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Effective Date: 04/26/2004

CCP-PO-022
Revision 0

CCP
Waste-Specific
Data Package TRAMPAC
for
Lawrence Berkeley National Laboratory

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RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	04/26/2004	Initial Issue

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this *Waste-Specific Data Package TRAMPAC for Lawrence Berkeley National Laboratory* is to describe and document how each of the requirements for TRUPACT-II transportation is met for 10 payload containers of contact-handled transuranic (TRU) waste generated at the Lawrence Berkeley National Laboratory (LBNL). The TRUPACT-II transportation requirements are defined in the *TRUPACT-II Authorized Methods for Payload Control (TRAMPAC)* [1]. As specified in Section 1.4 of the TRAMPAC, a waste-specific data TRAMPAC may be written by the shipper and approved by the U.S. Department of Energy Carlsbad Field Office for small quantity shipments. This *Waste-Specific Data Package TRAMPAC for Lawrence Berkeley National Laboratory* documents the evaluation of waste data against the requirements of the TRAMPAC. The data evaluation and the documentation of compliance results in this document were completed in accordance with the quality assurance (QA) program [2] under the Central Characterization Project (CCP) Waste Isolation Pilot Plant (WIPP) certification program.

This document presents the information necessary for TRUPACT-II shipment of the 10 LBNL payload containers to Lawrence Livermore National Laboratory (LLNL), where the containers will undergo characterization activities required for eventual disposal at WIPP.

1.2 Scope

This *Waste-Specific Data Package TRAMPAC for Lawrence Berkeley National Laboratory* applies to payload containers LLNL-TRU-01 through LLNL-TRU-10 belonging to LBNL Waste Stream BLCHDN.

1.3 Background

LBNL generated this waste under an established and controlled waste management program. This program is defined by a series of LBNL, and LLNL procedures that were implemented by the LBNL waste generators, and LLNL personnel. Using CCP procedures, Washington TRU Solutions LLC CCP personnel compiled acceptable knowledge documentation, and CCP waste certification personnel will certify the containers for shipment.

For acceptance of waste by the LBNL Waste Management Group, documentation of radiological and chemical/material properties of the waste is required. The LBNL waste generators, therefore, compile radiological and chemical/material information per individual “waste item” (e.g., a glass vial) on a Radioactive Waste Tag in accordance with generator guidelines and generator training requirements. For waste items to be transferred to the LBNL Waste Management Group, the LBNL

waste generators complete a Radioactive/Mixed Waste Requisition Form that compiles the information recorded on Radioactive Waste Tags for the individual waste items. The waste items and associated Radioactive Waste Tags and Radioactive/Mixed Waste Requisition Forms are transferred to the LBNL Waste Management Group. Following acceptance of waste items, the LBNL Waste Management Group uses the Radioactive Waste Tags and Radioactive/Mixed Waste Requisition Forms to enter waste radiological and chemical/material information into the LBNL *Waste Management Group Shoebox Database* [3]. EH&S Procedure 820 controls the entry of data to the LBNL *Waste Management Group Shoebox Database* [3] and defines responsibilities of individuals performing data entry and certification and compliance oversight roles [4]. Access to various screens and update capability of the LBNL *Waste Management Group Shoebox Database* [3] is controlled by the LBNL database administrator and requires specific approval from the supervisor and the group leader. Any changes to critical information are documented through date, time, and user identification in the LBNL *Waste Management Group Shoebox Database* [3]. Data (e.g., from Radioactive Waste Tags and Radioactive/Mixed Waste Requisition Forms provided by waste generators) entered into the database is reviewed by LBNL certification staff who also check the generator's training status. The data entered and results of the LBNL certification review are confirmed by LBNL compliance staff. The LBNL *Waste Management Group Shoebox Database* [3] is continuously updated in real time. The data used in this document was compiled in the LBNL *Waste Management Group Shoebox Database*, Version 4, as of April 13, 2004 [3].

For the 10 payload containers discussed in this document, waste items accepted and managed by the LBNL Waste Management Group as Waste Stream BLCHDN were packaged into "parcels" (e.g., into plastic bags) and placed into 55-gallon drums by LBNL. This packaging activity was completed under the LLNL Transuranic Waste Program and controlled specifically by the following LLNL documents:

- WCP-20, Management of TRU Waste by TRU Waste Generators [5]
- WCP-21, Certification of Transuranic Waste Packages [6]
- WIC 116, Disposal Requisition Completion [7].

All 10 payload containers were packaged as per WCP-20. The following two QA records were generated by the implementation of WCP-20 [5]:

- LLNL Radioactive Waste Parcel Card
- Waste Disposition Requisition Form

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The LLNL Radioactive Waste Parcel Card is completed for each parcel as directed by WCP-20 [5]. Several parcels, each of which consists of one or more waste items, were packaged into a single 55-gallon drum. For each parcel, WCP-20 directs the evaluation and documentation on the LLNL Radioactive Waste Parcel Card of the following [5]:

- Waste items contained by the parcel, including waste description and inventory information for each waste item
- Isotopic inventory and concentrations for the parcel
- Absence of prohibited items (e.g., free liquids, compressed gases, explosives, pyrophorics, corrosive material)
- Absence of sealed rigid containers greater than 4 liters
- Number of confinement layers

The Waste Disposition Requisition Form is completed for each 55-gallon drum as directed by WCP-20 [5] and by WIC 116 [7]. This form documents the following:

- Payload container identification and type
- Tare weight and contents weight
- Applicable LLNL Radioactive Waste Parcel Card Numbers for the contents

The LLNL Radioactive Waste Parcel Cards and the Waste Disposition Requisition Forms are signed and dated as QA records per WCP-20 [5] and WIC 116 [7]. The completed waste documentation package, which includes the cards and forms and supporting attachments, is reviewed by the Hazardous Waste Management Field Technician and verified by the Radiological Characterization Analyst in accordance with WCP-21 [6].

The implementation of the LBNL and LLNL processes described above resulted in the data and QA records used by this document to demonstrate compliance with the 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 55-gallon drum. 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).

