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Effective Date: 10/05/2005

CCP-PO-018
Revision 0

CCP
Waste-Specific
Data Package TRAMPAC
for
Battelle Columbus Laboratories
RH-TRU Waste

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RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	10/05/2005	Initial issue.

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this *Waste-Specific Data-Package TRAMPAC for Battelle Columbus Laboratories RH-TRU Waste* is to describe and document how each of the requirements for 72-B Cask transportation is met for two RH-TRU canisters of remote-handled (RH) transuranic (TRU) waste to be transported from Battelle Columbus Laboratories (BCL). The transportation requirements are defined in the *Remote-Handled Transuranic Waste Authorized Methods for Payload Control (RH-TRAMPAC)* [1]. As specified in Section 1.5.2 of the RH-TRAMPAC, a waste-specific data package may be written by the shipper and approved by the U.S. Department of Energy (DOE) Carlsbad Field Office (CBFO) for small quantity shipments. This *Waste-Specific Data-Package TRAMPAC for BCL RH-TRU Waste* documents the evaluation of waste data against the requirements of the RH-TRAMPAC. The data evaluation and the documentation of compliance results in this document were completed in accordance with the quality assurance (QA) program under the Central Characterization Project Waste Isolation Pilot Plant (WIPP) certification program.

Using the data collected by BCL procedures and evaluated as documented herein, a person knowledgeable in the requirements of the RH-TRAMPAC will assume the responsibilities of the Transportation Certification Official (TCO) as defined by Section 1.5.1 of the RH-TRAMPAC [1]. The TCO is responsible for administratively verifying the compliance of payload containers and the payload assembly with transportation requirements. The TCO shall approve by signature on the transportation certification documents every payload for transport. The compliance data required for completion by the TCO of the transportation certification documents for RH-TRU canisters BCO-002 and BCO-003 are contained in this *Waste-Specific Data Package TRAMPAC for BCL RH-TRU Waste*.

1.2 Scope

This *Waste-Specific Data Package TRAMPAC for BCL RH-TRU Waste* applies to RH-TRU canisters BCO-002 and BCO-003.

1.3 Background

BCL generated this waste under a controlled waste management program established under the Battelle Columbus Laboratories Decommissioning Project (BCLDP). The BCL program is defined by a series of procedures that were implemented by the BCL waste generators. RH-TRU canisters BCO-002 and BCO-003 were generated by the BCLDP during the decontamination of the Building JN-1 Hot Cell Laboratory at the West Jefferson North site. The decontamination and decommissioning activities involved removing from the hot cells equipment used in the fuel examination process, materials such as fines resulting from grinding and cuttings, miscellaneous fuel specimens and their containers, and general debris. The waste generation and packaging was completed in accordance with TCP-98-01.2, *Transuranic Waste Authorized Methods for Payload Control for the Battelle Columbus Laboratories Decommissioning Project Transuranic Waste Certification Program* [2], which is a compliance plan for the RH-TRAMPAC. TCP-98-01.2 and its implementing procedures and work instructions established the processes, controls, and techniques that were implemented by BCL to ensure compliance with the transportation requirements of the RH-TRAMPAC.

Transportation compliance demonstrations included the completion of records, visual examination, and audio and video monitoring during waste generation and packaging. A second operator verified payload container contents or waste records as the payload container was loaded. The implementation of the BCL processes resulted in the data and QA records used by this document to demonstrate compliance with the RH-TRAMPAC requirements. The references to the packaging procedures in the discussion of each transportation parameter requirement in this document are to the implementation results of the procedures for each RH-TRU canister. These references can be traced to the QA records resulting from the implementation of these procedures and to the original sources of the data (e.g., waste generator). The data for the BCL waste is tracked by the identification numbers for the individual steel liners contained by RH-TRU canisters BCO-002 and BCO-003. RH-TRU canister BCO-002 contains two steel liners (identification numbers BCO-036 and BCO-147) and BCO-003 contains three steel liners (identification numbers BCO-039, BCO-060, and BCO-146).

2.0 CONTAINER AND PHYSICAL PROPERTIES REQUIREMENTS

2.1 Container Description

As specified by Section 2.1.1 of the RH-TRAMPAC, the RH-TRU canister is the authorized payload container for transport in the 72-B Cask, provided it meets the specifications of Appendix 1.3.4 of the 72-B Cask Safety Analysis Report (SAR) [1, 3]. BCO-002 and BCO-003 are fixed lid RH-TRU canisters that were procured to the specifications of Appendix 1.3.4 of the 72-B Cask SAR [3] by WIPP and Los Alamos National Laboratory (LANL) and transferred to BCL [4]. The RH-TRU canisters were inspected by WIPP at the time of procurement to verify compliance with the Appendix 1.3.4 specifications [5]. "Fixed Lid" shall be recorded by the TCO as the Payload Container Type on the Payload Transportation Certification Documents (PTCDs) for RH-TRU canisters BCO-002 and BCO-003 (Table 6-1 of the RH-TRAMPAC [1]).

Section 2.1.2 of the RH-TRAMPAC also requires the inspection of the integrity of the payload container prior to shipment [1]. The integrity of RH-TRU canisters BCO-002 and BCO-003 were visually inspected during loading to ensure the canisters are in good and unimpaired condition. The TCO shall document the completion of this visual inspection by signing the PTCD (Table 6-1 of the RH-TRAMPAC [1]).

