

# Memorandum

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REPLY  
TO  
ATTN OF: EM-12 (C. Gelles, 301-903-1669)

SUBJECT: Contact-Handled Transuranic Waste Packaging Instructions

TO: Distribution

The Department of Energy (DOE) established DOE Order 435.1, *Radioactive Waste Management*, to ensure radioactive waste is managed in a manner protective of worker and public health and safety and the environment. DOE Manual 435.1-1, *Radioactive Waste Management Manual*, describes the requirements and establishes specific responsibilities for implementing DOE Order 435.1 for the management of DOE high-level waste, transuranic (TRU) waste, low-level waste, and the radioactive component of mixed waste.

The Office of Environmental Management's (EM) Office of Regulatory Compliance is issuing the attached *Contact-Handled Transuranic Waste Packaging Instructions* to facilitate TRU waste planning efforts and to provide specific, understandable, and concise requirements as part developing, implementing, and maintaining integrated complex-wide radioactive waste management program plans.

These instructions apply to all DOE elements and DOE contractors subject to the Order when packaging and/or repackaging contact-handled (CH) transuranic (TRU) waste. DOE elements and DOE contractors packaging and/or repackaging CH-TRU waste in conjunction with visual examination of waste using the approved procedures and qualified personnel of a Waste Isolation Pilot Plant certified program are exempt from following these instructions. These instructions will be considered for inclusion in the next revision of the Manual.

Compliance with applicable requirements must begin at the time the waste is generated, and DOE must effectively manage TRU waste in a fiscally responsible manner. Knowledge of each TRU waste generator and/or storage site's inventory is critical to developing and implementing a manageable integrated program plan. Knowing what type of waste is being generated and consistency in waste packaging reduces rework and minimizes accumulation of waste with no disposition path. The implementation of these instructions will help ensure projects can be accomplished within budgeted cost and on schedule.

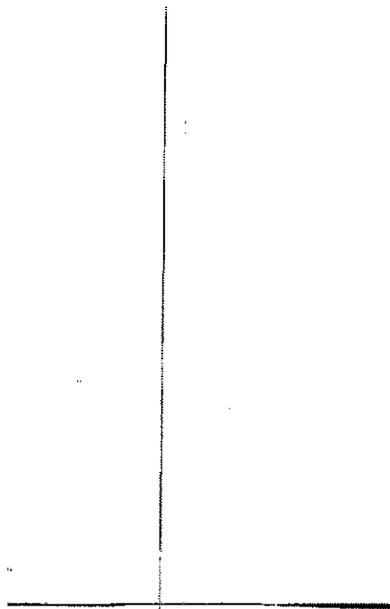
Should you have any questions, please contact me at (202) 586-0370.



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## **Contact-handled Transuranic Waste Packaging Instructions**

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10/8/2008

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# Contact-handled Transuranic Waste Packaging Instructions

## 1.0 Purpose

This document provides DOE elements and DOE contractors with specific instructions for packaging and/or repackaging contact-handled transuranic (CH TRU) waste in a manner that is consistent with DOE O 435.1-1, *Radioactive Waste Management*, DOE M 435.1-1, *Radioactive Waste Management Manual*, CH TRU transportation requirements, and Waste Isolation Pilot Plant (WIPP) programmatic requirements.

## 2.0 Scope

This instruction addresses the packaging and repackaging of CH TRU waste resulting from activities and operations at new and existing DOE radioactive waste management facilities where the planned path for disposition is the WIPP.

## 3.0 Applicability

The instructions provided in this document apply to DOE elements and DOE contractors as set forth in DOE O 435.1-1, *Radioactive Waste Management*, except, when CH TRU waste packaging and/or repackaging is performed in conjunction with visual examination of the waste using the approved procedures and qualified personnel of a WIPP certified program.

## 4.0 Prerequisites

Public Law 102-579, *Waste Isolation Pilot Plant Land Withdrawal Act*, 1992, specifies that WIPP is "to demonstrate the safe disposal of radioactive waste materials generated by atomic energy defense activities." The following activities are considered atomic energy defense activities for purposes of these instructions and disposal at WIPP:

- Naval reactors development
- Weapons activities, including defense inertial confinement fusion
- Verification and control technology
- Defense nuclear materials production
- Defense nuclear waste and materials by-products management
- Defense nuclear materials security and safeguards and security investigations
- Defense research and development

In order to establish the defense pedigree of the waste, a "defense determination" is required for all waste destined for WIPP disposal. The determination may be established as a part of the documentation of process knowledge that demonstrates the origin of the waste; or, for waste with a less direct tie to one of the defense activities, by a formal process initiated by the generator site and approved by the Carlsbad Field Office (CBFO) Manager or DOE Headquarters General Counsel.

CH TRU waste is defined as waste containing more than 100 nCi of alpha emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years and a surface dose rate  $\leq$  200 mrem/hr. To meet this prerequisite, each 55-gallon drum or Standard Waste Box (SWB) shall comply with this definition.

The WIPP Hazardous Waste Facility Permit specifies the hazardous waste numbers that are allowed at WIPP. These hazardous waste numbers are listed below; all other hazardous waste numbers are prohibited:

- F001, F002, F003, F004, F005, F006, F007, F009
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D026, D027, D028, D029, D030, D032, D033, D034, D035, D036, D037, D038, D039, D040, D043
- P015, P030, P098, P099, P106, P120
- U002, U003, U019, U037, U043, U044, U052, U070, U072, U078, U079, U103, U105, U108, U122, U133, U134

Since some of the CH TRU waste being packaged and/or repackaged will be shipped to Idaho for characterization and certification, the waste shall also meet the waste acceptance criteria of the Advanced Mixed Waste Treatment Project HWMA/RCRA Waste Storage and Treatment permits. The hazardous waste numbers listed above are also acceptable at Idaho. No additional hazardous waste numbers will be accepted.

## 5.0 Grouping Waste for Packaging and/or Repackaging

Categorize and package CH TRU waste by waste stream based on the following definition of a waste stream. A waste stream name shall be assigned by the site for each CH TRU waste stream

### Waste Stream

A waste stream is defined as waste that is similar in material, physical form, radiological properties and hazardous constituents and that is generated from a single process or similar types of processes.

There are three broad category groups that are related to the physical form of packaged and/or repackaged TRU waste. Each of the three category groups is defined as follows:

### Homogeneous Solids

Homogeneous solids are defined as solid materials, excluding soil, that do not meet the criteria for classification as debris as defined in 40 CFR §268.2(g) and (h). Included in the category of homogeneous solids are inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste. Other waste streams are included in this category based on the specific waste stream types and final waste form.

### Soil and Gravel

This category includes waste streams that are at least 50 percent by volume soil and/or gravel.

### Debris

This category includes heterogeneous waste that is at least 50 percent by volume materials that meet the criteria specified in 40 CFR §268.2(g). Debris means solid material exceeding a 60 mm particle size that is intended for disposal and that is

1. A manufactured object, or
2. Plant or animal matter, or
3. Natural geologic material

Particles smaller than 60 mm in size may be considered debris if the debris is a manufactured object and if it is not a particle of homogeneous solid or soil and gravel.

