Remote Handled Wipp Canisters at Los Alamos National Laboratory Characterized for Retrieval

J. Griffin
Shaw Environmental, Inc.
335 Central Park Square, Los Alamos, NM 87544, USA

W. Gonzales
Los Alamos National Laboratory
P.O. Box 1663, Los Alamos, NM 97544, USA

ABSTRACT

The Los Alamos National Laboratory (LANL) is pursuing retrieval, transportation, and disposal of 16 remote handled transuranic waste canisters stored below ground in shafts since 1994. These canisters were retrievably stored in the shafts to await Nuclear Regulatory Commission certification of the Model Number RH-TRU 72B transportation cask and authorization of the Waste Isolation Pilot Plant (WIPP) to accept the canisters for disposal. Retrieval planning included radiological characterization and visual inspection of the canisters to confirm historical records, verify container integrity, determine proper personnel protection for the retrieval operations, provide radiological dose and exposure rate data for retrieval operations, and to provide exterior radiological contamination data.

The radiological characterization and visual inspection of the canisters was performed in May 2006. The effort required the development of remote techniques and equipment due to the potential for personnel exposure to radiological doses approaching 300 R/hr. Innovations included the use of two nested 1.5 meter (m) (5-feet [ft]) long concrete culvert pipes (1.1-m [42 inch (in.)] and 1.5-m [60-in] diameter, respectively) as radiological shielding and collapsible electrostatic dusting wands to collect radiological swipe samples from the annular space between the canister and shaft wall. Visual inspection indicated that the canisters are in good condition with little or no rust, the welded seams are intact, and ten of the canisters include hydrogen gas sampling equipment on the pintle that will have to be removed prior to retrieval. The visual inspection also provided six canister identification numbers that matched historical storage records. The exterior radiological data indicated alpha and beta contamination below LANL release criteria and radiological dose and exposure rates lower than expected based upon historical data and modeling of the canister contents.

INTRODUCTION

The Legacy Transuranic (TRU) Waste Disposition Program at Los Alamos National Laboratory (LANL) is pursuing retrieval, transportation, and disposal of the 16 remote handled (RH) TRU waste canisters currently stored in Shafts 236-243 and 246-253 at Technical Area (TA) 54, Area G. The canisters were retrievably stored in the shafts between 1993 and 1994 to await Nuclear Regulatory Commission certification of the Model Number RH-TRU 72B transportation cask and authorization of the Waste Isolation Pilot Plant (WIPP) to accept the canisters for disposal. The purpose of this paper is to describe the characterization and inspection of the 16 RH-TRU canisters while stored in Shaft 236-243 and 246-253 performed in May 2006. The canisters were characterized and inspected to confirm historical records, verify container integrity, determine proper personnel protection for the retrieval operations, provide radiological dose and exposure rate data for retrieval operations, and to provide exterior radiological contamination data to meet LANL release criteria for transportation to the WIPP. This paper describes the characterization and inspection activities and key observations; and summarizes the data collected.

BACKGROUND

The 16 RH-TRU waste canisters are retrievably stored below ground in shafts located at the LANL waste treatment, storage, and disposal facility TA-54, Area G. The shaft field consists of 20 shafts in two horizontal rows oriented northwest to southeast. The shafts are approximately 1.8-m (6-ft) apart (from center) and are surrounded by a concrete pad. Each shaft is approximately 5-m (16.3-ft) deep, has a 0.91-m (3-ft) diameter, is lined with a corrugated metal pipe, and is filled with gravel at the bottom to promote drainage (Figure 1). The shafts are sealed with 0.41-m (16-in.) thick, 0.97-m (38-in.) diameter concrete plugs that are fitted with a lifting ring.