2.2 Container/Cask Weight

Each payload container and loaded 72-B Cask shall comply with the applicable weight limits specified in Section 2.2 of the RH-TRAMPAC [1]. The applicable weight limits for RH-TRU canisters BCO-002 and BCO-003 are as follows [1]:

- 8,000 pounds per RH-TRU canister.
- 45,000 pounds per loaded 72-B Cask.

The contents of RH-TRU canisters BCO-002 and BCO-003 were weighed in accordance with TC-OP-01.4, *Segregation and Packaging of TRU Waste* [6]. The measured weights were recorded in data packages in accordance with TC-AP-01.1, *TRU Waste Data Package Generation* [7]. The scales were calibrated to a National Institute of Standards and Technology traceable standard. Based on the calibration of the scales, bounding errors associated with the weight values were determined by adding the individual errors for the appropriately sized scale with the largest error for each item. The following table summarizes the weights for loaded RH-TRU canisters BCO-002 and BCO-003:

RH-TRU Canister No.	Weight (Pounds)	Error (Pounds)	Value Plus Error (Pounds)	Maximum Allowable Gross Weight Limit (Pounds)
BCO-002	4,282	30	4,312	8,000
BCO-003	4,280	35	4,315	8,000

RH-TRU canisters BCO-002 and BCO-003 comply with the applicable maximum allowable gross weight limit per RH-TRU canister of 8,000 pounds following the addition of the measurement error, as specified in Section 2.2 of the RH-TRAMPAC [1]. Because BCO-002 and BCO-003 comply with maximum RH-TRU canister weight limit, the loaded 72-B Cask weight limit of 45,000 pounds will be met for the 72-B Casks packaging these RH-TRU canisters. The weight data for loaded RH-TRU canisters BCO-002 and BCO-003 summarized in the table above shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003.

2.3 Container Marking

As specified by Section 2.3 of the RH-TRAMPAC, each payload container shall be marked with a unique container identification number [1]. In accordance with WA-OP-030, *Packaging, Marking and Labeling of Radioactive Waste and Radioactive Mixed Waste (RWM)* [8], the payload containers have been marked with the unique canister identification numbers BCO-002 and BCO-003.

2.4 Filter Vents

As specified by Section 2.4 of the RH-TRAMPAC, each payload container and any sealed containers (greater than 4 liters in size) overpacked in the payload container shall be either vented or filtered to meet the specifications of Appendix 1.3.5 of the 72-B Cask SAR [1, 9].
RH-TRU canisters BCO-002 and BCO-003, each installed with one filter meeting the specifications of Appendix 1.3.5 of the 72 B Cask SAR, were procured by WIPP and by LANL and transferred to BCL [4, 5]. Each filter

is a Model No. NFT-018 with a minimum hydrogen diffusivity value of 9.34E-05 moles/second/mole fraction (mol/s/mol fraction). The filters were manufactured by Nuclear Filter Technology in March 1989 and April 1989, for AAR Brooks & Perkins, who installed the filters in the canisters prior to their procurement by WIPP and by LANL [4, 5].

The internal steel liners BCO-036, BCO-147, BCO-039, BCO-060, and BCO-146 are each vented with one filter. These filter vents were procured to the specifications of Appendix 1.3.5 of the 72-B Cask SAR [9] by BCLDP purchasing and subcontracts representatives from qualified suppliers in accordance with QD-AP-07.1, *Supplier Evaluation and Qualification* [10], and QD-AP-04.1, *Documentation and Control of Purchased Items and Services* [11]. Upon receipt, the filters were inspected by BCLDP as directed by QD-AP-04.1 [11], to verify compliance with the Appendix 1.3.5 specifications and as directed by WA-OP-006, *Procurement and Inspection of Packagings for Hazardous Materials Shipments* [12]. Procurement documents are maintained by the BCLDP Records Management Department in accordance with PR-AP-17.1, *Operation of the Project Records Management System* [13]. The following table summarizes the filter information for the internal steel liners documenting compliance with the filter specifications of Appendix 1.3.5 of the RH-TRAMPAC [9]:

Container No.	Filter Model[①]	Supplier[①]	Filter Vent ID[①]	Minimum Hydrogen Diffusivity (mol/s/mol fraction)
Steel liner BCO-036	NFT-013	Nuclear Filter Technology	BMI-253	3.70E-06
Steel liner BCO-147	NFT-013	Nuclear Filter Technology	BMI-274	3.70E-06
Steel liner BCO-039	NFT-013	Nuclear Filter Technology	BMI-113	3.70E-06
Steel liner BCO-060	NFT-013	Nuclear Filter Technology	BMI-171	3.70E-06
Steel liner BCO-146	NFT-013	Nuclear Filter Technology	BMI-252	3.70E-06

[①]Battelle Columbus Laboratories, e-mail from P. Weaver (BCL) to J. Biedscheid (WTS), subject: BCL TRAMPAC, Battelle Columbus Laboratories, Columbus, Ohio, dated June 3, 2005.

mol/s/mol fraction = Moles per second per mole fraction

The above filter vent data shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003 and the internal steel liners ("Other Containers" on PTCD).