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In addition to LBNL and LLNL TRU waste program documents and data, this document references CCP plans and procedures that have been or will be used to qualify the 10 payload containers for TRUPACT-II shipment. Acceptable knowledge for Waste Stream BLCHDN has been assembled, evaluated, and documented by the CCP in accordance with the QA program [2] under the CCP WIPP certification program. The following CCP documents will be implemented for the certification of the 10 payload containers based on the compliance data documented herein:

- CCP-PO-003, *CCP TRUPACT-II Authorized Methods for Payload Control* (TRAMPAC) [8]
- CCP-TP-033, *CCP Shipping of CH TRU Waste* [9]
- CCP-TP-030, *CCP TRU Waste Certification and WWIS Data Entry* [10]

2.0 CONTAINER AND PHYSICAL PROPERTIES

2.1 Container Description

As specified in Section 2.1 of the TRAMPAC, a 55-gallon drum is an authorized payload container for transport in the TRUPACT-II, provided it meets the specifications of Appendix 2.1 of the TRAMPAC [1]. Payload containers LLNL-TRU-01 through LLNL-TRU-10 are 55-gallon drums. The empty 55-gallon drums were obtained from the LLNL Packaging and Transportation Group for use in packaging the waste in accordance with WCP-20 [5]. The LLNL Packaging and Transportation Group is responsible for the procurement of U.S. Department of Transportation Type A 55-gallon drums, including the performance of receipt inspection. The 55-gallon drums procured by LLNL have been verified by documented receipt inspection to meet the specifications of Appendix 2.1 of the TRAMPAC [1].

In addition, as required by WCP-20 [5], the 55-gallon drums were approved for use in accordance with the requirements of M-078-121, LLNL Transuranic Waste Program Certification and Quality Assurance Plan [11].

Section 2.1.2 of the TRAMPAC also requires the inspection of the integrity of the payload containers prior to shipment [1]. Prior to transport, the integrity of each 55-gallon drum will be visually inspected by CCP personnel in accordance with CCP-TP-033 [9].

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2.2 Dunnage

As specified by Section 2.2 of the TRAMPAC, a shipper shall use empty 55-gallon drums as dunnage to complete a payload configuration if too few payload containers are available [1].

Dunnage containers must meet the specifications of Appendix 2.1 of the TRAMPAC, with the exception that dunnage containers shall have open vent ports (i.e., not filtered or plugged) [1].

Four empty 55-gallon drums will be used as dunnage to complete the payload containing payload containers LLNL-TRU-01 through LLNL-TRU-10. Dunnage containers LLNL-DUN-01 through LLNL-DUN-04 meet the 55-gallon drum specifications of Appendix 2.1 of the TRAMPAC, except as required by Section 2.2 of the TRAMPAC, dunnage containers LLNL-DUN-01 through LLNL-DUN-04 have open vent ports (i.e., not filtered or plugged). The empty 55-gallon drums meeting these specifications were obtained for use as dunnage containers in accordance with the procedural guidance provided in WCP-20 [5]. As required by WCP-20, the 55-gallon drums were approved for use in accordance with the requirements of M-078-121 [11].

2.3 Container/Assembly Weight and Center of Gravity

2.3.1 Container/Assembly Weights

Each payload container, payload assembly, and loaded TRUPACT-II shall comply with the applicable weight limits specified in Section 2.3 of the TRAMPAC [1]. The applicable TRUPACT-II weight limits for payload containers LLNL-TRU-01 through LLNL-TRU-10 and dunnage containers LLNL-DUN-01 through LLNL-DUN-04 are as follows [1]:

- 1,000 pounds per 55-gallon drum
- 7,265 pounds per payload assembly of 55-gallon drums, including pallet, guide tubes, slip sheets (optional), reinforcing plates, and banding material
- 19,250 pounds per loaded TRUPACT-II

As specified by Section 2.3.2.1 of the TRAMPAC, the weight of each payload container (or dunnage) shall be determined using a calibrated scale [1]. Payload containers LLNL-TRU-01 through LLNL-TRU-10 and dunnage containers LLNL-DUN-01 through LLNL-DUN-04 were weighed in accordance with WIC 116 [7] and WCP-22, Control of Critical Measuring & Test Equipment [12].

Pursuant to Section 2.3.2.1 of the TRAMPAC, the scale calibrations shall be in accordance with the National Institute for Standards and Technology (NIST) Handbook 44, or an equivalent standard [1]. WCP-22 requires scales to be calibrated to American National Standards Institute/National Conference of Standards Laboratories Z540-1, *Calibration Laboratories and Measuring and Test Equipment – General Requirements* [12]. Scale calibration information is documented in the LLNL *Hazardous Waste Management Critical M&TE Database* [13]. Based on the calibration of the scale used to measure the weight of each payload container and dunnage container, the error associated with the weight values is 2 percent. The following table summarizes the weights for each payload container and dunnage container:

Payload Container No.	Weight (Pounds)	Error (2%) (Pounds)	Value Plus Error (Pounds)	Maximum Allowable Gross Weight Limit (Pounds)
LLNL-TRU-01	102.3	2.05	104.4	1,000
LLNL-TRU-02	99.2	1.98	101.2	1,000
LLNL-TRU-03	109.3	2.19	111.5	1,000
LLNL-TRU-04	101.9	2.04	103.9	1,000
LLNL-TRU-05	82.9	1.66	84.6	1,000
LLNL-TRU-06	131.0	2.62	133.6	1,000
LLNL-TRU-07	202.8	4.06	206.9	1,000
LLNL-TRU-08	353.2	7.06	360.3	1,000
LLNL-TRU-09	105.8	2.12	107.9	1,000
LLNL-TRU-10	99.6	1.99	101.6	1,000
LLNL-DUN-01	51.1	1.02	52.1	1,000
LLNL-DUN-02	51.1	1.02	52.1	1,000
LLNL-DUN-03	51.6	1.03	52.6	1,000
LLNL-DUN-04	51.1	1.02	52.1	1,000

Each payload container and dunnage container complies with the applicable maximum allowable gross weight limit per 55-gallon drum of 1,000 pounds following the addition of the measurement error, as specified in Section 2.3.1.1 of the TRAMPAC [1].

