1.1 Requirements

Radioactive pyrophoric materials shall be present only in small residual amounts (≤1 percent [weight]) in payload containers. Radioactive pyrophorics in concentrations greater than 1 percent by weight and all nonradioactive pyrophorics shall be reacted (or oxidized) and/or otherwise rendered nonreactive prior to placement in the payload container.

4.1.2 Methods of Compliance and Verification

Compliance shall be by one, or a combination, of the following methods:

- Review of records and database information, which may include knowledge of process
- Administrative and procurement controls.

[1] U.S. Nuclear Regulatory Commission (NRC), "Pyrophoric definition," Code of Federal Regulations Title 10 (10 CFR) §61.2, U.S. Nuclear Regulatory Commission, Washington, D.C.

4.2 Explosives, Corrosives, and Compressed Gases

An explosive is defined as:

> Any substance or article, including a device, which is designed to function by explosion (i.e., an extremely rapid release of gas and heat) or which, by chemical reaction within itself, is able to function in a similar manner.[2]

Examples of explosives are ammunition, dynamite, black powder, detonators, nitroglycerine, urea nitrate, and picric acid.

Corrosives are defined as:

> Aqueous materials which have a pH less than or equal to 2 or greater than or equal to 12.5.[3]

The physical form of the waste and waste generating procedures at the sites ensure that the waste is in a nonreactive form. All waste generating sites control the procurement, distribution, use, and disposal of explosives. Most sites have lists of restricted materials that include explosives. Typically, the TRU waste generating and storage sites do not allow explosives in the same facility as TRU waste. In addition, sampling programs for pH of inorganic sludges have shown that the sludges consistently meet the limitation on corrosives.[4]

4.2.1 Requirements

Explosives and corrosives are prohibited from the payload. Compressed gases (pressurized containers), except for the incidental presence of aerosol cans, are prohibited from the payload.

The allowance for the incidental presence of aerosol cans in the payload is specified to address retrievably stored payload containers that may occasionally contain used or partially filled aerosol cans disposed of along with waste items. While aerosol cans may have been used at a site, they are not primary components of the waste streams. The production and maintenance activities may have generated aerosol cans incidental to the primary waste generation processes. Aerosol cans that were used for their intended purpose would be used or partially filled if present as part of the waste.

Used (i.e., empty) aerosol cans are allowed as they do not impact the package internal pressure or flammability. Verification that any aerosol cans present in retrievably stored waste are empty

[2] U.S. Department of Transportation (DOT), "An Explosive; definition," Code of Federal Regulations Title 49 (49 CFR) § 173.50, U.S. Department of Transportation, Washington, D.C.

[3] U.S. Environmental Protection Agency (EPA), "Characteristic of corrosivity," Code of Federal Regulations Title 40 (40 CFR) § 261.22, U.S. Environmental Protection Agency, Washington, D.C.

[4] U.S. Department of Energy (DOE), "CH-TRU Waste Content Codes (CH-TRUCON)," current revision, DOE/WIPP-3194, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

shall be by radiography and/or process knowledge and shall be documented in site-specific compliance documents.

Any aerosol cans present in retrievably stored waste that are not empty shall be limited to one per container. In addition, to address flammability issues, containers with one partially filled aerosol can shall undergo headspace gas measurement as described in Section 5.2.5 to quantify total container flammability, including the possible contribution of any flammable contents potentially leaked or discharged from the aerosol can.

4.2.2 Methods of Compliance and Verification

Compliance shall be by one, or a combination, of the following methods:

- Visual examination of the waste
- Administrative and procurement controls
- Radiography
- Sampling program
- Review of records and database information, which may include knowledge of process.

4.3 Chemical Composition

The chemical constituents allowed in a given waste material type (e.g., concreted inorganic particulate waste) are restricted so that a conservative bounding G value may be established for the gas generation potential in each waste material type.

Compliance with the lists of allowable materials in Tables 4.3-1 through 4.3-8 has been demonstrated for each chemical list corresponding to each content code. The assignment of any content code to a waste material type will also be conservative with respect to G values. For example, if an inorganic solid waste material type (II.1) at a site contains materials that do not comply with the materials listed in Table 4.3-4 (e.g., solid organics excluding packaging), it shall be classified as Waste Material Type III.1 (solid organics), which has twice the bounding G value, and the appropriate content code shall be applied. Similarly, Waste Material Type II.2 may only contain materials with no gas generation potential (G value of zero).