2.5 Liquids

As required by Section 2.5 of the RH-TRAMPAC, liquid waste is prohibited in payload containers, except for residual amounts in well-drained containers [1]. The total volume of residual liquid in the payload container shall be less than 1 volume percent of the payload container. The steel liners contained by the RH-TRU canisters were generated and packaged in accordance with TC-OP-01.4 [6]. TC-OP-01.4 directed BCL operators to visually inspect payload containers during packaging to ensure the absence of residual liquids. Any TRU-contaminated liquids encountered during the packaging of TRU waste were solidified according to solidification methods of WA-OP-029, *Radioactive Waste and Radioactive Mixed Waste Absorption* [14]. If residual liquids were identified within a container in excess of the limit specified above, the payload container was segregated for repackaging. As documented by the records generated in accordance with TC-OP-01.4 [6] during waste packaging, liquids are not present in the waste. The absence of liquids was documented in the payload container data packages for the steel liners in accordance with TC-AP-01.1 [7]. As such, the total volume of residual liquid in RH-TRU canisters BCO-002 and BCO-003 is documented to be less than 1 percent (volume). Compliance with the less than 1 volume percent limit on liquid shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003.

2.6 Sharp or Heavy Objects

As required by Section 2.6 of the RH-TRAMPAC, sharp or heavy objects in the waste shall be blocked, braced, or suitably packaged as necessary to provide puncture protection for the payload containers packaging these objects [1]. RH-TRU canister BCO-002 contains steel liners BCO-036 and BCO-147 and a metal spacer. RH-TRU canister BCO-003 contains steel liners BCO-039, BCO-060, and BCO-146. The absence of sharp or heavy objects in the steel liners was verified by BCL operators through visual examination during the packaging of the steel liners in accordance with TC-OP-01.4 [6]. Compliance with the restrictions on sharp or heavy objects shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003.

2.7 Sealed Containers

Sealed containers greater than 4 liters are prohibited by Section 2.7 of the RH-TRAMPAC [1]. The absence of sealed containers was ensured by BCL operators through visual examination during the packaging of the steel liners in accordance with TC-OP-01.4 [6]. As described in Section 2.4, each of the steel liners contained by the RH-TRU canisters is vented with a filter vent. As such, the absence of sealed containers greater than 4 liters in RH-TRU canisters BCO-002 and BCO-003 is documented. The absence of sealed containers greater than 4 liters shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003.

3.0 NUCLEAR PROPERTIES REQUIREMENTS

3.1 Nuclear Criticality

As specified by Section 3.1 of the RH-TRAMPAC, an RH-TRU canister shall be acceptable for transport only if the requirements of one of two cases are met [1]:

- Unrestricted Case – The unrestricted case involves RH-TRU canisters where the form or distribution of the fissile radionuclides is not restricted.

- Low Enriched Uranium Case – The low enriched uranium case involves RH-TRU containers containing material that is primarily uranium (in terms of the heavy metal component) and waste matrix material distributed within a canister in such a manner that the maximum enrichment of the uranium does not exceed 0.96% uranium-235 fissile equivalent mass in any location of the waste material.

Per the description of the RH-TRU canister debris contents and the decontamination and decommissioning process that generated the waste, the distribution of the fissile radionuclides is not restricted in RH-TRU canisters BCO-002 and BCO-003. As such, the unrestricted case is applicable to RH-TRU canisters BCO-002 and BCO-003. As specified by Section 3.1.1 of the RH-TRAMPAC, under this case, the RH-TRU canister is acceptable for transport only if the plutonium (Pu)-239 fissile gram equivalent (FGE) plus error (i.e., one standard deviation) is less than or equal to 325 grams [1].

BCLDP accountability records indicate no more than approximately 50 grams of fissile material is dispersed throughout the West Jefferson North facility in low isotopic enrichments [15]. The BCLDP has concluded that there is no credible manner in which a criticality event could be initiated in the facility with the amount of fissile material that is currently present. Therefore, the Pu-239 FGE content of RH-TRU canisters BCO-002 and BCO-003 is well below the 325-gram limit.

The radionuclide composition and quantities of the waste contained by the steel liners contained by the RH-TRU canisters were determined using the methodology described in DD-98-04, *Waste Characterization, Classification and Shipping Support Technical Basis Document* [16]. This methodology establishes a “JN Standard Isotopic Mix” based on acceptable knowledge (AK), sampling, and computer modeling of a representative source term. Gamma exposure rates from waste packages are compared with the “standard,” and isotopic inventories in the waste packages are calculated from that comparison. Using the data collected

by the DD-98-04 methodology, BCL personnel calculated the FGE of the individual steel liners. The calculated FGE value plus error was documented in the payload container data package for each steel liner in accordance with TC-AP-01.1 [7]. Based on Section 3.3 of DD-98-04, the error in the determination of the FGE value is 60% [16]. To obtain the total FGE values for the loaded RH-TRU canisters BCO-002 and BCO-003, the FGE values and associated error values of the internal steel liners were added.

The following table summarizes the FGE values calculated for RH-TRU canisters BCO-002 and BCO-003 and demonstrates compliance with the 325-gram FGE limit (specified in Section 3.1.1 of the RH-TRAMPAC [1]).

Container No.	FGE (grams)	Error (grams)	Value + Error (grams)	Limit (grams)
RH-TRU canister BCO-002	5.54	3.32	8.86	325
RH-TRU canister BCO-003	5.74	3.45	9.19	325

The total FGE values of RH-TRU canisters BCO-002 and BCO-003 are each well below the 325-gram FGE limit per RH-TRU canister. The FGE data for loaded RH-TRU canisters BCO-002 and BCO-003 summarized in the table above shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003.