In accordance with CCP-PO-003 [8], CCP personnel will calculate the total weight of the 14-drum payload assembly and evaluate compliance with the maximum payload assembly and loaded TRUPACT-II limits as specified above and in Section 2.3 of the TRAMPAC. As shown in the above table, the total weight for all payload containers is well below the maximum payload assembly weight limit of 7,265 pounds. As such, payload assembly weight limit will be met for the payload comprised of these containers.

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2.3.2 Center of Gravity

As required by Section 2.3.1.2 of the TRAMPAC, the total weight of the top seven 55-gallon drums of the payload assembly shall be less than or equal to the total weight of the bottom seven 55-gallon drums [1]. In accordance with CCP-PO-003 [8], CCP personnel will complete the payload assembly and loading activities such that the total weight of the top seven 55-gallon drums of the payload assembly is less than or equal to the total weight of the bottom layer of drums. CCP personnel shall document compliance with the center of gravity requirement on the Payload Assembly Transportation Certification Document (PATCD).

2.4 Container Marking

As specified by Section 2.4 of the TRAMPAC, each payload container shall be labeled with a unique identification number [1]. In accordance with WCP-20 [5] and WIC 116 [7], each payload container has been labeled with a unique container identification number (i.e., LLNL-TRU-XX), as follows:

- LLNL-TRU-01
- LLNL-TRU-02
- LLNL-TRU-03
- LLNL-TRU-04
- LLNL-TRU-05
- LLNL-TRU-06
- LLNL-TRU-07
- LLNL-TRU-08
- LLNL-TRU-09
- LLNL-TRU-10

As specified in Section 2.4 of the TRAMPAC, if a dunnage container is used to complete a payload assembly, the dunnage container shall be labeled with a unique identification number and “EMPTY” or “DUNNAGE” [1]. In accordance with WCP-20 [5] and WIC 116 [7], each dunnage container is labeled with “DUNNAGE” and a unique identification number (i.e., LLNL-DUN-XX), as follows:

- LLNL-DUN-01
- LLNL-DUN-02
- LLNL-DUN-03
- LLNL-DUN-04

2.5 Filter Vents

As specified by Section 2.5 of the TRAMPAC, each payload container to be transported in the TRUPACT-II shall have one or more filter vents that meet the specifications of Appendix 2.5 of the TRAMPAC [1].

Payload containers LLNL-TRU-01 through LLNL-TRU-10 are each vented with one filter in accordance with WCP-20 [5] and WIC 116 [7]. The following table summarizes the filter information for each payload container documenting compliance with the filter specifications of Appendix 2.5 of the TRAMPAC:

Payload Container No.	Container Type	Filter Model[a]	Supplier[a]	Filter Vent ID[a]	Minimum Hydrogen Diffusivity (mol/s/mol fraction)
LLNL-TRU-01	55-gallon drum	DS19	NFT	KC041	1.85E-05
LLNL-TRU-02	55-gallon drum	DS19	NFT	KC061	1.85E-05
LLNL-TRU-03	55-gallon drum	DS19	NFT	KC133	1.85E-05
LLNL-TRU-04	55-gallon drum	DS19	NFT	KC106	1.85E-05
LLNL-TRU-05	55-gallon drum	DS19	NFT	KC042	1.85E-05
LLNL-TRU-06	55-gallon drum	DS19	NFT	KC044	1.85E-05
LLNL-TRU-07	55-gallon drum	DS19	NFT	KC094	1.85E-05
LLNL-TRU-08	55-gallon drum	DS19	NFT	GD113	1.85E-05
LLNL-TRU-09	55-gallon drum	DS19	NFT	KC141	1.85E-05
LLNL-TRU-10	55-gallon drum	DS19	NFT	KC074	1.85E-05

[a] Source: WCP-20 and WIC 116

mol/s/mol fraction = Moles per second per mole fraction
NFT = Nuclear Filter Technology

Nuclear Filter Technology Model DS19 is included on the list of approved WIPP filters as “NucFil®019DS.”

As stated in Section 2.2, dunnage containers LLNL-DUN-01 through LLNL-DUN-04 have open vent ports (i.e., not filtered or plugged) as required by Section 2.2 of the TRAMPAC.

2.6 Liquids

As required by Section 2.6 of the TRAMPAC, liquid waste is prohibited in the payload containers, except for residual amounts in well-drained containers [1]. As required by the LBNL waste certification program and documented on a Liquid Treatment Worksheet [14], liquid waste was solidified with Aquaset. For each waste parcel, WCP-20 [5] directs the evaluation and documentation on a checklist on the LLNL Radioactive

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Waste Parcel Card of the absence of free liquids. A LLNL Radioactive Waste Parcel Card is completed for each of the parcels packaged into drums LLNL-TRU-01 through LLNL-TRU-10 and compiled by the Waste Disposition Requisition Form for each drum. As such, the total volume of residual liquid in each of the payload containers is documented to be less than 1 percent (volume).

2.7 Sharp or Heavy Objects

As required by Section 2.7 of the 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]. The LBNL *Waste Management Group Shoebox Database* [3] lists all waste items emplaced in the containers. The waste items are primarily small containers (e.g., bottles) on the order of a few grams in weight and, as such; do not qualify as sharp or heavy objects. Drum LLNL-TRU-08 contains waste items packaged in one metal can. The metal can is positioned by dunnage material in the drum in accordance with WCP-20 [5]. Based on this evaluation, sharp or heavy objects are not present in or are suitably packaged to provide puncture protection for payload containers LLNL-TRU-01 through LLNL-TRU-10.