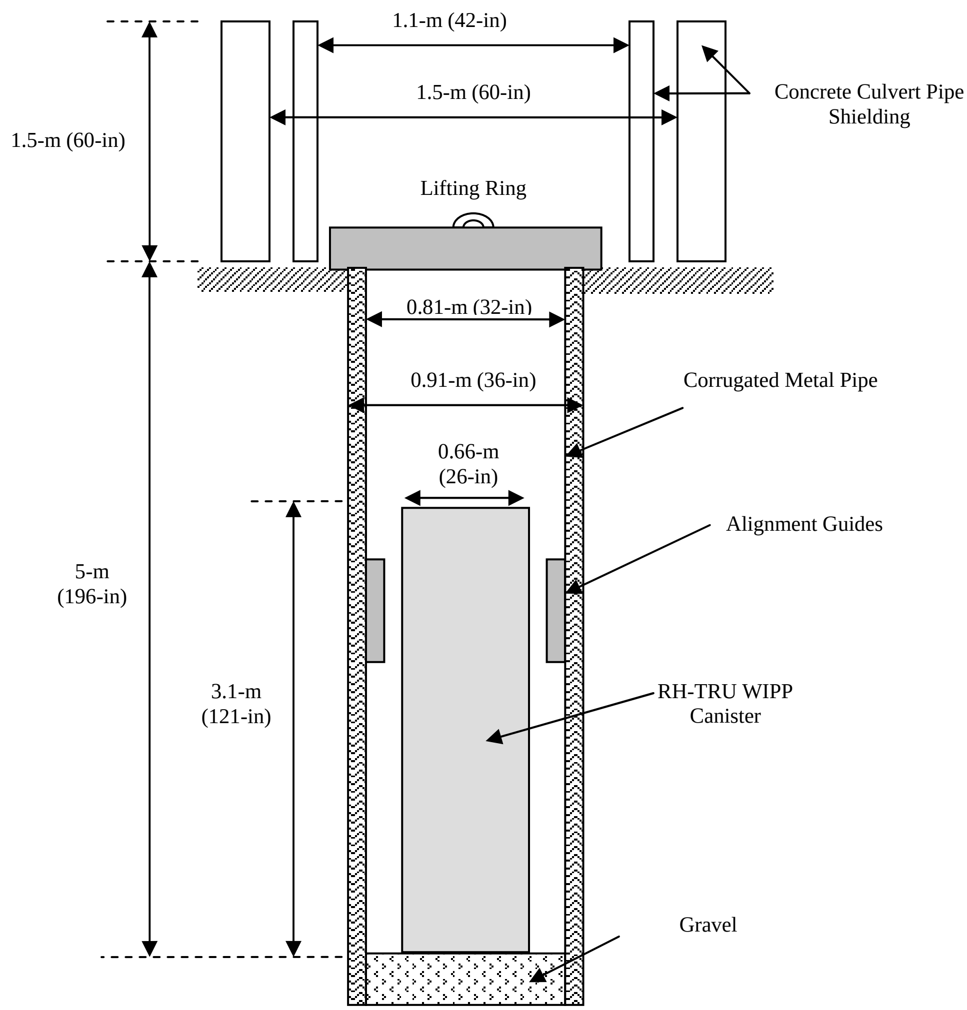

Figure 1. Shaft dimensions and shielding configuration for characterization

The shafts were designed to store the canisters pending transportation and disposal at the WIPP. The waste in the canisters was generated between 1970 and 1989 and consists predominately of rags, plastic, glassware, tools, and equipment with some solidified radioactive solutions. These materials were packaged into 208-Liter (L) (55-gallon) drums in the mid 1980's and early 1990's at the TA-3-29, Wing 9 hot cells. Each canister contains three of these 208-L (55-gallon) drums. In 1993 and 1994, the canisters were retrievably stored in the shafts to await Nuclear Regulatory Commission certification of the Model Number RH-TRU 72B transportation cask and authorization of the WIPP to accept the canisters for disposal. The canisters are 3.1-m (121-in.) long, 0.66-m (26-in.) diameter cylinders topped with a pintle lifting device. The canisters are constructed of ASTM A 156-82 grade 70 mild steel that is 0.64 centimeters (0.25-in.) thick. Each canister has a seam weld along the vertical length of the cylinder and two circumferential welds on each end.

Baseline Radiological Data

The baseline radiological data for each canister was obtained by reviewing historical records and the data reported in Appendix C-4 of *Historical Emplacement Data Review for Remote-Handled and Contact-Handled Transuranic Waste at Los Alamos National Laboratory* [1]. Table I summarizes the data and identified dose readings based upon the isotopic distribution for the waste materials packaged into each canister.

Table I. Historical Radiological Dose Data for Remote Handled Waste Storage Canisters at Los Alamos National Laboratory

Shaft	Canister	Canister Generation Date	Packaged Contact Dose Rate [a]		Decayed Contact Dose Rate [a]	
			mrem/hr	Sv/hr	mrem/hr	Sv/hr
236	LA17	1994	4.00E+04	4.00E-01	2.70E+04	2.70E-01
237	LA15	1993	1.20E+05	1.20E+00	7.80E+04	7.80E-01
238	LA13	1993	1.40E+04	1.40E-01	9.20E+03	9.20E-02
239	LA11	1993	3.20E+04	3.20E-01	2.10E+04	2.10E-01
240	LA10	1993	8.00E+04	8.00E-01	5.20E+04	5.20E-01
241	LA07	1993	2.60E+05	2.60E+00	1.70E+05	1.70E+00
242	LA05	1993	1.00E+03	1.00E-02	6.50E+02	6.50E-03
243	LA03	1993	1.50E+03	1.50E-02	9.80E+02	9.80E-03
246	LA18	1994	3.00E+04	3.00E-01	2.00E+04	2.00E-01
247	LA16	1994	8.00E+04	8.00E-01	5.40E+04	5.40E-01
248	LA14	1993	1.00E+05	1.00E+00	6.50E+04	6.50E-01
249	LA12	1993	5.50E+04	5.50E-01	3.60E+04	3.60E-01
250	LA09	1993	1.50E+05	1.50E+00	9.80E+04	9.80E-01
251	LA08	1993	3.10E+03	3.10E-02	2.00E+03	2.00E-02
252	LA06	1993	5.00E+03	5.00E-02	3.30E+03	3.30E-02
253	LA04	1993	8.00E+02	8.00E-03	5.20E+02	5.20E-03

