Remote-Handled Transuranic Waste Retrieval at Los Alamos National Laboratory

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ABSTRACT

Since the 1970s, transuranic (TRU) wastes generated by nuclear weapon programs and other operations at Los Alamos National Laboratory (LANL) have been stored at Technical Area 54 (TA-54), Material Disposal Area G (MDA-G) in anticipation of disposal at the Waste Isolation Pilot Plant (WIPP). LANL has a Legacy Waste Project whose goal is to dispose of all legacy mixed low-level (MLLW) and TRU wastes located at MDA-G by 2010 so that environmental corrective actions (closure) can be completed by 2015. One component of the legacy waste in interim storage at MDA-G consists of approximately 95 cubic meters of remote-handled (RH)-TRU waste placed in 60 shafts.

One of the storage configurations for this RH-TRU waste at MDA-G consists of 16 capped shafts that contain hot cell debris wastes in 55-gallon drums. Three 55-gallon drums were emplaced in welded and vented stainless steel canisters designed to be transported in the RH-72B cask. In anticipation of the New Mexico Environment Department’s (NMED’s) approval of the WIPP hazardous waste permit modification allowing RH TRU waste to be accepted at the WIPP, the Department of Energy (DOE) and LANL are preparing for the retrieval of the 16 canisters from the shafts at MDA-G for their transport to the WIPP.

This paper discusses the cooperative efforts of the DOE Carlsbad Field Office (CBFO), the DOE Los Alamos Site Office (LASO), LANL, and their subcontractors to obtain a determination of acceptable knowledge (AK) sufficiency for the waste, remove the caps and retrieve the canisters from the shafts, and load the canisters into RH-72B casks in preparation for shipment to the WIPP.

INTRODUCTION

LANL was established in the 1940’s to support the Manhattan Project and is located in northern New Mexico (NM), approximately 30 miles northwest of Santa Fe, NM. It encompasses 43 square miles, has 47 separate technical areas (TAs), and has more than 2,100 individual facilities [1]. One of the major missions of LANL is to support DOE defense programs, such as nonproliferation and nuclear safeguards,

counter-proliferation, stockpile surveillance, nuclear materials technologies, basic chemistry, environmental stewardship, and waste treatment, minimization, and management.

LANL generates CH and RH TRU waste as a result of various projects and activities. Three facilities have generated the majority of the TRU waste stored at LANL - the Plutonium Facility (PF) at TA-55, the former plutonium facility at TA-21, and the Chemistry and Metallurgy Research (CMR) facility at TA-3. The RH TRU debris waste has been generated primarily from the hot cells of Wing 9 of the CMR facility (TA-3, SM-29). It has been placed in interim storage in shafts located at Area G. This waste is considered retrievably stored TRU waste and will be retrieved for disposal at the WIPP.

Fig. 1 is an aerial view that illustrates the major features of Area G.

(Blue outlines currently active units; red outlines formerly used units; green outlines shaft fields; purple outlines trenches; and white structures are fabric domes.)

Fig. 1. Aerial view of Area G

BACKGROUND

The sixteen canister shafts, 236 through 243, and 246 through 253, are 0.9 meters in diameter and 4.9 meters deep at Area G. They contain hot cell debris waste that was placed in 210-liter drums. The drums were then placed in stainless steel canisters that fit into a WIPP RH 72B cask for transport to the WIPP. This debris waste was generated during the 1970’s and 1980’s by metallurgical examination operations conducted in the Wing 9 hot cells located in the CMR facility, TA-3, SM-29 [2]. These hot cells were cleaned out between January 1986 and June 1991, and the waste was placed in 210-liter drums between March 1993 and August 1995 [2].

