

## **CASE STUDY: RH-TRU WASTE TRANSPORTATION FROM BATTELLE COLUMBUS LABORATORIES**

James H. Eide  
Battelle Columbus Laboratories

Jennifer Griffin, Murthy Devarakonda  
IT Corporation

Mark Whittaker  
GTS Duratek

Tod Burrington, Randy Britain  
Westinghouse Waste Isolation Division

### **ABSTRACT**

Battelle Columbus Laboratories (BCL), located in Columbus, Ohio, must complete decontamination and decommissioning (D&D) activities for nuclear research buildings and grounds by 2005, pursuant to the U.S. Department of Energy (DOE) Ohio Strategic Plan. Most of the resulting waste (approximately 25 cubic meters [ $\text{m}^3$ ]) is projected to be remote-handled transuranic (RH-TRU) waste destined for shipment to and disposal at the Waste Isolation Pilot Plant (WIPP) outside Carlsbad, New Mexico. The baseline approach to RH-TRU waste transportation from BCL to WIPP involves the use of the 72-B Cask, a Type B packaging certified by the U.S. Nuclear Regulatory Commission (NRC). The 72-B Cask is designed to transport one RH-TRU waste canister either directly loaded with waste or overpacking three 55-gallon drums. BCL is currently developing a waste certification program for RH-TRU waste including this 72-B Cask baseline shipping option.

As a contingency plan, and to expedite RH-TRU waste shipments off-site by the end of 2002, BCL also is currently investigating alternative transportation options. These options include using the model CNS 10-160B Cask, a commercial shipping cask designed and fabricated by Chem-Nuclear Systems (CNS) (acquired by GTS Duratek in June 2000). The CNS 10-160B Cask is certified by the NRC as a Type B shipping container and is capable of transporting up to ten 55-gallon drums of waste. An application to add RH-TRU waste from BCL as authorized contents for the CNS 10-160B Cask is currently under review by the NRC. The Battelle Columbus Laboratories Decommissioning Project (BCLDP) conducted a mock demonstration of an RH-TRU waste shipment in the CNS 10-160B Cask in September 2000. Waste-handling activities at BCL were simulated using existing remote-handling equipment and approved procedures to load the CNS 10-160B Cask and prepare it for transportation to the WIPP. The CNS 10-160B Cask was then transported by truck along a DOE-approved shipping route to the WIPP, where WIPP personnel simulated remote unloading of the cask. The demonstrations provided sufficient evidence for the CNS 10-160B Cask to be considered a viable option for RH-TRU waste transportation.

## INTRODUCTION

Transuranic (TRU) waste is defined as waste contaminated with predominantly alpha-emitting radionuclides with an atomic number greater than 92, that have half-lives greater than 20 years and concentrations greater than 100 nanocuries per gram (1). TRU waste is generally divided into two classifications, depending on the dose rate at the surface of the container in which the waste is packaged. Contact-handled (CH-) TRU waste has dose rates less than or equal to 200 millirem per hour [mrem/hr] at the surface of the container, and RH-TRU waste has dose rates greater than 200 mrem/hr at the surface of the container) (1). Defense TRU waste generated and/or stored at various sites across the United States will be disposed of at the Waste Isolation Pilot Plant (WIPP), located in southeastern New Mexico. The WIPP site is an underground repository designed to provide permanent disposal for both CH-TRU and RH-TRU waste.

Currently, RH-TRU waste is prohibited from disposal at the WIPP site pending approval by the New Mexico Environment Department (NMED) of a Class III permit modification to the "Waste Isolation Pilot Plant Hazardous Waste Facility Permit, Identification Number NM4890139088-TSDF" (2). The modification to this permit includes specific information regarding the RH-TRU waste analysis plan (RH-WAP) to meet the requirements of the New Mexico Administrative Code, Title 20, Chapter 4, Part 1, Subpart V, 264.13 (incorporating the Code of Federal Regulations [CFR], Title 40, 264.13). The permit modification also includes process description information for RH-TRU waste-handling activities to be conducted in the RH Bay at the WIPP site. In addition to the RH-WAP and process description requirements, RH-TRU waste acceptance criteria (RH-WAC) requirements must be finalized and approved before RH-TRU waste can be shipped to the WIPP. The RH-WAC compiles all transportation, characterization, and certification criteria for WIPP disposal, including the requirements approved as part of the Class III permit modification. It is anticipated that both the permit modification and the RH-TRU WAC will be finalized and approved in late 2001. RH-TRU waste shipments to the WIPP are scheduled to begin in January 2002.