2.8 Sealed Containers

Sealed containers greater than 4 liters (nominal) are prohibited by Section 2.8 of the TRAMPAC [1]. For each waste parcel, WCP-20 [5] directs the evaluation and documentation on a checklist on the LLNL Radioactive Waste Parcel Card of the absence of sealed containers greater than 4 liters. A LLNL Radioactive Waste Parcel Card is completed for each of the parcels packaged into drums LLNL-TRU-01 through LLNL-TRU-10 and compiled by the Waste Disposition Requisition Form for each drum. As such, the absence of sealed containers greater than 4 liters in each of the payload containers is documented.

3.0 NUCLEAR PROPERTIES REQUIREMENTS

3.1 Nuclear Criticality

As specified by Section 3.1 of the TRAMPAC, a payload container shall be acceptable for transport only if the Pu-239 fissile gram equivalent (FGE) plus two times the measurement error (i.e., two standard deviations) is less than or equal to 200 grams for a 55-gallon drum [1].

The LBNL waste generators compile radiological information per individual waste item on a Radioactive Waste Tag in accordance with generator guidelines and generator training requirements. For waste items to be transferred to the LBNL Waste Management Group, the LBNL waste

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generators complete a Radioactive/Mixed Waste Requisition Form that compiles the information recorded on Radioactive Waste Tags for the individual waste items. The waste items and associated Radioactive Waste Tags and Radioactive/Mixed Waste Requisition Forms are transferred to the LBNL Waste Management Group. Following acceptance of waste items, the LBNL Waste Management Group uses the Radioactive Waste Tags and Radioactive/Mixed Waste Requisition Forms to enter waste radiological information into the LBNL *Waste Management Group Shoebox Database* [3]. The waste radiological information entered to the LBNL *Waste Management Group Shoebox Database* [3] was based on process knowledge and/or waste analysis (including radiochemistry or nondestructive assay [NDA]), which was performed on approximately one-half of the individual waste items. The radiological information for each waste item from the Radioactive Waste Tag was input to the LBNL *Waste Management Group Shoebox Database* [3]. As such, the LBNL *Waste Management Group Shoebox Database* [3] summarizes, by radionuclide and associated concentration, the radiological information for each waste item. Because the individual waste items are small (on the order of a few grams), the radiological information provided by the process knowledge records is detailed. This information was used to calculate the FGE value for each payload container.

The error conservatively assigned to the NDA measurements (performed on approximately one-half of the individual waste items by the LBNL analytical laboratory) is 25 percent based on discussions with the LBNL analytical laboratory personnel [15]. The same error margin has been assigned for the radionuclide information associated with the detailed process knowledge for remaining waste items. The fact that a 25 percent error is appropriate and conservative for approximately one-half of the waste items and the fact that the process knowledge information is detailed and similar for all waste items (including those assayed) justify the assignment of a 25 percent error to the radionuclide information for all waste items. As such, an error margin of 25 percent for the individual waste item radiological information bounds the error for the radiological information for the payload containers.

The following table summarizes the FGE values calculated for each payload container and demonstrates compliance of each with the 200 gram FGE payload container limit (specified in Section 3.1 of the TRAMPAC [1]).

Payload Container No.	FGE (grams)	Error (25%) (grams)	Value + 2X Error (grams)	Limit (grams)
LLNL-TRU-01	1.3900	0.3475	2.0850	200
LLNL-TRU-02	0.1190	0.0298	0.1786	200
LLNL-TRU-03	0.1460	0.0365	0.2190	200
LLNL-TRU-04	0.0557	0.0139	0.0835	200
LLNL-TRU-05	0.0525	0.0131	0.0787	200
LLNL-TRU-06	0.1960	0.0490	0.2940	200
LLNL-TRU-07	0.0627	0.0157	0.0941	200
LLNL-TRU-08	0.0072	0.0018	0.0108	200
LLNL-TRU-09	1.0500	0.2625	1.5750	200
LLNL-TRU-10	0.0151	0.0038	0.0227	200

The FGE value (plus two times the 25 percent error) of each payload container is well below the 200-gram FGE limit per 55-gallon drum.

As specified by Section 3.1 of the TRAMPAC, a TRUPACT-II shall be acceptable for transport only if the Pu-239 FGE plus two times the measurement error (i.e., two standard deviations) is less than or equal to 325 grams for a payload of 55-gallon drums [1]. Payloads that contain high concentrations of beryllium (>1 percent by weight of the contents) shall be acceptable for transport in a TRUPACT-II only if the Pu-239 FGE plus two times the measurement error is less than or equal to 100 grams. The weight percent of beryllium does not exceed 1 percent of the contents in any payload container as documented in the LBNL *Waste Management Group Shoebox Database* [3]. As such, the 325-gram FGE limit is applicable to the payload containing payload containers LLNL-TRU-01 through LLNL-TRU-10. In accordance with CCP-PO-003 [8], CCP personnel will calculate the total fissile mass (FGE) plus the total root mean square fissile mass error for the assembled payload and evaluate compliance with the maximum allowable FGE limit of 325 grams per payload.

As shown in the above table, the total FGE value for all payload containers is well below (by a factor of approximately 60) the 325-gram FGE limit per payload.

3.2 Radiation Dose Rate

As specified by Section 3.2 of the TRAMPAC, the external radiation dose rate of individual payload containers shall be less than or equal to 200 millirem per hour (mrem/hr) [1]. The surface radiation dose rates of payload containers LLNL-TRU-01 through LLNL-TRU-10 were surveyed by LBNL personnel in accordance with LBNL EH&S Procedure 710, *Radiological Survey Program* [16]. Pursuant to Section 3.2.2 of the TRAMPAC, the measurements shall be made with instruments traceable

to a national standard [1]. LBNL EH&S Procedure 710 requires the dose rate measurements to be made with instruments whose calibration is traceable to a NIST standard [16]. The following table summarizes the measured surface dose rate for each payload container and demonstrates compliance of each with the 200 mrem/hr 55-gallon drum limit specified in Section 3.2 of the TRAMPAC:

Payload Container No.	Surface Dose Rate (mrem/hr)	Limit (mrem/hr)
LLNL-TRU-01	0.5	200
LLNL-TRU-02	1.7	200
LLNL-TRU-03	9.0	200
LLNL-TRU-04	84.0	200
LLNL-TRU-05	13.5	200
LLNL-TRU-06	100.0	200
LLNL-TRU-07	13.0	200
LLNL-TRU-08	<0.3	200
LLNL-TRU-09	0.5	200
LLNL-TRU-10	20.0	200

As specified by Section 3.2 of the TRAMPAC, the external radiation dose rates of the loaded TRUPACT-II shall be less than or equal to 200 mrem/hr at the surface and less than or equal to 10 mrem/hr at 2 meters [1]. In accordance with CCP-PO-003 [8], CCP personnel will survey the loaded TRUPACT-II and evaluate compliance with these radiation dose rate limits.

