DOE/WIPP 90-045
Rev. 7

RH-TRU WASTE CONTENT CODES (RH-TRUCON)

Revision 7
July 2007

This document supercedes DOE/WIPP 90-045, Revision 6

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Rev. 7

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Revision 7
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PREFACE

In July 2006, the U.S. Nuclear Regulatory Commission approved the RH-TRU 72-B Safety Analysis Report (Revision 4) and the Remote-Handled Transuranic Waste Authorized Methods for Payload Control (RH-TRAMPAC) (Revision 0). Revision 0 of the RH-TRAMPAC outlines a procedure whereby new and revised content codes may be evaluated by the WIPP RH-TRU Payload Engineer for compliance with the transportation requirements of the RH-TRAMPAC and subsequently approved by DOE-CBFO for site use. The RH-TRAMPAC also requires that the WIPP RH-TRU Payload Engineer record all approved content code additions or revisions in the RH-TRUCON document.

This document, DOE/WIPP 90-045, RH-TRU Waste Content Codes (RH-TRUCON), Revision 7, has been revised to incorporate the following changes:

- Idaho National Laboratory: Content Codes ID 321A, ID 321D, ID 321K, ID 321N, ID 322D, ID 322N, ID 325D, and ID 325N have been added. In addition, Content Codes ID 322A, ID 322C, ID 322K, ID 322M, ID 325A, ID 325C, ID 325K and ID 325M have been revised.

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INTRODUCTION

The Remote-Handled Transuranic (RH-TRU) Content Codes (RH-TRUCON) document describes the inventory of RH-TRU waste within the transportation parameters specified by the Remote-Handled Transuranic Waste Authorized Methods for Payload Control (RH-TRAMPAC).[1] The RH-TRAMPAC defines the allowable payload for the RH-TRU 72-B. This document is a catalog of RH-TRU 72-B authorized contents by site.

A content code is defined by the following components:

- A two-letter site abbreviation that designates the physical location of the generated/stored waste (e.g., ID for Idaho National Laboratory [INL]). The site-specific letter designations for each of the sites are provided in Table 1.

- A three-digit code that designates the physical and chemical form of the waste (e.g., content code 317 denotes TRU Metal Waste). For RH-TRU waste to be transported in the RH-TRU 72-B, the first number of this three-digit code is "3." The second and third numbers of the three-digit code describe the physical and chemical form of the waste. Table 2 provides a brief description of each generic code.

Content codes are further defined as subcodes by an alpha trailer after the three-digit code to allow segregation of wastes that differ in one or more parameter(s). For example, the alpha trailers of the subcodes ID 322A and ID 322B may be used to differentiate between waste packaging configurations.

As detailed in the RH-TRAMPAC, compliance with flammable gas limits may be demonstrated through the evaluation of compliance with either a decay heat limit or flammable gas generation rate (FGGR) limit per container specified in approved content codes.

As applicable, if a container meets the watt*year criteria specified by the RH-TRAMPAC, the decay heat limits based on the dose-dependent G value may be used as specified in an approved content code.

If a site implements the administrative controls outlined in the RH-TRAMPAC and Appendix 2.4 of the RH-TRU Payload Appendices, the decay heat or FGGR limits based on a 10-day shipping period (rather than the standard 60-day shipping period) may be used as specified in an approved content code.

Requests for new or revised content codes may be submitted to the WIPP RH-TRU Payload Engineer for review and approval, provided all RH-TRAMPAC requirements are met.

The format for content codes is as follows:

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[1] U.S. Department of Energy, Remote-Handled Transuranic Waste Authorized Methods for Payload Control, current revision, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

- Content Code
- Content Description
- Generating Site
- Storage Site
- Waste Description
- Generating Source(s)
- Waste Form
- Waste Packaging
- Methods for Isotopic Determination
- Residual Liquids
- Explosives/Compressed Gases
- Pyrophorics
- Corrosives
- Chemical Compatibility
- Chemical List
- G Value
- Additional Criteria
- Maximum Allowable Flammable Gas Generation Rate Limits
- Maximum Allowable Decay Heat Limits

Each of these parameters is discussed below.

CONTENT CODE: Identifies the two-letter site abbreviation that designates the physical location of the waste and the three-digit code that designates the physical and chemical form of the waste.

CONTENT DESCRIPTION: Identifies the physical form of the waste, describing whether it is inorganic or organic, solidified, or solid.

GENERATING SITE: Provides the location of waste generation.

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.

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 specific information about the constituents. This includes an estimate of the average waste density as packaged.

WASTE PACKAGING: Describes, in detail, techniques necessary for waste packaging in a given content code. This includes the number and type of layers of confinement used in packaging waste, and the mechanism for bag, can, or container closure. In addition, this includes the size and shape of inner and outer waste containers, an estimate of the average void volume within each confinement layer, the number and type of filters (if present) in each confinement layer, and the number of waste containers per RH-TRU waste canister, as well as the type of RH-TRU waste canister to be used (i.e., fixed-lid or removable-lid canister). Default void volumes for standard layers of confinement are provided in Table 2.5-2 of Appendix 2.5 of the RH-TRU Payload Appendices.

