Final Status Survey of the Radioactive Source Storage Building at the Rose-Hulman Institute of Technology

27 September 2005

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This report was prepared by the staff of RAM Services, Inc based on documentary materials provided by Rose-Hulman personnel and on measurements made by RAM Services.

Please contact RAM Services, Inc. for additional information about this survey, for clarification of any items, or to report errors.

Summary

Mr. Jerry Wiza of RAM Services, Inc. conducted a preliminary survey of the radioactive source storage outbuilding, which is located about 60 feet north of Moench Hall, from 21 to 22 June 2005. Lead bricks contaminated with Cs-137 were discovered at this time in the northwest corner and further survey and decontamination efforts were suspended until they were removed. Wipe samples to detect removable contamination were collected at his time from the floor and walls and analyzed shortly thereafter. None of these samples displayed any radioactivity significantly above background. Consequently, and also in view of the ultimate fate of this structure, wipe samples were not collected on subsequent visits.

On 04 through 06 August 2005 Mr. Wiza returned to the facility to package the contaminated lead, cement blocks beneath the lead vault and other radioactive waste. The contaminated lead was transferred by Philotechnics under waste manifest 0866-01-0012 for disposal at Envirocare of Utah. The cement blocks, dismantled steel vault frame, and other radioactive waste, as described in the attached manifest 05-0307 L was removed by ADCO Services, Inc. on 17 August 2005 for final disposal.

On 6 August 2005 Mr. Wiza also scanned 100% of the storage building floor for total (fixed and removable) alpha and beta contamination. Elevated beta contamination, amounting to 4200 dpm, was discovered at one floor grid location (number F-11). Approximately 1/8" of the surface concrete was removed with an air hammer equipped with a brush head attachment until radiation levels were at background levels. The resulting rubble was disposed as radioactive waste. No other alpha or beta contamination was found on the floor, except for some very low-level fixed beta contamination (approximately 540 dpm) that remains in grid F-3. Mr. Wiza also measured gamma radiation rates at the surface of the floor and detected nothing significantly above background.

Mr. Wiza scanned 100% of the lower two meters of the walls for total alpha and beta contamination on 6 August 2005 and detected no residual contamination significantly above background. Fixed measurements of wall surfaces and were not obtained on this date because background reference measurements at the surface of the cinder block walls in Room 17 of Demming Hall were found to be significantly lower than those measured in the waste storage building. Further investigation indicated renovations made at Demming Hall after it was initially constructed had replaced the original cinder block walls with blocks having a different composition of raw materials from a later time period.

Mr. Wiza also measured gamma radiation levels at the wall surfaces and discovered nothing significantly above background. Measurements taken on this date were not

used because a suitable background reference area could not be established on 6 August.

The space beneath the grade-level concrete floor was not investigated in this survey. The exterior of the building, except for a few wipe samples, and the adjacent grounds were not investigated since contamination of these elements seemed highly improbable.

We recommend that Rose-Hulman retain this document, and all others pertaining to decontamination and decommissioning of the outbuilding, indefinitely so as to support any future license termination.

Historical Site Assessment

The Rose-Hulman Institute of Technology currently holds U.S. NRC license 13-17582-01. A copy of the license renewal application, dated 27 April 2004 and signed by Maarji Syed, Radiation Safety Officer, indicates that Rose-Hulman continues to possess one 100 millicurie Am-241 source, New England Nuclear Model NER-476S, and two Pu-239Be neutron "howitzers", which were described in a 26 January 1973 letter to the U.S. Atomic Energy Commission. The neutron sources contain a total of 80 grams of Pu-239 and are described in that application as in storage in an outbuilding, a.k.a. "shed", located approximately "...60 feet north of the northwest corner of Moench Hall (the Institute's main class-room building)" awaiting removal by the Off-Site Recovery Project of Los Alamos National Laboratory. These neutron sources appear to be further identified by an attachment to the 2001 license amendment, described below, as "MRC 40, 15g" and "MRC 371, 58g".

A license amendment application dated 15 August 2001 and signed by Daniel L. Hatten, Radiation Safety Officer states that the purpose of the amendment is to identify personnel changes, apparently including the R.S.O., and to remove the "regulated" Cs-137 sources, which apparently had been disposed, from the license.

RAM Services was provided with a copy of a facsimile sent by Mr. Hatten to Bionomics, a radioactive waste brokerage company, on 15 July 1998 that includes a handwritten document captioned "Rose-Hulman Waste Inventory". The items listed were:

Table 1. Rose-Hulman Waste Inventory from 15 July 1998	
1.	5 quarter-size copper buttons with Cs-137 deposited on them
2.	1 coffee can with (I believe) wipe cloths from cleanup of Cs-137
3.	Nuclear Chicago Model P22A instrument with a 3 millicurie Cs-137 source in it
4.	1 Nuclear Chicago Model P21 instrument with a 5 millicurie RaBe source in it
5.	1 Nuclear Chicago 5846 instrument with a 2 millicurie Ra 226 source in it.
6.	A few dozen unregulated button sources.

Another facsimile sent by Mr. Hatten on 22 July 1998 describes the radiation from the Cs-137 buttons as "≈ 50 mR/hr @ about 2" distance" and an additional item, which he wants to call "Item 7 on my list", described as "...a cylindrical lead vessel ... with 100 μCi of Cs-137 in it". There is no additional description of the chemical or physical form of the Cs-137.

An NRC Form 540 dated 29 September 1998 describes a waste shipment to Perma-Fix in Gainesville, Florida comprising a total of 373.922 MBq of Ra-226Be and Cs-137. The documentary materials from that time period provided to RAM Services also include an application for NARM disposal at Richland, Washington. The application is only dated "1999" and requests permission to dispose 7 mCi of Ra-226".

The license 2004 renewal application and the 2001 amendment request state [See Application Item 10] that "[s]ealed sources (the Am-241 and Pu/Be sources) are wipe tested for leakage at least as often as once every six months" and both documents assert that "... no leakage has ever been detected." In August 2004, the Pu-239BE sources were leak tested before removal from the radioactive storage shed for storage until final disposal can be arranged. The new storage building is a small metal structure located approximately 100 yards east of the Facilities Operations Building.

Facility Description

The radioactive materials license application from 2004 describes the use of the Am-241 and Pu-239Be sources for teaching purposes in Moench Hall rooms CL-117 and DL-105. These rooms were not investigated as part of this preliminary survey and are not encompassed by this report.

The 2004 license renewal application and the 2001 amendment request describe a small outbuilding used for source storage. This building, the sole subject of this report, is described in the 2004 renewal application as:

> "...a cinder block building of 100 – 150 square feet located about 60 feet northwest of the north end of Moench Hall (the Institute's main class-room building). This outbuilding contains a lead storage vault and is used to store licensable sources (the Pu/Be neutron sources, and the Am-241 source) when not in use in student laboratories."

Based on this description we indicate the approximate location of this out building on the campus map[1] included below as Figure 1. A photograph of the site made by RAM Services personnel as part of this survey, and included as Figure 2, shows another similar building, used for chemical storage, which was not investigated during this survey, located slightly to the north and east of the radioactive source storage building.

[1] Obtained from the "Interactive Map" displayed on the current Rose-Hulman Web site, "www.rose-hulman.edu".

A second photograph of the site, Figure 3, shows the source storage building in relation to other campus buildings.

The lead vault described above rests on a concrete block platform located in the northwest corner of the building. There are two circular floor penetrations near the southern edge of this platform and two sewer vent pipes rise from the floor along the western wall. Two ladders that rise a few feet above the floor level were built into the eastern wall for access to the lower level of the structure where water pumping equipment was previously used. The lower level of the building was not investigated as part of this survey. The locations of these elements are approximately indicated in the diagram displayed in Figure 3.

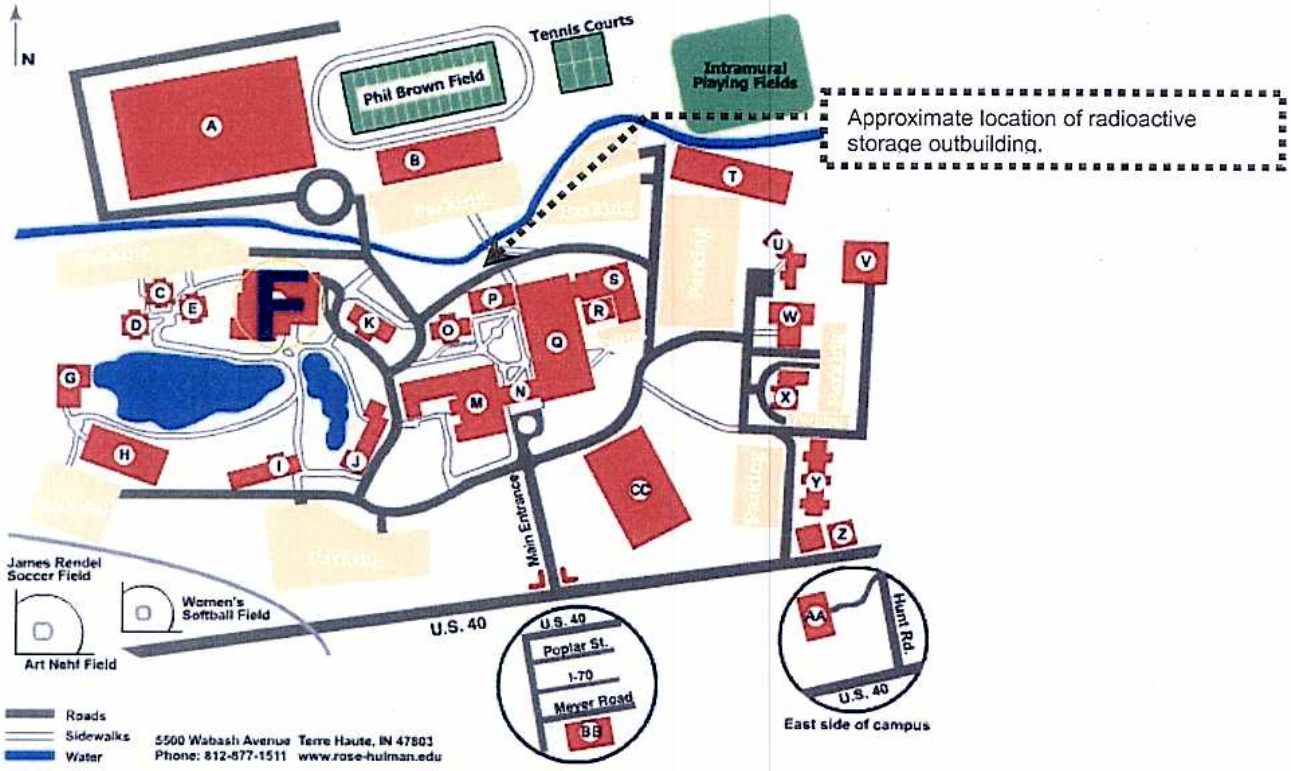

Figure 1. Rose-Hulman Campus Map.