The baseline approach to RH-TRU waste transportation to the WIPP involves using the 72-B Cask (Figure 1). The 72-B Cask is a Type B packaging certified by the NRC and designed to transport one RH-TRU waste canister either directly loaded with waste or overpacking three 55-gallon drums. It consists of a cylinder with inner and outer containment vessels protected by impact limiters at both ends. The inner vessel is made of stainless steel and provides an inner containment boundary and a cavity for the payload (3). The 72-B Cask should begin fabrication in December 2000. It is anticipated that the 72-B Cask will be ready for RH-TRU waste transportation to WIPP by January 2002.



Fig. 1. 72-B Cask and Trailer

Battelle Columbus Laboratories (BCL), located in Columbus, Ohio, must complete decontamination and decommissioning (D&D) activities for nuclear research buildings and grounds by 2005, pursuant to the U.S. Department of Energy (DOE)-Ohio Strategic Plan. Most of the resulting TRU waste (approximately 25 m<sup>3</sup>) is projected to be RH-TRU waste destined for shipment to and disposal at the WIPP. The RH-TRU must be removed from the BCL West Jefferson site prior to the end of 2002 to ensure compliance with the DOE-Ohio Strategic Plan. Battelle Columbus Laboratories is currently developing a waste certification program for RH-TRU waste to meet the requirements for the baseline option of using the 72-B Cask for waste transportation. As a contingency plan, and to expedite RH-TRU waste shipments off-site by the end of 2002, BCL is investigating alternative transportation options. These options include using the model CNS 10-160B, a commercial shipping cask designed and fabricated by Chem-Nuclear Systems, LLC. GTS Duratek acquired Chem-Nuclear in June 2000.

This paper presents a case study of the potential use of the CNS 10-160B Cask for shipment of RH-TRU waste from BCL.

## **CASE STUDY – BCL RH-TRU WASTE SHIPMENT IN THE CNS 10-160B CASK**

### **Background**

Battelle Memorial Institute (BMI) entered into a contract with the Manhattan Engineering District in 1943. The purpose of this contract was to support atomic energy research and development activities in the United States. As a result of BMI's activities over the past 57 years, several buildings are contaminated with varying amounts of radioactive materials. The oldest and most contaminated buildings are located at the BCL West Jefferson site and include Building JN-1, a Hot Cell Laboratory formerly used for metallurgical operations in support of nuclear research projects. When the Hot Cell Laboratory operations officially ceased in 1987, the laboratory housed four large hot cells and ten smaller alpha-gamma hot cells. The BCLDP uses these hot cells to remotely process and package materials contaminated during historical research activities performed in the Hot Cell Laboratory. These contaminated materials include defense-related TRU waste packaged for ultimate disposal at WIPP.

D&D activities for the buildings and grounds at the West Jefferson site began in 1989. As a result of these activities, approximately 25 m<sup>3</sup> of TRU waste will be generated and is planned for shipment and disposal at the WIPP site. The majority of this waste is projected to be RH-TRU waste and must be removed before the end of 2002 to ensure compliance with the DOE-Ohio Strategic Plan.

### **Waste Generation and Packaging**

BCLDP RH-TRU waste is packaged to meet anticipated WIPP certification requirements, pending NMED approval of the Class III permit modification addressing RH-TRU waste characterization. The BCLDP maintains detailed records of the waste generation and packaging processes, including audio and video records. RH-TRU waste is directly loaded into steel or polypropylene liners in the High Energy Cell (HEC). To date, approximately 30 liners have been packaged in the HEC, with complete data records, including audio and video. The first RH-TRU waste liner was removed from the HEC in June 2000 and packaged into a 55-gallon drum for eventual shipment to and disposal at the WIPP.

### **CNS 10-160B Cask**

The CNS 10-160B Cask (Figure 2) was originally intended for use by the utility market as a low-level waste transportation cask in response to changing transportation regulations for greater than Type A quantities.

The cask is certified by the NRC as a Type B shipping cask. It has a single containment vessel, and is authorized for a Type B quantity of radioactive material not to exceed 2,000 times a Type A quantity. The total weight of contents, shoring, secondary containers, and optional shield insert must not exceed 14,500 pounds (4). Fissile material is authorized for transportation, provided the mass limits of 10 CFR 71.53 are not exceeded and the plutonium content does not exceed 20 curies.