4.3.1 Requirements

Chemical constituents in a payload shall conform to the lists of allowable materials in Tables 4.3-1 through 4.3-8. The total quantity of chemicals/materials not listed as allowed materials for a given waste material type in any payload container is restricted to less than 5 weight percent total. These materials, if present, are, in general, present as trace chemicals/materials (materials that occur individually in the waste in quantities less than 1 weight percent).

4.3.2 Methods of Compliance and Verification

Compliance shall be by one, or a combination, of the following methods:

- Review of records and database information, which may include knowledge of process
- Administrative and procurement controls
- Sampling program.

Content codes approved by the WIPP CH-TRU Payload Engineer comply with the chemical composition requirements. Any proposed change in process technology at a generator site for a given content code must be evaluated for compliance with the lists of allowable materials in Tables 4.3-1 through 4.3-8. This change shall be evaluated and approved by the WIPP CH-TRU Payload Engineer for compliance with existing waste material type restrictions. All changes in the chemical characteristics of the waste shall be recorded, and the date of the new process, description of the process, and list of new chemicals submitted to the WIPP CH-TRU Payload Engineer. The WIPP CH-TRU Payload Engineer may allow transport of the waste under the approved content code if none of the restrictions are violated as a result of the change. If the WIPP CH-TRU Payload Engineer determines that the old content code and corresponding waste material type(s) are no longer valid, the waste may be assigned to a new content code for shipment under the appropriate approved waste material type. The NRC shall be notified of any change not covered by the authorized contents as defined by this document (e.g., addition of a new waste form with a new G value) through an amendment to the CH-TRAMPAC. All changes exceeding currently authorized contents shall be submitted to the NRC for review and approval prior to incorporation into a chemical list or content code.

Table 5.2-8 — Packaging-Specific DAC_3 Values (in Days) for Solid Waste (Waste Types II and III) (Continued)

Packaging Configuration 5	
Minimum Total Filter Diffusivity (m/s/mf)	**Headspace Sample Taken Inside Direct Load SWB/TDOP**
7.4×10^{-6} (SWB)	15
3.3×10^{-5} (TDOP)	15

Packaging Configuration 6	
Minimum Total Filter Diffusivity (m/s/mf)	**Headspace Sample Taken Inside Direct Load SWB/TDOP**
7.4×10^{-6} (SWB)	56
3.3×10^{-5} (TDOP)	56

Packaging Configuration 7[b]			
Drum Filter Minimum Hydrogen Diffusivity (m/s/mf)	**Inner Lid Filter Vent Minimum Hydrogen Diffusivity (m/s/mf)**		
	7.4×10^{-6}	**1.85×10^{-5}**	**9.25×10^{-5}**
3.7×10^{-6}	13	7	2
7.4×10^{-6}	10	6	2
1.85×10^{-5}	6	4	2

[a]DAC of 142 days is applicable provided that the packaging configuration does not exceed 3 inner bags and 2 liner bags. This DAC value for this bounding packaging configuration has been previously used to address headspace sampling issues at the sites for disposal purposes.[2]
[b]Headspace sample taken between inner and outer drum lids. If headspace sample is taken inside the filtered inner drum lid prior to placement of the outer drum lid, then a DAC_3 value of 2 days may be used.

m/s/mf = mole per second per mole fraction.

5.2.5 Unified Flammable Gas Test Procedure

5.2.5.1 Introduction

CH-TRU wastes to be transported in the TRUPACT-II and HalfPACT packages fall into one of two categories based on their gas generation potential—"analytical category waste" or "test category waste." The wastes that can be qualified for shipment based on decay heat limits derived from theoretical worst-case calculations of gas generation potential comprise the "analytical category." The CH-TRU waste containers that exceed the applicable decay heat limits set for the analytical category, or that exceed 500 ppm of flammable VOCs in the headspace, or that do not have an established theoretical bounding gas generation rate (G value), belong in the "test category." The Unified Flammable Gas Test Procedure (UFGTP) details the methodology used to evaluate compliance of test category wastes with flammable (gas/VOC) limits.