Figure 2. Aerial Photograph of Rose-Hulman Campus[2]

[2] Aerial photograph obtained from Google Earth on 14 November 2005. The exact date of the photograph is unknown but was claimed to be sometime in 2003.

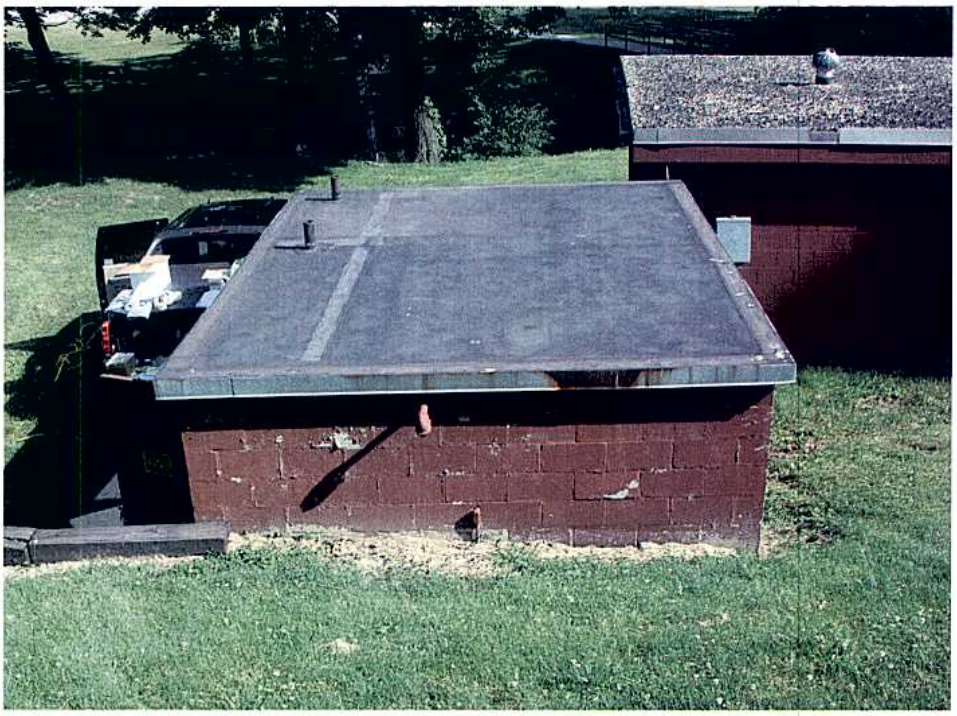

Figure 3. Radioactive source storage "shed" viewed from the south.

Figure 4. Storage building viewed from the west.

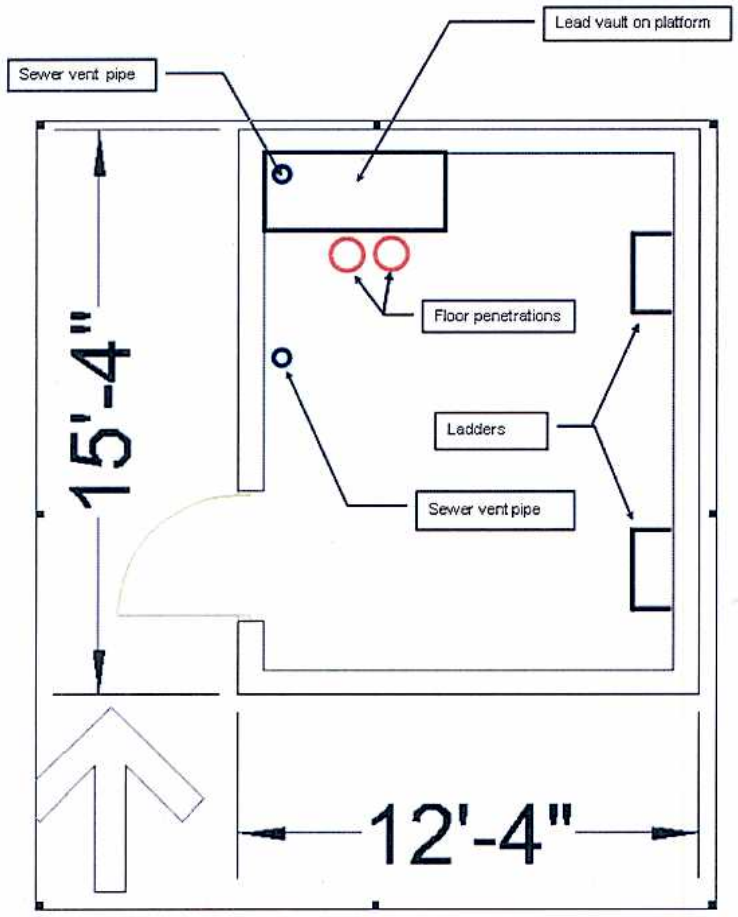

Figure 5. Floor plan of radioactive storage shed.

Item 10 of the license renewal application states that the Pu/Be sources are stored in the outbuilding in galvanized steel drums filled with paraffin and that "[t]he photon sources are stored in lead shields in a locked cabinet in Room DL105, Moench Hall. Shields include a cylindrical pig with 3" walls and a well constructed of 2 X 4 X 8" lead bricks." As of the date of this survey, the Pu-239Be sources had been removed from the outbuilding but a shield, apparently the storage vault referred to above, constructed of an estimated 184 lead bricks and measuring approximately 36" wide X 24" deep and 16" high remained near the northwest corner of the building.

Survey Methods

The floors and lower walls to a height of 2 meters were marked off in a 1-meter by 1-meter grid. The grid locations are numbered as described in Figure 5.

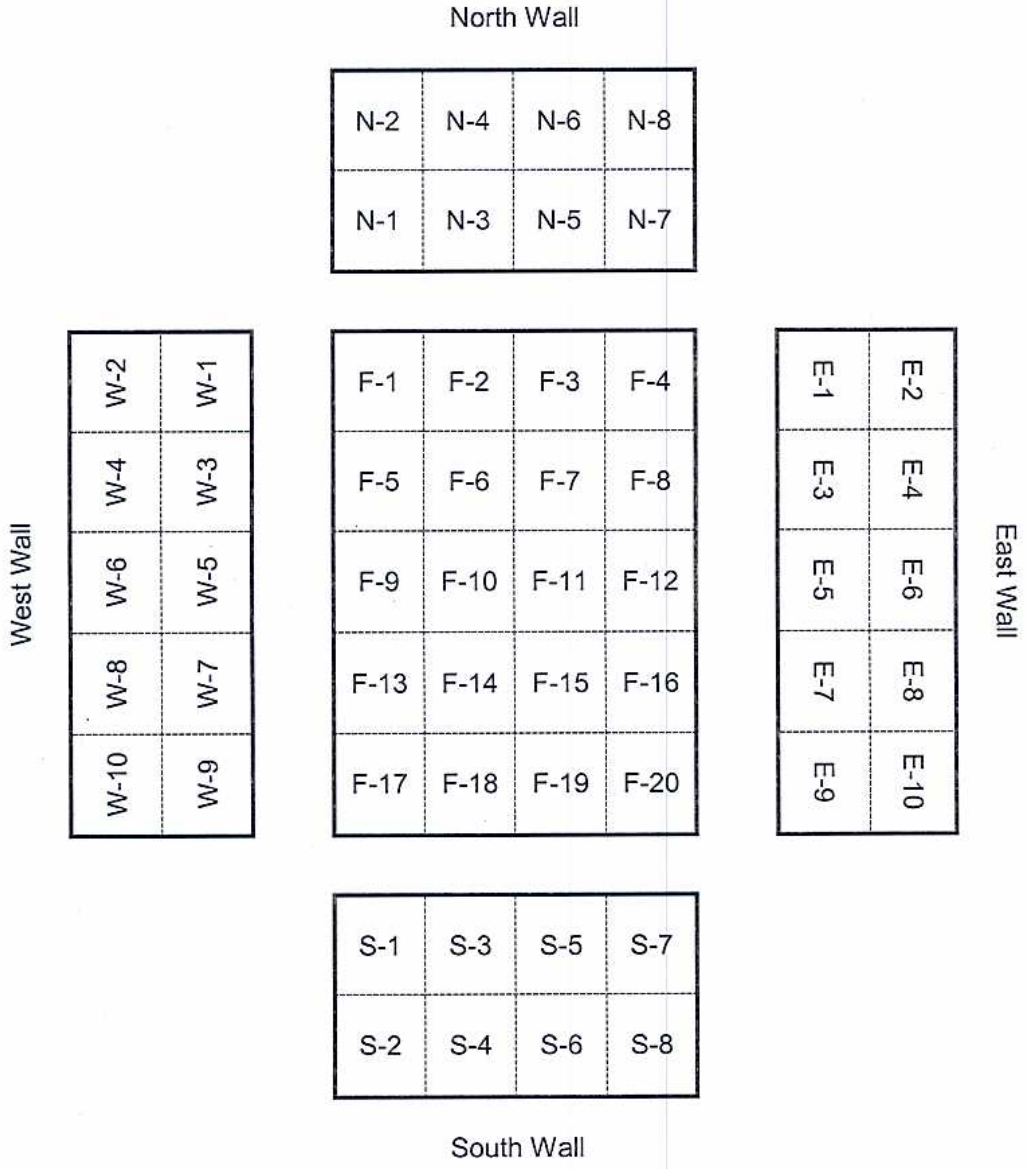

Figure 6. Radioactive Storage Shed Survey Grid.