## 6.0 Waste Containers

There are two container types that are allowable when packaging and/or repackaging CH TRU waste. These are 55-gallon drums for homogeneous solids, soil and gravel, and debris, or direct-loaded SWBs for debris waste only.

Each 55-gallon drum and SWB used to package CH TRU waste shall meet DOT Specification 7A, Type A, packaging requirements. These containers shall be made of steel (including stainless or galvanized steel), and be in good and unimpaired condition as determined by using the container examination criteria listed on Attachment 1, Payload Container Integrity Checklist, at a minimum. Acceptable 55-gallon drum dimensions are 34.5" to 35" tall including the locking ring and a diameter not exceeding 24" including the locking ring but not including the locking bolt.

Label each 55-gallon drum or SWB with a unique container identification number not exceeding 16 alpha-numeric characters. When the 55-gallon drum or SWB is the receiving container for repackaged waste, include in the unique container identification number "R" as the last character. The unique container identification number shall include a site identifier as a prefix.

## 7.0 Packaging Configuration

### 7.1 55-Gallon Drum

Package CH TRU waste into a 55-gallon drum using as few closed plastic bag layers as possible, but no more than two closed plastic bag layers. The closed bag layers, if used, shall meet the following specifications:

- The two closed bag layers may consist of one closed inner bag and one closed 55-gallon drum liner bag, two closed inner bags, or two closed 55-gallon drum liner bags. A 55-gallon drum liner bag may be used when the two closed bag layers consist of two closed inner bags if the 55-gallon drum liner bag is not closed. Drum liner bags are of a size sufficient to line a 55-gallon drum. Inner bags are smaller in size and may be used to package individual waste items.
- Each bag, if closed, shall be closed by the twist-and-tape method and fitted with a filter with a minimum hydrogen diffusivity value of  $1.075E-05$  mol/s/mol fraction.

Place the waste into a DOT Specification 7A, Type A, 55-gallon drum. When packaging or repackaging homogeneous solids that are in internal containers (i.e., container without lid), use a 55-gallon drum liner bag. When directly packaging homogeneous solids or soil and gravel, use a 90 mil. polyethylene drum liner inside the 55-gallon drum. Do not use a rigid polyethylene drum liner when packaging or repackaging debris. A fiberboard liner may be used in 55-gallon drums when packaging or repackaging debris. When using either polyethylene or fiberboard rigid drum liners, use the rigid drum liners without the lids. The 55-gallon drum lid shall be fitted with a container filter vent with an integral sample port septum.

### 7.2 Standard Waste Box

Package CH TRU waste in an SWB using as few closed plastic bag layers as possible, but no more than two closed plastic bag layers. The closed bag layers, if used, shall meet the following specifications:

- The two closed bag layers may consist of one closed inner bag and one closed SWB liner bag, two closed inner bags, or two closed SWB liner bags. A SWB liner bag may be used when the two closed bag layers consist of two closed inner bags if the SWB liner bag is not closed. SWB liner bags are of a size sufficient to line an SWB. Inner bags are smaller in size and may be used to package individual waste items.

- Each inner bag, if closed, shall be closed by the twist-and-tape method and fitted with a filter with a minimum hydrogen diffusivity value of  $1.075 \times 10^{-5}$  mol/s/mol fraction.
- Each SWB liner bag, if closed, shall be closed by folding and taping (twist and tape is allowed when using a sleeve as the liner). Each SWB liner bag or sleeve shall be fitted with a filter with a minimum hydrogen diffusivity value of  $1.075 \times 10^{-5}$  mol/s/mol fraction.

Place the waste into a DOT Specification 7A, Type A, SWB. A fiberboard liner may be used in SWBs when packaging or repackaging debris. When a fiberboard liner is used, use it without the lid. Fit the SWB with two container filter vents. Ensure that one of the filters has an integral sample port septum.

### 7.3 Container Filter Vent Specifications

Ensure that container filter vent(s) to be installed on 55-gallon drums and/or SWBs have a minimum hydrogen diffusivity value of  $1.85 \times 10^{-5}$  mol/s/mol fraction. Ensure that the filter selected for all 55-gallon drums and one of the filters selected for each SWB has an integral sample port septum. Container filter vents shall be legibly marked to ensure each of the following:

- Identification of the manufacturer
- Date of manufacture, or lot number, or unique serial number

Ensure that the container filter vent housing and elements have an operating temperature range between -40 degrees Celsius to +70 degrees Celsius (-40 to +158 degrees Fahrenheit). Ensure that the container filter vent threads are compatible with the bung in the container (55-gallon drum and SWB) or shall be self-tapping (55-gallon drum only).

### 8.0 **Prohibited Items**

The following items are prohibited in packaged CH TRU waste:

- Internal shielding or deliberate waste placement to provide shielding for high radiation items  
*This prohibition includes waste packaged in any manner that would shield items that could be >200 mrem/hr to reduce the surface dose rate of the payload container to  $\leq 200$  mrem/hr.*
- Machine compacted waste  
*Machine compacted waste is waste whose volume has been reduced by compaction using a mechanical compaction process.*
- Liquids
- Unvented containers larger than 4 liters
- Nonradioactive pyrophorics  
*Pyrophorics are 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 pyrophorics definition are spontaneously combustible materials, water reactive materials, and oxidizers. Examples of nonradioactive pyrophorics are organic peroxides, sodium metal, and chlorates.*
- Radioactive pyrophorics greater than 1% by weight  
*Examples of radioactive pyrophorics are metallic plutonium, uranium or americium.*
- Non-mixed hazardous waste  
*Hazardous wastes not occurring as co-contaminants with TRU waste.*

- Waste exhibiting the Resource Conservation and Recovery Act (RCRA) characteristics of ignitability, corrosivity, or reactivity
- Explosives
- Compressed gases
- Waste that has ever been managed as high-level waste, and waste from tanks specified in Table 1
- Materials with concentrations of plutonium in excess of 20% by weight for the aggregate of any material category as specified in Title III of the Energy and Water Development Appropriations Act

*In cases where the initial material category is subdivided, sites should seek guidance from DOE HQ General Counsel about how the aggregate can be determined. The prohibition on TRU waste containing concentrations of plutonium in excess of 20 percent by weight for the aggregate of any material category on the date of enactment of the Act, or generated after such date shall be applied prior to performing any activities to reduce plutonium content (e.g., blending). The date of enactment of the Act is October 7, 1998.*

- Classified shapes and/or classified composition (without prior approval of the CBFO Manager).

#### **9.0 Waste requiring written notice to the Director, Office of the National TRU Program, Carlsbad Field Office**

Sites shall provide written notice to the Director, Office of the National TRU Program, CBFO prior to packaging any of the following:

- Polychlorinated Biphenyls (PCBs)
- Discrete Radiological Sources (calibration or sealed sources)
- Be or BeO > 1% by weight
- Solidified organics (e.g., solvents, acids, halogenated organics, etc.)

Upon receipt of written notice from a site, the Director of the Office of the National TRU Program will provide in writing any additional packaging instructions and/or container limits as applicable.