METHODS FOR ISOTOPIC DETERMINATION: Describes the types of radioactive measurement techniques or other methods used to obtain fissile material content and decay heat values for a particular content code. Information on the radionuclide composition of the waste (ratios of isotopes/percentages by mass or activity) and date of determination must be provided by the site for the determination of decay heat limits.

RESIDUAL LIQUIDS: Describes the procedures used to ensure that the limit imposed on residual liquids (<1% by volume) is met for each content code.

EXPLOSIVES/COMPRESSED GASES: Identifies the methods used to preclude the presence of explosives or compressed gases.

PYROPHORICS: Describes the controls in place to ensure that pyrophoric materials in the waste are not present in quantities greater than 1% by weight.

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

CHEMICAL COMPATIBILITY: Describes the controls in place to ensure chemical compatibility for the waste contents and the RH-TRU 72-B packaging. All chemicals/materials in the waste in quantities greater than 1% by weight for a specific content code are restricted to the list of allowable chemicals/materials (Table 4.3-1 of the RH-TRAMPAC). The total quantity of trace chemicals/materials in the payload container not listed in Table 4.3-1 of the RH-TRAMPAC is limited to 5% as specified in Section 4.3.

CHEMICAL LIST: Lists the chemicals/materials that may be present in the content code in quantities greater than 1% (weight) (used in the chemical compatibility evaluation) and less than or equal to 1% (weight) and, additionally, may identify the predominant chemicals/materials or relevant quantities (% weight) of specific materials (used in the G value determination).

G VALUE: Defines the G value (gas generation potential) for the content code based on the chemicals/materials present in the waste.

ADDITIONAL CRITERIA: Provides details on how the waste qualifies for shipment by meeting additional transport requirements. This section documents the estimated total concentration of flammable volatile organic compounds (VOCs) per payload container headspace and the shipping period (60 or 10 days) to be used. As applicable, this section also includes information on the venting of containers and specific aspiration requirements.

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: Specifies the FGGR limits for the content code. The FGGR limits are calculated using information from the Waste Packaging and Additional Criteria (i.e., shipping period) parameters above.

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: Specifies the decay heat limits for the content code. The decay heat limits are calculated using information from the Waste Form, Waste Packaging, Methods for Isotopic Determination, G Value, and Additional Criteria parameters above. Decay heat limits based on dose-dependent G values are also specified, as applicable.

TABLE 1

WASTE SHIPPER SITE IDENTIFICATION CODES

SITE NAME	SITE IDENTIFICATION CODE
Argonne National Laboratory (ANL)	AE
Materials Fuels Complex (MFC) (formerly Argonne National Laboratory-West	AW
Bettis Atomic Power Laboratory	BE
General Electric Vallecitos Nuclear Center	GE
Idaho National Laboratory (INL)	ID
Knolls Atomic Power Laboratory-Schenectady	KS
Los Alamos National Laboratory (LANL)	LA
Oak Ridge National Laboratory (ORNL)	OR
Richland Hanford (RH)	RH
Sandia National Laboratories (SNL)	SL
Savannah River Site (SRS)	SR
West Valley Demonstration Project (WVDP)	WV

TABLE 2

CONTENT CODES FOR RH-TRU WASTE

Content Code	Description
311	TRU Solidified Aqueous or Homogeneous Inorganic Solids - cemented or dewatered sludge from aqueous waste treatment processes. Soils that are not contaminated with organic chemicals are classified as homogeneous solids.
314	TRU Solidified Inorganic Process Solids - cemented inorganic particulate or sludge-like (not chemically precipitated) waste from plutonium recovery operations.
315	TRU Graphite Waste - discarded graphite molds, laboratory equipment and furnace equipment (whole or pieces) from plutonium casting or laboratory operations.
316	TRU Combustible Waste - cellulosic, plastic, or cloth waste from various processes.
317	TRU Metal Waste - discarded metal (e.g., tantalum, aluminum, stainless steel) from production or maintenance operations.
318	TRU Glass Waste - discarded labware, windows, containers, or Raschig rings from various processes.
319	TRU Filter Waste - high-efficiency particulate air (HEPA) filters or processed filter media from filter change operations. (Most filters or the housings for filters are made of organic material.)
320	TRU Isotopic Source Waste.
321	TRU Organic Solid Waste - solid organic waste such as methyl methacrylate (Plexiglas) and Benelex.
322	TRU Inorganic Solid Waste - solid inorganic waste such as insulation, firebrick, concrete.
323	TRU Leaded Rubber - discarded leaded glovebox gloves and leaded aprons.
324	TRU Pyrochemical Salt Waste - used chloride salts from pyrochemical processes such as electrorefining, molten salt extraction or direct oxide reduction.
325	TRU Solid Organic and Solid Inorganic Waste - mixture of paper, plastic, metal and glass waste.