Alpha/beta surface contamination measurements were made with a Ludlum M/N 2224 Scaler/Ratemeter, S/N 170346, coupled to a 100 cm^2 (open area) alpha/beta probe, Ludlum M/N 43-89, S/N 182428. This system was calibrated on 18 July 2005 by the

manufacturer, who measured 2π detection efficiencies of 38.9% for Cs-137 and 42% for Pu-239 at that time.

Gamma radiation levels were measured with a Bicron "microanalyst", S/N B863H, which had been calibrated by Ludlum on 07 December 2004.

Calibration certificates for both instruments are included with this report as Attachment 1.

Proper operation of the alpha/beta scaler was verified on each day-of-use by recording 10 1-minute counts of reference check sources and comparing these measurements with previously obtained Conventionally True Values. The instrument was found to be in proper working order on both survey days.

RAM Services, Inc. Dual Scaler Operational Check Worksheet

Ludlum Model 2224 S/N 170346 Probe Model 43-89 S/N PR-182428

Calibration Date 18-Jul-2005 **Calibration Due** 18-Jul-2006

ALPHA Check Source

Isotope	Lot No.	Ref. DPM
Th-230	00TH4700764	7,580

Reference Count Rate 1,526 cpm

Beta Check Source

Isotope	Lot No.	Ref. DPM
Cs-137	00CS000766	270,840

Reference Count Rate 922 cpm

Date	Average Net Alpha Count	Average Alpha Bkg.	1 Minute Alpha MDA	Deviation	Alpha X^2	Average Net Beta	Average Beta Bkg.	1 Minute Beta MDA	Deviation	Beta X^2	Initials
	counts	counts	dpm			counts	cpm	dpm			
5-Aug-05	1468.0	0.1	21.3	3.8%	9.41	891.9	107.7	263.5	3.2%	7.55	JPW
6-Aug-05	1507.8	0.7	32.8	1.2%	15.30	899.9	107.1	262.8	2.4%	9.00	JPW
27-Sep-05	1522.0	0.4	28.3	0.3%	6.04	911.6	97.5	251.5	1.1%	8.70	JPW

Proper operation of the Bicron microanalyst was verified on each day-of use by measuring surface radiation levels from a "Delaware" radium dial watch. On each day the Bicron responded with the CTV value of 450 µRem/hr.

A gamma spectrum of the contamination on the surface of the lead was obtained with an EG&G Ortec µ Nomad portable NaI(Tl) spectrometer using a Bicron M/N 2M2 /2 detector, S/N 600003-00475-1, installed in an Ortec M/N 296 Scintipack PMT Base. The energy scale of the spectrometer was calibrated on the day of use with a 5 µCi Cs-137 check source.

100% of the surface of each floor and wall grid was scanned for alpha and beta contamination. If no elevated radiation was detected, then a 1-minute direct reading was recorded for each grid for both alpha and beta radiation.

"Smear" samples for removable contamination were collected from 100 cm^2 of each grid location, the roof vents, and a wooden box stored in the shed. Wipe samples were sent to RAM Services Wisconsin facility for analysis by liquid scintillation counting.

The wipe samples were counted for 10 minutes each using a protocol that included counting windows and efficiency corrections for H-3 and C-14, which were not isotopes of interest for this survey. The counting protocol did, however, also include a wide open counting window which would have detected any high-energy beta emitting isotopes (such as Cs-137) or alpha emitting isotopes with good (essentially 100%) efficiency.

Proper operation of the liquid scintillation counter was verified on the date the samples were counted by a Quality Assurance procedure that conforms to the ANSI N42.15-1997 Standard.

Background Measurements

Since the entire facility, i.e., the source storage shed, was the object of this survey obtaining a representative "background" reference became a problem. Moreover, measurements suggested that the nearby chemical storage shed, although outwardly similar to the source storage building, had been constructed of very dissimilar materials. Consequently, separate background measurements were obtained from different portions of the Rose-Hulman campus believed to be similar to the storage shed's floor and wall materials in age and composition.

The floor reference background was obtained on 06 August 2005 from the floor of the water conditioning room in Room 17 of Demming Hall, which is approximately the same age as the storage shed. The wall background reference was measured on 27 September 2005 at the surface of the south wall (F Boiler Room of Moench Hall) inside of door FL-201 at a height of 15 feet from floor and 8 feet from East doorway. In Table 1 below we present the averages and standard deviations of 10 1-minute counts obtained at these locations.

Table 1. Reference Background Measurements

Date	Location	Alpha	Beta
06 August 2005	Floor	2.9 ± 1.4	174.2 ± 14.7
27 September 2005	Walls	2.3 ± 1.1	154.6 ± 10.5

A gamma background of 7.5 μRem/hour was measured just outside of the source storage building on 06 August 2005. This background was not subtracted from the gamma survey measurement in order to provide a clearer picture of radiation levels inside the structure.

Minimum Detectable Activities

We computed the Minimum Detectable Activities [MDA] for the alpha and beta measurements using the different background reference values for the walls and the floor in Equation 3-12 of NUREG 1507 [December 1997]:

$$MDA = \frac{3 + 4.65\sqrt{B \times t}}{E \times t},$$

where B is the background count rate relevant for the particular structural feature and E is the efficiency appropriate for the radiation. The count time t is 1 minute for all alpha and beta measurements.

Survey Findings

During the 21-22 June 2005 preliminary survey Mr. Wiza discovered that several lead bricks comprising the lead storage vault in the northwest corner of the source storage building were contaminated. The maximum fixed contamination measured on the accessible lead brick surfaces was 33,667 cpm over the 100 cm^2 probe area. Assuming the C-14 calibrated[3] beta detection efficiency of 26.7% implies a surface contamination of 125,575 dpm. A NaI(Tl) gamma spectrum of the contaminated lead, displayed below as Figure 6, is consistent with Cs-137 as the likely contaminant. Upon finding unexpected contamination, further survey of the facility was terminated because no provision had been made for radioactive waste disposal.

Wipe samples for removable contamination were, however, collected during the preliminary survey and analyzed the following day at RAM Services facility in Two Rivers, WI. The wipe samples did not indicate the presence of any removable contamination significantly above background. A complete report of the wipe sample analysis is included as Table 2 below. Since these samples displayed no unusual activity, they were not repeated during the final survey.

[3] A different instrument was used in the preliminary survey. Since no other quantitative measurements employing this instrument are presented here, we have omitted its calibration data.