a. Appendix C-4 of *Historical Emplacement Data Review for Remote-Handled and Contact-Handled Transuranic Waste at Los Alamos National Laboratory* [1].

Background radiological doses at the shaft plugs and nearby buildings (i.e., TA-54-412, Dome 226, Dome 48, Dome 231, and Dome 375) were verified by LANL radiological control personnel on April 10, 2006. Radiological dose readings at all locations were at or below 2.0E-06 Sieverts (Sv) (0.2 millirem per hour [mrem/hr]). This baseline data was used to determine the health and safety requirements for characterization effort performed in May 2006.

Previous Characterization Activities

Ten of the canisters stored in Shafts 236-243 and 246-253 were headspace gas sampled during fiscal year 2000 to determine the flammable gas generation and decay heat. This effort evaluated compliance with the transportation requirements specified in the Model Number RH-TRU 72B transportation cask Safety Analysis Report (SAR). The results of this sampling effort are discussed in *Headspace Gas Sampling of Remote-Handled Transuranic Waste Containers at Los Alamos National Laboratory Fiscal Year 2000 Year-End Status Report* [2] and showed a maximum measured hydrogen concentration of 2.3 percent.

CHARACTERIZATION APPROACH

The characterization approach for the RH-TRU Canisters in Shafts 236-243 and 246-253 included review of historical data, collection of subsurface air monitoring data, dose measurements, exposure rate measurements, remote collection of radiological swipe samples, and remote video inspection..

A review of the baseline radiological data and the anticipated doses (Table I) indicated that remote techniques and shielding be utilized to minimize radiation exposure to personnel in accordance with the "as low as reasonably achievable" (ALARA) policy at LANL [3]. To assess this further, health physics personnel performed modeling of the exposure rate in and around each shaft using isotopic gamma spectroscopy data for the canister contents. The exposure rates were conservatively calculated and are summarized in Table II.

Table II. Calculated Dose for Shafts 236-243 and 246-253

Shaft	Canister	Calculated Exposure Rate At Top of Shaft (mR/hr)	Calculated Exposure Rate At 5-ft Above Top of Shaft (mR/hr)
236	LA17	476	187
237	LA15	1,180	417
238	LA13	1,780	630
239	LA11	1,840	653
240	LA10	1,620	571
241	LA07	1,570	551
242	LA05	5.1	1.8
243	LA03	73.1	26.6
246	LA18	153	58.0
247	LA16	306	117
248	LA14	1,610	573
249	LA12	1,910	681
250	LA09	1,880	663
251	LA08	1,900	669
252	LA06	84.0	29.6
253	LA04	2.6	0.91

Several configurations of shielding for personnel were considered including various forms of concrete, metal, and lead. The most versatile configuration consisted of two 1.5-m (5-ft) long sections of concrete pipe (1.1-m [42-in.] and 1.5-m [60-in.] diameter) nested together and set over the shaft opening as shown in Figure 1.The exposure rates actually observed during the characterization and inspection were low enough to reduce the shielding to only one section of concrete pipe for the last five shafts.

A cold demonstration and equipment mock up of the characterization field activities was planned and performed May 1-May 3, 2006 to ensure that proposed work could be executed efficiently and effectively to minimize radiation exposure as required by ALARA [3]. The demonstration was performed using an empty adjacent storage shaft and a canister packaged with non-radiological materials. It included placement of the concrete shielding, removal of the shaft plug, and extensive testing of various characterization sampling and inspection equipment.

HEALTH AND SAFETY CHARACTERIZATION DATA

Surface Dose

Dose readings were recorded at the surface of the shielding, top of the shielding, shaft surface, and the top of the canister (Figure 1) to characterize the potential streaming field and dose associated with each canister while located in the storage shaft. This data was collected primarily to ensure radiation protection for characterization and retrieval personnel when the shaft plug is not in place. Table III provides a summary of the surface dose reading results.