Content Code	Description
326	TRU Cemented Organic Process Solids - cemented organic particulate, sludge-like (not chemically precipitated) waste or resins.
327	TRU Combined Solid Organics, Solid Inorganics, and Solidified Inorganics - cellulosic, plastic, or cloth waste from various processes, discarded graphite, nonpyrophoric waste metals, glass and ceramic waste, and spent chloride salts, combined with cemented or dewatered sludge precipitated from aqueous waste treatment process.
328	Combined Solidified Inorganics and Solid Inorganics - discarded graphite pieces, metal, glass, firebrick, concrete, and pyrochemical salt waste from various processes, combined with aqueous effluent and particulate and sludge-type wastes that have been solidified with Portland cement.

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CONTENT CODE: ID 321A

CONTENT DESCRIPTION: Solid organic waste (up to 50% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of no more than 50% (by weight) solid organic waste with solid inorganic waste comprising the remainder.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. Up to three 30-gallon drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
Two PVC bags	1
30-gallon drum	16.1
Canister	448

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 50% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	6.5779E-9
30-Gallon Drum	2.1926E-9

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	0.0468	0.0951
30-Gallon Drum	0.0156	0.0317

CHEMICAL LIST

Idaho National Laboratory Content Code ID 321A

Solid Inorganic Waste with up to 50% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 321A

Solid Inorganic Waste with up to 50% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 321D

CONTENT DESCRIPTION: Solid organic waste (up to 50% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of no more than 50% (by weight) solid organic waste with solid inorganic waste comprising the remainder.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. Both PVC bags are later breached and are not considered layers of confinement. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol

fraction. Up to three 30-gallon drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
30-gallon drum	16.1
Canister	448

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 50% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	**Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)**
Canister	7.4573E-8
30-Gallon Drum	2.4857E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	**Maximum Allowable Decay Heat Limits Removable Lid Canister**	
	≤0.012 watt*year (watts)	**>0.012 watt*year (watts)**
Canister	0.5314	1.0792
30-Gallon Drum	0.1771	0.3597

CHEMICAL LIST

Idaho National Laboratory Content Code ID 321D

Solid Inorganic Waste with up to 50% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 321D

Solid Inorganic Waste with up to 50% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 321K

CONTENT DESCRIPTION: Solid organic waste (up to 50% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of no more than 50% (by weight) solid organic waste with solid inorganic waste comprising the remainder.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. The 30-gallon drum may then be placed into a 55-gallon drum. The

55-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 1.85E-05 mol/s/mol fraction. Up to three drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
Two PVC bags	1
30-gallon drum	16.1
55-gallon drum	56
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste

generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 50% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	6.5521E-9
55-Gallon Drum	2.1840E-9
30-Gallon Drum	2.1840E-9

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	0.0466	0.0948
55-Gallon Drum	0.0155	0.0316
30-Gallon Drum	0.0155	0.0316

CHEMICAL LIST

Idaho National Laboratory Content Code ID 321K

Solid Inorganic Waste with up to 50% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 321K

Solid Inorganic Waste with up to 50% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 321N

CONTENT DESCRIPTION: Solid organic waste (up to 50% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of no more than 50% (by weight) solid organic waste with solid inorganic waste comprising the remainder.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. Both PVC bags are later breached and are not considered layers of confinement. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol

fraction. The 30-gallon drum may then be placed into a 55-gallon drum. The 55-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 1.85E-05 mol/s/mol fraction. Up to three drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
30-gallon drum	16.1
55-gallon drum	56
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste

generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 50% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	7.1308E-8
55-Gallon Drum	2.3769E-8
30-Gallon Drum	2.3769E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	0.5081	1.0319
55-Gallon Drum	0.1693	0.3439
30-Gallon Drum	0.1693	0.3439

CHEMICAL LIST

Idaho National Laboratory Content Code ID 321N

Solid Inorganic Waste with up to 50% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 321N

Solid Inorganic Waste with up to 50% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 322A

CONTENT DESCRIPTION: Solid inorganic waste with up to 20% (by weight) solid organic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of solid inorganic waste with no more than 20% (by weight) of solid organic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. Up to three 30-gallon drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
Two PVC bags	1
30-gallon drum	16.1
Canister	448

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 20% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	**Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)**
Canister	6.5606E-9
30-Gallon Drum	2.1868E-9

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	**Maximum Allowable Decay Heat Limits Removable Lid Canister**	
	≤0.012 watt*year (watts)	**>0.012 watt*year (watts)**
Canister	0.1168	0.2372
30-Gallon Drum	0.0389	0.0790

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322A
Solid Inorganic Waste with up to 20% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)
Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)
Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322A
Solid Inorganic Waste with up to 20% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 322C

CONTENT DESCRIPTION: Solid inorganic waste with up to 20% (by weight) solid organic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of solid inorganic waste with no more than 20% (by weight) of solid organic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1995.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can or two 7-gallon steel cans. Each can is closed with a lid without a gasket. The steel can(s) is not considered a layer of confinement because the lid does not have a gasket and there are holes drilled in the container sides to accommodate the placement of a lifting cable attachment. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed and filtered. The filter in the bag has a minimum total hydrogen diffusivity value of 1.075E-05 mol/s/mol fraction. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed and filtered. The filter in the bag has a minimum total hydrogen diffusivity value of 1.075E-05 mol/s/mol fraction. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. Up to three 30-gallon drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Two PVC bags	1
30-gallon drum	16.1
Canister	448

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or

radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 20% by weight).