5.2.5.1.1 Purpose

This UFGTP provides the technical basis for determining whether a test category payload container demonstrates compliance with the flammable (gas/VOC) limits. It also provides instructions for the methodology by which each test activity will be performed. The first, or short-term, objective of the UFGTP is to facilitate shipment of waste in the test category by testing individual payload containers to show compliance with the flammable gas generation and concentration requirements. The second, or long-term, objective is to improve waste shippability for specific populations or subpopulations of waste by arriving at more realistic gas generation rates based on the results of measurement and testing. The process for implementation of the long-term objective is defined in the "UFGTP Long-Term Objective Implementation Methodology"[3] and described in Section 5.2.5.5.

[3] Shaw Environmental & Infrastructure, Inc., current version, "UFGTP Long-Term Objective Implementation Methodology," Shaw Environmental & Infrastructure, Inc., Albuquerque, New Mexico.

- Gas sampling
- Gas analyses.

In order to test the waste for gas generation, the temperature of the container will either be at room temperature or will be raised for Waste Type IV, as shown in Table 5.2-10. Where elevated temperature testing is required, the selected waste container is placed in an insulated overpacking container enclosure or a temperature-controlled environment. Insulation, heat tape, thermocouples, and controllers may be used to monitor and control the temperature. The test temperature for Waste Type IV has been calculated based upon the maximum allowed wattage for shipped waste and is listed in Table 5.2-10.

Barometric pressure will be determined in a location that will give sufficient information regarding the pressure of the sampled gas(es). Each sample analysis must have an associated barometric pressure measurement.

Data will be gathered from the test apparatus using a flow measurement or gas sampling device. Measurements or determinations of the total gas flow rate and/or associated hydrogen/methane gas concentrations will be used to calculate the hydrogen/methane gas generation rate. A mass flow meter, or other device, if used, may be placed outside of the waste container but within the overpacking container enclosure to avoid condensation of any gases within the flow device.

Sampling of gases may be accomplished using either of two methods. A sampling manifold will be a part of the waste container test unit. This manifold will be used to either collect discrete samples in containers or to divert a stream of gas to an analytical instrument. If discrete samples are collected, they will be sent to an analytical laboratory for analyses. If a stream is diverted to an analytical instrument, such as a mass spectrometer, this is called on-line sampling and analysis. Once the test begins, gas sampled during the test will be analyzed for hydrogen and methane (if applicable), and possibly for other gases of interest (e.g., oxygen, nitrogen, carbon dioxide, hydrogen sulfide, sulfur dioxide, and sulfur trioxide).

The headspace of the containers will be sampled and analyzed for VOCs, if necessary, before the container is qualified for shipment.

5.2.5.4.3 Data Quality Objectives

Data quality objectives (DQOs) are the qualitative and quantitative statements developed by data users to specify the quality of data required from a particular data collection activity. The DQOs for the testing are specified in the QAPP[4].

The QAPP[4] defines the QA objectives associated with these data measurements. Specific QA measures will also be followed for sample custody, calibration of equipment, data reporting, and data reduction.

5.2.5.4.4 Test Startup and Test Completion

The test startup consists of placing the waste container in the test apparatus and, if specified in Table 5.2-10, heating the test unit to the required test temperature. Site-specific operating procedures describe the sampling and analysis required on a routine basis. The test will be terminated after sufficient data are obtained to calculate the hydrogen gas generation rate.

The term "sufficient data" is defined as data on the parameters needed to quantify a bounding and applicable gas generation rate for the container under the test conditions prescribed in the UFGTP. In the case of containers that are tested at room temperature (Waste Types I, II, and III), sufficient data is measurement of the flammable gas concentration, temperature, and pressure. For these containers there is no thermal equilibration of the contents with respect to the testing temperature and the gas generation rates are constant or decreasing (see Appendices 3.2 and 3.3 of the CH-TRU Payload Appendices). For containers that are tested at an elevated temperature (Waste Type IV), a thermal equilibration period exists. Measurements are taken after the equilibration period to quantify the maximum flammable gas and total gas generation rates. In this case, sufficient data is measurement of flammable gas and total gas generation rates, temperature, and pressure during a testing period that is extended until the rates are shown to remain constant or decrease, or until the testing period (time from container isolation and commencement of heating to the collection of the final gas sample) equals or exceeds the time of the allowed shipping period. In all cases, the collection of data as described herein ensures that the measured rates determined through testing are representative of the gas generation properties of the container over the allowed shipping period. The measured rates are then compared to the respective limits to demonstrate compliance with the allowable gas generation rates.