3.2 Radiation Dose Rates

As specified by Section 3.2 of the RH-TRAMPAC, the external radiation surface dose rate of the 72-B Cask shall be less than or equal to 200 millirem (mrem)/hour at the surface and less than or equal to 10 mrem/hour at 2 meters from the side of the package under normal conditions of transport [1]. In accordance with HP-OP-019, *Radiation and Contamination Survey Techniques* [17], BCL personnel will survey the loaded 72-B Casks containing RH-TRU canisters BCO-002 and BCO-003. The TCO will use the data collected in accordance with HP-OP-019 to evaluate compliance with the normal conditions of transport radiation dose rate limits.

As specified by Section 3.2 of the RH-TRAMPAC, under accident conditions, the external radiation dose rate of the 72-B Cask shall be less than or equal to 1 rem/hour at any point 1 meter from the surface of the cask [1]. Compliance with the hypothetical accident conditions (HAC) dose rate requirement shall be met using one of two cases [1]:

- General Payload Case – The general payload case bounds any authorized contents, regardless of form or configuration.

- Controlled Self-Shielding Payload Case – The controlled self-shielding payload case applies to wastes that are constrained in terms of payload form and configuration (i.e., homogeneous solid/sludge generated from a waste stream process that ensures a particle size characteristic dimension of 1 inch or less in size or pucks, or equal, that are compacted with a minimum 20,000-pound compressive force).

Per the description of the RH-TRU canister debris contents and the decontamination and decommissioning process that generated the waste, the waste does not meet the requirements for the controlled self-shielding payload case. As such, the general payload case is applicable to RH-TRU canisters BCO-002 and BCO-003. As specified by Section 3.2.2 of the RH-TRAMPAC, under this case, compliance with the dose rate requirements for HAC shall be ensured through compliance with limits on the quantities of each radionuclide specified in Table 3-1 of the RH-TRAMPAC [1].

As described in Section 3.1, the radionuclide composition and quantities of the waste contained by the steel liners in the RH-TRU canisters were determined using the methodology described in DD-98-04 [16]. As required by Section 3.2.2, this data was used in the method for summing partial fractions to determine compliance for the combination of radionuclides present in RH-TRU canisters BCO-002 and BCO-003 [1]. The data and calculations demonstrating compliance with the HAC radiation dose rate requirement are shown in Attachment 1 for RH-TRU canisters BCO-002 and BCO-003.

Compliance with the radiation dose rate limits for the casks under normal conditions of transport and HAC shall be recorded by the TCO on the PTCDs.

4.0 CHEMICAL PROPERTIES REQUIREMENTS

4.1 Pyrophoric Materials

As specified by Section 4.1 of the RH-TRAMPAC, radioactive and nonradioactive pyrophoric materials shall be limited to less than 1 percent (weight) of the payload container [1]. The steel liners contained by the RH-TRU canisters were generated and packaged in accordance with TC-OP-01.4 [6]. TC-OP-01.4 directed BCL operators to use AK information documented in TCP-98-03, *Building JN-1 Hot Cell Laboratory Acceptable Knowledge Document* [18], and TCP-98-03.1, *Newly Generated Waste Process Descriptions* [19], in conjunction with visual examination during waste generation and packaging to verify the absence of pyrophorics. As documented by the AK records and the records generated in accordance with TC-OP-01.4 [6] during waste packaging, pyrophorics are not present in the waste. The absence of pyrophorics was documented in the payload container data packages for the steel liners in accordance with TC-AP-01.1 [7]. As such, the absence of pyrophoric materials in RH-TRU canisters BCO-002 and BCO-003 is documented. Compliance with the less than 1 weight percent limit on radioactive and nonradioactive pyrophorics shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003.

4.2 Explosives, Corrosives, and Compressed Gases

As specified by Section 4.2 of the RH-TRAMPAC, explosives, corrosives, and compressed gases (pressurized containers) are prohibited in the payload [1]. The steel liners contained by the RH-TRU canisters were generated and packaged in accordance with TC-OP-01.4 [6]. TC-OP-01.4 directed BCL operators to use AK information documented in TCP-98-03 [18] and TCP-98-03.1 [19] in conjunction with visual examination during waste generation and packaging to verify the absence of explosives, corrosives, and compressed gases. As documented by the AK records and the records generated in accordance with TC-OP-01.4 [6] during waste packaging, explosives, corrosives, and compressed gases are not present in the waste. The absence of explosives, corrosives, and compressed gases was documented in the payload container data packages for the steel liners in accordance with TC-AP-01.1 [7]. As such, the absence of explosives, corrosives, and compressed gases in RH-TRU canisters BCO-002 and BCO-003 is documented. The absence of explosives, corrosives, and pressurized containers shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003.

4.3 Chemical Composition

As specified by Section 4.3 of the RH-TRAMPAC, chemical constituents in a payload shall conform to the allowable chemical list for the applicable site-specific content code approved in the *RH-TRU Waste Content Codes* (RH-TRUCON) document [20]. The total quantity of trace chemicals/materials (materials that occur in the waste in quantities less than 1 percent [weight]) in the payload container is restricted to less than 5 percent (weight) [1].

The waste contained in RH-TRU canisters BCO-002 and BCO-003 is solid organic and inorganic materials. The applicable content code for the RH-TRU canisters is BC 321A, Solid Organic Waste. Content Code BC 321A and its chemical list are provided in Attachment 2. In accordance with TC-OP-01.4 [6], BCL personnel documented the waste materials during the packaging of each steel liner. The chemicals and materials packaged in the liners in RH-TRU canisters BCO-002 and BCO-003 conform to the chemical list for Content Code BC 321A. Content Code BC 321A shall be recorded by the TCO on the PTCDs for both RH-TRU canisters BCO-002 and BCO-003. Note that “Content Codes for Inner Containers” on the PTCD is not applicable for the BCO-002 and BCO-003 configurations.