#### **10.0 Packaging activities requiring prior written approval from the Director, Office of Disposal Operations, EM Headquarters Office of Regulatory Compliance**

Prior to any planned packaging activities that will deviate from these packaging instructions, sites shall obtain written approval for the deviation from the Director, Office of Disposal Operations, EM Headquarters Office of Regulatory Compliance

#### **11.0 Conditions and Limitations for all Packaged and Repackaged CH TRU Waste**

- Only waste that is similar in material, physical form, radiological properties and hazardous constituents and that is generated from a single process or similar types of processes shall be packaged together.
- Waste with different radiological properties (e.g., isotopic distributions) shall not be mixed in the same container
- Each 55-gallon drum shall have  $\leq 200$  <sup>239</sup>Pu fissile gram equivalents (FGEs) of radioactive materials. Standard waste boxes shall have  $\leq 325$  <sup>239</sup>Pu FGEs of radioactive materials. The calculation for FGE (Attachment 2, Fissile Gram Equivalent) shall include two times the measurement error (uncertainty). Sites shall document the data and measurement error for any assay done. Results of the FGE calculation shall be documented on Attachment 4, the Waste Container Packaging Form
- Plutonium Equivalent Curies (PE-Ci) quantities shall be calculated for each 55-gallon drum or SWB and shall not exceed 80 PE-Ci per 55-gallon drum or 560 PE-Ci per SWB

Results of the PE-Ci calculation (Attachment 3, <sup>239</sup>Pu Equivalent Activity) shall be documented on the Waste Container Packaging Form.

- Each 55-gallon drum or SWB shall have a surface dose of  $\leq 200$  mrem/hr. Measured surface dose rate after packaging shall be documented on the Waste Container Packaging Form.
- Sites shall identify 95% of the radiological hazard for each container pursuant to 49 CFR §173.433(g). (49 CFR (10-1-07 edition)) The activities and masses of the isotopes contributing to 95% of the radiological hazard shall be documented on the Waste Container Packaging Form.
- Chemical compatibility shall be ensured for the waste repackaged into each individual 55-gallon drum and/or SWB. A guide for determining potentially incompatible waste can be found in 40 CFR Part 264 Appendix V.

## 12.0 Repackaging CH TRU Waste

### 12.1 Repackaging Waste into 55-gallon Drums and SWBs

Video record all 55-gallon drum and SWB loading with an audio narration that will provide indisputable evidence of packaging configuration, all waste contents, and absence of prohibited items. Document a written record of waste packaging for each receiving container on a Waste Container Packaging Form. Good quality video images with thorough narrative descriptions of the waste and well written Waste Container Packaging Forms are the best insurance that waste containers will not need to be repackaged again at a future date.

When repackaging CH TRU waste each of the following actions shall be performed:

- Ensure that the original (feed) container(s) identification number(s) are clearly visible to the camera, read for the audio narration, and documented on the Waste Container Packaging Form.
- Describe for the audio narration the repackaging activity that is to be performed (e.g., repackaging of feed 55-gallon drum # xyz into receiving 55-gallon drum # LL123R; repackaging of feed 55-gallon drums (state all container identification numbers) into receiving SWB # LL345R).
- Ensure that the receiving 55-gallon drum(s) or SWB unique container identification number(s) is clearly visible to the camera, read for the audio narration, and documented on the Waste Container Packaging Form(s).
- Clearly state the date(s) of loading waste into the receiving 55-gallon drum(s) or SWB for the audio narration and document on the Waste Container Packaging Form(s).
- Ensure that all personnel loading waste into the receiving 55-gallon drum(s) or SWB are identified by name for the audio narration and documented on the Waste Container Packaging Form(s).
- Precede each interruption of the video by audio narration explaining the reason for the interruption.
- Ensure that each individual item placed into the receiving 55-gallon drum(s) or SWB is clearly visible to the camera, described in detail for the audio narration, and documented on the Waste Container Packaging Form.
- Ensure that the description of each item of waste placed into the receiving container includes estimated weight percent composition of the following waste constituents:
  - Iron-based metals/alloys
  - Aluminum-based metals/alloys
  - Other metals
  - Cellulosics
  - Rubber
  - Plastics

- o Inorganic materials
- o Soil/gravel

When a feed container that has mixed contents of CH TRU homogeneous solids and debris is repackaged, perform the following actions:

- Remove the lids from all inner containers, describe contents and material composition, and display to the camera. If all contents are not clearly visible to the camera, remove the contents such that each waste item is described in detail and displayed to the camera.
- Separate debris items and package into a debris receiving 55-gallon drum or SWB using the debris waste repackaging instructions. Continue with these instructions to repackage the homogeneous solids portion of the waste.
- Open all inner containers of homogeneous solids and determine the absence of liquid prior to packaging into a receiving 55-gallon drum.
- When liquid is present in the opened inner containers of homogeneous solids, mix the liquid with a nonbiodegradable absorbent or solidify so that liquid is no longer observed prior to packaging into a receiving 55-gallon drum.
- Completely empty all inner containers determined to contain only liquids, and handle as follows:
  - o When the liquid is unused product (e.g., Windex® remaining in a container), and not TRU, segregate the liquid to a LLW or MLLW waste stream as appropriate.
  - o If suspected or known to be TRU, treat the liquid.
  - o Following treatment and prior to packaging, determine that the waste does not contain free liquid (whether or not absorbents have been added), by using EPA Publication SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Method 9095B (Paint Filter Liquids Test).
  - o When a Paint Filter Liquids Test is performed, establish traceability by labeling the waste that was tested (e.g., container 1), displaying the tested waste to the camera, stating that the waste was tested and determined not to contain liquid for the audio narration, and documenting the container # and Paint Filter Liquids Test result on the Waste Container Packaging Form.
  - o When waste is treated for any reason prior to packaging, describe the waste that was treated and the treatment method(s) used on the Waste Container Packaging Form.

When feed 55-gallon drums contain direct-loaded homogeneous solid CH TRU waste, perform the following actions, as applicable:

- When the feed 55-gallon drum is not a DOT Specification 7A, Type A, container and the homogeneous solid waste is in a rigid polyethylene liner, lift the liner and waste to a compliant 55-gallon drum. This action shall be completed as follows:
  - o If the rigid liner lid is present, remove the lid. Ensure that this action is clearly visible to the camera, described in detail for the audio narration, and documented on the Waste Container Packaging Form.
  - o Verify the absence of liquid by thoroughly looking (with the aid of a flashlight) at the waste surface and down the annulus between the waste and liner and between the liner and container. Ensure that this activity is clearly visible to the camera and described in detail for the audio narration.
  - o When liquid is determined to be present, add a nonbiodegradable absorbent added in a quantity sufficient to absorb all liquid. Ensure that this activity is clearly visible to the camera, described in detail for the audio narration, and documented on the Waste Container Packaging Form.
  - o Do not reinstall rigid liner lid.

- When the feed 55-gallon drum is not a DOT Specification 7A, Type A, container and the homogeneous solid waste is not in a rigid polyethylene liner, notify the Director, Office of the National TRU Program, CBFO, for packaging instruction.
- When the feed 55-gallon drum is a DOT Specification 7A, Type A, container in good and unimpaired condition and the homogeneous solid waste either is or is not in a rigid polyethylene liner, perform the following:
  - Verify the absence of liquid by removing the rigid liner lid (if present) and thoroughly looking (with the aid of a flashlight) at the waste surface and down the annulus between the waste and liner, and between liner and container. Ensure that this activity is clearly visible to the camera and described in detail for the audio narration.
  - When liquid is determined to be present, add a nonbiodegradable absorbent in a quantity sufficient to absorb all liquid. Ensure that this activity is clearly visible to the camera, described in detail for the audio narration, and documented on the Waste Container Packaging Form.
  - Do not reinstall the rigid liner lid.