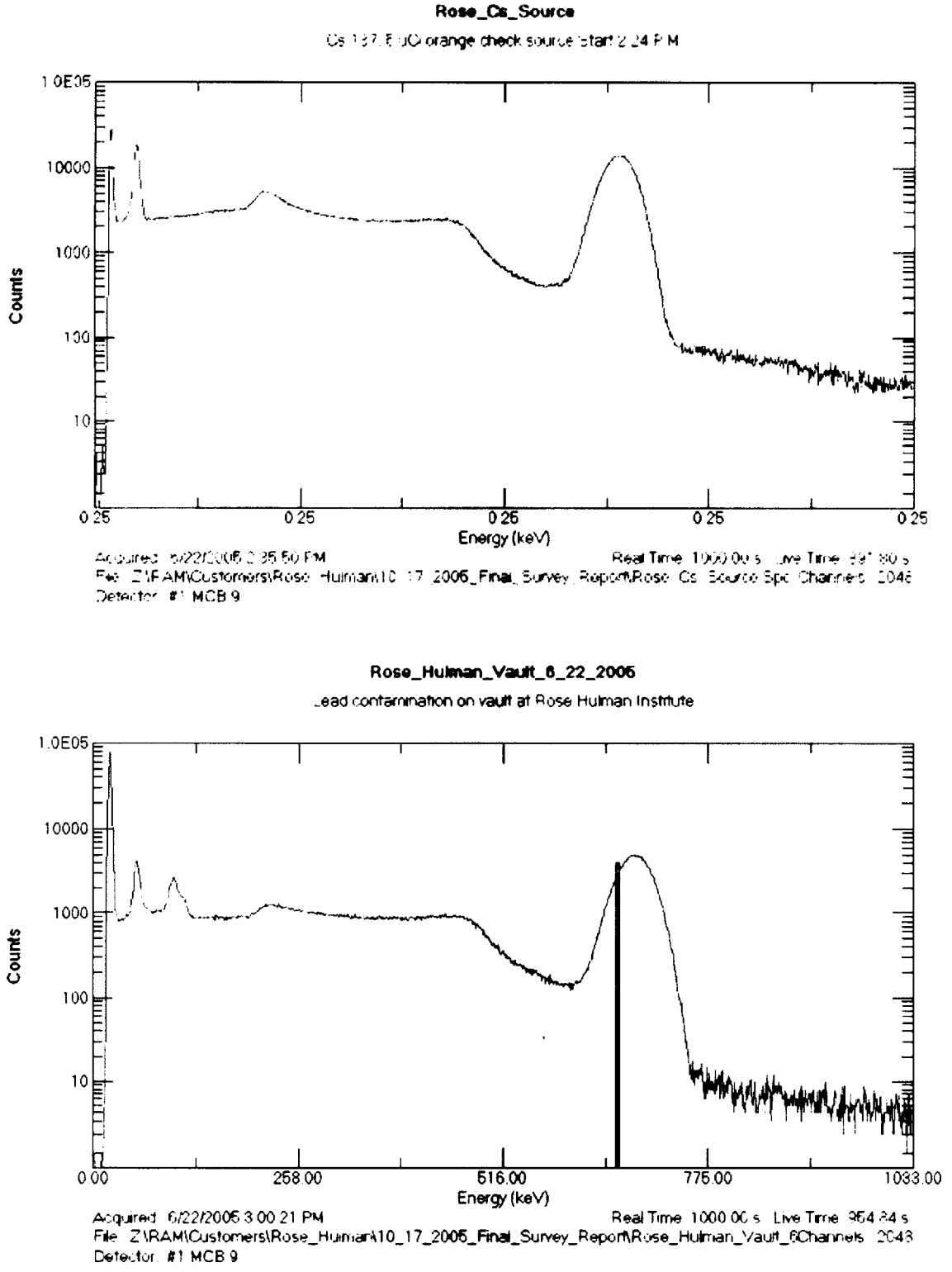

Figure 7. NaI(Tl) Spectrum of Contamination.

On 08 August 2005 Mr. Wiza scanned 100% of the floor grid locations for total alpha/beta contamination. Elevated beta radiation was found in grid F-11 and decontaminated to background levels by removing the top 1/8" of concrete. When corrected for background and counting efficiency, this localized contamination seemed to have an activity of approximately 4200 dpm over the 100 cm^2 active area of the detector.

Approximately 540 dpm/100 cm^2 of beta activity was detected at floor grid F-3, but this was not decontaminated. Beta activity was at or below the MDA over the remainder of the floor. Essentially no alpha activity was detected on the floor.

On 27 September 2005 Mr. Wiza scanned 100% of the interior wall surfaces to a height of 2 meters using the same instrumentation as employed on 06 August. No elevated alpha or beta activity was found on any of the walls.

Complete radiation measurements from the interior of the source storage building are presented in Table 3 below.

The exterior walls and the roof of the source storage shed were not investigated as part of this survey, except for a few wipes collect from the roof vents. Also, the grounds surrounding the building were not sampled for contamination. Since unsealed forms of radioactive materials were not actively used in this building, it seems extraordinarily unlikely that any of these elements would be radioactively contaminated.

Waste Disposal

On 17 August 2005 ADCO Services, Inc. removed the radioactive waste generated by dismantling the lead storage vault frame and decontaminating the facility. This waste had been packaged in one 10-gallon and two 55-gallon drums. The concrete blocks which had formed the base of the lead vault were packaged in a 32 ft^3 wooden box and removed for disposal. The total estimated activity in all these waste drums was 0.085 mCi.

Table 2. Removable Contamination Final Report

Wipe Date	Analysis Date	Report Date	Analyst
23-Jun-2005	24-Jun-2005	15-July-2005	Don Jordan

Location		H-3 Counting Window				C-14 Window				Wide Open Window		
Rose-Hulman Institute of Technology		Counting window automatically adjusted for quench.				Counting window automatically adjusted for quench.				Assume C-14 Efficiency		
Utility out-building		Background 11.34 dpm				Background 10.67 dpm				Background 34.35 dpm		
Terre Haute, IN 47803												
Assay No.	Sample Description	Raw Count	Efficiency	MDA	Activity	Raw Count	Efficiency	MDA	Activity	Raw Count	MDA	Activity
		cpm	%	dpm	dpm	cpm	%	dpm	dpm	cpm	dpm	dpm
34075	F-1	5.40	40.16	13.08	-6.30	13.90	73.13	21.18	8.29	33.10	12.19	10.91
34076	F-2	6.10	37.45	14.02	-5.50	16.10	72.69	21.31	11.42	37.30	12.27	16.97
34077	F-3	6.20	34.59	15.18	-1.95	12.20	72.20	21.45	6.13	29.60	12.35	6.65
34078	F-4	8.40	48.62	10.80	1.51	9.00	74.41	20.82	1.30	25.20	11.98	-0.48
34079	F-5	4.80	21.12	24.87	-1.65	12.00	68.90	22.48	6.61	28.30	12.94	6.73
34080	F-6	6.50	34.79	15.10	0.48	9.90	72.23	21.44	2.91	26.80	12.35	2.76
34081	F-7	4.40	24.38	21.54	-3.79	10.90	69.92	22.15	4.82	27.00	12.75	4.27
34082	F-8	7.80	48.45	10.84	-0.09	9.80	74.39	20.82	2.40	26.80	11.99	1.68
34083	F-9	7.00	33.68	15.59	1.57	11.00	72.03	21.50	4.46	27.20	12.38	3.41
34084	F-10	5.50	34.42	15.26	-2.60	10.30	72.17	21.46	3.51	25.00	12.36	0.29
34085	F-11	5.70	39.52	13.29	-3.48	10.70	73.02	21.21	3.90	26.30	12.21	1.67
34086	F-12	8.20	48.48	10.83	0.23	10.80	74.39	20.82	3.74	27.30	11.99	2.35
34087	F-13	3.20	8.83	59.48	4.39	9.90	62.05	24.96	4.98	29.10	14.37	12.55
34088	F-14	2.80	22.59	23.25	-12.72	13.30	69.38	22.33	8.51	27.90	12.85	5.87
34089	F-15	3.00	26.26	20.00	-8.16	9.10	70.42	22.00	2.21	22.90	12.66	-1.83
34090	F-16	5.00	29.62	17.73	-3.62	11.30	71.22	21.75	5.11	25.70	12.52	1.74
34091	F-17	6.70	43.19	12.16	-1.98	11.00	73.59	21.05	4.19	25.40	12.12	0.17
34092	F-18	5.80	38.36	13.69	-3.04	10.80	72.84	21.26	4.07	25.10	12.24	0.11
34093	F-19	5.40	23.00	22.83	0.73	11.30	69.51	22.28	5.43	25.50	12.83	2.34

Removable Contamination Final Report

Wipe Date	Analysis Date	Report Date	Analyst
23-Jun-2005	24-Jun-2005	15 July 2005	Don Jordan

Location		H-3 Counting Window Counting window automatically adjusted for quench.				C-14 Window Counting window automatically adjusted for quench.				Wide Open Window Assume C-14 Efficiency		
Rose-Hulman Institute of Technology Utility out-building Terre Haute, IN 47803		Background 11.34 dpm				Background 10.67 dpm				Background 34.35 dpm		
Assay No.	Sample Description	Raw Count cpm	Efficiency %	MDA dpm	Activity dpm	Raw Count cpm	Efficiency %	MDA dpm	Activity dpm	Raw Count cpm	MDA dpm	Activity dpm
34094	F-20	7.60	37.11	14.15	1.65	11.50	72.63	21.33	5.03	28.10	12.28	4.34
34095	N-1	5.80	39.98	13.14	-2.58	9.50	73.10	21.19	2.24	23.30	12.20	-2.47
34096	N-2	6.80	34.98	15.01	2.12	8.70	72.27	21.43	1.22	26.20	12.34	1.91
34097	N-3	6.40	38.50	13.64	-2.14	11.80	72.86	21.26	5.43	28.40	12.24	4.63
34098	N-4	6.80	39.16	13.41	-0.08	9.90	72.97	21.23	2.78	26.20	12.22	1.56
34099	N-5	6.60	44.78	11.73	-1.76	9.60	73.83	20.98	2.24	27.90	12.08	3.44
34100	N-6	6.40	37.22	14.11	-1.36	11.10	72.65	21.32	4.50	26.50	12.28	2.13
34101	N-7	8.20	55.23	9.51	-0.23	8.70	75.44	20.53	0.76	25.70	11.82	-0.28
34102	N-8	5.70	41.23	12.74	-3.44	10.10	73.29	21.13	3.03	24.00	12.17	-1.60
34103	S-1	4.80	33.85	15.51	-4.31	10.00	72.06	21.49	3.13	24.50	12.38	-0.35
34104	S-2	5.40	34.96	15.02	-2.04	8.90	72.26	21.44	1.55	24.10	12.34	-1.00
34105	S-3	3.40	29.98	17.52	-7.55	9.40	71.29	21.73	2.47	22.70	12.51	-2.51
34106	S-4	7.50	50.72	10.35	-1.79	11.10	74.73	20.73	4.09	27.30	11.93	2.18
34107	S-5	6.60	46.58	11.27	-1.66	8.70	74.10	20.90	0.98	24.60	12.03	-1.15
34108	S-6	8.20	51.19	10.26	0.82	8.30	74.80	20.71	0.31	23.00	11.92	-3.60
34109	S-7	7.00	43.83	11.98	-0.98	10.20	73.69	21.02	3.07	25.50	12.10	0.26
34110	S-8	6.10	40.84	12.86	-4.36	13.40	73.23	21.15	7.56	28.20	12.18	4.16
34111	W-1	7.40	40.15	13.08	0.84	10.40	73.13	21.18	3.43	26.90	12.19	2.44
34112	W-2	8.80	49.91	10.52	1.89	9.20	74.61	20.76	1.54	27.40	11.95	2.38