5.2.5.4.5 Determination of Shippability

At the completion of the test, the test results will be analyzed to determine if the container can be shipped in the TRUPACT-II or HalfPACT packages under the test category. Record the identification parameters identified in Section 1 of the Data Sheet and complete the following:

[A] Determine compliance with the methane screening limit, as specified in Steps A through C of Section 5.2.5.3.1.

[B] If the methane concentration exceeds the 1,250 ppm screening limit, the container is not eligible for shipment and cannot be tested under this procedure and must be segregated for repackaging or other treatment measures. If the methane concentration is less than or equal to 1,250 ppm and if flammable VOCs could be present at concentrations greater than 500 ppm in the payload container headspace based on process knowledge (Step 1b, Figure 5.2-1), proceed to Step C. If the flammable VOCs in the headspace are less than or equal to 500 ppm, proceed to Step D.

[C] Determine concentration of flammable VOCs, as specified in Steps A through C of Section 5.2.5.3.2.

[D] Determine the sum of the measured decay heat value and the decay heat measurement error (one standard deviation) for the payload container from its data package. Record the decay heat plus the associated error (Section 5 of the Data Sheet).

[E] From Table 5.2-10, record the maximum decay heat per container and per TRUPACT-II or HalfPACT (Section 5 of the Data Sheet), and determine if gas generation testing is to be performed at room temperature (Waste Types I, II, and III). If so, the total gas generation rate limit is met through theoretical analysis as shown in Section 5.2.5.3.3.

[F] If gas generation testing is not performed at room temperature (Waste Type IV), record the total measured gas release rate for the payload container and the maximum allowable total gas release rate for the payload container (from Table 5.2-11). Compare the total measured gas release rate to the limit for the corresponding container type. If the total measured gas release rate of the container exceeds the maximum allowable total gas release rate, the container may be reassessed for compliance with transportation requirements through the evaluation of compliance with the payload total gas release rate limits as described in Section 6.2.5. Otherwise, the container shall be reconfigured or mitigative measures shall be adopted.

Table 5.2-11 — Maximum Allowable Total Gas Release Rates for Waste Type IV

Waste Type IV Payload Container	Maximum Allowable Total Gas Release Rate (mol/s/container) [a,b]
55-Gallon Drum	3.97E-06
Direct Load SWB	1.98E-05
55-gallon drum in SWB overpack	9.87E-06
85-Gallon Drum, 85-Gallon Drum Overpack, or 55-Gallon Drum in 85-Gallon Drum Overpack	5.90E-06
100-Gallon Drum	1.02E-05

[a] The maximum total gas release rates (in moles per second per payload container) were determined from analysis as described in Section 3.4.4 of the TRUPACT-II and HalfPACT SARs.
[b] If the measured gas release rate exceeds the maximum total gas release rate per container, the container may qualify for shipment using the methodology for evaluation of compliance with the payload total gas release rate limits described in Section 6.2.5.

[G] Record the measured FGGR for the payload container (Section 5 of the Data Sheet).

[H] If flammable VOCs are present in the container headspace at concentrations less than or equal to 500 ppm, as determined in Step B, determine the maximum allowable hydrogen gas generation rate for the corresponding shipping category (as listed in Table 5.2-1 or as determined in accordance with the methodology described in Section 5.2.3). Record the maximum allowable hydrogen gas generation rate (Section 5 of the Data Sheet). Compare the measured FGGR to the allowable rate limit.

If the measured FGGR of the container is less than or equal to the maximum allowable hydrogen gas generation rate for the corresponding shipping category, then the container may be shipped if compliance with all other transportation requirements is demonstrated.

If the measured FGGR of the container exceeds the maximum allowable hydrogen gas generation rate, the container may be reassessed for compliance with transportation requirements through the evaluation of a payload with different shipping categories or dunnage containers, as described in Section 6.2.4. Otherwise, the container shall be reconfigured or mitigative measures shall be adopted.