When repackaging CH TRU soil and gravel into receiving 55-gallon drums, perform the following:

- Empty the feed container
- Verify the absence of liquid by visual observation. Ensure that this activity is clearly visible to the camera and described in detail for the audio narration.
- When liquid is observed, add a nonbiodegradable absorbent in a quantity sufficient to absorb all liquid
- Following treatment and prior to packaging, determine that the waste does not contain free liquid using EPA Publication SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Method 9095B (Paint Filter Liquids Test)
- When a Paint Filter Liquids Test is performed, document the result on the Waste Container Packaging Form.
- When packaging soil and gravel into the receiving 55-gallon drum, ensure that the activity is clearly visible to the camera. Describe material composition and confirm the absence of liquid for the audio narration.
- After packaging and prior to closing the receiving 55-gallon drum, add approximately three to four inches of absorbent to the top surface of the waste.
- When waste is treated for any reason prior to packaging, describe the following on the Waste Container Packaging Form:
  - The waste that was treated
  - The treatment method(s) used
  - Type of absorbent used
  - Product name and manufacturer of all material(s) added to the waste

When repackaging CH TRU debris into receiving 55-gallon drums or SWBs, perform the following actions:

- Demonstrate the absence of liquid in empty containers by turning the open container upside down. Ensure that this activity is clearly visible to the camera and described in detail for the audio narration.
- Empty aerosol cans and cut in half. Do not just puncture.
- Demonstrate for the video the absence of liquid in pipe by holding in an inclined position (prior to capping or taping ends if applicable) and describe for the audio narration.
- Demonstrate for the video the absence of liquid in pipe with inline valve(s) by opening the valve(s), holding in an inclined position (prior to capping or taping ends if applicable), and describe for the audio narration.

- Demonstrate for the video and describe for the audio narration that lubricant reservoirs and other components of mechanical equipment that may contain liquid (e.g., pump housings, gear boxes, oil sumps, etc.), have been completely drained and the plugs removed. If the equipment contains non-flowing lubricant (at ambient temperatures), the lubricant does not have to be removed but acknowledge its presence for the audio narration and document on the Waste Container Packaging Form.
- Cut hoses and tubing into approximate one foot sections to demonstrate the absence of liquids.
- Place individual items with dose rates approaching 200 mrem/hr against the wall of the receiving container in a manner that ensures the item will remain where it was placed until the container is closed and the surface dose measurement is performed. Describe the placement location of these items for the audio narration.
- Block, brace, or suitably package sharp or heavy objects in the waste as necessary to provide puncture protection for the container. Describe protective measures for the audio narration.

## 12.2 Installation of Tamper-Indicating Devices

Once the receiving 55-gallon drum or SWB has been closed in accordance with the manufacturer's specifications, perform the following actions:

- Affix a tamper-indicating device (TID) with a unique identification number to the 55-gallon drum or SWB
- Install TIDs such that the container cannot be opened without breaking one or more seals.
  - Ensure that TID placement locations do not interfere with filter vent diffusivity or accessibility to the sample port septum
  - Ensure that TID placement locations do not interfere with the operation of the 55-gallon drum closure bolt and lock nut, or the SWB closure bolts.
- Ensure that the unique TID identification number(s) are clearly visible to the camera, read for the audio narration, and documented on the Waste Container Packaging Form

## 12.3 Removable Surface Contamination

- Monitor the container for surface contamination. Removable surface contamination that exceeds 20 dpm/100 cm<sup>2</sup> alpha and/or 200 dpm/100 cm<sup>2</sup> beta-gamma is not permitted. Fixing of surface contamination is not allowed.

## 13.0 **Packaging CH TRU Waste**

### 13.1 Waste into 55-gallon Drums and SWBs

Video record all 55-gallon drum and SWB loading with an audio narration that will provide indisputable evidence of packaging configuration, all waste contents, and absence of prohibited items. Document a written record of waste packaging on a Waste Container Packaging Form. Good quality video images with thorough narrative descriptions of the waste and well written Waste Container Packaging Forms are the best insurance that waste containers will not need to be repackaged again at a future date.

When packaging CH TRU waste, perform each of the following actions:

- Ensure that the 55-gallon drum or SWB unique container identification number is clearly visible to the camera, read for the audio narration, and documented on the Waste Container Packaging Form.
- State the date(s) of loading waste into the 55-gallon drum or SWB for the audio narration and document on the Waste Container Packaging Form.
- Identify all personnel loading waste into the 55-gallon drum or SWB by name for the audio narration and document on the Waste Container Packaging Form.
- Precede each interruption of the video by audio narration explaining the reason for the interruption.
- Ensure that each individual item placed into the waste container is clearly visible to the camera, described in detail for the audio narration, and documented on the Waste Container Packaging Form.
- Ensure that the description of each item of waste includes estimated weight percent composition of the following waste constituents:
  - Iron-based metals/alloys
  - Aluminum-based metals/alloys
  - Other metals
  - Cellulosics
  - Rubber
  - Plastics
  - Inorganic materials
  - Soil/gravel.

When homogeneous solids are packaged into 55-gallon drums, perform the following actions:

- Ensure that all containers of homogeneous solids are opened and determined to be free of liquid prior to packaging into a 55-gallon drum.
- When liquid is present in the opened containers of homogeneous solids, mix the liquid with a nonbiodegradable absorbent or solidified so that liquid is no longer observed prior to packaging into a 55-gallon drum.
- Completely empty all containers determined to contain only liquids, and handle as follows:
  - When the liquid is unused product (e.g., Windex® remaining in a container) and not TRU, segregate the liquid to a LLW or MLLW waste stream as appropriate
  - If suspected or known to be TRU, treat the liquid
  - Following treatment and prior to packaging, determine that the waste does not contain free liquid (whether or not absorbents have been added) using EPA Publication SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Method 9095B (Paint Filter Liquids Test).
  - When a Paint Filter Liquids Test is performed, establish traceability by labeling the waste that was tested (e.g., container 1), displaying the tested waste to the camera, stating that the waste was tested and determined not to contain liquid for the audio narration, and documenting the container # and Paint Filter Liquids Test result on the Waste Container Packaging Form.
- When waste is treated for any reason prior to packaging, describe the following on the Waste Container Packaging Form:
  - The waste that was treated
  - The treatment method(s) used
  - Type of absorbent used (when applicable)

- Solidification agent used (when applicable)
- Product name and manufacturer of all material(s) added to the waste.