Removable Contamination Final Report						Wipe Date	Analysis Date	Report Date	Analyst			
						23-Jun-2005	24-Jun-2005	15 July 2005	Don Jordan			
Location Rose-Hulman Institute of Technology Utility out-building Terre Haute, IN 47803		H-3 Counting Window Counting window automatically adjusted for quench.				C-14 Window Counting window automatically adjusted for quench.				Wide Open Window Assume C-14 Efficiency		
		Background 11.34 dpm				Background 10.67 dpm				Background 34.35 dpm		
Assay No.	Sample Description	Raw Count cpm	Efficiency %	MDA dpm	Activity dpm	Raw Count cpm	Efficiency %	MDA dpm	Activity dpm	Raw Count cpm	MDA dpm	Activity dpm
34113	W-3	6.70	45.44	11.56	-1.68	9.60	73.93	20.95	2.22	25.60	12.06	0.28
34114	W-4	4.60	45.90	11.44	-6.63	10.10	74.00	20.93	2.93	24.60	12.05	-1.10
34115	W-5	6.40	32.37	16.22	-0.66	12.20	71.78	21.58	6.21	27.80	12.42	4.38
34116	W-6	6.80	29.78	17.64	3.16	10.40	71.25	21.74	3.76	27.20	12.52	3.83
34117	W-7	6.70	39.53	13.29	-0.07	9.30	73.03	21.21	1.95	27.30	12.21	3.03
34118	W-8	6.90	41.65	12.61	-0.92	10.60	73.36	21.11	3.68	26.10	12.16	1.23
34119	W-9	6.90	41.97	12.51	0.11	8.70	73.41	21.10	1.07	24.40	12.15	-1.11
34120	W-10	5.70	37.50	14.00	-2.01	9.10	72.70	21.31	1.75	23.80	12.27	-1.61
34121	E-1	5.60	40.75	12.89	-3.60	10.10	73.22	21.15	3.05	25.50	12.18	0.48
34122	E-2	9.70	47.20	11.13	4.20	9.90	74.20	20.87	2.53	28.10	12.02	3.52
34123	E-3	8.30	38.39	13.68	3.56	10.70	72.84	21.26	3.87	27.70	12.24	3.68
34124	E-4	3.50	29.72	17.67	-6.84	9.00	71.24	21.74	1.91	20.80	12.52	-5.15
34125	E-5	8.30	45.44	11.56	1.64	10.00	73.93	20.95	2.73	29.20	12.06	5.15
34126	E-6	5.10	41.11	12.77	-4.71	9.80	73.28	21.14	2.64	22.60	12.17	-3.51
34127	E-7	7.10	38.99	13.47	0.43	10.40	72.94	21.24	3.47	27.30	12.23	3.08
34128	E-8	7.20	38.03	13.81	2.28	8.40	72.79	21.28	0.73	25.30	12.25	0.41
34129	E-9	6.50	40.68	12.91	-1.36	10.10	73.21	21.16	3.03	25.90	12.18	1.03
34130	E-10	5.60	33.45	15.70	-2.03	10.30	71.99	21.52	3.54	25.40	12.39	0.93
34131	Roof vent, northwest	0.00	16.12	32.58	-25.53	10.30	66.88	23.16	4.94	21.10	13.33	-2.80

Removable Contamination Final Report

Wipe Date	Analysis Date	Report Date	Analyst
23-Jun-2005	24-Jun-2005	15 July 2005	Don Jordan

Location		H-3 Counting Window Counting window automatically adjusted for quench.				C-14 Window Counting window automatically adjusted for quench.				Wide Open Window Assume C-14 Efficiency		
Rose-Hulman Institute of Technology Terre Haute, IN 47803		Background 11.34 dpm				Background 10.67 dpm				Background 34.35 dpm		
Assay No.	Sample Description	Raw Count cpm	Efficiency %	MDA dpm	Activity dpm	Raw Count cpm	Efficiency %	MDA dpm	Activity dpm	Raw Count cpm	MDA dpm	Activity dpm
34132	Roof vent	3.90	16.90	31.08	-2.15	10.70	67.24	23.04	5.10	28.10	13.26	7.44
34133	Wooden cover, northeast corner	4.90	41.55	12.64	-5.08	9.50	73.34	21.12	2.22	23.90	12.16	-1.76
34134	Wooden rad. Labeled box, northeast corner	5.80	40.25	13.05	-2.21	8.80	73.14	21.18	1.27	25.00	12.19	-0.17

Table 3. Rose Hulman Source Storage Building Radiation Survey.

Grid Location	Raw Alpha Count cpm	Alpha MDA DPM	Alpha Activity DPM / 100 cm^2	Raw Beta Count cpm	Beta MDA DPM	Beta Activity DPM / 100 cm^2	Gamma Radiation µRem/hr
F-1	3	26.0	0.2	189	165.5	38.0	9
F-2	3	26.0	0.2	239	165.5	166.6	10
F-3	3	26.0	0.2	384	165.5	539.3	8
F-4	1	26.0	-4.5	178	165.5	9.8	9
F-5	0	26.0	-6.9	233	165.5	151.2	9
F-6	4	26.0	2.6	201	165.5	68.9	9
F-7	3	26.0	0.2	182	165.5	20.1	9
F-8	1	26.0	-4.5	163	165.5	-28.8	9
F-9	1	26.0	-4.5	143	165.5	-80.2	9
F-10	0	26.0	-6.9	162	165.5	-31.4	8
F-11	0	26.0	-6.9	185	165.5	27.8	8
F-12	1	26.0	-4.5	156	165.5	-46.8	9
F-13	1	26.0	-4.5	175	165.5	2.1	8
F-14	1	26.0	-4.5	188	165.5	35.5	9
F-15	0	26.0	-6.9	181	165.5	17.5	8
F-16	1	26.0	-4.5	145	165.5	-75.1	9
F-17	1	26.0	-4.5	156	165.5	-46.8	8
F-18	1	26.0	-4.5	159	165.5	-39.1	8
F-19	0	26.0	-6.9	133	165.5	-105.9	7
F-20	2	26.0	-2.1	112	165.5	-159.9	9
N-1	2	23.9	-0.7	157	156.3	6.2	9
N-2	2	23.9	-0.7	145	156.3	-24.7	8

Table 3. Rose Hulman Source Storage Building Radiation Survey.

Grid Location	Raw Alpha Count cpm	Alpha MDA DPM	Alpha Activity DPM / 100 cm^2	Raw Beta Count cpm	Beta MDA DPM	Beta Activity DPM / 100 cm^2	Gamma Radiation µRem/hr
N-3	3	23.9	1.7	169	156.3	37.0	9
N-4	4	23.9	4.0	156	156.3	3.6	7
N-5	2	23.9	-0.7	158	156.3	8.7	8
N-6	3	23.9	1.7	142	156.3	-32.4	7
N-7	4	23.9	4.0	143	156.3	-29.8	8
N-8	3	23.9	1.7	172	156.3	44.7	8
E-1	4	23.9	4.0	136	156.3	-47.8	8
E-2	6	23.9	8.8	159	156.3	11.3	8
E-3	1	23.9	-3.1	140	156.3	-37.5	7
E-4	2	23.9	-0.7	166	156.3	29.3	7
E-5	4	23.9	4.0	157	156.3	6.2	7
E-6	1	23.9	-3.1	135	156.3	-50.4	8
E-7	3	23.9	1.7	146	156.3	-22.1	8
E-8	7	23.9	11.2	151	156.3	-9.3	7
E-9	4	23.9	4.0	156	156.3	3.6	8
E-10	4	23.9	4.0	160	156.3	13.9	8
S-1	6	23.9	8.8	146	156.3	-22.1	7
S-2	4	23.9	4.0	134	156.3	-53.0	8
S-3	1	23.9	-3.1	136	156.3	-47.8	7
S-4	1	23.9	-3.1	141	156.3	-35.0	7
S-5	2	23.9	-0.7	151	156.3	-9.3	7
S-6	4	23.9	4.0	141	156.3	-35.0	8

Table 3. Rose Hulman Source Storage Building Radiation Survey.

Grid Location	Raw Alpha Count cpm	Alpha MDA DPM	Alpha Activity DPM / 100 cm^2	Raw Beta Count cpm	Beta MDA DPM	Beta Activity DPM / 100 cm^2	Gamma Radiation µRem/hr
S-7	2	23.9	-0.7	137	156.3	-45.2	8
S-8	2	23.9	-0.7	143	156.3	-29.8	8
W-1	1	23.9	-3.1	188	156.3	85.9	8
W-2	2	23.9	-0.7	135	156.3	-50.4	8
W-3	3	23.9	1.7	152	156.3	-6.7	8
W-4	1	23.9	-3.1	152	156.3	-6.7	9
W-5	3	23.9	1.7	150	156.3	-11.8	8
W-6	1	23.9	-3.1	149	156.3	-14.4	7
W-7	0	23.9	-5.5	109	156.3	-117.2	8
W-8	0	23.9	-5.5	96	156.3	-150.6	7
W-9	2	23.9	-0.7	137	156.3	-45.2	7
W-10	2	23.9	-0.7	151	156.3	-9.3	7

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER: RAM SERVICES INC ORDER NO. 239119/ 293495

Mfg. Ludlum Measurements, Inc. Model 2224 Serial No. 170346

Mfg. Ludlum Measurements, Inc. Model 43-89 Serial No. PR 182428

Cal Date 18-Jul-05 Cal Due Date 18-Jul-06 Cal Interval 1 Year Meterface 202-694

Check mark ✓ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 43 % Alt 702.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

✓ Mechanical ck ✓ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ✓ Reset ck ☐ Window Operation ☐ Geotropism
✓ Audio ck ☐ Alarm Setting ck ☑ Batt. ck (Min. Volt) 2.2 VDC
✓ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97

Instrument Volt Set 850 V Input Sens. Comments mV Det. Oper. 850 V at Comments mV Threshold Dial Ratio ____ = ____