4.4 Chemical Compatibility

As specified in Section 4.4.2 of the RH-TRAMPAC, chemical compatibility of all content codes in the RH-TRUCON has been demonstrated for transport in the 72-B Cask using the chemicals in Table 1 of Appendix 2.10.12 of the 72-B Cask SAR [21]. The restrictions imposed on the chemical constituents of the content codes ensure compliance with the compatibility requirements. Because RH-TRU canisters BCO-002 and BCO-003 contain only chemicals that conform to the BC 321A chemical list, the chemical compatibility requirement is met.

5.0 GAS GENERATION REQUIREMENTS

As specified by Section 5.0 of the RH-TRAMPAC, the gases generated in the 72-B Cask payload and released into the 72-B Cask inner vessel (IV) cavity shall be controlled to maintain the pressure within the IV cavity below the acceptable design pressure of 150 pounds per square inch gauge (psig) [1]. As described in Section 5.0 of the RH-TRAMPAC, compliance with the design pressure limit is ensured by the analysis presented in Section 3.4.4.3 of the 72-B Cask SAR for all payloads authorized for transport in the 72-B Cask [1].

5.1 Decay Heat

As specified by Sections 5.0 and 5.2 of the RH-TRAMPAC, compliance with the 5 percent restriction on hydrogen concentration may be demonstrated by meeting decay heat limits for the RH-TRU canister and internal containers based on the assigned content code [1]. The RH-TRAMPAC refers to this compliance method as Option 2.

As specified in Section 5.2.2.2 of the RH-TRAMPAC, content codes that comply with the watt*year criterion of 0.012 watt*year may use a dose dependent G value to obtain maximum allowable decay heat limits. Using the methodology detailed in Section 5.2.2.2 of the RH-TRAMPAC, compliance with the 0.012 watt*year criterion has been demonstrated for RH-TRU Canisters BCO-002 and BCO-003. This calculation is shown in Attachment 3 for each canister. For Option 2 under Gas Generation and Hydrogen Concentration Limits, 3 years (date of generation August 2002 until July 2005) shall be recorded by the TCO as the Time Since Waste Packaging on the PTCDs for RH-TRU canisters BCO-002 and BCO-003. The TCO shall indicate that RH-TRU canisters BCO-002 and BCO-003 meet the watt*year criteria on the PTCD.

RH-TRU canisters BCO-002 and BCO-003 are assigned to RH-TRUCON Code BC 321A, Solid Organic Waste. RH-TRU canisters BCO-002 and BCO-003 contain waste packaged directly into a steel liner with no layers of confinement. The steel liner is placed directly into the RH-TRU canister. The steel liner is vented with one filter with a minimum hydrogen diffusivity value of 3.7E-06 mol/s/mol fraction. Two steel liners are placed into RH-TRU canister BCO-002. Three steel liners are placed into RH-TRU canister BCO-003.

Per RH-TRUCON Code BC 321A, an individual container decay heat limit is not established for liners and the decay heat limit specified per canister is applicable. The decay heat limit for canisters assigned to BC 321A is 0.9790 watt (with dose-dependent G value) (see Attachment 2). The TCO shall record this canister-specific decay heat limit on the PTCDs for BCO-002 and BCO-003.

The radiological information summarized in Section 3.1 was obtained at the time of waste generation in August 2002. This data has been decayed to July 2005 using RadCalc [22, 23] and used to determine the decay heat values for RH-TRU canisters BCO-002 and BCO-003. Based on Section 3.3 of DD-98-04, the error in the determination of the decay heat value is 65% [16]. The following table summarizes the decay heat values reported to four decimal places for RH-TRU canisters BCO-002 and BCO-003 and evaluates compliance with the Content Code BC 321A decay heat limit per canister following the addition of the error:

Container No.	Decay Heat Value (watts)	Error (watts)	Value Plus Error (watts)	Governing Limit [a] (watts)
RH-TRU canister BCO-002	0.4668	0.3034	0.7702	0.9790
RH-TRU canister BCO-003	0.4837	0.3144	0.7981	0.9790

[a] Limit is for the fixed lid RH-TRU canister configuration for the case with dose-dependent G values from Table 5-3 of the RH-TRAMPAC [1] and the RH-TRUCON document [20].

As shown in the above table, RH-TRU canisters BCO-002 and BCO-003 comply with the Content Code BC 321A decay heat limit per canister and are well below the 72-B Cask design limit of 50 watts for organic waste forms [1].

The decay heat data summarized in the table above shall be recorded by the TCO on the PTCDs for RH-TRU canisters BCO-002 and BCO-003.

5.2 Flammable (Gas/VOC) Concentration Limits

As specified by Section 5.3 of the RH-TRAMPAC, the total concentration of potentially flammable volatile organic compounds (VOCs) is restricted to less than or equal to 500 parts per million (ppm) in the headspace of the RH-TRU canister or containers overpacked in the canister unless the requirements of the Flammability Assessment Methodology described in Attachment 5 of the RH-TRAMPAC are met [1]. The chemical list for Content Code BC 321A does not list any potentially flammable VOCs [20]. Based on this process knowledge and the documentation of individual waste items packaged in RH-TRU canisters BCO-002 and BCO-003, no flammable VOCs are present in RH-TRU canisters BCO-002 and BCO-003. As such, the total concentrations of potentially flammable VOCs in RH-TRU canisters BCO-002 and BCO-003 are less than 500 ppm. The TCO shall indicate that flammable VOCs are less than or equal to 500 ppm on the PTCD.