The activities that generated this waste included post-irradiation examination of irradiated fuels from the Liquid Metals Fast Breeder Reactor Program and support of the ROVER Space Propulsion Program. In 1986, sample processing operations were initiated and decommissioning of the cells began. The wastes consisted of residues, hot cell decontamination waste, and discarded process equipment [2]. The waste was packaged in 5.7-liter cans and placed in 210-liter drums or larger items were directly packaged in 210-liter drums. Each of the 16 canisters contains three 210-liter drums. The canisters were transferred to Area G using shielded transfer casks. The canisters were placed in storage shafts between 1993 and 1995 and shielding lids placed on top of the shafts. These shielded transfer casks were not designed to meet current safety basis requirements. Therefore, major modifications and documentation would be required to use them.

In 1999 to 2000, the shielding lids of the shafts were removed to attach sample tubing to the filter vents on top of the canisters to collect headspace gas samples. The lids were then replaced. In 2000, headspace gas samples were obtained on ten of the sixteen canisters to determine their flammable gas generation rates to evaluate compliance with transportation requirements specified in the 72-B Safety Analysis Report for Packaging (SARP) [3]. In 1999, the headspace gas of each of the 10 selected canisters was sampled a minimum of six times over a 15-week period. In 2000, each of the canisters was sampled 3 times. Hydrogen was detected in all ten of the canisters with concentrations ranging from 0.01 to 2.3 volume percent. These results demonstrated that the calculated hydrogen generation rates were well below the 72-B SARP allowable hydrogen gas generation rate for these ten canisters.

In 2003, the Central Characterization Project (CCP) prepared five draft reports including an AK summary report [2], a RH TRU waste certification plan [4], a Quality Assurance (QA) equivalency demonstration [5], an equivalency matrix [6], and a radiological characterization report [7] for the 16 canisters. The AK summary report was prepared in accordance with the *RH TRU Waste Characterization Program Implementation Plan (WCPIP), Acceptable Knowledge Procedure for Remote-Handled TRU Waste* [8] as part of the DOE demonstration program for RH TRU waste and in anticipation of the New Mexico Environment Department’s approval of the permit modification allowing RH TRU waste to be disposed of at WIPP. The other four draft documents were prepared to meet the requirements of the WCPIP and the CBFO Quality Assurance Program Document (QAPD) [9].

DISCUSSION

Preparation for RH TRU Waste Retrieval at Area G

The permit modification and WAC updates must be finalized and approved before RH TRU waste can be shipped to the WIPP. In anticipation of these approvals, the process of canister retrieval, cask loading, and shipment to the WIPP involves several steps and the cooperation of CBFO, the WIPP, CCP, LASO, and LANL and their subcontractors.

The responsibilities of the WIPP include obtaining all approvals to accept the RH 72B casks and dispose of the RH TRU waste. At the time of the preparation of this paper (November 2005), the WIPP was working toward this end and anticipated full approval in FY06. In addition, an NMED procedure to determine AK sufficiency must be prepared and approved.

Planning activities begin with development of project objectives and a review of the available historical data. The *Project Management Objectives for Remote-Handled TRU Wastes Stored in Below-Grade Shafts, TA-54, MDA-G* [10], presents the physical description of the shafts and canisters, and the project objectives. The planning activities identify the data necessary to develop complete retrieval plans and to fill the gaps within the available data. Historical data includes physical, chemical, and radiological data and is documented in *Historical Emplacement Data Review for Remote-Handled and Contact-*

Handled Transuranic Waste at Los Alamos National Laboratory [11]. Decayed radiological data, radionuclide activity and dose rate, are included in this report. Radiological data are listed in Table I.