✓ HV Readout (2 points) Ref./Inst. 500 / 495 V Ref./Inst. 1500 / 1490 V

COMMENTS:

Calibrated w/ 6ft cable Firmware: 390063

operational check source reads ≈ 100cpm @ x100 (10Kcpm) with screen side of probe centered on source.

overload set to simulate light leak

Alpha threshold: 120mv
Beta threshold: 3.5mv
Beta window: 30mv

Cs-137 eff: 38.9% (2π) Source Count: 1,508 cpm − 111cpm background ÷ 3,588cpm Source ~~count~~ size 2π

Pu-239 eff: 42% (2π) Source Count: 6,726cpm − 0cpm background ÷ 15,900 cpm Source size

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400kcpm	400	400
x1000	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

*Uncertainty within ±10% C.F. within ±20% ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	401989	401989
	40kcpm	40139	40139
	4kcpm	4015	4015
	400cpm	402	402
	40cpm	41	41

Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ 3112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-3

✓ Alpha S/N 5283-04 ✓ Beta S/N Tc-99 5279-04 ☑ Other Cs-137 158-112, Sr/Y-90 5281-04

✓ m 500 S/N 57881 ☐ Oscilloscope S/N ____ ☑ Multimeter S/N 80040300

Calibrated By: Michael J Thomas Date 18-July-05

Reviewed By: [signature] Date 20 Jul 05

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

AC Inst. ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556 U.S.A

Bench Test Data For Detector

Detector 43-89 Serial No. PR 182428 Order #. 239119/293495
Customer RAM SERVICES INC Alpha Input Sensitivity 120 mv
Counter 2224 Serial No. 170346 Beta Input Sensitivity 3.5 mv
Count Time 1 Minute Beta Window 30 mv
Other _____ Distance Source to Detector Surface

High Voltage	Background Alpha	Background Beta	Isotope Tc-99 Size 18,000cpm Alpha	Tc-99 Beta	Isotope SrY-90 Size 83,496cpm Alpha	SrY-90 Beta	Isotope Pu-239 Size 15,900cpm Alpha	Pu-239 Beta
825	0	76	13	3,351	0	27,112	5,968	368
→ 850	0	111	8	5,074	0	35,469	6,726	399
875	1	150	13	5,863	3	42,085	6,806	477
900	0	196	4	6,858	2	44,310	6,904	782

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable
☐ Gas Proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter

Signature Michael J Thomas Date 18-July-05

• Serving The Nuclear Industry Since 1962 •

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A

CUSTOMER RAM SERVICES INC ORDER NO 226568/26667C

Probe: Bicron Mode: MICRO ANALYS Serial No. B863H

Probe: Mode: Serial No.

Cal Date 7-Dec-04 Cal Due Date 7-Dec-05 Cal. Interval 1 Year Meterface D-5

Check mark ✓ applies to applicable instr. and/or detector AW mfg. spec. T. 73 °F RH 31 % Alt 700.8 mm Hg

New Instrument Instrument Received Within Toler. +-10% 10-20% Out of Tol. Requiring Repair ✓ Other-See comments

✓ Mechan. cal. ck ✓ Meter Zeroed Background Subtract Input Sens. Linearity
✓ F/S Resp. ck Reset ck. ✓ Window Operation ✓ Geotropism
✓ Audio ck Alarm Setting ck ✓ Batt. ck. (Min. Volt) VDC
Calibrated in accordance with LMI SOP 14.8 rev. 12/05/89 ✓ Calibrated in accordance with LMI SOP 14.9 rev. 02/07/97

Instrument Volt Set 807 V Input Sens 310 mV Det. Oper. V at mV Threshold Dial Ratio = mV

✓ HV Readout (2 points) Ref./Inst 400 / V Ref./Inst 1600 / V

COMMENTS:

No as-founds (loss of high voltage)

Operational check performed by Jim Pluyt on 6/11/2005

RED Cs-137, 5uC: READS 2650 uR/hr BATTERY READS 3.6
ORANGE Co-137, 5uC: READS 3400 uR/hr
DELAWARE Ra-226 WATCH READS 450 uR/hr

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 1000	4000 uR/hr	N/A	4
X 1000	1000 uR/hr		1
X 100	400 uR/hr = 71000cpm		4
X 100	100 uR/hr		1
X 10	7100 cpm		4
X 10	1770 cpm		1
X 1	710 cpm		4
X 1	177 cpm		1

*Uncertainty within ± 10% C.F. within ± 20% X 10, X 1 **Range(s) Calibrated Electronically**

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			
Log Scale			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology or to the calibration facilities of other International Standards Organization members or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The quality system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs 137 Gamma S/N 1162 G-12 M565 5105 T1008 ✓ T879 E552 E551 720 734 1616 Neutron Am-241 Be S/N T-304

Alpha S/N Beta S/N Other

~ 500 S/N 50800 Oscilloscope S/N ✓ Multimeter S/N 83990502

Calibrated By Charles Disk Date 7 Dec 04

Reviewed By [signature] Date 7 Dec 04

This certificate shall not be reproduced except in full without the written approval of Ludlum Measurements, Inc.

AC Inst Only Passed Dielectric (Hi-Pot) and Continuity Test Failed

FORM 540 — **ADCO SERVICES, INC.**

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

SHIPPING PAPER

1 EMERGENCY TELEPHONE NUMBER (Include Area Code): 812-877-8124

ORGANIZATION: ROSE HULMAN

2 IS THIS AN "EXCLUSIVE USE" SHIPMENT? [X] YES [ ] NO

3 TOTAL NUMBER OF PACKAGES IDENTIFIED ON THIS MANIFEST =====> 4

4 DOES EPA REGULATED WASTE REQUIRING A MANIFEST ACCOMPANY THIS SHIPMENT? [ ] YES [X] NO
If "Yes," provide Manifest Number =====>

EPA MANIFEST NUMBER: NONE REQUIRED

5 SHIPPER -- NAME AND FACILITY
ROSE HULMAN/FOR THE ACCOUNT OF
ADCO SERVICES, INC
5500 WABASH AVENUE
TERRE HAUTE, IN 47803

SC PERMIT: NA
SHIPMENT NUMBER: 05-0307 L
CONTACT: MICHAEL R. HOWARD

6 CARRIER -- Name and Address
ADCOM EXPRESS, INC
17650 DUVAN DRIVE
TINLEY PARK, IL 60477

CONTACT: BOB BASSETT

SIGNATURE -- *Authorized carrier acknowledging waste receipt*

SHIPMENT I.D. NUMBER: 60542
[ ] COLLECTOR
[ ] PROCESSOR
[X] GENERATOR TYPE (Specify): A

TELEPHONE NUMBER (Include Area Code): 812-877-8124

EPA I.D. NUMBER: ILD 047267364

SHIPPING DATE: 8/17/05

TELEPHONE NUMBER (Include Area Code): 708-429-3013

DATE

7 FORM 540 AND 540A — PAGE 1 OF 1 PAGE(S)
FORM 541 AND 541A — 1 PAGE(S)
FORM 542 AND 542A — None PAGE(S)
ADDITIONAL INFORMATION — None PAGE(S)

8 MANIFEST NUMBER (Use this number on all continuation pages): 05-0307 L

9 CONSIGNEE - Name and Facility Address
ADCO SERVICES, INC.
17650 DUVAN DRIVE
TINLEY PARK, IL 60477

CONTACT: LEN WARBIANY/FACILITY MGR
TELEPHONE NUMBER (Include Area Code): 708-429-1660

SIGNATURE - *Authorized consignee acknowledging waste receipt*

DATE

10 CERTIFICATION

This is to certify that the herein-named materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. This also certifies that the materials are classified, packaged, marked, and labeled and are in proper condition for transportation and disposal as described in accordance with the requirements of 10 CFR Parts 20 and 61, or equivalent state regulations.

AUTHORIZED SIGNATURE | TITLE | DATE

11 U.S. DEPARTMENT OF TRANSPORTATION DESCRIPTION (including proper shipping name, hazard class, UN ID number, and any additional information)	12 DOT LABEL "RADIOACTIVE"	13 TRANSPORT INDEX	14 PHYSICAL AND CHEMICAL FORM	15 INDIVIDUAL RADIONUCLIDES		16 TOTAL PACKAGE ACTIVITY MBq	mCi	17 LSA/SCO CLASS	18 TOTAL WEIGHT OR VOLUME (Use appropriate units)	19 IDENTIFICATION NUMBER OF PACKAGE
Radioactive material, excepted package-limited quantity of material, 7, UN2910	NA	NA	Solid METAL PARTS	Cs-137		7.4000E-01	2.0000E-02	NA	113. LBS; 7.5 FT3	05-0307-01
Radioactive material, excepted package-limited quantity of material, 7, UN2910	NA	NA	Solid PAPER PLASTIC GLASS	Cs-137		3.7000E-01	1.0000E-02	NA	199. LBS; 7.5 FT3	05-0307-02
Radioactive material, excepted package-limited quantity of material, 7, UN2910	NA	NA	Solid PAPER PLASTIC GLASS	Cs-137		1.8500E-01	5.0000E-03	NA	65. LBS; 1.4 FT3	05-0307-03
Radioactive material, excepted package-limited quantity of material, 7, UN2910	NA	NA	Solid CINDER BLOCKS	Cs-137		1.8500E+00	5.0000E-02	NA	1809. LBS; 32. FT3	05-0307-04

FOR CONSIGNEE USE ONLY

20. Check appropriate items

___ Customer represents and warrants that all data set forth in this Uniform Low-Level Radioactive Manifest is true and correct in all respects.

___ Packages listed as "Limited Quantity of Radioactive Material" on this manifest conform to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material UN2910.