When soil and gravel are packaged into 55-gallon drums, perform the following actions:

- Prior to packaging, determine that soil and gravel does not contain free liquid using EPA Publication SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Method 9095B (Paint Filter Liquids Test).
- When liquid is determined to be present, add a nonbiodegradable absorbent in a quantity sufficient to absorb all liquid
- Following treatment and prior to packaging, determine that the waste no longer contains free liquid by repeating the Method 9095B Paint Filter Liquids Test.
- If liquid is determined to be present, add additional nonbiodegradable absorbent until the soil and gravel is determined not to contain free liquid using the Method 9095B Paint Filter Liquids Test.
- Document the result of the final Method 9095B Paint Filter Liquids Test performed on the Waste Container Packaging Form
- When packaging soil and gravel into the 55-gallon drum, ensure that the activity is clearly visible to the camera. Describe material composition and the absence of liquid confirmed for the audio narration
- After packaging and prior to closing the 55-gallon drum, add approximately three to four inches of absorbent to the top surface of the waste.
- When waste is treated for any reason prior to packaging, describe the following on the Waste Container Packaging Form:
  - The waste that was treated
  - The treatment method(s) used
  - Type of absorbent used
  - Product name and manufacturer of all material(s) added to the waste

When debris is packaged into 55-gallon drums or SWBs, perform the following actions:

- Remove the lids from all containers, describe contents and material composition, and display to the camera. If all contents are not clearly visible to the camera, remove the contents such that each waste item is described in detail and displayed to the camera.
- Demonstrate the absence of liquid in empty containers by turning the open container upside down
- If waste was treated at any time and for any reason prior to packaging, describe the waste that was treated and the treatment method(s) used on the Waste Container Packaging Form.
- Show that all aerosol cans have been emptied and cut in half. Do not just puncture.
- Demonstrate for the video the absence of liquid in pipe by holding in an inclined position (prior to capping or taping ends if applicable), and describe for the audio narration.
- Demonstrate for the video the absence of liquid in pipe with inline valve(s) by opening the valve(s), holding in an inclined position (prior to capping or taping ends if applicable), and describe for the audio narration.
- Demonstrate for the video and describe for the audio narration that lubricant reservoirs and other components of mechanical equipment that may contain liquid (e.g., pump housings, gear boxes, oil sumps, etc.) have been completely drained and the plugs removed. If the equipment contains non-flowing lubricant (at ambient temperatures) the lubricant does not have to be removed but its presence shall be acknowledged for the audio narration and documented on the Waste Container Packaging Form.
- Cut hoses and tubing into approximate one foot sections to demonstrate the absence of liquids.

- Place individual items with dose rates approaching 200 mrem/hr against the wall of the container in a manner that ensures the item will remain where it was placed until the container is closed and the surface dose measurement is performed. Describe the placement location of these items for the audio narration.
- Block, brace, or suitably package sharp or heavy objects in the waste as necessary to provide puncture protection for the container. Describe protective measures for the audio narration.

### 13.2 Bagging or Wrapping Before Packaging

When bagging or wrapping waste in one location and transferring the bagged or wrapped waste to another location for packaging or when bagging or wrapping waste and packaging the bagged or wrapped waste at a later time, video record the bagging and/or wrapping with an audio narration that will provide indisputable evidence of all waste contents, waste constituent composition, and absence of prohibited items in each bag or wrap.

When bagging and/or wrapping CH TRU waste, comply with the following instructions:

- Mark each bag or wrap with a unique identification number. Ensure that the number is clearly visible to the camera, read for the audio narration and documented on the Waste Bag or Wrap Inventory Form (Attachment 5).
- State the date(s) of placing waste into each bag or wrap for the audio narration and document on the Waste Bag or Wrap Inventory Form.
- Identify personnel bagging or wrapping each waste item by name for the audio narration and document on the Waste Bag or Wrap Inventory Form.
- Precede each interruption of the video during a bagging or wrapping action by audio narration explaining the reason for the interruption.
- Identify each bag or wrap with dose rates approaching 200 mrem/hr on the Waste Bag or Wrap Inventory Form.
- Ensure that recordings of waste bagging and/or wrapping activities are traceable to each bag or wrap by the labeling of each recording with the unique bag or wrap identification number(s).
- Remove the lids from all containers, describe contents and waste constituent composition, and display to the camera. If all contents are not clearly visible to the camera, remove the contents such that each waste item is described in detail and displayed to the camera.
- Bag or wrap debris items separately from homogeneous solids.
- Document the corresponding waste category group for each bag or wrap on the Waste Bag or Wrap Inventory Form.
- Determine all containers of homogeneous solids to be free of liquid prior to bagging or wrapping.
- When liquid is present in the opened containers of homogeneous solids, mix the liquid with a nonbiodegradable absorbent or solidify so that liquid is no longer observed prior to bagging or wrapping.
- Completely empty all containers determined to contain only liquids and handle as follows:
  - When the liquid is unused product (e.g., Windex® remaining in a container), and not TRU, segregate the liquid to a LLW or MLLW waste stream as appropriate
  - If suspected or known to be TRU, treat the liquid
  - Following treatment and prior to bagging or wrapping, determine that the waste does not contain free liquid (whether or not absorbents have been added) using EPA Publication SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Method 9095B (Paint Filter Liquids Test).
  - When a Paint Filter Liquids Test is performed, establish traceability labeling the waste that was tested (e.g., container 1), displaying the tested waste to the camera,

stating that the waste was tested and determined not to contain liquid for the audio narration, and documenting the container #, the bag or wrap unique identification number and the result of the Paint Filter Liquids Test on the Waste Bag or Wrap Inventory Form.

- When waste is treated for any reason prior to bagging or wrapping, describe the following on the Waste Bag or Wrap Inventory Form:
  - The waste that was treated
  - The treatment method(s) used
  - Type of absorbent used (when applicable)
  - Solidification agent used (when applicable)
  - Product name and manufacturer of all material(s) added to the waste.
- Demonstrate the absence of liquid in empty containers by turning the open container upside down.
- Show that all aerosol cans have been emptied and cut in half. Do not just puncture.
- Demonstrate for the video the absence of liquid in pipe by holding in an inclined position (prior to capping or taping ends if applicable) and describe for the audio narration.
- Demonstrate for the video the absence of liquid in pipe with inline valve(s) by opening the valve(s), holding in an inclined position (prior to capping or taping ends if applicable), and describe for the audio narration.
- Demonstrate for the video and describe for the audio narration that lubricant reservoirs and other components of mechanical equipment that may contain liquid (e.g., pump housings, gear boxes, oil sumps, etc.) have been completely drained and the plugs removed. If the equipment contains non-flowing lubricant (at ambient temperatures) the lubricant does not have to be removed, but acknowledge its presence for the audio narration and document on a Waste Bag or Wrap Inventory Form.
- Cut hoses and tubing into approximate one foot sections to demonstrate the absence of liquids

### 13.3 Packaging Bagged or Wrapped Waste

Video record all 55-gallon drum and SWB loading of waste bags and/or wraps with an audio narration that will provide indisputable evidence of packaging configuration and the bags and/or wraps packaged. Ensure compliance with the following:

- Package bagged and/or wrapped debris items into a debris receiving 55-gallon drum or SWB.
- Package bagged and/or wrapped homogeneous solids into a homogeneous solids receiving 55-gallon drum.
- Ensure that the 55-gallon drum or SWB unique container identification number is clearly visible to the camera, read for the audio narration, and documented on the Waste Container Packaging Form.
- State the date(s) of loading waste into the 55-gallon drum or SWB for the audio narration and document on the Waste Container Packaging Form.
- Identify all personnel loading waste into the 55-gallon drum or SWB by name for the audio narration and document on the Waste Container Packaging Form.
- Precede each interruption of the video by audio narration explaining the reason for the interruption.
- For each individual waste bag or wrap placed into 55-gallon drums or SWBs, ensure that the unique bag or wrap identification number is clearly visible to the camera, read for the audio narration, and documented on the Waste Container Packaging Form.