Fig. 2. CNS 10-160B Cask and Trailer

Transportation parameters for both the 72-B and the CNS 10-160B Casks are provided for comparison in Table I. These parameters are found in the respective Certificates of Compliance (C of C) (4, 5) and are discussed in detail in the “Safety Analysis Report for the 72-B Cask Shipping Package” (3) and the “Safety Analysis Report for the Chem-Nuclear Systems Model CNS 10-160B Type B Radwaste Shipping Cask” (6), respectively.

Table I. Comparison of Transportation Parameters for the 72-B and CNS 10-160B Casks

Parameter	72-B Cask	CNS 10-160B Cask
Payload	1 RH canister (may overpack three 55-gallon drums)	Ten 55-gallon drums
Maximum Total Weight of Contents	8,000 lb	14,500 lb
Maximum Gross Weight (packaging and contents)	45,000 lb	72,000 lb <sup>a</sup>

Table I (continued)

Parameter	72-B Cask	CNS 10-160B Cask
Gas Generation Requirements	Hydrogen concentration limited to 5 percent (%) by volume in any layer of confinement during the maximum 60-day shipping period	Hydrogen concentration limited to 5% by volume in any layer of confinement during the maximum 60-day shipping period
Fissile Gram Equivalent Limits	$\leq 325$ grams Pu-239 Fissile Gram Equivalents	Contents may include fissile material provided the mass limits of 10 CFR 71.53 are not exceeded
Activity Limit	Limiting quantity, referred to as "curie (Ci) limit," is established such that the dose rates are at the hypothetical accident conditions limit (as specified in 10 CFR 71.51 to be 1 rem per hour at 1 meter) <sup>b</sup>	Type B quantity of radioactive material not to exceed 2,000 times Type A quantity
Total Pressure	Maximum design internal pressure of 150 pounds per square inch gauge (psig)	Package design limit of 31.2 psig
Cask Decay Heat Limits	50 watts (W)	100 W
Pu Limits	None	20 Ci
Flammable Volatile Organic Compounds	500 parts per million (ppm)	500 ppm <sup>c</sup>

- An overweight permit is required to transport the CNS 10-160B Cask.
- Curie limits for radionuclides provided in Table 12-1 of Appendix 1.3.7 of the "Safety Analysis Report for the 72-B Cask Shipping Package" (3).
- Recommended as part of the most recent submission of the "Safety Analysis Report for the Chem-Nuclear Systems Model CNS 10-160B Type B Radwaste Shipping Cask" (6) (awaiting final NRC approval).

The CNS 10-160B Cask is constructed of two carbon-steel concentric shells welded to a carbon-steel bottom plate. Lead is poured into the cavity between the steel shells forming a 1.825-inch lead shield. A 12-gauge stainless steel thermal shield surrounds the casks' outer shell. The cask is transported in the upright position and is equipped with two steel-encased, rigid polyurethane-foam impact limiters fitting over the top and bottom of the cask. Eight ratchet binders secure the impact limiters to each other. Four additional ratchet binders secure the cask to the transportation trailer. Two 5-drum pallets specifically designed for BCL can be stacked in the cask. Each pallet has five pick points that can be attached to lifting slings for low-level waste shipments or to a solid remote lifting mechanism for RH-TRU waste shipments. The 55-gallon drums associated with RH-TRU waste shipments are fitted with drum slings before being packaged with waste. These drum slings allow a crane to lift the drums remotely and load them onto into the pallets for insertion in the cask.

## **Certificate of Compliance Status**

The CNS 10-160B Cask is not yet licensed to transport BCLDP RH-TRU waste. An application to amend the C of C (4) to include BCLDP RH-TRU waste as an authorized payload was submitted to the NRC for review in May 2000. GTS Duratek is currently responding to NRC questions received in September 2000, and NRC approval is anticipated in December 2000. Upon issuance of the revised CNS 10-160B Cask C of C, additional amendments are planned to include RH-TRU waste from other sites as authorized payloads, with NRC approval.

## **TRANSPORTATION STRATEGY**

To comply with the DOE-Ohio Strategic Plan for the removal of all RH-TRU waste from the BCL West Jefferson site before the end of 2002, the BCLDP has initiated a transportation strategy to expedite RH-TRU waste shipments off-site to interim storage and then to WIPP for disposal. This strategy includes transportation of the waste from BCL to

- Hanford for interim storage, using the model CNS 10-160B Cask, and
- WIPP for disposal, using either the 72-B Cask or the CNS 10-160B Cask.