Table III. Dose Readings Adjacent to Shielding, Above Shielding, Shaft Top, and Canister Top

Shaft	Adjacent to Shielding		Above Shielding		Shaft Top		Canister Top	
	(mrem/hr)	(Sv/hr)	(mrem/hr)	(Sv/hr)	(mrem/hr)	(Sv/hr)	(mrem/hr)	(Sv/hr)
236	2.00E-01	2.00E-06	3.00E+00	3.00E-05	5.00E+00	5.00E-05	2.50E+01	2.50E-04
237	2.00E-01	2.00E-06	3.00E+00	3.00E-05	7.00E+00	7.00E-05	2.50E+01	2.50E-04
238	2.00E-01	2.00E-06	1.50E+01	1.50E-04	3.00E+01	3.00E-04	-	-
239	3.00E-01	3.00E-06	1.50E+01	1.50E-04	9.00E+01	9.00E-04	1.70E+02	1.70E-03
240	2.00E-01	2.00E-06	3.00E+01	3.00E-04	1.00E+02	1.00E-03	1.50E+02	1.50E-03
241	7.00E-01	7.00E-06	5.00E+01	5.00E-04	1.50E+02	1.50E-03	7.00E+02	7.00E-03
242	5.00E-01	5.00E-06	1.00E-01	1.00E-06	3.00E-01	3.00E-06	5.00E-01	5.00E-06
243	2.00E-01	2.00E-06	1.00E+00	1.00E-05	-	-	-	-
246	4.00E-01	4.00E-06	5.00E-01	5.00E-06	-	-	-	-
247	2.00E-01	2.00E-06	-	-	1.00E+01	1.00E-04	-	-
248	2.00E-01	2.00E-06	7.00E-01	7.00E-06	2.00E+01	2.00E-04	1.50E+02	1.50E-03
249	2.00E-01	2.00E-06	1.50E+01	1.50E-04	3.50E+01	3.50E-04	5.00E+01	5.00E-04
250	5.00E-01	5.00E-06	1.00E+01	1.00E-04	6.00E+01	6.00E-04	9.00E+01	9.00E-04
251	2.00E-01	2.00E-06	5.00E+01	5.00E-04	1.70E+02	1.70E-03	3.00E+02	3.00E-03
252	2.00E-01	2.00E-06	3.00E+00	3.00E-05	4.00E+00	4.00E-05	-	-
253	2.00E-01	2.00E-06	2.00E-01	2.00E-06	-	-	1.00E+02	1.00E-03

The dose readings outside the shielding (i.e., adjacent to shielding, above shielding) ranged from 1.00E-06– 5.0E-04 Sv/hr (0.1 - 50 mrem/hr) and never exceeded the action level of 8.0e-04 Sv/hr (80 mrem/hr) set by health physics personnel. The maximum dose reading for the shaft surface (inside the shielding) was 1.7E-03 Sv/hr (170 mrem/hr) at Shaft 251. The maximum dose reading for a canister top was 7.0E-03 Sv/hr (700 mrem/hr) at Shaft 241.

Subsurface Air Monitoring

Subsurface air monitoring was performed to determine the lower explosive limit (LEL), and concentrations of volatile organic compounds (VOC), oxygen (O_2), hydrogen sulfide (H_2S), and carbon monoxide (CO) gases, and tritium was performed at each shaft to ensure the health and safety of characterization and retrieval personnel working in and around the open shaft.

A Multi-RAE Plus gas monitor was used to monitor LEL, VOC, O_2, H_2S, and CO. This monitor is designed to provide continuous exposure monitoring of toxic organic and inorganic gases, O_2, and combustible gases. The Multi-RAE Plus gas monitor was calibrated each day using a 4-gas calibration mix (50% LEL methane, 20.9% O_2, and 25 parts per million [ppm] H_2S, 50 ppm CO in a single gas cylinder), and isobutylene span gas (100 ppm) for calibration of the photo ionization detector (PID). The Multi-RAE Plus gas meter was configured with a high efficiency particulate air filter and approximately 3.1-m (10-ft) of poly tubing. The end of the poly tubing was lowered into the shaft opening for approximately 3 minutes. The subsurface air monitoring results are presented in Table IV.