4.0 CHEMICAL PROPERTIES REQUIREMENTS

4.1 Pyrophoric Materials

As specified by Section 4.1 of the TRAMPAC, nonradioactive pyrophoric materials shall not be packaged into payload containers [1]. Radioactive pyrophoric materials, if present in the waste, shall be limited to less than 1 percent (weight) of the payload container [1]. For each waste parcel, WCP-20 [5] directs the evaluation and documentation on a checklist on the LLNL Radioactive Waste Parcel Card of the absence of pyrophoric materials. A LLNL Radioactive Waste Parcel Card is completed for each of the parcels packaged into drums LLNL-TRU-01 through LLNL-TRU-10 and compiled by the Waste Disposition Requisition Form for each drum. As such, the absence of pyrophoric materials in each of the payload containers is documented.

4.2 Explosives, Corrosives, and Compressed Gases

As specified by Section 4.2 of the TRAMPAC, explosives, corrosives, and compressed gases are prohibited from payload containers [1]. For each waste parcel, WCP-20 [5] directs the evaluation and documentation on a checklist on the LLNL Radioactive Waste Parcel Card of the absence of explosives, corrosives, and compressed gases. A LLNL Radioactive Waste Parcel Card is completed for each of the parcels packaged into drums LLNL-TRU-01 through LLNL-TRU-10 and compiled by the Waste Disposition Requisition Form for each drum. As such, the absence of explosives, corrosives, and compressed gases in each of the payload containers is documented.

4.3 Chemical Composition

As specified by Section 4.3 of the TRAMPAC, chemical constituents in a payload shall conform to the lists of allowable materials in Tables 4-1 through 4-8 of the TRAMPAC [1]. In addition, the total quantity of trace chemicals/materials (materials that occur individually in the waste in quantities less than 1 weight percent) not listed as allowable materials for a given waste material type in any payload container is restricted to less than 5 weight percent [1].

The waste contained in payload containers LLNL-TRU-01 through LLNL-TRU-10 is solid organic and inorganic materials, including paper, plastic, glass, metal, and cellulosics, and inorganics solidified with Aquaset [3]. Other waste materials include cork, concrete, resin, sludge, and Styrofoam [3]. Based on the chemicals and materials documented in the LBNL *Waste Management Group Shoebox Database* [3] for payload containers LLNL-TRU-01 through LLNL-TRU-10, the payload containers have been assigned to Content Code SQ 121 in the TRUPACT-II Content Codes (TRUCON) document [17]. The chemicals and materials packaged in these payload containers conform to the SQ 121 chemical list, which complies with the list of allowable chemicals and materials for Waste Material Type III.1 (Table 4-6 of the TRAMPAC) [1]. Content Code SQ 121 and its chemical list are provided in Attachment A.

4.4 Chemical Compatibility

As specified in Section 4.4.2 of the TRAMPAC, chemical compatibility of all waste material types has been demonstrated for transport in the TRUPACT-II using the chemicals in the allowable chemicals and materials lists (Tables 4-1 through 4-8 of the TRAMPAC) [1]. The restrictions imposed on the chemical constituents of the content codes ensure

compliance with the compatibility requirements. Because payload containers LLNL-TRU-01 through LLNL-TRU-10 contain only chemicals that conform to the SQ 121 chemical list, the payload containers contain only chemicals and materials that are compatible.

5.0 GAS GENERATION REQUIREMENTS

As specified by Section 5.0 of the TRAMPAC, the gases generated in the payload containers and released into the packaging inner containment vessel (ICV) cavity shall be controlled to maintain the pressure within the TRUPACT-II ICV cavity below the acceptable design pressure of 50 pounds per square inch gauge [1]. As described in the TRUPACT-II Safety Analysis Report (SAR) [18], compliance with the design pressure limit is ensured by the analysis presented in Chapter 3.0 of the TRUPACT-II SAR for Waste Type III payloads up to a decay heat of 7 watts.

As shown in Section 5.3, the total decay heat (plus error) in payload containers LLNL-TRU-01 through LLNL-TRU-10 is only 0.1123 watt; therefore, compliance with the design pressure limit is ensured.

As specified by Section 5.0 of the TRAMPAC, hydrogen gas in any confinement layer of the TRUPACT-II is limited to a concentration less than or equal to 5 percent (by volume) [1]. Compliance with this limit is ensured by limiting the allowable decay heat per payload container or by headspace gas measurement to demonstrate compliance with a limit on the allowable hydrogen generation rate per payload container. This compliance is evaluated for payload containers LLNL-TRU-01 through LLNL-TRU-10 in the following sections.

5.1 Payload Shipping Category

As specified by Section 5.1.1 of the TRAMPAC, each payload container shall be assigned to a payload shipping category that provides information on the waste type, waste material type, and resistance to gas release from the inner layers of confinement [1]. Containers LLNL-TRU-01 through LLNL-TRU-10 are 55-gallon drums with no more than three layers of confinement, all closed by the twist-and-tape method in accordance with WCP-20 [5]. No rigid liners are present in any of the drums, except for LLNL-TRU-08, which uses a rigid liner without the lid. Complete descriptions of the internal packaging configurations for the payload containers are provided in Content Code SQ 121 under packaging configurations SQ 121AA, SQ 121DA, and SQ 121E in the TRUCON [17] (see Attachment A).