6.0 PAYLOAD ASSEMBLY REQUIREMENTS

As specified by Section 6.1 of the RH-TRAMPAC, a 72-B Cask payload shall be authorized for shipment by the completion and signing of the PTCD (Table 6-1 of the RH-TRAMPAC) after verification of compliance with all transportation requirements of the RH-TRAMPAC [1]. Using the data and direction summarized by this document, the certification of RH-TRU canisters BCO-002 and BCO-003 will be completed by the TCO. During the completion of these documents, compliance with the transportation parameter requirements as documented in the previous sections will be verified by the TCO. The PTCDs shall be maintained for a minimum period of 3 years.

7.0 REFERENCES

1. U.S. Department of Energy, "Remote-Handled Transuranic Waste Authorized Methods for Payload Control (RH-TRAMPAC)," Appendix 1.3.7 of the RH-TRU 72-B Cask Safety Analysis Report, Revision 3, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

2. TCP-98-01.2, "Transuranic Waste Authorized Methods for Payload Control for the Battelle Columbus Laboratories Decommissioning Project Transuranic Waste Certification Program," Battelle Columbus Laboratories Decommissioning Project, Columbus, Ohio.

3. U.S. Department of Energy, "Specification for RH-TRU Waste Canisters," Appendix 1.3.4 of the RH-TRU 72-B Cask Safety Analysis Report, Revision 3, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

4. AAR Brooks & Perkins, Certificate of Compliance for Waste Container for Customer Order No. 75WRSZ9286EX, Advanced Structures Division, AAR Brooks & Perkins, Livonia, Michigan, dated November 27, 1991.

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Attachment 1 – Determination of Compliance with the HAC Radiation Dose Rate Limit for RH-TRU Canisters BCO-002 and BCO-003

The isotopic composition and radionuclide inventory data for each canister were used to evaluate compliance with the hypothetical accident condition curie limits specified in Table 3-1 of the RH-TRAMPAC. As per Section 3.2 of the RH-TRAMPAC, the sum of the partial fractions for any combination of the radionuclides must be less than or equal to 1.

For RH-TRU Canisters BCO-002 and BCO-003, this condition is met as documented by this attachment.

Attachment 1 – Determination of Compliance with the HAC Radiation Dose Rate Limit for RH-TRU Canisters BCO-002 and BCO-003 (Continued)

BC-002 and BC-003 HAC Fractions

Prepared by S.J. Maheras, 07/22/2005

BCO-002 contains BC0036 and BC0147.

BCO-003 contains BC0039, BC0060, and BC0146.

Radionuclide	HAC Limit (Ci)	BCO-002		BCO-003	
		Activity (Ci)	BCO-002 HAC Fraction	Activity (Ci)	BCO-003 HAC Fraction
Be-10	Unlimited	3.38E-09	0.00E+00	3.51E-09	0.00E+00
C-14	Unlimited	8.48E-04	0.00E+00	8.80E-04	0.00E+00
Si-32	No Limit	2.80E-11	0.00E+00	2.90E-11	0.00E+00
Cl-36	No Limit	8.48E-06	0.00E+00	8.79E-06	0.00E+00
K-40	No Limit	3.36E-12	0.00E+00	3.48E-12	0.00E+00
Ni-59	Unlimited	3.33E-04	0.00E+00	3.45E-04	0.00E+00
Co-60	3.643E+01	1.40E+01	3.85E-01	1.46E+01	4.00E-01
Ni-63	Unlimited	4.10E-02	0.00E+00	4.25E-02	0.00E+00
Se-79	Unlimited	2.69E-04	0.00E+00	2.79E-04	0.00E+00
Sr-90	Unlimited	2.98E+01	0.00E+00	3.09E+01	0.00E+00
Mo-93	No Limit	4.76E-07	0.00E+00	4.93E-07	0.00E+00
Zr-93	Unlimited	1.26E-03	0.00E+00	1.30E-03	0.00E+00
Nb-94	1.887E+02	1.03E-07	5.44E-10	1.06E-07	5.64E-10
Tc-99	Unlimited	8.54E-03	0.00E+00	8.86E-03	0.00E+00
Pd-107	Unlimited	8.39E-05	0.00E+00	8.70E-05	0.00E+00
Cd-113m	Unlimited	1.84E-02	0.00E+00	1.91E-02	0.00E+00
Sn-121m	Unlimited	4.39E-04	0.00E+00	4.55E-04	0.00E+00
Sb-125	4.166E+03	2.08E-01	4.99E-05	2.15E-01	5.17E-05
Sn-126	Unlimited	5.47E-04	0.00E+00	5.67E-04	0.00E+00
I-129	Unlimited	2.16E-05	0.00E+00	2.24E-05	0.00E+00
Ba-133	1.967E+06	2.82E-28	1.43E-34	2.92E-28	1.49E-34
Cs-134	2.444E+02	1.86E-01	7.63E-04	1.93E-01	7.91E-04
Cs-135	Unlimited	2.26E-04	0.00E+00	2.34E-04	0.00E+00
Cs-137	1.268E+03	4.53E+01	3.58E-02	4.70E+01	3.71E-02
Sm-147	Unlimited	2.97E-09	0.00E+00	3.08E-09	0.00E+00
Eu-150	2.750E+02	7.65E-09	2.78E-11	7.93E-09	2.88E-11
Sm-151	Unlimited	2.15E-01	0.00E+00	2.23E-01	0.00E+00
Eu-152	1.149E+02	1.70E-03	1.48E-05	1.76E-03	1.53E-05
Gd-152	Unlimited	2.67E-16	0.00E+00	2.77E-16	0.00E+00
Eu-154	1.108E+02	7.00E-01	6.31E-03	7.25E-01	6.55E-03
Re-187	No Limit	1.32E-11	0.00E+00	1.37E-11	0.00E+00
Pb-210	Unlimited	1.46E-10	0.00E+00	1.51E-10	0.00E+00
Ra-226	Unlimited	6.77E-10	0.00E+00	7.02E-10	0.00E+00
Ac-227	Unlimited	5.01E-09	0.00E+00	5.20E-09	0.00E+00
Ra-228	Unlimited	9.04E-14	0.00E+00	9.38E-14	0.00E+00
Th-228	Unlimited	2.09E-05	0.00E+00	2.16E-05	0.00E+00
Th-229	Unlimited	1.36E-10	0.00E+00	1.41E-10	0.00E+00
Th-230	1.000E+06	1.39E-07	1.39E-13	1.44E-07	1.44E-13
Pa-231	7.288E+05	1.30E-08	1.78E-14	1.35E-08	1.85E-14
Th-232	2.090E+06	1.52E-13	7.29E-20	1.58E-13	7.56E-20
U-232	6.389E+05	2.09E-05	3.28E-11	2.17E-05	3.40E-11
U-233	8.720E+05	2.44E-08	2.80E-14	2.53E-08	2.90E-14
U-234	8.909E+05	7.83E-04	8.79E-10	8.12E-04	9.11E-10