___ Packages listed as "NON-REGULATED MATERIAL" on this manifest are classified in accordance with 49 CFR 173.403 (Definition of Radioactive Material). These Materials must still be disposed of at a licensed facility.

FORM 540 (10-96)

FORM 541 — ADCO SERVICES, INC.

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

CONTAINER AND WASTE DESCRIPTION

Additional Nuclear Regulatory Commission (NRC) Requirements for Control, Transfer and Disposal of Radioactive Waste

1. MANIFEST TOTALS

NUMBER OF PACKAGES/ DISPOSAL CONTAINERS	NET WASTE VOLUME	NET WASTE WEIGHT	SPECIAL NUCLEAR MATERIAL (grams) U-233	U-235	Pu	TOTAL
4	m3 1.3705	kg 991.5530	NP	NP	NP	NP
	ft3 48.4000	lb 2186.0000				

ACTIVITY	ALL NUCLIDES	TRITIUM	C-14	Tc-99	I-129	SOURCE	
MBq	3.1460E+00	NP	NP	NP	NP	(kgs)	NA
mCi	8.5000E-02	NP	NP	NP	NP	(lbs)	NA

2. MANIFEST NUMBER: 05-0307 L

3. PAGE 1 OF 1 PAGE(S)

4. SHIPPER NAME: ROSE HULMAN/FOR THE ACCO

SHIPMENT ID NUMBER: 60542

DISPOSAL CONTAINER DESCRIPTION							WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER							
							PHYSICAL DESCRIPTION			14 CHEMICAL DESCRIPTION		15 RADIOLOGICAL DESCRIPTION			16 WASTE CLASSIFICATION A-Class A Stable A/U-Class A Unstable B-Class B C-Class C
5 CONTAINER IDENTIFICATION NUMBER / SC PERMIT	6 CONTAINER DESCRIPTION (See Note 1 & Note 1A)	7 VOLUME (m3) (ft3)	8 WASTE AND CONTAINER WEIGHT (kg) (lb)	9 SURFACE RADIATION LEVEL mrem/hr mSv/hr	10 SURFACE CONTAMINATION dpm/100 cm2 MBq/100 cm2 ALPHA	BETA-GAMMA	11 WASTE DESCRIPTOR (See Note 2 & Note 2A)	12 APPROXIMATE WASTE VOLUME(S) IN CONTAINER (m3) (ft3)	13 SOLIDIFICATION OR STABILIZATION MEDIA (See Note 3 & Note 3A)	CHEMICAL FORM/ CHELATING AGENT	WEIGHT % CHELATING AGENT IF>0.1%	INDIVIDUAL RADIONUCLIDES AND ACTIVITY (MBq) AND CONTAINER TOTAL OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT RADIONUCLIDES	MBq	mCi	
05-0307-01/NA 8600 WABASH AVENUE TERRE HAUTE, IN 47803	4	0.2124	51.2650	3.0000E-04	NP	NP	39-H	0.2124	100	METAL PARTS/NP	0.00	Cs-137	7.4000E-01	2.0000E-02	AU
		7.5000	113.0000	3.0000E-02	NP	NP		7.5000				Subtotal	7.4000E-01	2.0000E-02	
												Total	7.4000E-01	2.0000E-02	
05-0307-02/NA 8600 WABASH AVENUE TERRE HAUTE, IN 47803	4	0.2124	90.2649	3.0000E-04	NP	NP	59-VERIFICATION AND TRANSLOAD-H	0.2124	100	PAPER PLASTIC GLASS/NP	0.00	Cs-137	3.7000E-01	1.0000E-02	AU
		7.5000	199.0000	3.0000E-02	NP	NP		7.5000				Subtotal	3.7000E-01	1.0000E-02	
												Total	3.7000E-01	1.0000E-02	
05-0307-03/NA 8600 WABASH AVENUE TERRE HAUTE, IN 47803	4	0.0396	29.4835	3.0000E-04	NP	NP	59-VERIFICATION AND TRANSLOAD-H	0.0396	100	PAPER PLASTIC GLASS/NP	0.00	Cs-137	1.8500E-01	5.0000E-03	AU
		1.4000	65.0000	3.0000E-02	NP	NP		1.4000				Subtotal	1.8500E-01	5.0000E-03	
												Total	1.8500E-01	5.0000E-03	
05-0307-04/NA 8600 WABASH AVENUE TERRE HAUTE, IN 47803	1	0.9061	820.5487	3.0000E-04	NP	NP	29-H	0.9061	100	CINDER BLOCKS/NP	0.00	Cs-137	1.8500E+00	5.0000E-02	AU
		32.0000	1809.0000	3.0000E-02	NP	NP		32.0000				Subtotal	1.8500E+00	5.0000E-02	
												Total	1.8500E+00	5.0000E-02	
Shipment Totals		1.3705	991.5530										3.1450E+00	8.5000E-02	
		48.4000	2186.0000												

NOTE 1: Container Description Codes. For containers/ waste requiring disposal in approved structural overpacks the numerical code must be followed by "-OP."

1 Wooden Box or Crate
2 Metal Box
3 Plastic Drum or Pail
4 Metal Drum or Pail
5 Metal Tank or Liner
6 Concrete Tank or Liner
7 Polyethlene Tank or Liner
8 Fiberglass Tank or Liner
9 Demineralizer
10 Gas Cylinder
11 Bulk, Unpackaged Waste
12 Unpackaged Components
13 High Integrity Container
19 Other. Describe in Item 6, or additional page

Note 1A: Barnwell Specific Container Description Codes (Choose one code as may be applicable.)

A High Integrity Container - Poly
B High Integrity Container - Poly with Steel Shell
C High Integrity Drum Overpack - Poly
D High Integrity Container - Stainless Steel
E High Integrity Container - Fiberglass
F Liner - Steel

NOTE 2: Waste Descriptor Codes (Choose up to three which predominate by volume.)

20 Charcoal
21 Incinerator Ash
22 Soil
23 Gas
24 Oil
25 Aqueous Liquid
26 Filter Media
27 Mechanical Filter
28 EPA or State Hazardous
29 Demolition Rubble
30 Cation Ion exchange Media
31 Anion Ion-exchange Media
32 Mixed Bed Ion-exchange Media
33 Contaminated Equipment
34 Organic Liquid (except oil)
35 Glassware or Labware
36 Sealed Source/Device
37 Paint or Plating
38 Evaporator Bottoms/Sludges/ Concentrates
39 Compactible Trash
40 Noncompactible Trash
41 Animal Carcass
42 Biological Material (except animal carcass)
43 Activated Material
59 Other. Describe in item 11 or additional page

Note 2A: Barnwell Specific Waste Descriptor Codes (Choose all applicable codes.)

G Dewatered
H Solid
I Combustible
J Non-combustible
K Air Filtration Filters
L Asbestos

Note 3: Solidification and Stabilization Media Codes. (Choose up to three which predominate by volume.) For media meeting disposal site structural stability requirements, the numerical code must be followed by "-S" and the media vendor and brand name must also be identified in Item 13. Code 100=NONE REQUIRED.

Solidification
90 Cement
91 Concrete (encapsulation)
92 Bitumen
93 Vinyl Chloride
94 Vinyl Ester Styrene
99 Other. Describe in Item 13. or additional page
100 None Required

Note 3A: Barnwell Specific Solidification and Stabilization Media Codes (Choose this code if applicable)

M Wax Binder

FORM 541 (10/96)

FORM 540 Envirocare of Utah, Inc.

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

SHIPPING PAPER

1. EMERGENCY TELEPHONE NUMBER (Include Area Code) 800-424-9300	5. SHIPPER NAME AND FACILITY Philotechnics, Ltd 118 Mitchell Road Oak Ridge, TN 37830
ORGANIZATION CHEMTREC	USER PERMIT NUMBER 0300002368 / SHIPMENT NUMBER 0866-01-0012
2. IS THIS AN "EXCLUSIVE USE" SHIPMENT? [ ] YES [X] NO	CONTACT Don Hartje
3. TOTAL NUMBER OF PACKAGES IDENTIFIED ON THIS MANIFEST → 1	6. CARRIER – Name and Address Tri State Motor Transit 8141 East 7th Street Joplin, MO 64802
4. DOES EPA REGULATED WASTE REQUIRING A MANIFEST ACCOMPANY THIS SHIPMENT? [X] YES [ ] NO If "Yes," provide Manifest Number →	CONTACT Mark Gooch
EPA MANIFEST NUMBER IN 406730	SIGNATURE - Authorized carrier acknowledging waste accept [signature] TSMT

SHIPMENT ID NUMBER 0866-01-0012	7. FORM 540 AND 540A PAGE 1 OF 1 PAGE(S); FORM 541 AND 541A 1 PAGE(S); FORM 542 AND 542A 1 PAGE(S); ADDITIONAL INFORMATION None PAGE(S)
X COLLECTOR	8. MANIFEST NUMBER (Use this number on all continuation pages) 0866-01-0012
PROCESSOR	
GENERATOR TYPE (Specify)	9. CONSIGNEE – Name and Facility Address Envirocare of Utah, Inc. Clive Disposal Site Interstate 80, Exit 49 Clive, UT 84029 "Treatment Facility"
TELEPHONE NUMBER (Include Area Code) 970-256-0377	CONTACT Shipping and Receiving
EPA I.D. NUMBER [illegible] OHD 065 038 994	TELEPHONE NUMBER (Include Area Code) (435)884-4300
SHIPPING DATE 8/18/05	SIGNATURE - Authorized consignee acknowledging waste receipt
TELEPHONE NUMBER (Include Area Code) 800-234-8763	DATE
DATE 8 18 05	

10. CERTIFICATION

This is to certify that the herein-named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. This also certifies that the materials are classified, packaged, marked, and labeled and are in proper condition for transportation and disposal as described in accordance with the requirements of 10 CFR Parts 20 and 61, or equivalent state regulations.