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The following table summarizes the payload shipping categories determined from the packaging descriptions documented on the LLNL Radioactive Waste Parcel Cards and the Waste Disposition Requisition Form for each payload container in accordance with WCP-20 [5] and WIC 116 [7]:

Payload Container No.	Content Code	Packaging Configuration	Payload Shipping Category
LLNL-TRU-01	SQ 121E	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 3 inner bags and no rigid liner in the drum	30 0340 0615
LLNL-TRU-02	SQ 121E	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 3 inner bags and no rigid liner in the drum	30 0340 0615
LLNL-TRU-03	SQ 121DA	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 2 inner bags and 1 drum liner bag and no rigid liner in the drum	30 0340 0457
LLNL-TRU-04	SQ 121E	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 3 inner bags and no rigid liner in the drum	30 0340 0615
LLNL-TRU-05	SQ 121E	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 3 inner bags and no rigid liner in the drum	30 0340 0615
LLNL-TRU-06	SQ 121DA	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 2 inner bags and 1 drum liner bag and no rigid liner in the drum	30 0340 0457
LLNL-TRU-07	SQ 121E	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 3 inner bags and no rigid liner in the drum	30 0340 0615
LLNL-TRU-08	SQ 121AA	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no layers of confinement and the rigid liner lid in the drum removed	30 0340 0079
LLNL-TRU-09	SQ 121E	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 3 inner bags and no rigid liner in the drum	30 0340 0615
LLNL-TRU-10	SQ 121E	55-gallon drum (drum filter with 1.85E-05 mol/s/mf hydrogen diffusivity) with no more than 3 inner bags and no rigid liner in the drum	30 0340 0615

Mol/s/mf = Moles per second per mole fraction.

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The payload containers are conservatively assigned shipping categories assuming that the dose criterion for a lower G value does not apply (see Section 5.1 of the TRAMPAC [1]). This accounts for the presence of solidified inorganic waste in some payload containers.

5.2 Flammable Volatile Organic Compounds

As specified by Section 5.2 of the TRAMPAC, wastes to be transported in the TRUPACT-II are restricted so that no flammable gas/volatile organic compounds (VOC) mixtures can occur in any layer of confinement during shipment [1]. Based on process knowledge and the documentation of individual waste items packaged in the payload containers in the LBNL *Waste Management Group Shoebox Database* [3], the concentration of potentially flammable VOCs in each of the payload containers LLNL-TRU-01 through LLNL-TRU-10 is less than 500 parts per million. Any small quantities of potentially flammable VOCs (e.g., acetone) used in the generation of certain waste items are negligible as these items were dry at the time of packaging and/or were solidified as documented in the LBNL *Waste Management Group Shoebox Database* [3].

5.3 Decay Heat

As specified by Section 5.2 of the TRAMPAC, compliance with flammable (gas/VOC) limits per payload container may be demonstrated by meeting a decay heat limit per payload container based on the assigned payload shipping category [1]. Radiological information summarized in the LBNL *Waste Management Group Shoebox Database* [3] (see Section 3.1) has been used to determine the decay heat value for each payload container. As described in Section 3.1, the error associated with this data is bounded by a conservative value of 25 percent.

The following table summarizes the decay heat values reported to four decimal places for each payload container and evaluates compliance of each with the applicable decay heat limit following the addition of the error:

Payload Container No.	Decay Heat Value (watts)	Error (25%) (watts)	Value Plus Error (watts)	Limit[a] (watts)
LLNL-TRU-01	0.0005	0.0001	0.0006	0.0231
LLNL-TRU-02	0.0010	0.0003	0.0013	0.0231
LLNL-TRU-03	0.0003	0.0001	0.0004	0.0310
LLNL-TRU-04	0.0019	0.0005	0.0024	0.0231
LLNL-TRU-05	0.0026	0.0007	0.0033	0.0231
LLNL-TRU-06	0.0074	0.0019	0.0093	0.0310
LLNL-TRU-07	0.0420	0.0105	0.0525	0.0231
LLNL-TRU-08	0.0329	0.0082	0.0411	0.1796
LLNL-TRU-09	0.0004	0.0001	0.0005	0.0231
LLNL-TRU-10	0.0006	0.0002	0.0008	0.0231

[a]Limit calculated as specified in the TRAMPAC from the shipping category listed in Section 5.1.

As shown in the above table, each payload container complies with the applicable decay heat limit, except for LLNL-TRU-007. Because LLNL-TRU-07 exceeds the applicable decay heat limit, headspace gas measurement of this payload container was performed, as specified in Section 5.2 and Appendix 5.7 of the TRAMPAC, by LLNL personnel in accordance with the LLNL Work Instruction, "TRU Drum Head Space Gas Sampling Operational Guide" [19]. The operational guide was used in accordance with the applicable LBNL Radiological Work Permit. The CCP analyzed the sample for hydrogen in accordance with CCP-TP-090, *CCP Headspace Gas Sampling Using the Automated Manifold System* [20].

Hydrogen was not detected in the headspace gas sampling results for LLNL-TRU-07. Based on the results of the headspace gas sampling, LLNL-TRU-07 complies with the maximum allowable hydrogen generation rate per payload container.

As shown in the above table, the total decay heat of the payload containers (plus error) (0.1123 watt) is well below the TRUPACT-II design limit of 40 watts. During payload assembly activities to be completed in accordance with CCP-PO-003 [8], CCP personnel will document compliance of the assembled payload with the TRUPACT-II design limit of 40 watts.

5.4 Venting and Aspiration

As specified by Section 5.3 of the TRAMPAC, payload containers that have been stored in an unvented condition (i.e., no filter or unpunctured liner) shall be aspirated for a specific length of time to ensure equilibration of any gases that may have accumulated in the closed container [1].

Payload containers LLNL-TRU-01 through LLNL-TRU-10 are newly generated and were vented during packaging in accordance with WCP-20 [5]. Therefore, the aspiration requirement of Section 5.3 of the TRAMPAC is not applicable.