The BCLDP plans to characterize and package all the RH-TRU waste once. This waste-packaging effort will require collecting sufficient data to meet the transportation criteria and WAC for both Hanford and the WIPP site. This effort also will include audio and video records to provide any additional data that may be required as a result of the Class III permit modification addressing RH-TRU waste. These audio and video records also may serve as verification data, should they be required.

## **Hanford Interim Storage Proposal**

The BCLDP has proposed transporting RH-TRU waste containers in the CNS 10-160B Cask to Hanford for interim storage to expedite off-site waste shipments. The BCLDP is currently certified as a generator/shipper of low-level waste to Hanford for disposal and is seeking certification as a generator/shipper of RH-TRU waste to Hanford for interim storage. Waste profile sheets for the RH-TRU waste streams to be generated and shipped by the BCLDP were submitted to Hanford for review in October 2000. A West Jefferson site inspection is expected in early February 2001, and Hanford approval is anticipated in late March 2001.

The Hanford site has a shielded storage area and a high bay with equipment capable of unloading/loading the CNS 10-160B Cask. The BCLDP plans to develop an implementing procedure, in cooperation with Hanford and GTS Duratek, to unload/load the CNS 10-160B Cask and will facilitate a dry-run demonstration of that procedure in March 2001. The first shipment of RH-TRU waste from the BCL West Jefferson site to Hanford for interim storage is scheduled for April 2001.

## **WIPP Disposal**

The RH-TRU waste-handling facility at the WIPP site is currently scheduled to begin receiving RH-TRU waste shipments in January 2002. The BCLDP plans to begin shipping from the BCL West Jefferson site directly to the WIPP using the CNS 10-160B Cask and from interim storage at the Hanford site using the 72-B Cask (if available) and/or the CNS 10-160B Cask in early 2002 (if the permit modification is approved).

Discussing the potential use of the CNS 10-160B Cask identified several possible impacts to the existing RH-TRU waste-handling facility and raised "as low as is reasonably achievable" (ALARA) concerns regarding unloading the cask in the RH Bay. Several process descriptions were developed for methods to unload the cask in a shielded environment and remove the 55-gallon drums from the pallets for packaging into WIPP disposal canisters. These methods were required to meet WIPP facility standards for worker exposure to radiation and to have a limited impact on expected operations in the RH Bay for unloading the 72-B Cask. The BCLDP facilitated a demonstration at the WIPP site in September 2000 to test the preferred alternative.

## **OPERATIONAL DEMONSTRATIONS**

The CNS 10-160B Cask was leased by the BCLDP in August and September 2000 to demonstrate its potential as an RH-TRU waste transportation cask. The BCLDP, in cooperation with WIPP, conducted a mock demonstration of an RH-TRU waste shipment in September 2000. Waste-handling activities at the BCL site were simulated using available equipment and approved procedures to load the CNS 10-160B Cask and prepare it for transport to the WIPP. The cask was then transported by truck along a DOE-approved shipping route to the WIPP, where WIPP personnel simulated unloading the cask. The following sections describe the mock demonstrations that have been or will be conducted with the CNS 10-160B Cask by the BCLDP and WIPP.

### **West Jefferson Site, Columbus, Ohio**

A mock demonstration of the CNS 10-160B Cask was conducted at the West Jefferson site High Bay (JN-1) on September 13 and 14, 2000, in Columbus, Ohio. The objective was to successfully load the CNS 10-160B Cask using remote equipment. The demonstration was conducted by BCLDP and GTS Duratek personnel according to the "Handling Procedure for Chem-Nuclear Systems (CNS) Transport Cask CNS 10-160B, Certificate of Compliance Number 9204"<sup>(7)</sup> and under the supervision of a GTS cask supervisor. The BCLDP cask demonstration included:

- Removing the top impact limiter and cask lid.
- Loading a drum pallet with five 55-gallon drums.
- Loading both pallets into the cask.
- Closing the cask lid.
- Replacing of the top impact limiter.

The demonstration successfully showed that the cask and pallets could be loaded using remote-handling equipment. Figure 3 shows the cask being loaded with one of two drum pallets in the JN-1 High Bay.



Fig. 3. JN-1 High Bay – Pallet Lowered Into CNS 10-160B Cask

### **Waste Isolation Pilot Plant, Carlsbad, New Mexico**

A mock demonstration also was conducted at the WIPP site (RH Bay) on September 26 and 27, 2000, in Carlsbad, New Mexico. The objectives included:

- Using existing equipment and facilities at the WIPP RH Bay to unload the cask.
- Removing the CNS 10-160B Cask from the transportation trailer.
- Demonstrating of the Hot Cell in the RH Bay as the preferred alternative for cask unloading and overpacking of three 55-gallon drums in a WIPP disposal canister hereinafter referred to as canisterization.