Table IV. Summary of Subsurface Air Monitoring Results

Shaft	PID (ppm)	O_2 (%)	CO (ppm)
236	0.1	20.9	0
237	0.3	20.9	100
238	1.2	20.9	0
239	0.1	20.9	1
240	0.5	20.9	1
241	0.1	20	3
242	0	20.9	0
243	0.4	20.9	2
246	0.3	24.1	0
247	0	20.9	2
248	0	20.9	12
249	0.4	20.9	42
250	0.2	20.9	2
251	0	20.9	1
252	0.1	20.9	7
253	0	20.9	3

Detectable concentrations of VOCs were observed in 12 of the shafts and ranged from 0.1-1.2 ppm. The action level for unknown VOCs is equal to the background concentration detected within the breathing zone [4]. Background VOC levels were collected within the breathing zone for comparison. Carbon monoxide was detected in 10 of the shafts at concentrations from 1.0-100 ppm. The action level for CO detected within the breathing zone must be less than 25 ppm [4]. Shafts 237 and 249 exceeded the action level for CO at 100 and 42 ppm, respectively. No action was taken because personnel were not allowed to enter the confined space of the shaft during characterization due to the radiological hazards. Oxygen was generally detected at concentrations of 20.9% with the exception of Shaft 246 where the instrument indicated an oxygen-rich environment of 24.1% (May 8, 2006) due to an improperly calibrated Multi-RAE Plus gas monitor. There were no detectable concentrations of LEL, H_2S, or tritium.

RADIOLOGICAL CHARACTERIZATION

Contamination

Radiological swipe samples were collected using a custom remote sampling device that consisted of an electrostatic duster wrapped in maslin. The sampling device was attached to 7.6-m (25-ft) of 1.3-cm (½-in.) conduit and suspended over each shaft from a crane boom. The conduit was attached to a rope and pulleys were used to lower the device into the shaft and down the narrow annulus between the canister shell and shaft wall. A video camera (also suspended off the crane boom and positioned near the top of the shielding) was used to record and visually confirm each swipe sample location. The orientation of each sample was determined by a weighted rope marked with yellow and red tape (visible in the recording) located at approximately the north side of the shaft.

Four swipe samples were collected in the annulus between the canister shell and shaft wall at 90-degree intervals from the top to the bottom of the canister (i.e., four sample locations). A fifth swipe sample was collected across the top of the pintle. One field duplicate swipe sample was collected from each canister on either the canister shell or from the pintle. Each swipe sample collected was individually sealed in a plastic gallon size Ziploc bag and analyzed for alpha and beta activity. The canisters located in Shafts

246, 247, 250, and 253 were not perfectly centered in the shafts resulting in a reduction of the number of swipe samples collected due to the limited annulus space between the canister shell and the shaft wall.

Each swipe was cut into 5 sections and counted for 3 minutes using the alpha/beta protocol. Table V summarizes the maximum detected removable alpha contamination detected for each gross swipe sample collected.

Table V. Detected Removable Alpha Surface Contamination

Shaft	Location	Maximum Removable Alpha Contamination [a]	
		(dpm/100 cm^2)	(Bq/100 cm^2)
236	Pintle	6.00E+00	1.00E-01
	SE Quadrant	7.60E+00	1.27E-01
237	SW Quadrant Duplicate	6.50E+00	1.08E-01
	Pintle	7.90E+00	1.32E-01
	SE Quadrant	9.30E+00	1.55E-01
	NE Quadrant	1.09E+01	1.82E-01
238	NW Quadrant	1.07E+01	1.78E-01
241	SE Quadrant	6.50E+00	1.08E-01
	SW Quadrant	8.10E+00	1.35E-01
246	NE Quadrant	6.70E+00	1.12E-01
247	Pintle	6.60E+00	1.10E-01
	NE Quadrant	9.10E+00	1.52E-01
248	SE Quadrant	6.10E+00	1.02E-01
	Pintle Duplicate	6.20E+00	1.03E-01
249	SW Quadrant	6.60E+00	1.10E-01
	SE Quadrant	7.70E+00	1.28E-01
	Pintle	7.90E+00	1.32E-01
	NW Quadrant Duplicate	1.37E+01	2.28E-01
250	Pintle Duplicate	6.60E+00	1.10E-01
	SE Quadrant	9.10E+00	1.52E-01
253	NE Quadrant	6.60E+00	1.10E-01
	SW Quadrant	1.51E+01	2.52E-01

a. Action level for removable gross alpha contamination is 3.3E-01 Bq/100 cm^2 (20 dpm/100 cm^2) [5].

The maximum detected alpha contamination ranged from 1.00E-01 - 2.52E-01 Becquerel (Bq) per 100 square centimeters (cm^2) (6.0 - 15.1 disintegrations per minute (dpm) per 100 cm^2). Table VI summarizes the maximum detected removable beta contamination detected for each gross swipe sample collected.