6.0 PAYLOAD ASSEMBLY REQUIREMENTS

As specified by Section 6.1 of the TRAMPAC, a TRUPACT-II payload shall be authorized for shipment by the completion and signing of the Payload Container Transportation Certification Document(s) (PCTCD) and the PATCD after verification of compliance with all transportation requirements of the TRAMPAC [1]. The certification of each payload container and the payload will be completed by the CCP Transportation Certification Official in accordance with CCP-PO-003 [8] and CCP-TP-030 [10]. CCP-TP-030 details the completion of required transportation certification documents (PCTCDs and PATCD). During the completion of these documents, compliance with the transportation parameter requirements as documented in the previous sections will be verified by the CCP Transportation Certification Official. The shipping records, whose generation is described in CCP-PO-003, shall be maintained by the CCP for a minimum period of three years.

7.0 REFERENCES

1. DOE, “TRUPACT-II Authorized Methods for Payload Control (TRAMPAC),” Revision 19c, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

2. CCP-PO-001, “CCP Transuranic Waste Characterization Quality Assurance Project Plan (QAPjP)”, current revision, Washington TRU Solutions LLC, Carlsbad, New Mexico.

3. LBNL, “Waste Management Group Shoebox Database,” Version 4, dated April 13, 2004, Lawrence Berkeley National Laboratory, Waste Management Group, Berkeley, California.

4. LBNL EH&S Procedure 820, "Hazardous, Radioactive, and Mixed Waste Acceptance Criteria: Characterization and Compliance," Revision 10, Lawrence Berkeley National Laboratory, Berkeley, California.

5. WCP-20, “Management of TRU Waste by TRU Waste Generators,” Revision 2, Lawrence Livermore National Laboratory, Livermore, California.

6. WCP-21, “Certification of Transuranic Waste Packages,” Revision 5, Lawrence Livermore National Laboratory, Livermore, California.

7. WIC 116, “Disposal Requisition Completion,” Revision 5, Lawrence Livermore National Laboratory, Livermore, California.

8. CCP-PO-003, “CCP TRUPACT-II Authorized Methods for Payload Control (TRAMPAC),” current revision, Washington TRU Solutions LLC, Carlsbad, New Mexico.

9. CCP-TP-033, “CCP Shipping of CH TRU Waste,” current revision, Washington TRU Solutions LLC, Carlsbad, New Mexico.

10. CCP-TP-030, “CCP TRU Waste Certification and WWIS Data Entry,” current revision, Washington TRU Solutions LLC, Carlsbad, New Mexico.

11. M-078-121, “LLNL Transuranic Waste Program Certification and Quality Assurance Plan,” Lawrence Livermore National Laboratory, Livermore, California.

12. WCP-22, “Control of Critical Measuring & Test Equipment,” Revision 5, Lawrence Livermore National Laboratory, Livermore, California.

13. LLNL, “Hazardous Waste Management Critical M&TE Database,” Lawrence Livermore National Laboratory, Livermore, California.

14. LBNL-I-28, "Liquid Treatment Worksheet," Lawrence Berkeley National Laboratory, Berkeley, California.

15. LBNL, Personal communication, N. Rothermich, Lawrence Berkeley National Laboratory, Berkeley, California, March 11, 2004.

16. LBNL EH&S Procedure 710, “Radiological Survey Program,” current revision, Lawrence Berkeley National Laboratory, Berkeley, California.

17. DOE/WIPP 89-004, “TRUPACT-II Content Codes (TRUCON),” Revision 14.5, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

18. DOE, “Safety Analysis Report for the TRUPACT-II Shipping Package,” Revision 19c, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico.

19. LLNL, “TRU Drum Head Space Gas Sampling Operational Guide,” Lawrence Livermore National Laboratory, Livermore, California.

20. CCP-TP-090, “CCP Headspace Gas Sampling Using the Automated Manifold System,” Revision 5, Washington TRU Solutions LLC, Carlsbad, New Mexico.

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ATTACHMENT A
CONTENT CODE SQ 121 AND CHEMICAL LIST

CONTENT CODE: SQ 121, SQ 221 (See Waste Packaging Description Table)

CONTENT DESCRIPTION: Solid Organic Waste

GENERATING SITE: Various

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

GENERATING SOURCES: These wastes were generated from various operations at the sites.

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. This waste may also include particulate and sludge-type organic process solids immobilized/solidified with Portland cement, vermiculite, Aquaset, or Petroset.

WASTE PACKAGING: Details of the waste packaging for each code are presented in the following table:

WASTE PACKAGING DESCRIPTION TABLE

Code	Description*
SQ 121A SQ 221A	The waste is placed directly into a 55-gallon drum, an SWB, or a TDOP with no layers of confinement.
SQ 121AA SQ 221AA	The waste is placed directly into a metal can with the filter removed from the bung hole. The metal can is contained in a 55-gallon drum that is lined with a rigid liner. The rigid liner lid is removed.
SQ 121B SQ 221B	The waste is packaged directly into one plastic bag and is then placed into a 55-gallon drum, an SWB, or a TDOP.
SQ 121C SQ 221C	The waste is packaged directly into two plastic bags and is then placed into a 55-gallon drum, an SWB, or a TDOP.
SQ 121D SQ 221D	The waste is packaged directly into three plastic bags and is then placed into a 55-gallon drum, an SWB, or a TDOP.
SQ 121DA SQ 221DA	The waste is packaged directly into two plastic inner bags and one plastic liner bag. The waste is then placed into a 55-gallon drum with no rigid liner.
SQ 121E SQ 221E	The waste is packaged directly into three plastic inner bags and is then placed into a 55-gallon drum with no rigid liner. No closed plastic liner bags are used inside the 55-gallon drum.

* If drums are overpacked in an SWB, a TDOP, or an 85-gallon drum, no closed liner bags are used inside the SWB, the TDOP, or the 85-gallon drum. If waste is placed directly in a TDOP, any liner bag is an SWB liner. All bag closures are in accordance with the TRAMPAC.