AUTHORIZED SIGNATURE	TITLE	DATE
[signature]	Philotechnics Shipper	08-18-05
[signature]	MLE - EHS	08-18-05

11. U.S. DEPARTMENT OF TRANSPORTATION DESCRIPTION (Including proper shipping name, hazard class, UN ID number, and any additional information)	12. DOT LABEL "RADIOACTIVE"	13. TRANSPORT INDEX	14. PHYSICAL AND CHEMICAL FORM	15. INDIVIDUAL RADIONUCLIDES	16. TOTAL PACKAGE ACTIVITY MBq	16. TOTAL PACKAGE ACTIVITY mCi	17. LSA/SCO CLASS	18. TOTAL WEIGHT OR VOLUME (Use appropriate units)	19. IDENTIFICATION NUMBER OF PACKAGE
Hazardous Waste Solid, N.O.S., 9, NA3077 PGIII (Contains Lead, Non-Radioactive per DOT)	NA	NA	Solid Metal Oxides	Cs-137	4.4215E-01	1.1950E-02	NA	4775 LBS; 30.4 FT3	RHIT-1

FOR CONSIGNEE USE ONLY

- ___ Record Waste Description Inadequate
- ___ Contamination or Leakage Detected
- ___ Unexpected Exposure Rates Detected
- ___ Labels, Markings, etc. Inadequate
- ___ Container Integrity Inadequate
- ___ Other
- ___ No Violations Detected on this Shipment

20. TERMS AND CONDITION

A. HAZARDOUS MATERIALS. Generator represents & warrants that Waste Material ✓ is (or) ___ is not a hazardous waste as defined in 40 CFR 261. Where the material is a hazardous waste, this shipment is also accompanied by a separate and completed hazardous waste manifest, along with the appropriate land-disposal restriction notice and/or certification as required by 40 CFR 268.1.

B. TITLE. Upon acceptance at the disposal site by Envirocare of Utah, Inc., and all appropriate regulatory authorities, title to the Waste Material which conforms to Generator's representations herein shall thereupon transfer from Generator and be vested in Envirocare of Utah, Inc.

C. WASTE MATERIAL. Generator represents and warrants that all data set forth in this (UNIFORM LOW LEVEL RADIOACTIVE WASTE MANIFEST) are true and correct in all respects and in accordance with all applicable governmental laws, rules, regulations and Envirocare of Utah, Inc.'s facility license.

D. INDEMNIFICATION. Generator agrees to indemnify Envirocare of Utah, Inc., its officers, employees and agents against all losses and liability whatsoever if such losses or liability results from the failure of the Waste Material to conform in all material respects to the data supplied on the (UNIFORM LOW LEVEL RADIOACTIVE WASTE MANIFEST) and this shipment fails to meet the standards prescribed by the Department of Transportation or any governmental agency having jurisdiction over such matters.

FORM 540 (10/98)

FORM 541 Envirocare of Utah, Inc.

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

CONTAINER AND WASTE DESCRIPTION

Additional Nuclear Regulatory Commission (NRC) Requirements for Control, Transfer and Disposal of Radioactive Waste

1. MANIFEST TOTALS

NUMBER OF PACKAGES/ DISPOSAL CONTAINERS	NET WASTE VOLUME	NET WASTE WEIGHT	SPECIAL NUCLEAR MATERIAL (grams) U-233	U-235	Pu	TOTAL
1	m3 0.7476 ft3 26.4000	kg 2165.9037 ton 2.3875	NP	NP	NP	NP

ACTIVITY	ALL NUCLIDES	TRITIUM	C-14	Tc-99	I-129	SOURCE	
MBq		NP	NP	NP	NP	(kgs)	NA
mCi		NP	NP	NP	NP	(tons)	NA

2. MANIFEST NUMBER 0866-01-0012

3. PAGE 1 OF 1 PAGE(S)

4. SHIPPER NAME Philotechnics, Ltd.

SHIPMENT ID NUMBER 0866-01-0012

DISPOSAL CONTAINER DESCRIPTION / WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER

5. CONTAINER IDENTIFICATION NUMBER / GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1 & Note 1A)	7. VOLUME (m3) (ft3)	8. WASTE AND CONTAINER WEIGHT (kg) (ton)	9. SURFACE RADIATION LEVEL mSv/hr mrem/hr	10. SURFACE CONTAMINATION MBq/100 cm2 dpm/100 cm2 ALPHA	BETA-GAMMA	PHYSICAL DESCRIPTION 11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	12. APPROXIMATE WASTE VOLUME(S) IN CONTAINER m3 (ft3)	13. SOLIDIFICATION OR STABILIZATION MEDIA (See Note 3)	14. CHEMICAL DESCRIPTION CHEMICAL FORM/ CHELATING AGENT	WEIGHT % CHELATING AGENT IF>0.1%	15. RADIOLOGICAL DESCRIPTION INDIVIDUAL RADIONUCLIDES AND ACTIVITY (MBq) AND CONTAINER TOTAL; OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT RADIONUCLIDES	pCi/gm	MBq	mCi	16. WASTE CLASSIFICATION AS-Class A Stable AU-Class A Unstable B-Class B C-Class C
RHIT-VE0012	1	0.7476 26.4000	2165.9037 2.3875	1.0000E-04 1.0000E-02	<3.6740E-06 <2.200E+02	<3.6740E-05 <2.200E+03	59-LEAD-H	0.7476 26.4000	100 100	Metal Oxides/ NA	0.00					NA AU
Shipment Totals		0.7476 26.4000	2165.9037 2.3875											0.0000E+00	0.0000E+00	

NOTE 1: Container Description Codes. For containers/ waste requiring disposal in approved structural over-packs the numerical code must be followed by "-OP."

1 Wooden Box or Crate
2 Metal Box
3 Plastic Drum or Pail
4 Metal Drum or Pail
5 Metal Tank or Liner
6 Concrete Tank or Liner
7 Polyethylene Tank or Liner
8 Fiberglass Tank or Liner
9 Demineralizer
10 Gas Cylinder
11 Bulk, Unpackaged Waste
12 Unpackaged Components
13 High Integrity Container
19 Other. Describe in Item 6 or additional page

Note 1A: Bulk Packaging Description Codes (Choose one code as may be applicable.)

A Gondola
B Intermodal
C End-dump
D Roll-off
E Seavan

NOTE 2: Waste Descriptor Codes. (Choose up to three which predominate by volume.)

20. Charcoal
21 Incinerator Ash
22. Soil
23. Gas
24. Oil
25. Aqueous Liquid
26. Filter Media
27. Mechanical Filter
28. EPA or State Hazardous
29 Demolition Rubble
30. Cation Ion-exchange Media
31 Anion Ion exchange Media
32. Mixed Bed Ion-exchange Media
33 Contaminated Equipment
34. Organic Liquid (except oil)
35 Glassware or Labware
36 Sealed Source/Device
37 Paint or Plating
38 Evaporator Bottoms/Sludges/ Concentrates
39 Compactible Trash
40 Noncompactible Trash
41 Animal Carcass
42. Biological Material (except animal carcass)
43 Activated Material
59 Other. Describe in item 11, or additional page

Note 2A: Specific Waste Descriptions (Choose all applicable codes.)

G Dewatered
H Solid
I Combustible
J Non-combustible
K Air Filtration Filters
L Asbestos

Note 3: Solidification and Stabilization Media Codes (Choose up to three which predominate by volume.) For media meeting disposal site structural stability requirements, the numerical code must be followed by "-S" and the media vendor and brand name must also be identified in item 13. Code 100=NONE REQUIRED

Solidification
90. Cement
91 Concrete (encapsulation)
92. Bitumen
93. Vinyl Chloride
94. Vinyl Ester Styrene
99 Other. Describe in item 13, or additional page
100. None Required

FORM 541 (10.98)

FORM 542

Envirocare of Utah, Inc.

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

MANIFEST INDEX AND REGIONAL COMPACT TABULATION

List all original "PROCESSED WASTE" generators (if any) before "COLLECTED WASTE" generators.

1. WASTE COLLECTOR/PROCESSOR

NAME: Philotechnics, Ltd.

IDENTIFICATION NUMBER: 0001

SHIPPING DATE: 9/18/05

SHIPPER USE ONLY

2. MANIFEST NUMBER: 0866-01-0012

3. PAGE 1 OF 1 PAGE(S)

4 GENERATOR IDENTIFICATION NUMBER	5 GENERATOR NAME AND TELEPHONE NUMBER	6 GENERATOR FACILITY ADDRESS	6A WASTE DESCRIPTION (NOMENCLATURE)	7. PREPROCESSED WASTE (OR MATERIAL) VOLUME (m3)	(ft3)	8 MANIFEST NUMBER(S) UNDER WHICH WASTE (OR MATERIAL) RECEIVED AND DATE OF RECEIPT	9 WASTE CODE P = PROCESSED C = COLLECTED	10 ORIGINATING COMPACT REGION OR STATE	11 AS PROCESSED/COLLECTED TOTAL: A. SOURCE MATERIAL (kg)	(lb)	B. SNM (g)	C. ACTIVITY (MBq)	(mCi)	D. VOLUME (m3)	(ft3)	E. WEIGHT (tons)	F. MAXIMUM PACKAGE RADIATION LEVEL mrem/hr
E0012 O	Rose Hulman Inst. of Technology 812-877-8124	5500 Wabash Ave., CM-29 Terre Haute, IN 47803 3999	LEAD	0.7476	26.4000	0866-01-0012 (09/18/2005)	C	IN	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.7476	26.4000	2.3875	1.000E-02
TOTALS OF ALL PAGES (FORMS 542 AND 542A)									0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.7476	26.4000	2.3875	1.00E-02

Form 542 (10-95)