[I] If VOCs are present in the container headspace at concentrations greater than 500 ppm, as demonstrated in Step C, calculate the predicted innermost confinement layer flammable gas concentration (X_{inner}) at the end of the shipping period as:

$$X_{inner} = CG * R_T$$

where,

CG = Measured FGGR (mole/second)
R_T = The total resistance to hydrogen release (second/mole) (see Appendix 2.2 of the CH-TRU Payload Appendices).

Record the calculated innermost confinement layer flammable gas concentration (Section 5 of the Data Sheet).

[J] Calculate the MLEL as described in Section 5.2.5.3.5. Record the MLEL (Section 5 of the Data Sheet).

[K] Calculate the sum of the concentrations of the flammable gas in the innermost confinement layer and the flammable VOCs in the innermost confinement layer. Record the sum (Section 5 of the Data Sheet).

[L] Compare the sum of the flammable gas and flammable VOC concentrations within the innermost confinement layer to the calculated MLEL. Indicate by (Yes/No) if the limit is met (Section 5 of the Data Sheet).

If the sum of the flammable gas and VOC concentrations is less than or equal to the MLEL, then the container may be shipped if compliance with all other transportation requirements is demonstrated.

If the sum of the flammable gas and VOC concentrations exceeds the MLEL, the container may be reassessed for compliance with transportation requirements through the evaluation of a payload with different shipping categories or dunnage containers, as described in Section 6.2.4. Otherwise, the container shall be reconfigured or mitigative measures shall be adopted.

[M] In cases of overpack configurations with multiple containers (drums in an SWB or TDOP), the configuration must be assessed under the logic of Section 6.2.4 and Appendix 2.4 of the CH-TRU Payload Appendices.

If the above relevant limits are met, the payload container satisfies the test category criteria. If the Data Sheet is used to document compliance, then the Data Sheet is signed by the Transportation Certification Official. If compliance is determined using a verified/validated software package, then the necessary data are stored electronically and the Transportation Certification Official signs the completed PCTCD or OPCTCD, as appropriate. The payload container qualifies for shipment after verification of all of the transportation parameters. Containers that do not meet the test category criteria may be qualified for shipment in accordance with Section 6.2.4 and/or Section 6.2.5. If the payload container cannot be qualified for shipment, the container must be segregated for repackaging or reprocessing.

5.2.5.5 Implementation of Unified Flammable Gas Test Procedure Long-Term Objective

The long-term objective of the UFGTP is applied to a population of containers with consistent gas generation properties. The long-term objective of the UFGTP may be implemented once the required data have been collected through measurement and/or testing for a subpopulation of these containers. If a bounding FGGR value for compliance determination can be established and shown to be below the maximum allowable FGGR for the population, no further need exists to test every container in the population. If the bounding FGGR value exceeds the maximum allowable FGGR, the population will continue to be processed under the measurement and testing methodology of the UFGTP. This methodology is consistent with that used in the determination of dose-dependent G values in Appendix 3.3 of the CH-TRU Payload Appendices.

Site implementation of the UFGTP long-term objective must be documented in site-specific programs approved by DOE-CBFO.

Required Data and Criteria for Subpopulation

Containers that are identified by process knowledge or other characterization to have similar properties with respect to gas generation are grouped into populations. The basis for grouping individual containers into a population shall be documented (e.g., by item description codes showing all containers are generated from the same waste stream). Within a given population, a subpopulation size may be determined and subjected to gas generation testing (i.e., measurement or container gas generation testing). The results of testing the subpopulation may be used to calculate flammable gas generation properties for the remainder of the population. The following data for each container of the subpopulation (i.e., that has undergone gas generation testing or measurement) shall be available:

- Content code and shipping category, from which the maximum allowable FGGR is determined
- Date of container closure, date of venting, and date of measurement or testing
- Methane concentration (Section 5.2.5.3.1)

- Flammable gas generation rate (Section 5.2.5.3.4 or 5.2.5.4)
- Total gas generation rate for Waste Type IV (Section 5.2.5.4).

Statistics for Required Subpopulation Size

Containers selected for evaluation (i.e., the subpopulation) must be representative of the population with random or stratified sampling techniques used to avoid any bias in container selection. The required subpopulation size to implement the long-term objective will be calculated through the following equation[3]:

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

where,

n_0	=	A conservative subpopulation size for an infinite population for a confidence level of 95% and a ±5% precision level. In this case, the upper tail of the distribution curve is of interest, and n_0 has a value of 271.[3]
n	=	The required subpopulation size
N	=	The true population size.