Table VI. Detected Removable Beta Surface Contamination

Shaft No.	Location	Maximum Removable Beta Contamination [a]	
		(dpm/100 cm^2)	(Bq/100 cm^2)
236	SE Quadrant	2.40E+01	4.00E-01
237	Pintle	1.67E+01	2.78E-01
	SW Quadrant Duplicate	1.76E+01	2.93E-01
	SW Quadrant	2.52E+01	4.20E-01
238	Pintle	2.42E+01	4.03E-01
240	NW Quadrant	1.98E+01	3.30E-01
	Pintle	5.29E+01	8.82E-01
241	NW Quadrant	1.69E+01	2.82E-01
	SE Quadrant	1.87E+01	3.12E-01
242	NE Quadrant	1.77E+01	2.95E-01
246	Pintle	1.92E+01	3.20E-01
247	SW Quadrant	1.62E+01	2.70E-01
	SE Quadrant	1.64E+01	2.73E-01
	NE Quadrant	1.73E+01	2.88E-01
250	SW Quadrant	1.64E+01	2.73E-01
	SE Quadrant	1.73E+01	2.88E-01
251	Pintle Duplicate	9.20E+00	1.53E-01
	SE Quadrant	1.24E+01	2.07E-01
	NW Quadrant	1.60E+01	2.67E-01
	NE Quadrant	2.80E+01	4.67E-01
	SW Quadrant	4.21E+01	7.02E-01
253	NE Quadrant	1.73E+01	2.88E-01
	Pintle	2.31E+01	3.85E-01
	SW Quadrant	2.48E+01	4.13E-01

a. The action level for removable gross beta contamination is 3.3 Bq/100 cm^2 (200 dpm/100 cm^2) [5].

The maximum detected beta contamination ranged from 1.53E-01 - 8.82E-01 Bq/100 cm^2 (9.2 - 52.9 dpm/100 cm^2). These ranges of values for alpha and beta contamination are below the LANL container release criteria of 3.3E-01 Bq/100 cm^2 (20 dpm/100 cm^2) and 3.3 Bq/100 cm^2 (200 dpm/100 cm^2), respectively [5].

Exposure Rate Data

Exposure rate data was collected at each canister by dropping an Geiger Mueller probe from an Eberline RO7 High Dose Meter into the annular space between the canister shell and shaft wall. This allowed personnel to collect exposure rate data from each canister at various depths and in quadrants based upon 90-degree intervals starting on the north side of the shaft. Most of the canisters were not perfectly centered inside the shaft and this prevented insertion of the instrument probe into the annular space between the canister shell and shaft wall around the entire circumference of the canister. The probe was inserted into three quadrants and readings were collected at 0.61-m (2-ft) intervals (3 data points for each quadrant of the canister) from the top of the shielding. On May 17, 2006, the interval used to collect dose readings was modified for the canisters in Shafts 237, 241, and 248 to provide a more extensive dose profile. This modification was made after the initial exposure rate at Shaft 241 exceeded 200 Roentgens per hour (R/hr). This exposure rate was within the limits of the radiological work permit but was significantly higher than the doses recorded for the canisters in the previous 13 shafts. Exposure rates for Shaft 241 were collected at 0.31-m (1-ft) intervals, starting at the top of the canister and from the two quadrants that were accessible to the probe. This approach was repeated at Shafts 237 and 248 to provide data for comparison. Table VII summarizes the maximum and average exposure rate for each canister.

Table VII. Maximum and Average Canister Exposure Rates

Shaft	Canister	Exposure Rate (R/hr)	
		Maximum	Average
236	LA17	37.2	17.9
237	LA15	31	14.6
238	LA13	49.5	12.4
239	LA11	56.9	14.6
240	LA10	17.5	8.7
241	LA07	290	115.3
242	LA05	0.8	0.6
243	LA03	1.2	0.7
246	LA18	2.8	1.2
247	LA16	3.2	0.7
248	LA14	21	9.9
249	LA12	5.9	2.6
250	LA09	45.6	14.3
251	LA08	18.5	7.8
252	LA06	3.1	1.3
253	LA04	0	0

Figure 2 provides a bar graph that visually demonstrates the average exposure rate profile throughout the three canisters (LA15, LA07, and LA14 located in Shafts 237, 241, and 248, respectively.