Table I. Radiological Data for 16 WIPP Canisters

Shaft Number	Package ID	Storage Date	Decayed Isotopic Distribution		Initial Contact Dose Rate (mRem/hr)	Decayed Contact Dose Rate (mRem/hr)
			Isotope	Activity (Ci)		
236	LA17	1994	Cs-137	2.76E+01	40,000	27,000
			Pu-239	1.81E+00		
			Sr-90	2.50E+01		
			U-235	2.66E-04		
237	LA15	1993	Cs-137	1.48E+02	120,000	78,000
			Pu-239	9.89E+00		
			Sr-90	1.33E+02		
			U-235	1.65E-06		
238	LA13	1993	Cs-137	2.20E+02	14,000	9,200
			Pu-239	1.48E+01		
			Sr-90	2.00E+02		
			U-235	1.72E-06		
239	LA11	1993	Cs-137	2.29E+02	32,000	21,000
			Pu-239	1.54E+01		
			Sr-90	2.08E+02		
			U-235	1.73E-06		
240	LA10	1993	Cs-137	2.17E+02	80,000	52,000
			Pu-239	1.45E+01		
			Sr-90	1.96E+02		
			U-235	1.72E-06		
241	LA07	1993	Cs-137	2.52E+02	260,000	170,000
			Pu-239	1.69E+01		
			Sr-90	2.28E+02		
			U-235	1.76E-06		
242	LA05	1993	Cs-137	6.26E-01	1,000	650
			Pu-239	4.20E-02		
			Sr-90	5.66E-01		
			U-235	6.16E-06		
243	LA03	1993	Cs-137	7.05E+00	1,500	980
			Pu-239	4.70E-01		
			Sr-90	6.34E+00		
			U-235	6.90E-05		
246	LA18	1994	Cs-137	1.12E+01	30,000	20,000
			Pu-239	7.28E-01		
			Sr-90	1.01E+01		
			U-235	1.07E-04		
247	LA16	1994	Cs-137	2.12E+01	80,000	54,000
			Pu-239	1.39E+00		
			Sr-90	1.92E+01		
			U-235	2.04E-04		
248	LA14	1993	Cs-137	1.98E+02	100,000	65,000

Shaft Number	Package ID	Storage Date	Decayed Isotopic Distribution		Initial Contact Dose Rate (mRem/hr)	Decayed Contact Dose Rate (mRem/hr)
			Isotope	Activity (Ci)		
			Pu-239	1.33E+01		
			Sr-90	1.80E+02		
			U-235	1.70E-06		
249	LA12	1993	Cs-137	2.20E+02	55,000	36,000
			Pu-239	1.48E+01		
			Sr-90	2.00E+02		
			U-235	1.72E-06		
250	LA09	1993	Cs-137	2.48E+02	150,000	98,000
			Pu-239	1.66E+01		
			Sr-90	2.24E+02		
			U-235	1.75E-06		
251	LA08	1993	Cs-137	2.51E+02	3,100	2,000
			Pu-239	1.68E+01		
			Sr-90	2.27E+02		
			U-235	1.76E-06		
252	LA06	1993	Cs-137	2.25E+00	5,000	3,300
			Pu-239	1.50E-01		
			Sr-90	2.03E+00		
			U-235	2.21E-05		
253	LA04	1993	Cs-137	3.45E-01	800	520
			Pu-239	2.31E-02		
			Sr-90	3.12E-01		
			U-235	3.40E-06		

A plan will be developed to obtain additional information and data for a complete historical data package for safe retrieval operations, including gross visual, chemical, and radiological inspection of the shaft contents. Because the WIPP canisters are located in a portion of Area G classified as a category 2 nuclear facility, a safety analysis for the field characterization procedures will be required.

Field Characterization

Characterization activities of the external surface of the canisters and the surrounding shaft are required before actual retrieval operations begin. These include visual inspection and radiological characterization. Visual inspection activities include:

- Visual inspection of the canister identification and tracking labeling information
- 360 degree visual inspection of the Pintle lifting device attached to the top of the waste canister.
- 360 degree visual inspection of the welded connection between the dished head and the top of the waste canister shell
- 360 degree visual inspection of the annulus clearance between the canister and the storage vault for the entire length of the canister
- Visual inspection along the entire length of the canister of the vertical seam weld(s)
- 360 degree inspection of the bottom of the canister.