As shown by the formula, the minimum number of required containers depends on the true population size.

Assignment of Flammable Gas Generation Properties for Population

A 95% upper tolerance limit (UTL) (the 95% upper confidence limit of the 95th percentile) of the methane concentration, FGGR, and total gas generation rate (if required) shall be calculated for each subpopulation using a bootstrapping or comparable non-parametric technique[3]. Non-parametric statistics are used to ensure the validity of this procedure regardless of the distribution shape of the subpopulation gas generation values. The 95% UTL of the methane concentration, FGGR, and total gas generation rate values will then be assigned to the remainder of the containers in the population in place of actual test values in evaluating compliance with the flammable gas/VOC limits using the methodology documented in Section 5.2.5.

Fixed Configurations:

NOTE: The completion of Table 6.2-3 is not required for these configurations.

- Six-Inch Standard Pipe Overpack: Select Fixed Configuration "6-in. Standard Pipe Overpack" for waste packaged in one 6-in. pipe component overpacked in one 55-gallon drum, as described in Section 2.9. Complete Table 6.2-1 for the 6-in. standard pipe overpack using the appropriate shipping category for the standard pipe overpack. A 6-in. standard pipe overpack may only be combined in a seven-pack with other 6-in. standard pipe overpacks.
- Twelve-Inch Standard Pipe Overpack: Select Fixed Configuration "12-in. Standard Pipe Overpack" for waste packaged in one 12-in. pipe component overpacked in one 55-gallon drum, as described in Section 2.9. Complete Table 6.2-1 for the 12-in. standard pipe overpack using the appropriate shipping category for the standard pipe overpack. A 12-in. standard pipe overpack may only be combined in a seven-pack with other 12-in. standard pipe overpacks.
- S100 Pipe Overpack: Select Fixed Configuration "S100 Pipe Overpack" for waste packaged in one S100 pipe component overpacked in one 55-gallon drum, as described in Section 2.9. Complete Table 6.2-1 for the S100 pipe overpack using the appropriate shipping category for the S100 pipe overpack.
- S200 Pipe Overpack: Select Fixed Configuration "S200 Pipe Overpack" for waste packaged in one S200A or S200B pipe component overpacked in one 55-gallon drum, as described in Section 2.9. Complete Table 6.2-1 for the S200 pipe overpack using the appropriate shipping category for the S200 pipe overpack.
- S300 Pipe Overpack: Select Fixed Configuration "S300 Pipe Overpack" for waste packaged in one S300 pipe component overpacked in one 55-gallon drum, as described in Section 2.9. Complete Table 6.2-1 for the S300 pipe overpack using the appropriate shipping category for the S300 pipe overpack.
- SWB with Bin (Bin Overpack): Select Fixed Configuration "SWB with Bin (Bin Overpack)" for waste packaged in one bin overpacked in one SWB. Note that the bin is only authorized for use in this configuration. Complete Table 6.2-1 for the bin overpack using the appropriate shipping category for the bin overpack configuration (no associated shipping category recorded for the SWB).

Overpacked Configurations:

- 85-Gallon Drum with 55-Gallon Drum (85-Gallon Drum Overpack): Select Overpacked Configuration "85-Gallon Drum with 55-Gallon Drum (85-Gallon Drum Overpack)" for waste packaged in one 55-gallon drum overpacked in one 85-gallon drum. Complete Table 6.2-1 for the 55-gallon drum using the appropriate shipping category for the 85-gallon drum overpack configuration and

Table 6.2-3 for the 85-gallon drum (no associated shipping category recorded for the 85-gallon drum).

- SWB with 55-Gallon Drum(s) (SWB Overpack): Select Overpacked Configuration "SWB with 55-Gallon Drum(s) (SWB Overpack)" for waste packaged in one 55-gallon drum to be overpacked in one SWB (up to four 55-gallon drums per SWB). Complete Table 6.2-1 for each of the 55-gallon drums using the appropriate shipping category for each 55-gallon drum and Table 6.2-3 for the SWB (no associated shipping category recorded for the SWB).