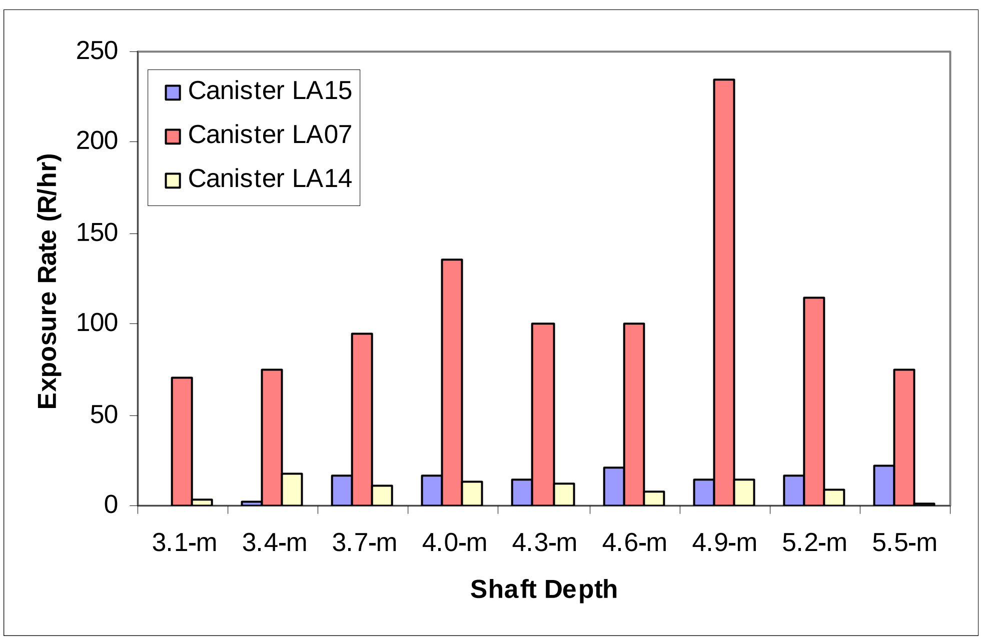

Figure 2. Average exposure rate for canisters in shafts 237, 241, and 248

Examination of this graph indicates that the majority of the dose in each canister is located in the middle and bottom drum. The characterization and inspection activities conducted between May 1, 2006 and

May 16, 2006 indicated that the actual exposure rate is much lower than the exposure rates modeled by health physics personnel.

VISUAL INSPECTION

A visual inspection of each canister was conducted using the video camera suspended over the shaft during the swipe sampling and canister dose readings. The camera was lowered into the shaft to inspect and document the following information:

- Canister identification/tracking labeling information
- Pintle and filter device
- Canister shell from top to bottom
- Shaft bottom, to verify whether any water was present
- Welded seam at canister bottom, to verify whether any rust was present

Shaft Dimensions and Configuration

The historical information for the shafts provided dimensions and materials of construction. This information included a specified diameter of 0.91-m (36-in.) with a corrugated metal pipe liner. It was discovered during cold demonstration that the inner diameter was closer to 0.81-m (32 in.). Visual inspection of the shafts also revealed that each shaft has four alignment guides installed on the interior of the corrugated metal pipe. These guides are constructed of wood and provide stability to the canister so that it sits upright and fairly close to the center of the shaft. This configuration is ideal for remote retrieval of the canister using the pintle picking device designed by the WIPP for moving canisters.

Integrity and Condition for Retrieval

The video camera was lowered into the shaft to inspect the integrity and condition of each canister. This inspection included an examination of the canister lid, pintle, sides, and welded seams. It also allowed for personnel to determine the presence, if any, of standing water inside the shafts. Standing water was not expected due to the arid climate of New Mexico, the shaft location at Mesa top, general topography of the site, and a shaft design (gravel bottom to promote drainage). The annular space between the shaft wall and the canister was approximately 7.6-cm (3-in.). This limited the video camera angle to vertical during inspection and prevented a detailed inspected of the canister welded seams. The video recorded during inspection showed the top and pintle of most canisters to be in good condition. There was condensation present and most of the lids showed a small amount of rust. A considerable amount of water and rust were observed on the lids of the canisters located in Shafts 246 and 252. This water appeared to be due to condensation and infiltration of rain water from the surface. Figure 3 provides a photograph of the canister in Shaft 252.

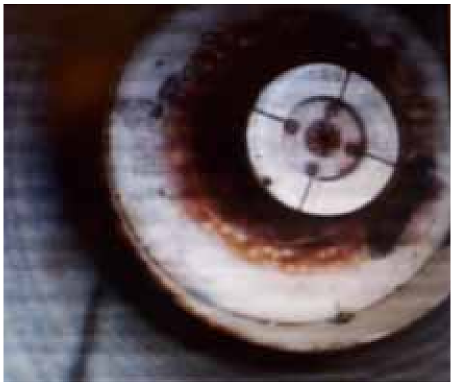

Figure 3. Condition of canister LA06 in shaft 252

The video camera was lowered to the bottom of each shaft to determine the condition of the canister sides and the presence of standing water at the shaft bottom. Visibility of the canister sides was limited but appeared intact and there was no standing water located in the bottom of the shafts despite several rain storms while characterization activities were being conducted. The welded seams near the bottom of the canisters also appeared intact and had no visible rust. This inspection combined with the swipe results previously discussed indicates that the canisters are in good condition and have maintained integrity while in retrievable storage.