ASSAY: Assay for all payload containers shall be performed in accordance with the TRAMPAC. The isotopic composition of the waste is determined from measurements taken on the product material during the processing at the site. The processing organizations transmit the isotopic composition information to the site waste certification organization. Therefore, the isotopic composition of the waste need not be determined by direct analysis or measurement of the waste unless process information is not available.

FREE LIQUIDS: Liquid waste is prohibited in the payload containers (drums, SWBs, or TDOPs) except for residual amounts in well-drained containers. 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.

EXPLOSIVES/COMPRESSED GASES: Explosives and compressed gases in the payload containers are prohibited by waste packaging procedures.

PYROPHORICS: Nonradioactive pyrophorics in the payload containers are prohibited by waste packaging procedures. Waste packaging procedures shall ensure that all pyrophoric radioactive materials are present only in small residual amounts (less than 1 weight percent) in payload containers.

CORROSIVES: Corrosives are prohibited in the payload containers. 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% weight) quantities. The chemicals found in this content code are restricted to the table of allowable materials for Waste Material Type III.1 in the TRAMPAC.

PAYLOAD CONTAINER VENTING AND ASPIRATION: Payload containers in this content code that have been stored in an unvented condition (i.e., no filter and unpunctured liner) will be aspirated using one of the three options described in the TRAMPAC.

ADDITIONAL CRITERIA: In accordance with the TRAMPAC, each drum is fitted with a minimum of one filter vent, and the rigid liner (if present) is punctured. Each SWB is fitted with at least two and up to four filters. Each TDOP is fitted with at least nine filters.

SHIPPING CATEGORY: See Table 2, Summary of Approved Content Codes and Corresponding Shipping Categories.

MAXIMUM ALLOWABLE WATTAGE: The maximum allowable wattages for analytical and test category waste are specified in the TRAMPAC.

Small Quantity Site
List of Chemicals and Materials
in TRU Waste Content Codes

Content Code SQ 121/221

SOLID ORGANIC WASTE

GROUP 1:	ACIDS, MINERAL, NON-OXIDIZING (Constituents reacted prior to loading in payload containers)	T
GROUP 2:	ACIDS, MINERAL, OXIDIZING (Constituents reacted prior to loading in payload containers)	T
GROUP 3:	ACIDS, ORGANIC (Constituents reacted prior to loading in payload containers)	T
GROUP 4:	ALCOHOLS AND GLYCOLS	T
GROUP 8:	AZO COMPOUNDS, DIAZO COMPOUNDS, AND HYDRAZINES (Constituents reacted prior to loading in payload containers)	T
GROUP 10:	CAUSTICS (Constituents reacted prior to loading in payload container	T
GROUP 11:	CYANIDES	T
GROUP 13:	ESTERS	T
GROUP 14:	ETHERS	T
GROUP 15:	FLUORIDES	T
GROUP 16:	HYDROCARBONS, AROMATIC	T
GROUP 17:	HALOGENATED ORGANICS	T
GROUP 18:	ISOCYANATES	T
GROUP 19:	KETONES	T
GROUP 21:	METALS, ALKALI AND ALKALINE EARTH, ELEMENTAL AND ALLOYS (Constituents reacted prior to loading in payload containers)	T
GROUP 22:	METALS OTHER ELEMENTAL AND ALLOYS IN THE FORM OF POWDERS, VAPORS OR SPONGES	T
GROUP 23:	METALS, OTHER ELEMENTAL AND ALLOYS, AS SHEETS, RODS, MOLDINGS, DROPS, ETC.	D
GROUP 24:	METALS AND METAL COMPOUNDS, TOXIC	D

Small Quantity Site
List of Chemicals and Materials
in TRU Waste Content Codes

Content Code SQ 121/221
(Continued)

SOLID ORGANIC WASTE

GROUP 25:	NITRIDES	T
GROUP 28:	HYDROCARBON, ALIPHATIC, UNSATURATED	T
GROUP 29:	HYDROCARBON, ALIPHATIC, SATURATED	T
GROUP 30:	PEROXIDES AND HYDROPEROXIDES, ORGANIC (Constituents reacted prior to loading in payload containers)	T
GROUP 32:	ORGANOPHOSPHATES, PHOSPHOTHIOATES AND PHOSPHODITHIOATES	
	Tributyl Phosphate	D
GROUP 101:	COMBUSTIBLE AND FLAMMABLE MATERIALS, MISCELLANEOUS	
	Asphalt	D
	Benelex	D
	Cardboard	D
	Cellulose	D
	Cloth	D
	Fiberglass	M
	Grease	D
	Hydraulic oil	T
	Ion exchange resin	D
	Mineral oil	T
	Molds and Crucibles	D
	Oil	D
	Paper	D
	Plastic	D
	Plexiglas	D
	Polybutadiene	T
	Polyethylene	D
	Polymethyl methacrylate	D
	Polypropylene	D
	Polystyrene	M
	Polyurethane	T
	Polyvinyl chloride	D
	Rags and Cloth	D
	Rubber	D
	Rubber gloves	D
	Rubber gloves (Leaded)	T
	Synthetic rubber	M
	Wood	D
GROUP 103:	POLYMERIZABLE COMPOUNDS (Constituents reacted prior to loading in payload containers)	T

Small Quantity Site
List of Chemicals and Materials
in TRU Waste Content Codes

Content Code SQ 121/221
(Continued)

SOLID ORGANIC WASTE

GROUP 104:	OXIDIZING AGENTS, STRONG (Constituents reacted prior to loading in payload containers)	T
GROUP 105:	REDUCING AGENTS, STRONG (Constituents reacted prior to loading in payload containers)	T
GROUP 106:	WATER AND MIXTURES CONTAINING WATER	T
GROUP 107:	WATER REACTIVE SUBSTANCES (Constituents reacted prior to loading in payload containers)	
OTHER INORGANICS		D
OTHER ORGANICS		T
OTHER SOLIDIFICATION MATERIALS/ABSORBENT		
	Diatomaceous Earth	M
	Florco	M
	Hydrated Aquaset II	D
	Radsorb	M

Refer to Introduction for a description of the designations used in this chemical list.