- TDOP with 55-Gallon Drum(s): Select Overpacked Configuration "TDOP with 55-Gallon Drum(s)" for waste packaged in one 55-gallon drum to be overpacked in one TDOP (up to ten 55-gallon drums per TDOP). Complete Table 6.2-1 for each of the 55-gallon drums using the appropriate shipping category for each 55-gallon drum and Table 6.2-3 for the TDOP (no associated shipping category recorded for the TDOP).

- TDOP with SWB Overpack: Select Overpacked Configuration "TDOP with SWB Overpack" for waste packaged in one 55-gallon drum to be overpacked in one SWB (up to four 55-gallon drums per SWB) to be overpacked in one TDOP (one SWB per TDOP). Complete Table 6.2-1 for each of the 55-gallon drums using the appropriate shipping category for each drum and Table 6.2-3 once for the SWB and once for the TDOP (no associated shipping category recorded for the SWB or TDOP).

- TDOP with 85-Gallon Drum Overpack(s): Select Overpacked Configuration "TDOP with 85-Gallon Drum Overpack(s)" for waste packaged in one 55-gallon drum overpacked in one 85-gallon drum to be overpacked in one TDOP (up to six 85-gallon drum overpacks per TDOP). Complete Table 6.2-1 for each of the 55-gallon drum(s) using the appropriate shipping category for the 85-gallon drum overpack configuration and Table 6.2-3 for each 85-gallon drum and for the TDOP (no associated shipping category recorded for the 85-gallon drum or TDOP).

- TDOP with 85-Gallon Drum(s): Select Overpacked Configuration "TDOP with 85-Gallon Drum(s)" for waste packaged in one 85-gallon drum to be overpacked in one TDOP (up to six 85-gallon drums per TDOP). Complete Table 6.2-1 for each of the 85-gallon drums using the appropriate shipping category for each 85-gallon drum and Table 6.2-3 for the TDOP (no associated shipping category recorded for the TDOP).

- TDOP with SWB: Select Overpacked Configuration "TDOP with SWB" for waste packaged in one SWB to be overpacked in one TDOP (one SWB per TDOP). Complete Table 6.2-1 for the SWB using the appropriate shipping category for the SWB and Table 6.2-3 for the TDOP (no associated shipping category recorded for the TDOP).

6.2.2 Procedure for Assembly and Certification of a CH-TRU Payload

Generating and storage sites shall qualify a payload for transport in the TRUPACT-II or HalfPACT by verifying that the payload meets the parameter requirements/limits listed in the PATCD (Table 6.2-4). Table 6.2-4 may be reformatted for site use. All parameters noted on the form shall be included in any modified version. As an alternative to manually completing the PATCD, a verified/validated software package may be used to determine payload assembly compliance and prepare an equivalent PATCD form.

Table 6.2-4 shall be completed as follows (section numbers in parentheses refer to sections in the CH-TRAMPAC that provide requirement and compliance and verification information for the transportation parameter described):

Identification Parameters

- Shipment #: The shipment number of the trailer or railcar of TRUPACT-IIs or HalfPACTs shall be recorded. For shipments by railcar, each railcar shall be assigned a separate shipment number or shipment number suffix.

- Packaging OCA Body/Lid #: The identification numbers on the TRUPACT-II or HalfPACT OCA body and lid shall be recorded.

- Payload Assembly Designated for Controlled Shipment? (Section 5.1): Using information from the PCTCD (Table 6.2-1 or 6.2-2) and OPCTCD (Table 6.2-3), determine if any payload container comprising the payload assembly has been designated for controlled shipment. If any container is designated for controlled shipment, the payload assembly must be qualified for controlled shipment. Indicate if the payload assembly is designated for controlled shipment in accordance with the conditions specified in Appendix 3.6 of the CH-TRU Payload Appendices. If the payload assembly is designated for controlled shipment, Table 6.2-5 must also be completed for the shipment of the payload (Section 6.2.3).

- Shipping Category (Section 5.1): The shipping category of the payload shall be recorded only if all containers belong to the same shipping category. Mixing of shipping categories, including credit for dunnage, is allowed as described in Section 6.2.4. If mixing shipping categories pursuant to Section 6.2.4, indicate that the shipping category of the payload is not applicable (e.g., "NA – Mixing").