The demonstration was conducted by Westinghouse RH-TRU waste handlers, also according to the “Handling Procedure for Chem-Nuclear Systems (CNS) Transport Cask CNS 10-160B, Certificate of Compliance Number 9204” (7) and under the supervision of a GTS cask supervisor. The demonstration included:

- Removing the top impact limiter.
- Removing the cask from the trailer to the Road Cask Transfer Car (RCTC).

- Unbolting the cask lid.
- Transferring the loaded RCTC into the Cask Unloading Room (CUR).
- Transferring the cask lid through the roof of the CUR and into the Hot Cell.
- Removing the drum pallets from the cask and transferring them through the roof of the CUR and into the Hot Cell.

The demonstration successfully met its objectives, including showing that the RH Bay Hot Cell is a viable option for unloading and canisterizing 55-gallon drums transported in the cask. Figure 4 shows a drum pallet successfully being lifted into the RH Bay Hot Cell.



Fig. 4. Drum Pallet Lifted into the RH Bay Hot Cell

## CONCLUSIONS

The CNS 10-160B Cask will supplement RH-TRU waste shipments to the WIPP using the 72-B Cask. The CNS 10-160B Cask is operationally simple, uses available standard high bay equipment, and increases RH-TRU waste shipment capacity from three 55-gallon drums (in the 72-B Cask) to ten (in the CNS 10-160B Cask). Successful completion of the WIPP demonstration shows that the CNS 10-160B Cask is a viable option for RH-TRU waste transportation to the WIPP. The Hot Cell at the WIPP site is capable of providing a shielded environment in which 55-gallon drums of RH-TRU waste may be unloaded from the pallets and canisterized. Once canisterized, the waste shipments from the BCLDP can be managed by the same remote-handling system that will be used to unload the canisters transported in the 72-B Cask. This unloading option yields minimal impact to the existing RH-TRU waste-handling

operation for the 72-B Cask and provides adequate shielding to minimize radiological exposure to RH-TRU waste-handling personnel.

The BCLDP continues to work with WIPP RH-TRU waste-handling personnel to determine any potential impacts to the facility that may result from using the CNS 10-160B Cask. This work includes developing process descriptions that continue to emphasize minimal impact to the existing facility and equipment.

## **FUTURE ACTIVITIES**

The BCLDP plans to conduct an operational readiness review demonstration at the West Jefferson site before shipping RH-TRU waste in the CNS 10-160B Cask. This review, using procedures and equipment required for remote loading of waste containers into the cask, will likely be conducted in cooperation with similar reviews at the WIPP site and Hanford in March 2001. These demonstrations will be conducted under the supervision of a cask supervisor and will include using existing equipment and facilities at the respective sites to unload/load drum pallets from the CNS 10-160B Cask. Each demonstration will serve as a dry run of applicable implementation procedures and process descriptions to be developed in cooperation with the BCLDP, WIPP, and Hanford for unloading/loading the cask. Prior to shipment of RH-TRU waste to either the WIPP site or Hanford, a transportation plan including stakeholder notifications will be completed.

The BCLDP is actively seeking certification as a generator/shipper of RH-TRU waste to both the WIPP site and Hanford. BCLDP certification for RH-TRU waste disposal at the WIPP is dependent upon NMED approval of the Class III permit modification addressing RH-TRU waste. BCLDP certification for interim storage at the Hanford site is expected in March 2001. It is dependent upon a BCL West Jefferson site inspection by Hanford waste management personnel in early February 2001.

## **SUMMARY**

The BCLDP needs to complete off-site shipment of all RH-TRU waste by the end of 2002. The WIPP site and the baseline-shipping cask (i.e., the 72-B Cask) will not be available to begin transport RH-TRU waste until January 2002. As a contingency plan and to accelerate the shipping schedule for RH-TRU waste, the BCLDP examined the possibility of using a commercial transportation cask, the CNS 10-160B, to begin transporting RH-TRU waste from Battelle to Hanford for interim storage in 2001, and eventually to the WIPP site for disposal.

Two mock demonstrations of the CNS 10-160B Cask were successfully completed in September 2000 and provided sufficient evidence to indicate that the CNS 10-160B Cask is a viable option for RH-TRU waste shipments.

## **REFERENCES**

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