- Attach Waste Bag or Wrap Inventory Forms correlating to each waste bag and/or wrap packaged to the Waste Container Packaging Form, and record the total number of pages on the Waste Container Packaging Form.
- Place bagged or wrapped items with dose rates approaching 200 mrem/hr against the wall of the container in a manner that ensures the item will remain where it was placed until the container is closed and the surface dose measurement is performed. Describe the placement location of these items for the audio narration.
- Block, brace, or suitably package sharp or heavy objects that have been bagged or wrapped as necessary to provide puncture protection for the container. Describe protective measures for the audio narration.

#### 13.4 Installation of Tamper-Indicating Devices

Once the waste container has been closed in accordance with the manufacturer's specifications, perform the following actions:

- Affix a tamper-indicating device (TID) with a unique identification number to the 55-gallon drum or SWB.
- Install TIDs such that the container cannot be opened without breaking one or more seals.
  - Ensure that TID placement locations do not interfere with filter vent diffusivity or accessibility to the sample port septum.
  - Ensure that TID placement locations do not interfere with the operation of the 55-gallon drum closure bolt and lock nut, or the SWB closure bolts.
- Ensure that the unique TID identification number(s) is clearly visible to the camera, read for the audio narration, and documented on the Waste Container Packaging Form.

#### 13.5 Removable Surface Contamination

- Monitor the container for surface contamination. Removable surface contamination that exceeds 20 dpm/100 cm<sup>2</sup> alpha and/or 200 dpm/100 cm<sup>2</sup> beta-gamma is not permitted. Fixing of surface contamination is not allowed.

#### 14.0 **Required Documentation**

Ensure that the following documentation for each container is available

##### 14.1 55-gallon Drum and Standard Waste Box

- Documentation for the procurement and receipt inspection, or certification of the 55-gallon drum or SWB to the DOT Specification 7A, Type A, requirements
- For 55-gallon drums:
  - Documentation that the maximum gross weight of the 55-gallon drum is no more than the maximum tested weight and no more than 1000 pounds
  - Documentation of the presence/absence of rigid drum liner
  - Documentation of the absence of rigid drum liner lid
- For standard waste boxes:
  - Documentation that the maximum gross weight of the standard waste box is no more than the maximum tested weight and no more than 4000 pounds

## 14.2 Container Filter Vent

- Documentation for the procurement and receipt inspection or certification of container filter vents to the container filter vent specifications.

## 14.3 Packaging

Ensure that recordings and Waste Container Packaging Forms are traceable to each 55-gallon drum or SWB by the labeling of each recording and Waste Container Packaging Form with the unique container identification number(s).

- Ensure that waste packaging documentation includes:
  - Good quality video recordings with thorough narrative descriptions for all waste packaged into each 55-gallon drum and/or SWB
  - Good quality video recordings with thorough narrative descriptions for all waste bagged and/or wrapped (when applicable)
  - Well written and complete Waste Container Packaging Forms with any associated Waste Bag or Wrap Inventory Forms attached
- Ensure that at a minimum, the following information is included on Waste Container Packaging Forms
  - DOE or DOE contract site name
  - Unique container identification number
  - The date(s) of loading waste into the container
  - The unique identification number of each waste bag and/or wrap packaged (when applicable)
  - The container identification number(s) of feed container(s)
  - Video with audio recorded media number
  - Number of pages (Waste Container Packaging Form and attachments)
  - Site procedure number including revision number used to perform work
  - Waste stream name
  - Waste category group
  - Detailed description of each waste item and percent composition of iron-based metals/alloys, aluminum-based metals/alloys, other metals, cellulose, rubber, plastics, inorganic materials, and soil/gravel
  - Description of any treatment done prior to packaging the waste
  - Presence or absence of inner bag(s) and/or liner bag(s) and number of bag layers
  - Statement that each inner bag and/or liner bag was fitted with a filter having a minimum hydrogen diffusivity value of  $1.075E-05$  mol/s/mol fraction
  - Statement of bag closure method
  - Presence or absence of rigid drum liner
  - Type of liner (e.g., plastic, fiberboard) and liner thickness
  - Absence of rigid drum liner lid
  - Container fill percentage (how full of waste the container is at time of closure, expressed in percent)
  - Container filter vent(s) information
  - Final closure date of the container
  - Unique TID identification number
  - Printed names and signatures of two persons who packaged waste into the container
  - Weight of loaded container
  - $^{239}\text{Pu}$  FGEs
  - PE-Ci
  - Highest measured surface dose rate of the loaded container
  - 95% of the radiological hazard

When attaching Waste Bag or Wrap Inventory Forms it is not necessary to duplicate all documented information on the Waste Container Packaging Forms. Entries of "see attached" will suffice as long as the Waste Container Packaging Forms with attachments provide the information specified in this instruction

- At a minimum, the following information shall be included on Waste Bag or Wrap Inventory Forms
  - Unique bag or wrap identification number
  - The date of placing waste into the bag or wrap
  - Video with audio recorded media number
  - Number of pages
  - Site procedure number including revision number used to perform work
  - Waste stream name
  - Waste bagging and/or wrapping location (e.g., building, room number, and process)
  - Detailed description of each waste item and percent composition of iron-based metals/alloys, aluminum-based metals/alloys, other metals, cellulose, rubber, plastics, inorganic materials, and soil/gravel
  - Description of the waste and any treatment method used prior to bagging or wrapping the waste
  - Identification of heavy, sharp objects that will require additional packaging protection (e.g., electric motor with exposed shaft)
  - Identification of items with dose rates approaching 200 mrem/hr
  - Statement that the bag was fitted with a filter having a minimum hydrogen diffusivity value of  $1.075E-05$  mol/s/mol fraction
  - Bag closure method
  - Printed names and signatures of two persons who bagged or wrapped the waste

**TABLE 1  
WASTE TANKS SUBJECT TO EXCLUSION**

Hanford Site - 177 Tanks	
A-101 through A-106	C-201 through C-204
AN-101 through AN-107	S-101 through S-112
AP-101 through AP-108	SX-101 through SX-115
AW-101 through AW-106	SY-101 through SY-103
AX-101 through AX-104	T-101 through T-112
AY-101 through AY-102	T-201 through T-204
B-101 through B-112	TX-101 through TX-118
B-201 through B-204	TY-101 through TY-106
BX-101 through BX-112	U-101 through U-112
BY-101 through BY-112	U-201 through U-204
C-101 through C-112	
Savannah River Site - 51 Tanks	
Tank 1 through 51	
Idaho National Engineering and Environmental Laboratory - 15 Tanks	
WM-103 through WM-106	WM-180 through 190