Radiological characterization includes:

- Obtain swipe and contact dose rate of the area around the Pintle lift device attached to the top of the waste canister
- Obtain swipe and contact dose rate circumferentially at 90 degree intervals of the top of the waste canister at approximately midpoint between centerline (vertical) and the exterior perimeter.
- Obtain swipe and contact dose rate circumferentially at 90 degree intervals at an elevation of 0.31 meters below the top of the waste canister
- Obtain swipe and contact dose rate circumferentially at 90 degree intervals at 0.46 meters on center below the above for the balance of the length of the waste canister
- Obtain swipe and contact dose circumferentially at 90 degree intervals of the bottom of the waste container at an approximate midpoint location between the exterior perimeter and centerline (vertical).

A site-specific Health and Safety Plan (SSHASP), a sampling and analysis plan (SAP), integrated work documents (IWDs), and design and fabrication documents will be prepared and approved by LANL and DOE to support the above activities. Procurement records, welding specifications, and lifting pin design, and construction documents are required to document that the canisters meet the RH 72B cask fabrication requirements. LANL will validate the lifting pin strength, the lifting clamp, the welds, and maximum weights by conducting a performance test on one loaded, cold, surrogate canister.

Retrieval Operations and Loading of the RH 72B Cask

After field characterization activities are complete, the new data will be reviewed and used to modify the initial retrieval project requirements, plans, and procedures. A complete approach to retrieval will be developed. Special consideration will be given to the safety aspects of lifting and manipulation of the canisters, as necessary, to meet all safety analysis and health and safety requirements. After DOE approvals have been obtained, final planning activities will be executed, including obtaining all required permits and final authorizations.

After all preparations and approvals have been completed, retrieval activities will begin with mobilization and site preparation. The area containing the WIPP canisters will be isolated from other Area G activities to maintain project access control. Site support, such as setting up office trailers, training personnel, mobilizing specialized equipment and supplies, will be completed and final preparations will be made for an operational readiness review.

The caps on each storage shaft will be removed, the canisters drawn up using specialized retrieval equipment, and the canisters placed into RH-72B casks for shipment to the WIPP. Three options will be evaluated: 1.) an elevated vertical lift, and 2.) a ground level vertical lift, and 3.) a vertical lift with free air transfer.

For the elevated vertical lift scenario, the 72B cask is removed from the trailer and placed in a vertical storage stand and the inner and outer vessel lids removed. The waste canister shaft is opened and an overhead/mobile crane positions the bottom loading cask over the canister storage shaft. The bottom valve of the loading cask is opened and the cask lowered to the final operation position. The waste canister is hoisted into the bottom loading cask and the bottom valve closed.
Then, the crane inserts the bottom loading cask into the 72B cask. The lift height is approximately 4.6 meters above the ground. When the bottom loading cask is positioned above the 72B cask, the bottom valve is opened and the waste canister is lowered in to the 72B cask. The cask lids are installed, leak tests performed, and then the entire unit is loaded back onto the trailer.

For the ground level vertical lift scenario, a borehole is drilled and the 72B cask is lowered into the ground. The canister is loaded using the bottom loading cask.

For the final scenario, a free air transfer vertical lift, a crane lifts the canister from the shaft and inserts it into a 72B cask that has been positioned in the vertical cask stand. It does not use the bottom loading cask for retrieval.

CONCLUSIONS

Based on the November 2006 announcement that the NMED intends to approve the permit modification to allow RH TRU waste to be disposed at the WIPP, LANL, CCP, and DOE are preparing to retrieve16 canisters containing RH TRU wastes from interim storage in shafts at LANL’s Area G. The draft AK summary report for this waste has been prepared and will be finalized. The CCP RH TRU waste certification plan has been written. The CCP certification program will be audited and certified to characterize, certify, and transport RH TRU waste to the WIPP. LANL and CCP are cooperating to prepare, obtain approval of, and execute the retrieval plan to safely and compliantly place the canisters into RH 72B casks.

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