- Decay Heat Limit (Section 5.2.3): If all containers belong to the same shipping category, the maximum allowable decay heat per payload container for the shipping category shall be recorded from the PCTCD (Table 6.2-1 or 6.2-2) and OPCTCD (Table 6.2-3). Mixing of shipping categories and payloads of any authorized contents, including credit for dunnage, is allowed as described in Section 6.2.4. If mixing shipping categories pursuant to Section 6.2.4, indicate that the decay heat limit for the payload is not applicable (e.g., "NA – Mixing").

- Hydrogen/Flammable Gas Generation Rate Limit (Section 5.2): If all containers belong to the same shipping category, the maximum allowable hydrogen/flammable gas generation rate per payload container for the shipping category shall be recorded from the OPCTCD(s) (Table 6.2-3), if used; from Table 5.2-1 or determined using the methodology described in Section 5.2.3 (for analytical category waste) or from Section 5.2.5 (for test category waste). Mixing of shipping categories and payloads of any authorized contents, including credit for dunnage, is allowed as described in Section 6.2.4. If mixing shipping categories pursuant to Section 6.2.4, indicate that the hydrogen/ flammable gas generation rate limit for the payload is not applicable (e.g., "NA – Mixing").

- Type of Payload (Section 2.1): The payload configuration shall consist of an approved type of payload container. If the payload type is "Standard Pipe Overpacks," each seven-pack in the payload must be comprised of only 6-in. standard pipe overpacks or 12-in. standard pipe overpacks.

- Transportation Packaging: The type of packaging used (TRUPACT-II or HalfPACT) shall be recorded

- Date ICV Closed: The date that the ICV is closed shall be recorded.

- Time ICV Closed: For payloads designated for controlled shipment only, the time that the ICV is closed shall be recorded. For other payloads, the time that the ICV is closed need not be recorded.

Bottom Payload Assembly Composition and Top Payload Assembly Composition

The following data shall be recorded from each PCTCD (Tables 6.2-1 and 6.2-2) or from the OPCTCD (Table 6.2-3), as applicable, for each payload container comprising the payload:

- Payload container ID number or "DUNNAGE" or "EMPTY" (Section 2.4)
- Measured weight and measurement error (Section 2.3)
- Measured decay heat and measurement error (one standard deviation) (Section 5.2.3)
- Measured fissile mass and two times the measurement error (two standard deviations or one times the RSS error if values are taken from an OPCTCD) (Section 3.1)

If the data are obtained from the OPCTCD, errors should be the calculated RSS errors (the square root of the sum of the squares of the individually listed errors).

In addition, record the measured hydrogen/flammable gas generation rate for payloads containing test category waste from each PCTCD (Section 5.2.5 of the CH-TRAMPAC). If mixing shipping categories pursuant to Section 6.2.4, calculate and record the hydrogen/flammable gas generation rate and the FI for each payload container. If the payload assembly consists of overpacked configurations, indicate that the hydrogen/flammable gas generation rate and FI are not applicable (e.g., "NA – Mixing") and record the hydrogen/flammable gas generation rate and FI for each overpacked container on the appropriate

Attachment F1

List of Revised Pages (Insert/Delete) for Revision 0 (May 2004) of the CH-TRU Payload Appendices

SECTION	DELETE	INSERT
Covers and Spine	Covers and Spine	Covers and Spine
Appendix 2.2	Cover Page, 2.2-5, 2.2-6	Cover Page, 2.2-5, 2.2-6
Appendix 3.5	Cover Page, 3.5-1 through 3.5-4	Cover Page, 3.5-1 through 3.5-6
Appendix 3.6	Cover Page, 3.6-1 through 3.6-4	Cover Page, 3.6-1 through 3.6-4
Appendix 4.1	Cover Page, 4.1-1 through 4.1-14	Cover Page, 4.1-1 through 4.1-18
Appendix 4.2	Cover Page, 4.2-1 through 4.2-14	Cover Page, 4.2-1 through 4.2-14
Appendix 4.3	Cover Page, 4.3-1 through 4.3-12	Cover Page, 4.3-1 through 4.3-12
Appendix 4.4	Cover Page, 4.4-1 through 4.4-8	Cover Page, 4.4-1 through 4.4-8