ADDITIONAL CRITERIA: Because all containers were generated in a vented condition, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	1.0659E-7
30-Gallon Drum	3.5532E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	1.8988	3.8525
30-Gallon Drum	0.6329	1.2841

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322C
Solid Inorganic Waste with up to 20% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Graphite
Glass
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322C
Solid Inorganic Waste with up to 20% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 322D

CONTENT DESCRIPTION: Solid inorganic waste with up to 20% (by weight) solid organic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of solid inorganic waste with no more than 20% (by weight) of solid organic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. Both PVC bags are later breached and are not considered layers of confinement. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol

fraction. Up to three 30-gallon drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
30-gallon drum	16.1
Canister	448

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 20% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	7.4573E-8
30-Gallon Drum	2.4857E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	1.3292	2.698
30-Gallon Drum	0.4430	0.8993

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322D

Solid Inorganic Waste with up to 20% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322D

Solid Inorganic Waste with up to 20% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 322K

CONTENT DESCRIPTION: Solid inorganic waste with up to 20% (by weight) solid organic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of solid inorganic waste with no more than 20% (by weight) of solid organic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. The 30-gallon drum may then be placed into a 55-gallon drum. The

55-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 1.85E-05 mol/s/mol fraction. Up to three drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
Two PVC bags	1
30-gallon drum	16.1
55-gallon drum	56
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste

generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 20% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable gas generation rate limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	6.5350E-9
55-Gallon Drum	2.1783E-9
30-Gallon Drum	2.1783E-9

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	0.1164	0.2362
55-Gallon Drum	0.0388	0.0787
30-Gallon Drum	0.0388	0.0787

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322K
Solid Inorganic Waste with up to 20% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)
Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)
Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322K
Solid Inorganic Waste with up to 20% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 322M

CONTENT DESCRIPTION: Solid inorganic waste with up to 20% (by weight) solid organic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of solid inorganic waste with no more than 20% (by weight) of solid organic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1995.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can or two 7-gallon steel cans. Each can is closed with a lid without a gasket. The steel can(s) is not considered a layer of confinement because the lid does not have a gasket and there are holes drilled in the container sides to accommodate the placement of a lifting cable attachment. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed and filtered. The filter in the bag has a minimum total hydrogen diffusivity value of 1.075E-05 mol/s/mol fraction. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed and filtered. The filter in the bag has a minimum total hydrogen diffusivity value of 1.075E-05 mol/s/mol fraction. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. The 30-gallon drum may then be placed into a 55-gallon drum. The 55-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 1.85E-05 mol/s/mol fraction. Up to three drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Two PVC bags	1
30-gallon drum	16.1
55-gallon drum	56
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste

generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 20% by weight).

ADDITIONAL CRITERIA: Because all containers were generated in a vented condition, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	1.0003E-7
30-Gallon Drum	3.3344E-8
55-Gallon Drum	3.3344E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	1.7819	3.6153
30-Gallon Drum	0.5939	1.2051
55-Gallon Drum	0.5939	1.2051

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322M
Solid Inorganic Waste with up to 20% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)
Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)
Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322M
Solid Inorganic Waste with up to 20% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 322N

CONTENT DESCRIPTION: Solid inorganic waste with up to 20% (by weight) solid organic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of solid inorganic waste with no more than 20% (by weight) of solid organic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. Both PVC bags are later breached and are not considered layers of confinement. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol

fraction. The 30-gallon drum may then be placed into a 55-gallon drum. The 55-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 1.85E-05 mol/s/mol fraction. Up to three drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
30-gallon drum	16.1
55-gallon drum	56
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste

generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 20% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	7.1308E-8
55-Gallon Drum	2.3769E-8
30-Gallon Drum	2.3769E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	1.2710	2.5799
55-Gallon Drum	0.4236	0.8599
30-Gallon Drum	0.4236	0.8599

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322N

Solid Inorganic Waste with up to 20% Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 322N

Solid Inorganic Waste with up to 20% Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 325A

CONTENT DESCRIPTION: Solid organic waste (up to 100% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of both solid organic and solid inorganic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. Up to three 30-gallon drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
Two PVC bags	1
30-gallon drum	16.1
Canister	448

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose.

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	6.5606E-9
30-Gallon Drum	2.1868E-9

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	0.0233	0.0474
30-Gallon Drum	0.0077	0.0158

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325A
Solid Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325A
Solid Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 325C

CONTENT DESCRIPTION: Solid organic waste (up to 100% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of both solid organic and solid inorganic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1995.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can or two 7-gallon steel cans. Each can is closed with a lid without a gasket. The steel can(s) is not considered a layer of confinement because the lid does not have a gasket and there are holes drilled in the container sides to accommodate the placement of a lifting cable attachment. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed and filtered. The filter in the bag has a minimum total hydrogen diffusivity value of 1.075E-05 mol/s/mol fraction. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed and filtered. The filter in the bag has a minimum total hydrogen diffusivity value of 1.075E-05 mol/s/mol fraction. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol

fraction. Up to three 30-gallon drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Two PVC bags	1
30-gallon drum	16.1
Canister	448

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose.