## Attachment 1 Payload Container Integrity Checklist

CONTAINER EXAMINATION		DISCUSSION OF CRITERIA
1	Is the payload container obviously degraded?	Obviously degraded means clearly visible and potentially significant defects in the payload container or payload container surface.
2.	Is there evidence that the payload container is, or has been, pressurized?	Pressurization can be indicated by a fairly uniform expansion of the sidewalls, bottom or top. Past pressurization can be indicated by a notable outward deflection of the bottom or top. Verify that the payload container is not warped.
3.	Is there any potentially significant rust or corrosion such that wall thinning, pin holes, or breaches are likely or the load bearing capacity is suspect?	<p>Rust shall be assessed in terms of its type, extent, and location. Pitting, pocking, flaking, or dark coloration characterizes potentially significant rust or corrosion. This includes the extent of the payload container surface area covered, thickness, and if it occurs in large flakes or built-up (caked) areas. Rusted payload containers may not be accepted if:</p> <ul style="list-style-type: none"> <li>• Rust is present in caked layers or deposits</li> <li>• Rust is present in the form of deep metal flaking, or built-up areas of corrosion products</li> </ul> <p>In addition, the location of rust should be noted; for example on a drum: top lid; filter region; locking chine; top one-third, above the second rolling hoop; middle one-third, between the first and second rolling hoops; bottom one-third, below the second rolling hoop; and on the bottom</p> <p>Payload containers may still be considered acceptable if the signs of rust show up as:</p> <ul style="list-style-type: none"> <li>• Some discoloration on the payload container</li> <li>• If rubbed would produce fine grit or dust or minor flaking (such that wall thinning does not occur)</li> </ul>
4.	Are any of the following apparent? <ul style="list-style-type: none"> <li>• Wall thinning</li> <li>• Pin holes</li> <li>• Breaches</li> </ul>	Wall thinning, pin holes, and breaches can be a result of rust/corrosion (see discussion for #3).

CONTAINER EXAMINATION		DISCUSSION OF CRITERIA
5	Are there any split seams, tears, obvious holes, punctures (of any size), creases, broken welds, or cracks?	Payload containers with obvious leaks, holes or openings, cracks, deep crevices, creases, tears, broken welds, sharp edges or pits, are either breached or on the verge of being breached. Verify that there is no warping that could cause the container to be unstable or prevent it from fitting properly in the applicable package.
6	Is the load-bearing capacity suspect?	The load-bearing capacity could be reduced for excessive rust (see discussion for #3), wall thinning (see discussion for #4), breaches, cracks, creases, broken welds, etc (see discussion for #5).
7	Is the payload container improperly closed?	Inspect the fastener and fastener ring (chine) if applicable for damage or excessive corrosion. Check the alignment of the fastener to ensure that it is in firm contact around the entire lid and the payload container will not open during transportation.
8	Are there any dents, scrapes, or scratches that make the payload container's structural integrity questionable or prevent the top and bottom surfaces from being parallel?	Deep gouges, scratches, or abrasions over wide areas are not acceptable. If top and bottom surfaces are not parallel, this would indicate that the container is warped. Dents should be less than ¼ inch deep by 3 inches long and between ½ inch to 6 inches wide. All other dents must be examined to determine impact of structural integrity.
9	Is there discoloration which would indicate leakage or other evidence of leakage of material from the payload container?	Examine the payload container regions near vents, top lid fittings, bottom fittings, welds, seams and intersections of one or more metal sheets or plates. Payload containers must be rejected if evidence of leakage is present.
10	Is the payload container bulged?	For the purposes of this examination, bulging is indicated by: <ul style="list-style-type: none"> <li>• A fairly uniform expansion of the sidewalls, bottom, or top (e.g., in the case of a drum, either the top or bottom surface protrudes beyond the planar surface of the top or bottom ring,</li> <li>• A protrusion of the side wall (e.g., in the case of a drum, beyond a line connecting the peaks of the surrounding rolling hoops or a line between a surrounding rolling hoop and the bottom or top ring), or</li> <li>• Expansion of the sidewall (e.g., in the case of a drum, such that it deforms any portion of a rolling hoop).</li> </ul>

## Attachment 2 Fissile Gram Equivalent

Determination of FGE requires the following information:

1. The isotopic composition of the waste in a 55-gallon drum or SWB
2. The quantity of each isotope contained in a 55-gallon drum or SWB
3. The measurement error for each isotope contained in the 55-gallon drum or SWB

### Calculation of the FGE and Compliance Evaluation

Only the isotopes listed below contribute to the FGE calculation:

Isotope	Equivalent Factor (EF)
U-233	9.00E-01
U-235	6.43E-01
Np-237	1.50E-02
Pu-238	1.13E-01
Pu-239	1.00E+00
Pu-240	2.25E-02
Pu-241	2.25E+00
Pu-242	7.50E-03
Am-241	1.87E-02
Am-242m	3.46E+01
Am-243	1.29E-02
Cm-243	5.00E+00
Cm-244	9.00E-02
Cm-245	1.50E+01
Cm-247	5.00E-01
Cf-249	4.50E+01
Cf-251	9.00E+01

The following equation is used to calculate FGE:

$$\sum_{i=1}^n (G_{isotope} + 2 TMU_{isotope}) \cdot EF_{isotope}$$

Where:

$n$  is the number of isotopes from the list above, contained in the waste

$G_{isotope}$  is the value in grams for each isotope listed above

$TMU_{isotope}$  is the total measurement uncertainty for each isotope and

$EF_{isotope}$  is the Equivalent Factor for each isotope listed above

The FGE of each 55-gallon drum or SWB shall be calculated from the isotopic composition and quantity of isotopes. The FGE value plus two times the TMU shall be less than or equal to the applicable limit for each payload container.

*Example:*

A 55-gallon drum is assayed and found to contain:

Isotope	Grams	TMU
Pu-239	10.00	15%
Am-241	0.012	7%
Cs-137 <sup>1</sup>	0.001	3%

The FGE is calculated by:

$$FGE = \{G_{Pu-239} + 2(TMU_{Pu-239})\} EF_{Pu-239} + \{G_{Am-241} + 2(TMU_{Am-241})\} EF_{Am-241}$$

$$FGE = \{10.00 + 2(10.00 \times 0.15)\} * 1.00E+00 + \{0.012 + 2(0.012 \times 0.07)\} * 1.87E-02$$

$$FGE = \{10.00g + 2(1.50g)\} * 1 + \{0.012g + 2(0.00084)\} * 0.0187$$

$$FGE = \{10.00g + 3.00g\} * 1 + \{0.012g + 0.00168\} * 0.0187$$

$$FGE = 13.00g + 0.000256g = 13.00g$$

<sup>1</sup> Cs-137 is ignored for the calculation of FGE because it does not appear in the list above.

## Attachment 3 <sup>239</sup>Pu Equivalent Activity

For a known radioactivity quantity and isotopic distribution, the <sup>239</sup>Pu equivalent activity is determined using isotope-specific weighting factors. The <sup>239</sup>Pu equivalent activity (EA) can be characterized by

$$EA = \sum_{i=1}^K A_i / WFi$$

where  $K$  is the number of TRU<sup>1</sup> isotopes,  $A_i$  is the activity of isotope  $i$ , and  $WFi$  is the PE-Ci weighting factor for isotope  $i$ .