Attachment 1 – Determination of Compliance with the HAC Radiation Dose Rate Limit for RH-TRU Canisters BCO-002 and BCO-003 (Continued)

Radionuclide	HAC Limit (Ci)	BCO-002		BCO-003	
		Activity (Ci)	BCO-002 HAC Fraction	Activity (Ci)	BCO-003 HAC Fraction
U-235	9.472E+05	1.14E-05	1.21E-11	1.19E-05	1.25E-11
U-236	9.680E+05	1.52E-04	1.57E-10	1.57E-04	1.62E-10
Np-237	9.030E+05	2.05E-04	2.27E-10	2.12E-04	2.35E-10
Pu-238	4.638E+05	2.19E+00	4.72E-06	2.27E+00	4.89E-06
U-238	1.180E+04	2.22E-04	1.88E-08	2.30E-04	1.95E-08
Pu-239	7.014E+05	2.81E-01	4.01E-07	2.92E-01	4.16E-07
Pu-240	9.140E+04	4.58E-01	5.01E-06	4.75E-01	5.20E-06
Am-241	5.455E+05	2.27E+00	4.17E-06	2.36E+00	4.32E-06
Pu-241	Unlimited	3.69E+01	0.00E+00	3.82E+01	0.00E+00
Am-242m	2.780E+07	4.54E-03	1.63E-10	4.71E-03	1.69E-10
Pu-242	1.060E+03	1.37E-03	1.29E-06	1.42E-03	1.34E-06
Am-243	6.199E+05	1.70E-02	2.74E-08	1.76E-02	2.84E-08
Cm-243	5.830E+04	1.19E-02	2.04E-07	1.24E-02	2.12E-07
Cm-244	3.410E+03	1.83E+00	5.37E-04	1.90E+00	5.56E-04
Pu-244	4.500E+00	5.86E-10	1.30E-10	6.07E-10	1.35E-10
Cm-245	2.140E+04	2.91E-04	1.36E-08	3.02E-04	1.41E-08
Cm-246	1.480E+01	9.97E-05	6.74E-06	1.03E-04	6.98E-06
Cm-247	1.774E+05	4.64E-10	2.61E-15	4.81E-10	2.71E-15
Cm-248	4.870E-02	1.91E-09	3.91E-08	1.98E-09	4.06E-08
Cf-249	1.685E+05	2.72E-08	1.62E-13	2.82E-08	1.68E-13
Cf-250	4.580E+00	6.39E-08	1.40E-08	6.63E-08	1.45E-08
Cm-250	5.710E-03	4.39E-16	7.68E-14	4.55E-16	7.97E-14
Cf-251	4.580E+05	1.08E-09	2.36E-15	1.12E-09	2.44E-15
Total			0.429		0.445

Attachment 2 – Content Code BC 321A and Chemical List

DOE/WIPP 90-045 Rev. 3, August 2001

CONTENT CODE: BC 321A

CONTENT DESCRIPTION: Solid Organic Waste

GENERATING SITE: Battelle Columbus Laboratories (BCL)

STORAGE SITE: BCL

WASTE DESCRIPTION: This waste consists of a variety of combustible and noncombustible items.

GENERATING SOURCE(S): This waste is generated from activities supporting the decontamination and decommissioning of Building JN-1 under the Battelle Columbus Laboratories Decommissioning Project (BCLDP).