ADDITIONAL CRITERIA: Because all containers were generated in a vented condition, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	**Maximum Allowable FGGR Limits Removable Lid Canister (mole/second)**
Canister	1.0659E-7
30-Gallon Drum	3.5532E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	**Maximum Allowable Decay Heat Limits Removable Lid Canister**	
	≤0.012 watt*year (watt)	**>0.012 watt*year (watt)**
Canister	0.3796	0.7705
30-Gallon Drum	0.1265	0.2568

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325C
Solid Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)
Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Graphite
Glass
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)
Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325C
Solid Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 325D

CONTENT DESCRIPTION: Solid organic waste (up to 100% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of both solid organic and solid inorganic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. Both PVC bags are later breached and are not considered layers of confinement. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. Up to three 30-gallon drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
30-gallon drum	16.1
Canister	448

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose.

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	**Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)**
Canister	7.4573E-8
30-Gallon Drum	2.4857E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	**Maximum Allowable Decay Heat Limits Removable Lid Canister**	
	≤0.012 watt*year (watts)	**>0.012 watt*year (watts)**
Canister	0.2657	0.5396
30-Gallon Drum	0.0885	0.1798

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325D

Solid Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325D

Solid Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 325K

CONTENT DESCRIPTION: Solid organic waste (up to 100% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of both solid organic and solid inorganic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. The 30-gallon drum may then be placed into a 55-gallon drum. The 55-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of

1.85E-05 mol/s/mol fraction. Up to three drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
Two PVC bags	1
30-gallon drum	16.1
55-gallon drum	56
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or

radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose.

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable gas generation rate limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	6.5350E-9
55-Gallon Drum	2.1783E-9
30-Gallon Drum	2.1783E-9

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	0.0232	0.0472
55-Gallon Drum	0.0077	0.0157
30-Gallon Drum	0.0077	0.0157

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325K
Solid Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325K
Solid Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 325M

CONTENT DESCRIPTION: Solid organic waste (up to 100% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of both solid organic and solid inorganic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1995.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can or two 7-gallon steel cans. Each can is closed with a lid without a gasket. The steel can(s) is not considered a layer of confinement because the lid does not have a gasket and there are holes drilled in the container sides to accommodate the placement of a lifting cable attachment. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed and filtered. The filter in the bag has a minimum total hydrogen diffusivity value of 1.075E-05 mol/s/mol fraction. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed and filtered. The filter in the bag has a minimum total hydrogen diffusivity value of 1.075E-05 mol/s/mol fraction. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol

fraction. The 30-gallon drum may then be placed into a 55-gallon drum. The 55-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 1.85E-05 mol/s/mol fraction. Up to three drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Two PVC bags	1
30-gallon drum	16.1
55-gallon drum	56
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste

generating procedures ensure that the waste is in a nonreactive form. Visual examination or radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose.

ADDITIONAL CRITERIA: Because all containers were generated in a vented condition, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	1.0003E-7
30-Gallon Drum	3.3344E-8
55-Gallon Drum	3.3344E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watt)	>0.012 watt*year (watt)
Canister	0.3573	0.7253
30-Gallon Drum	0.1191	0.2417
55-Gallon Drum	0.1191	0.2417

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325M
Solid Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)
Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Graphite
Glass
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)
Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: ID 325N

CONTENT DESCRIPTION: Solid organic waste (up to 100% by weight) and solid inorganic waste

GENERATING SITE: Argonne National Laboratory (ANL)

STORAGE SITE: Idaho National Laboratory (INL)

WASTE DESCRIPTION: The waste consists of both solid organic and solid inorganic waste.

GENERATING SOURCE(S): The waste was generated from the destructive and non-destructive examination of radiological materials such as fuel pins, reactor structural materials and targets in the ANL Alpha-Gamma Hot Cell Facility (AGHCF) between 1971 and 1990.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the AGHCF and contains cellulosic materials, plastic materials, rubber, glass, and metal. This waste contains lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents were used during the neutralization and evaporation of acids, etchants, and alcohol solutions generated during the passivation of reactive metals. These absorbents were mixed with the liquids while the liquids were being heated to dryness on a hot plate. Charcoal and ion exchange resins filter media used in the AGHCF water and air filtration systems were also included in this waste. The radioactive component in the waste is due to contamination from nuclear fuel materials derived almost exclusively from fuel pins. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, and yttrium (Y)-90.

The waste density is 0.783 g/cm^3.