Canister Filters

The visual inspection also included video of the canister lid to identify the presence of a WIPP certified filter and to record the filter serial number. An external filter with serial number was not visible to the camera for any of the canisters. A review of the historical documentation for these canisters provided a lid design drawing with the filter built into the pintle design. This design does not allow for visual confirmation of the filter presence or serial number.

Hydrogen Gas Sampling Equipment

The canisters in Shafts 237-241 and 247-251 are fitted with hydrogen gas sampling equipment and thermocouples attached to the canister filter vent located in the pintle. This equipment was used to obtain headspace gas samples from the canisters to determine the flammable gas generation and decay heat for evaluation of compliance with the transportation requirements specified in the Model Number RH-TRU 72B transportation cask SAR. Figure 4 provides a photograph that shows the equipment attached to the canister filter vent.

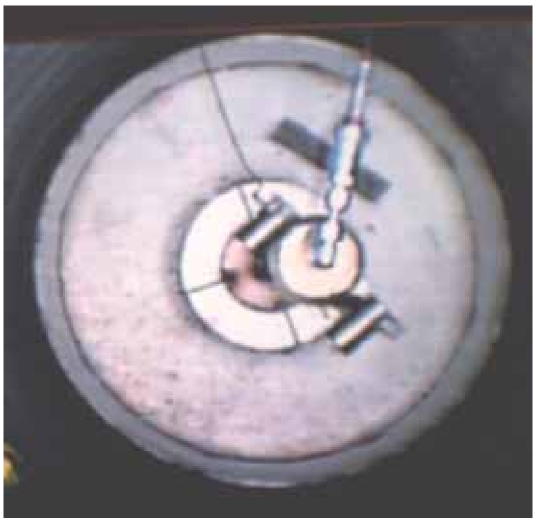

Figure 4. Hydrogen gas sampling equipment attached to canister filter vent

The characterization and inspection team examined the sampling equipment and was unable to remove one for further inspection. The analytical group responsible for the equipment was contacted to determine how the equipment was attached so that it can be removed prior to retrieval. The equipment was inserted into the pintle up to the filter and has an o-ring designed to expand and form a leak tight seal. A review of the video also shows that the equipment is attached using a sealant at the pintle surface. This equipment must be removed from the canisters prior to retrieval. As installed, it will interfere with the pintle lifting device used to load canisters into the Model Number RH-TRU 72B cask for transportation to WIPP.

Canister Labels and Identification Numbers

The canister labels and identification numbers were generally not visible during the inspection or upon review of the video because the numbers were welded onto the lid and painted white to match the paint on the canister. This makes them difficult to see unless they happen to be in right light or were outlined by rust and/or ink. A review of the video for six of the canisters showed identification numbers outlined in black or blue ink and in at least one case the number is outlined on the side of the canister. These six canister numbers were verified against the historical data in Appendix C-4 of *Historical Emplacement Data Review for Remote-Handled and Contact-Handled Transuranic Waste at Los Alamos National Laboratory*, [1]. The canister identification numbers for the six matched the historical data and it is assumed that the remaining 10 canister identification numbers will also correlate when retrieved.

CONCLUSIONS

Radiological characterization confirms integrity of the containers with results for alpha and beta contamination below the LANL release criteria [5] for waste containers to be transported offsite for disposal. The radiological dose and exposure rates at the top of the shafts and due to the canister contents is far lower than expected after review of the historical data and modeling of the canister contents. The maximum surface dose reading was 1.7E-03 Sv/hr (170 mrem/hr) at Shaft 251. The maximum canister exposure rate was 290 R/hr at Shaft 241. This will facilitate retrieval operations by reducing the required personnel and equipment distances from the canisters as they are retrieved and packaged into the RH-TRU 72B transportation cask.

Visual inspection indicated that the canisters are in good condition with little or no rust and intact welded seams. The shafts are not full of standing water but there is condensation and some infiltration of surface water, particularly at Shafts 246 and 252. This water will have to be removed or allowed to evaporate prior to packaging in the RH-TRU 72 B transportation cask. The shafts were constructed with wooden alignment guides along the interior and these guides have kept the canisters in a near vertical configuration. This configuration will facilitate alignment of the pintle with the pintle lifting device during retrieval. Ten of the canisters have hydrogen gas sampling equipment attached to the pintle. This equipment will have to be removed prior to retrieval because it will interfere with the pintle lifting device used to load canisters into the Model Number RH-TRU 72B cask for transportation to WIPP. The visual inspection was also used to validate historical data by comparing the visible canister identification numbers against the historical record for six of the canisters.

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