WASTE FORM: The waste may include combustible items such as cloth and paper products (e.g., from the cleanup of spills), rags, coveralls and booties, plastic, cardboard, rubber, wood, surgeons gloves, and Kimwipes. The waste may also include filter waste (e.g., dry box filters, HEPA filters, and filter cartridges); noncombustible Benelex and Plexiglas neutron shielding, blacktop, concrete, dirt, and sand; leaded gloves and aprons comprised of Hypalon rubber and lead oxide impregnated neoprene; and small amounts of metal waste. The waste may also include particulate and sludge-type organic process solids immobilized/solidified with Portland cement, vermiculite, Aqua-Set, or Petro-Set.

WASTE PACKAGING: The waste will be placed directly into a 55-gallon drum with no layers of confinement. The drum is lined with a steel liner. Three drums will then be placed into the RH-TRU waste canister.

METHOD(S) FOR ISOTOPIC DETERMINATION: The isotopic information required to demonstrate compliance with the limits on fissile content, decay heat, and curie content will be determined based on the waste generation source and configuration, which establish the initial radionuclide compositions based on location and initial use. A combination of assaying samples and modeling of the isotopic generation process, results in the establishment of a mixture that characterizes the waste in the content code and the majority of waste at the BCLDP. Using shipping package modeling, dose rate and weight measurement based on the mixture then allow the BCLDP

Attachment 2 – Content Code BC 321A and Chemical List (Continued)

to determine the isotopic inventory. As required, additional radioassays (e.g., confirming gamma spectroscopy) will be performed.

FREE LIQUIDS: Liquid waste, except for residual amounts in well-drained containers, is prohibited in the drums. The total volume of residual liquid in a payload container shall be less than 1 volume percent of the payload container. Waste packaging procedures ensure that free liquids are less than 1 volume percent of the payload container. Absorbents such as Radsorb or diatomaceous earth (e.g., Floor Dry) will be added to any waste matrix that has the potential to dewater after packaging.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures. If present, pressurized cans shall be punctured and emptied prior to packaging.

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 in the payload container. Acids and bases that are potentially corrosive shall be 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.

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 identified in the attached list and are restricted to the allowable chemical lists determined by the methodology found in the RH-TRU 72-B Cask SAR.

ADDITIONAL CRITERIA: Each drum is fitted with a minimum of one filter vent with a minimum hydrogen diffusivity of 3.7E-06 mole/second/mole fraction. The steel liner is fitted with a filter with a minimum hydrogen diffusivity of 3.7E-06 mole/second/mole fraction.

Attachment 2 – Content Code BC 321A and Chemical List (Continued)

MAXIMUM ALLOWABLE HYDROGEN GENERATION RATES - OPTION 1: The maximum allowable hydrogen generation rate limits are as follows:

Confinement Layer	Maximum Allowable Hydrogen Generation Rate Limits Fixed Lid Canister (moles/second)	Maximum Allowable Hydrogen Generation Rate Limits Removable Lid Canister (moles/second)
Can	N/A	N/A
Drum	4.4110E-08	3.6380E-08
Canister	1.3233E-07	1.0914E-07

MAXIMUM ALLOWABLE DECAY HEAT LIMITS - OPTION 2: The maximum allowable decay heat limits are as follows:

Confinement Layer	Maximum Allowable Decay Heat Limits Fixed Lid Canister (watts)		Maximum Allowable Decay Heat Limits Removable Lid Canister (watts)	
	Without Dose-Dependent G Values	With Dose-Dependent G Values (watt*year ≥0.012)	Without Dose-Dependent G Values	With Dose-Dependent G Values (watt*year ≥0.012)
Can	N/A	N/A	N/A	N/A
Drum	0.1283	0.3263	0.1127	0.2710
Canister	0.3850	0.9790	0.3380	0.8130

Attachment 2 – Content Code BC 321A and Chemical List (Continued)

DOE/WIPP 90-045 Rev. 3, August 2001

BATTELLE COLUMBUS LABORATORIES CONTENT CODE BC 321A
SOLID ORGANIC WASTE

MATERIALS AND CHEMICALS >1%

BLACKTOP (Asphalt)
CELLULOSICS
RUBBER
DIATOMACEOUS EARTH (Floor Dry)
GLASS
IRON-BASED METAL/ALLOYS
PAPER
PLASTIC
RADSORB
CLOTH
CARDBOARD
WOOD
KIMWIPES
FILTERS
BENELEX
PLEXIGLAS
NEOPRENE
PORTLAND CEMENT
VERMICULITE
AQUA-SET/PETRO-SET
OTHER INORGANICS

MATERIALS AND CHEMICALS <1%

METALS (including aluminum, lead, zirconium, stainless steel, and carbon steel)
CONCRETE
SOIL

Attachment 3 – Determination of Compliance with the 0.012 Watt*Year Criterion for RH-TRU Canisters BCO-002 and BCO-003

This attachment demonstrates that RH-TRU Canisters BCO-002 and BCO-003 meet the 0.012 watt*year criterion for the use of a dose-dependent G value. The date of generation for the waste is August 2002, so that the elapsed time until July 2005 is approximately 3 years. The alpha, beta portions of the wattage for RH-TRU Canisters BCO-002 and BCO-003 are 0.245 watt and 0.236 watt, respectively. Using this information, the watt*year values for the RH-TRU canisters are summarized as follows:

RH-TRU Canister	Alpha, Beta Portion of Wattage (watt)	Elapsed Time (years)	watt*year
BCO-002	0.245	3	0.735
BCO-003	0.236	3	0.708

RH-TRU Canisters BCO-002 and BCO-003 meet the watt*year criterion as the watt*year value for each is greater than 0.012 watt*year as specified in Section 5.2.2 of the RH-TRAMPAC.