WASTE PACKAGING: The waste material is placed in one 7-gallon steel can, two 7-gallon steel cans, one 5-gallon steel can and one 10-gallon steel can, or three 5-gallon steel cans. Each can is closed with a lid with a gasket, and there are holes drilled in the container sides to accommodate placement of a lifting cable attachment such that it has a minimum total hydrogen diffusivity value of 1.860E-06 mol/s/mol fraction. The steel can(s) is placed inside a fiberboard liner and then in a 20-mil PVC bag that is heat sealed. The fiberboard liner serves the purpose of dividing and supporting the PVC bag as the can(s) is placed inside. The PVC-bagged waste is placed in a 100-mil polyethylene liner for a 30-gallon waste drum. There is no lid on the drum liner. A 60-mil thick polyethylene disc puncture guard is placed over the first PVC pouch. The 100-mil polyethylene liner is then placed into a second 20-mil PVC bag that is heat sealed. Both PVC bags have effective dimensions of 26 inches in height and 16 inches in diameter for determination of surface area. The second bag is placed into a 30-gallon steel drum. Both PVC bags are later breached and are not considered layers of confinement. The 30-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. The 30-gallon drum may then be placed into a 55-gallon drum. The 55-gallon drum is vented such that it has a minimum total hydrogen diffusivity value of 1.85E-05 mol/s/mol fraction. Up to three drums may be placed in an RH-TRU canister with a removable lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 1.48E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	1
30-gallon drum	16.1
55-gallon drum	56
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Records and AK information on the pre-irradiation composition of the nuclear fuel pin materials contaminating the waste were used as inputs to a computer model (ORIGEN2.2) to derive post-irradiation radioisotopic composition and scaling factors (with respect to Cs-137) for the remaining reportable radioisotopes. The AK information used as input to ORIGEN2.2 was qualified and the ORIGEN2.2 results were confirmed using mass spectrometry measurements on fuel pin samples. Gamma dose measurements are taken on individual containers of waste and a dose-to-curie method is used to derive the Cs-137 concentration. Then the derived scaling factors are applied to quantify all of the remaining reportable radionuclides. The Pu-239 fissile gram equivalent value (plus two times the error) and decay heat (plus error) within the containers were quantified based on the radionuclide content of the container developed from the dose-to-curie and scaling factor application.

RESIDUAL LIQUIDS: Waste packaging procedures ensure that residual liquids are less than 1 volume percent of the payload container and that other materials are not included. Visual examination or radiography of waste contents may also be performed to verify the absence of residual liquids greater than one volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination or radiography of waste contents may also be performed to verify the absence of explosives/compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered noncorrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination or

radiography of waste contents may also be performed to verify the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose.

ADDITIONAL CRITERIA: Because all containers in this content code have reached steady-state conditions following venting, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Removable Lid Canister (moles/second)
Canister	7.1308E-8
55-Gallon Drum	2.3769E-8
30-Gallon Drum	2.3769E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Removable Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	0.2540	0.5159
55-Gallon Drum	0.0846	0.1719
30-Gallon Drum	0.0846	0.1719

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325N

Solid Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Charcoal
Clay and vermiculite absorbents (Oil Dri)
Glass
Graphite
Light bulbs
Metal (ferrous and nonferrous)
Plastic
Resin (zeolite)
Rubber

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acetyl cellulose
Acids (acetic, chromic, citric, hydrochloric, hydrofluoric, nitric, oxalic, phosphoric, sulfuric)
Alcohols (1-butanol, ethanol, methanol, isobutanol, isopropanol)
Alumina
Ammonia
Arsenic
Asbestos
Barium
Benzene
Beryllium
Cadmium
Chromium
Diamond paste/powder
Dioctyl phthalate
Ethyl ether
Ethylene glycol
Fluorinert-FC-43
Hyprez (1,1,1-trichloroethane and 1,4-dioxane)
Kerosene
Lead
Mercury
Octoil
Permatex #2
Selenium
Silver
Silver nitrate
Sodium carbonate
Sodium salts

CHEMICAL LIST

Idaho National Laboratory Content Code ID 325N

Solid Organic Waste

Tetrachloroethylene
Toluene
Xylene
Zinc bromide
Zircaloy

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CONTENT CODE: LA 325A

CONTENT DESCRIPTION: Solid organic and inorganic waste

GENERATING SITE: Los Alamos National Laboratory (LANL)

STORAGE SITE: LANL

WASTE DESCRIPTION: The waste consists of solid organic and inorganic wastes with up to 30% organic materials.

GENERATING SOURCE(S): The waste was generated from post-irradiation fuel examination research and development activities and cell cleanout as part of decontamination and decommissioning of the Chemistry and Metallurgy Research (CMR) building Wing 9 Hot Cells conducted from 1986 to 1991. The research and development activities included the mechanical sectioning of reactor fuel, metallographic and destructive examination of that fuel, and analysis of irradiated materials from the Liquid Metal Fast Breeder Reactor (LMFBR) Program and from other Department of Energy test and research reactor facilities.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the mechanical sectioning of reactor fuel, metallographic and destructive examination of that fuel, analysis of irradiated materials, and cell cleanout as part of decontamination and decommissioning activities in the CMR building Wing 9 Hot Cells. The waste contains cellulosic materials, plastic materials, rubber, glass, and metal in various combinations. This waste contains lesser amounts of homogeneous organic and inorganic materials including floor sweepings, solidified liquids (aqueous and organic matrices), and solidified particulates. Envirostone (gypsum cement), Portland cement, vermiculite, and neutralization chemicals were used during the solidification of acids, alcohols, etchant solutions, kerosene, oils, and particulates. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, cobalt (Co)-60, and yttrium (Y)-90.

The waste density is 0.115 g/cm^3.

WASTE PACKAGING: The waste is packaged in 1.5 gallon steel cans that were welded closed and vented with a sintered metal filter with a 20 micron or smaller pore size and a minimum hydrogen diffusivity value of 5.18E-06 mol/s/mol fraction. The cans were then packed into filtered DOT 17C 55-gallon drums, which have a minimum hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. Each drum contains a maximum of 12 cans. A maximum of three 55-gallon drums were packaged into an RH-TRU canister with a fixed lid. The RH-TRU canister is vented such that it has a minimum total hydrogen diffusivity value of 9.34E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
Cans	2.75
55-gallon drum	99.3
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: Passive-active neutron (PAN) assay measurements were used in combination with pre-irradiation fuel composition information and the Oak Ridge Isotope Generation and Depletion (ORIGEN) computer code calculations. The ORIGEN computer code was used to qualify the pre-irradiation fuel composition information, to extend the mass spectroscopy results from 400 fuel pins to the total fuel pin population of 1610 fuel pins processed at the CMR Wing 9 Hot Cells, and to develop isotopic scaling factors ratios.

RESIDUAL LIQUIDS: Waste packaging procedures and visual examination ensure that residual liquids are less than 1 volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination of the waste contents verifies the absence of explosives and compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered non-corrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination verifies the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 30% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code were generated in a vented condition, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable flammable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Fixed Lid Canister (moles/second)
Canister	5.4720E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Fixed Lid Canister	
	≤0.012 watt*year (watts)	>0.012 watt*year (watts)
Canister	0.8879	1.4883

CHEMICAL LIST

Los Alamos National Laboratory Content Code LA 325A
Solid Inorganic Waste with up to 30% Solid Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Envirostone (gypsum cement)
Glass
Metal (ferrous)
Metal (nonferrous)
Plastic
Portland cement
Rubber
Vermiculite

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acids (acetic, boric, chromic, hydrochloric, hydrofluoric, lactic, nitric, oxalic, perchloric, and sulfuric)
Alcohols (butanol, ethanol, isopropanol, and methanol)
Aluminum oxide
Barium
Bases (potassium hydroxide, sodium carbonate, and sodium hydroxide)
Butyl acetate
Cadmium
Carbon tetrachloride
Chromium
Diamond paste/blades
Dowanol EB
EDTA
Epoxies (Epon Resin 815 and Eccobond 26)
Fiberlay P19 (polyester resin)
Freon TF (1,1,2-trichloro-1,2,2-trifluoroethane)
Glycerol
Graphite
Hydrogen peroxide
Hydroxylamine hydrochloride
Hyprez (1,1,1-trichloroethane and 1,4 dioxane)
Kerosene
Lead
Light bulbs
Mercury
Methyl isobutyl ketone

CHEMICAL LIST

Los Alamos National Laboratory Content Code LA 325A
Solid Inorganic Waste with up to 30% Solid Organic Waste

Metl-X (fire extinguishing agent)
Oil (mineral, hydraulic, and Hoffman)
Paint
Paint thinners, removers, and strippers (benzene, methylene chloride, methyl ethyl ketone, and toluene)
Polychlorinated biphenyls
Silver
Sodium/sodium-potassium alloy
Sodium silicate
Tetrachloroethylene
Trichloroethylene (Vythene)
Xylene

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CONTENT CODE: LA 325B

CONTENT DESCRIPTION: Solid organic and inorganic waste

GENERATING SITE: Los Alamos National Laboratory (LANL)

STORAGE SITE: LANL

WASTE DESCRIPTION: The waste consists of solid organic and inorganic wastes with up to 30% organic materials.

GENERATING SOURCE(S): The waste was generated from post-irradiation fuel examination research and development activities and cell cleanout as part of decontamination and decommissioning of the Chemistry and Metallurgy Research (CMR) building Wing 9 Hot Cells conducted from 1986 to 1991. The research and development activities included the mechanical sectioning of reactor fuel, metallographic and destructive examination of that fuel, and analysis of irradiated materials form the Liquid Metal Fast Breeder Reactor (LMFBR) Program and from other Department of Energy test and research reactor facilities.

WASTE FORM: This waste consists predominantly of organic and inorganic debris generated during the mechanical sectioning of reactor fuel, metallographic and destructive examination of that fuel, analysis of irradiated materials, and cell cleanout as part of decontamination and decommissioning activities in the CMR building Wing 9 Hot Cells. The waste contains cellulosic materials, plastic materials, rubber, glass, and metal in various combinations. This waste contains lesser amounts of homogeneous organic and inorganic materials including floor sweepings, solidified liquids (aqueous and organic matrices), and solidified particulates. Envirostone (gypsum cement), Portland cement, vermiculite, and neutralization chemicals were used during the solidification of acids, alcohols, etchant solutions, kerosene, oils, and particulates. The predominant radionuclides are: plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242, americium (Am)-241, uranium (U)-233, U-234, U-235, U-238, cesium (Cs)-137, barium (Ba)-137m, strontium (Sr)-90, cobalt (Co)-60, and yttrium (Y)-90.

The waste density is 0.384 g/cm^3.

WASTE PACKAGING: The waste is packaged in filtered DOT 17C 55-gallon drums, which have a minimum hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. A maximum of three 55-gallon drums were packaged into an RH-TRU canister with a fixed lid. The RH-TRU canister is vented such that it has a minimum hydrogen diffusivity value of 9.34E-05 mol/s/mol fraction.

The estimated void volumes for each confinement layer are provided in the following table:

Estimated Void Volumes for Layers of Confinement

Confinement Layer	Void Volume (Liters)
55-gallon drum	156.7
Canister	240

METHOD(S) FOR ISOTOPIC DETERMINATION: A modified Dose-to-Curie (DTC) technique was used based on radionuclide information developed in the characterization of the canisters loaded with cans (i.e., LA 325A). Dose rate information on the 55-gallon drums was available and used in a DTC method. Based on the relative abundances of Cs-137 and Co-60 calculated for the waste cans in conjunction with Microshield software as a function of waste density for 55-gallon drums, the curies of Cs-137 and Co-60 were calculated for each drum. The ratio of the Cs-137 to fissile nuclide quantity was then used to determine the content of the other radionuclides in each drum, and summed to obtain the result for each canister.

RESIDUAL LIQUIDS: Waste packaging procedures and visual examination ensure that residual liquids are less than 1 volume percent of the payload container.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. Visual examination of the waste contents verifies the absence of explosives and compressed gases in the payload container.

PYROPHORICS: Waste packaging procedures shall ensure that all pyrophoric radioactive and nonradioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited by waste packaging procedures in the payload container. Acids and bases that are potentially corrosive are neutralized and rendered non-corrosive prior to being a part of the waste. The physical form of the waste and the waste generating procedures ensure that the waste is in a nonreactive form. Visual examination verifies the absence of corrosives in the payload container.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% by weight) quantities. The chemicals found in this content code are restricted to the allowable chemical list in Table 4.3-1 of the RH-TRAMPAC.

G VALUE: The G value for this content code is based on polyethylene and cellulose (up to 30% by weight)

ADDITIONAL CRITERIA: Because all containers in this content code were generated in a vented condition, aspiration of the containers is not applicable.

Flammable volatile organic compounds (VOCs) in this content code are ≤ 500 parts per million based on process knowledge.

The radionuclide composition for this content code is consistent with that listed in the RH-TRUCON Maintenance Application (RTMA) software.

The shipping period for this content code is 60 days (general case).

MAXIMUM ALLOWABLE FLAMMABLE GAS GENERATION RATE LIMITS: The maximum allowable gas generation rate (FGGR) limits are as follows:

Confinement Layer	Maximum Allowable FGGR Limits Fixed Lid Canister (moles/second)
Canister	8.8794E-8

MAXIMUM ALLOWABLE DECAY HEAT LIMITS: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Fixed Lid Canister	
	≤0.012 watt*year (watt)	>0.012 watt*year (watt)
Canister	1.2547	1.9333

CHEMICAL LIST

Los Alamos National Laboratory Content Code LA 325B
Solid Inorganic Waste with up to 30% Solid Organic Waste

MATERIALS AND CHEMICALS (>1% by weight)

Cellulosic materials
Envirostone (gypsum cement)
Glass
Metal (ferrous)
Metal (nonferrous)
Plastic
Portland cement
Rubber
Vermiculite

MATERIALS AND CHEMICALS (≤1% by weight)

Acetone
Acids (acetic, boric, chromic, hydrochloric, hydrofluoric, lactic, nitric, oxalic, perchloric, and sulfuric)
Alcohols (butanol, ethanol, isopropanol, and methanol)
Aluminum oxide
Barium
Bases (potassium hydroxide, sodium carbonate, and sodium hydroxide)
Butyl acetate
Cadmium
Carbon tetrachloride
Chromium
Diamond paste/blades
Dowanol EB
EDTA
Epoxies (Epon Resin 815 and Eccobond 26)
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Glycerol
Graphite
Hydrogen peroxide
Hydroxylamine hydrochloride
Hyprez (1,1,1-trichloroethane and 1,4 dioxane)
Kerosene
Lead
Light bulbs
Mercury
Methyl isobutyl ketone

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Oil (mineral, hydraulic, and Hoffman)
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Polychlorinated biphenyls
Silver
Sodium/sodium-potassium alloy
Sodium silicate
Tetrachloroethylene
Trichloroethylene (Vythene)
Xylene

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