$WFi$  is further defined as the ratio

$$WFi = E_o / E_i$$

where  $E_o$  (rem/ $\mu$ Ci) is the 50-year effective whole-body dose commitment due to the inhalation of <sup>239</sup>Pu particulates with a 1.0  $\mu$ m activity median aerodynamic diameter (AMAD) and a weekly pulmonary clearance class, and  $E_i$  (rem/ $\mu$ Ci) is the 50-year effective whole-body dose commitment due to the inhalation of isotope ( $i$ ) particulates with a 1.0  $\mu$ m AMAD and the pulmonary clearance class resulting in the highest 50-year effective whole-body dose commitment. Weighting factors calculated in this manner are presented in below for isotopes typically present in CH TRU waste. If other TRU isotopes are determined to be present in the payload container, their weighting factors can be obtained from the values of  $E_o$  and  $E_i$  contained in DOE/EH-0071<sup>2</sup>.

### PE-Ci Weighting Factors for Selected Isotopes<sup>3</sup>

Isotope	Pulmonary Clearance Class <sup>4</sup>	Weighting Factor
U-233	Y	3.9
Np-237	W	1.0
Pu-236	W	3.2
Pu-238	W	1.1
Pu-239	W	1.0
Pu-240	W	1.0
Pu-241	W	51.0
Pu-242	W	1.1
Am-241	W	1.0

### PE-Ci Weighting Factors for Selected Isotopes (continued)

<sup>1</sup> TRU as designated in this equation refers to any radionuclide with an atomic number greater than 92 and including U-233.

<sup>2</sup> U.S. Department of Energy Internal Dose Conversion Factors for Calculation of DOSE to the Public DOE/EH-0071 July 1988.

<sup>3</sup> PE-Ci must be calculated using all radionuclides, not just these selected radionuclides

<sup>4</sup> (W) Weekly (Y) Yearly

Isotope	Pulmonary Clearance Class	Weighting Factor
Am-243	W	1.0
Cm-242	W	30.0
Cm-244	W	1.9
Cf-252	Y	3.9

Example:

A 55-gallon drum is assayed and found to contain:

Nuclide	Grams	Activity (Ci)
Pu-239	10.00	0.629
Am-241	0.012	0.042
Cs-137	0.001	0.088

The weighting factor for Cs-137 must be calculated because it does not appear in the list :

$$WF_i = E_o / E_i$$

$$WF_{Cs-137} = 510 / 0.032 = 15,937$$

The PE-Ci is calculated by

$$EA = A_{Pu-239} / WF_{Pu-239} + A_{Am-241} / WF_{Am-241} + A_{Cs-137} / WF_{Cs-137}$$

$$EA = 0.629 / 1 + 0.042 / 1 + 0.088 / 15937$$

$$EA = 0.629 + 0.042 + 0.0000055$$

$$EA = 0.671 \text{ PE-Ci}$$

## Attachment 4 Waste Container Packaging Form

<b>Section 1: General Information</b>	
Unique Container Identification Number:	
DOE or DOE Contract Site Name:	
<input type="checkbox"/> Initial Waste Packaging	<input type="checkbox"/> Repackaging
Date(s) of Packaging or Repackaging:	
Audio-Video Recording Number:	
Site Procedure Number and Revision Used:	

<b>Section 2: Waste Container Information</b>	
Container Type: <input type="checkbox"/> 55-gallon drum <input type="checkbox"/> SWB	
Rigid Liner Used? <input type="checkbox"/> Yes <input type="checkbox"/> No If rigid liner was used, list the type of rigid liner and affirm that the lid was not installed: _____	
Container Filter Vent #1 with sample port septum: Minimum H <sub>2</sub> Diffusivity 1.85E-05 mol/s/mol? <input type="checkbox"/> Yes <input type="checkbox"/> No Identification of the filter manufacturer: _____ Date of manufacture, or lot number, or unique serial number: _____	
Container Filter Vent #2: (required for SWB only) Minimum H <sub>2</sub> Diffusivity 1.85E-05 mol/s/mol? <input type="checkbox"/> Yes <input type="checkbox"/> No Identification of the filter manufacturer: _____ Date of manufacture, or lot number, or unique serial number: _____	
Number layers of confinement: <input type="checkbox"/> one <input type="checkbox"/> two	
Closure Method used for 55-gallon drum or SWB liner bag: Closure Method used for inner bags:	
All Bag Layers Vented? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Minimum H <sub>2</sub> Diffusivity of Bag Filters 1.075E-05 mol/s/mol? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Waste Container Weight	Container gross wt: _____ kg Container tare wt: _____ kg Waste net wt: _____ kg.
Container Fill Percentage: _____%	
Waste Category Group: <input type="checkbox"/> Homogeneous Solids <input type="checkbox"/> Soil/gravel <input type="checkbox"/> Debris	
Waste Stream Name:	
TID Identification Number(s):	



Section 5: Packaging Summary		Yes	No
Does this waste contain any treated liquids? If waste contains treated liquid, describe in the Comments section: <ul style="list-style-type: none"> <li>• The waste that was treated</li> <li>• Treatment method used</li> <li>• The type of absorbent used,</li> <li>• Solidification agent used,</li> <li>• Product name and manufacturer of any material added to the waste</li> <li>• Results of a Method 9095B Paint Filter Liquids Test for each container tested (including container #).</li> </ul>			
Was any other treatment performed prior to packaging? If yes, describe the treatment in the Comments section.			
Was this waste packaged in accordance with the "CH TRU Waste Packaging Instructions"? If not, attach the letter from the Director, Office of Disposal Operations, EM Headquarters Office of Regulatory Compliance that approves the variance.			
Comments:			

Section 6: Operator Information	
List all personnel loading waste into container:	
Printed names and signatures of two site personnel who are approving this form attesting to the contents of the waste container (Section 7: Radiological Properties completion occurs after signature)	
Printed Name:	Printed Name:
Signature:	Signature:
Date:	Date:





Bag or Wrap Number: \_\_\_\_\_

Section 4: Bagging or Wrapping Summary	Yes	No
Does this bag or wrap include any high dose rate items, approaching 200 mrem/hr, that require placement against the wall of the 55-gallon drum or SWB?		
Does this waste contain any treated liquids? If waste contains treated liquid, describe in the Comments section: <ul style="list-style-type: none"> <li>• The waste that was treated</li> <li>• Treatment method used</li> <li>• The type of absorbent used</li> <li>• Solidification agent used</li> <li>• Product name and manufacturer of any material added to the waste, and</li> <li>• results of a Method 9095B Paint Filter Liquids Test for each container treated (including container ID#).</li> </ul>		
Was any other treatment performed prior to bagging or wrapping? If yes, describe the treatment in the Comments section.		
Was this waste bagged or wrapped in accordance with the "CH TRU Waste Packaging Instructions"? If not, attach the letter from the Director, Office of Disposal Operations, EM Headquarters Office of Regulatory Compliance that approves the variance.		
Comments:		

Section 5: Printed names and signatures of two site personnel who are approving this form attesting to the contents of the bag or wrap	
This completed Waste Bag or Wrap Inventory Form consists of _____ pages	
Printed Name:	Printed Name:
Signature:	Signature:
Date:	Date: