

August 15, 2011

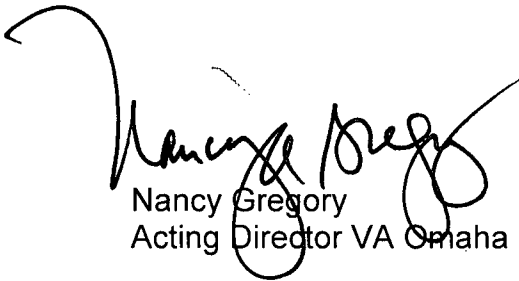
U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Re : Characterization Report regarding Alan J. Blotcky Reactor Facility, License R-57, Docket # 50-131

The Reactor Safeguards Committee for the Alan J. Blotcky Reactor Facility submits the enclosed document.

*"AJ Blotcky Facility Characterization Report
VA Nebraska-Western Iowa Health Care System
Omaha, Nebraska
Order No. VA701-BP-004/VA-101-G05020
July 2011"*

This report was prepared by AECOM. AECOM is the technical support service contracted by the VA Nebraska Western Iowa Healthcare System to assist with the decommissioning of the Alan J. Blotcky Reactor Facility.



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1.0 Introduction

The Alan J. Blotcky reactor facility located within the United States (U.S.) Department of Veterans Affairs (VA) Medical Center (VAMC) in the city of Omaha, Douglas County, Nebraska maintains U.S. Nuclear Regulatory Commission (NRC) Facility Operating License R-57. The reactor is housed in the basement of the southwest wing of the medical center building. The Omaha VAMC is part of the VA Nebraska-Western Iowa Health Care System.

The reactor is a Training, Research, Isotopes, and General Atomics (TRIGA) MARK I Reactor, owned by the VA. It is a pool-type facility that was previously fueled with standard TRIGA fuel elements enriched to less than 20% uranium-235 zirconium hydride. Fuel elements were removed in June 2002 and shipped to the U.S. Geological Survey TRIGA reactor in Denver, Colorado.

The VAMC building is constructed of brick and reinforced concrete, including the floors, walls, and ceiling. Entrance to the reactor laboratory is normally through the secured door marked B526 on Figure 1.

Table 1 lists the rooms and areas within the Radioisotope Reactor Research Laboratory (B526). Historically, samples to be irradiated in the reactor were typically prepared in rooms B537, B535 and B533A. Irradiated samples were then processed in room B540 and stored in the isotope storage area B540A.

The reactor room ventilation supply provides 100% outside air, heated or cooled, to the reactor laboratory through six ceiling ducts. The exhaust exits the reactor room to the outside air through either an exhaust fan installed in the outside wall of the building or one of two continuously operated laboratory fume hoods. The exhaust suction fans are located in a small penthouse on the roof above the 12th story of the medical center. Since the hood exhaust is operated as a suction system, the entire ductwork is under negative pressure; therefore any air leakage would be into the duct rather than out, eliminating the potential for exposure within the medical center.

1.1 Site Characterization

A previous characterization of the reactor facility was performed in 2003 (Duratek 2003). This characterization included rooms, ventilation systems, drainage systems, cooling systems, storage areas, the reactor structures, and outside areas. The purpose of the characterization survey was to collect sufficient survey data to allow VA to develop a detailed Decommissioning Plan (DP, VA 2004). Upon its review of the draft decommissioning plan, NRC requested that additional characterization be performed to support conclusions and objectives presented in the plan (NRC 2008). The specific items noted in the Request for Additional Information (RAI) were the subject of discussion during an on-site meeting between VA and NRC in October 2010, as well as subsequent teleconference discussions.

In April 2011 AECOM prepared a Characterization Work Plan (AECOM 2011) to direct the additional characterization effort and provide the procedures to be used in addressing the additional items. The work plan was reviewed by both the VA and the NRC prior to mobilization.

Section 4 of the work plan contained the Sampling and Analysis Plan which described the survey and sampling protocols.

AECOM mobilized to the Omaha facility in May 2011 to perform the additional characterization activities as described in the work plan. Characterization activities included collecting surface and subsurface soil samples, surveying wastewater drain-lines and lab hood exhaust ducts, and performing additional surveys in the general reactor area. Additionally, samples from the reactor tank water demineralizer resins were collected to address questions about the isotope mix to be used in evaluating residual contamination. Results of these characterization activities are provided in the following sections of this report.

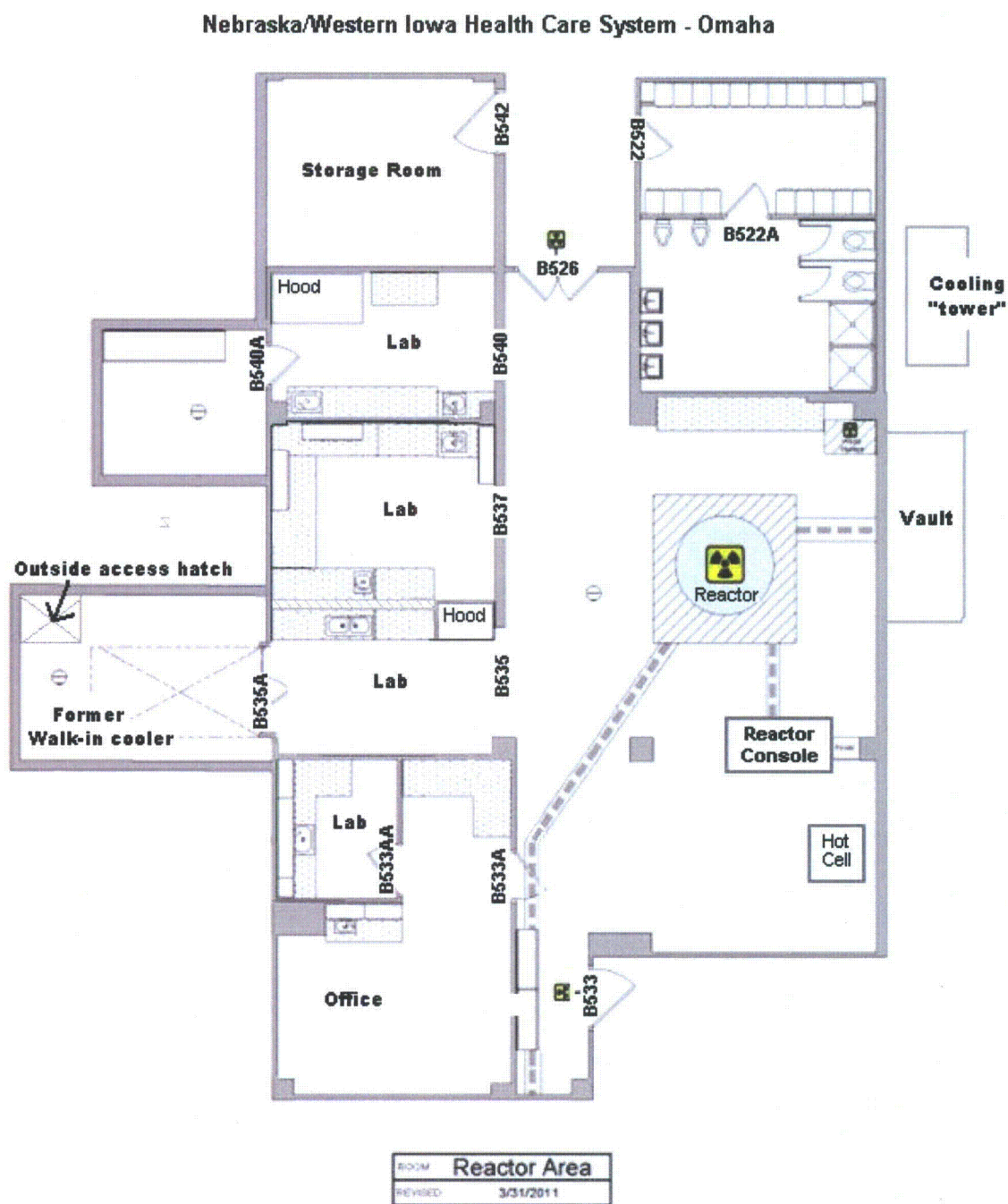
1.2 Additional Site Activities

In addition to the characterization activities, AECOM removed a significant amount of non-operational loose materials (e.g., desks, chairs, bookcases, etc.) from the reactor area after surveying the materials and demonstrating that they met free-release criteria. Along with the loose materials free-released, the walk-in cooler was disassembled and free-released to allow direct access to the outside of the facility (through roof of the cooler alcove) during decontamination efforts. A description of these activities, a listing of all free-released items, and the accompanying survey data are documented in the AJ Blotcky Reactor Facility Free Release Materials Report provided to the VA.

Table 1. Reactor Area Rooms

Room Numbers New (old)	Description	Former Use	Current Use
B522 (SW 1)	Locker Room	Storage of personal items by hospital staff	Storage of personal items by hospital staff
B522A (SW 1A)	Restroom and shower	Restroom and shower for hospital staff	Restroom and shower for hospital staff
B526 (SW 2)	Radioisotope Reactor Research Laboratory	Research activities and storage; contains 1 of 2 fume hoods	None
B533A (SW 2A)	Nuclear research lab and office	Sample Preparation	None
B533AA (SW 2B)	Office/Darkroom	Darkroom, office, and storage space	None
B537 (SW 2C)	Nuclear research lab and office	Sample preparation	None
B535A (SW 2D)	Walk-in Cooler	Cold storage	None
B540 (SW 2E)	Nuclear research lab and office	Sample processing; contains 1 of 2 fume hoods	None
B540A (SW 2F)	Isotope and general storage	Storage of irradiated samples	None

Figure 1. Reactor Area Map



2.0 Characterization Activities

2.1 Resin Bed Sampling

The reactor water demineralizer tank, located in the water cooling system “vault” or “pit” outside the building foundation east of the reactor area was sampled to determine the mix of isotopes that may be applicable to the contamination in and around the reactor. Previous resin sample analysis reported identified several isotopes of concern (Duratek 2003) that were not expected and the analysis or reporting of the analysis was called into question by the NRC (NRC 2008). Three resin samples were collected from the tank in a layered approach from the top, middle, and bottom of the tank to ensure representative sampling.

Resin samples were analyzed for ten isotopes using the technique and equivalent methods as listed in Table 2. Analysis included hard-to-detect (HTD) isotopes as well as gamma spectroscopy for activated metals. Analysis was performed by TestAmerica Laboratories (St. Louis, Missouri). Analytical methods were selected based on potential contaminants and to confirm or dismiss uncertain results from the previous sampling effort. Table 3 provides a summary of the results with the complete results are provided in Appendix A.

Table 2. Resin Sample Analytical Requirements

Isotope or Isotope Series	Analysis Technique	Analysis Method
Tritium (H-3)	liquid scintillation counting	EML HASL 300
Carbon-14 (C-14)	liquid scintillation counting	EERRF – C01
Iron-55 (Fe-55)	liquid scintillation counting	Column Separation
Nickel-59/63 (Ni-59/63)	liquid scintillation counting	EML HASL 300
Polonium-210 (Po-210)	alpha spectroscopy	EML HASL 300
Plutonium-241 (Pu-241)	liquid scintillation counting	EML HASL 300
Plutonium isotopes	alpha spectroscopy	EML HASL 300
Uranium isotopes	alpha spectroscopy	EML HASL 300
Thorium isotopes	alpha spectroscopy	EML HASL 300
Gamma emitting isotopes	Gamma spectroscopy	EML HASL 300

Notes:

EML – Environmental Measurements Laboratory
HASL – Health and Safety Laboratory

Table 3. Resin Sample Results Summary

Isotope	Test Method	Top Layer (pCi/g)	Middle Layer (pCi/g)	Bottom Layer (pCi/g)
H-3	LSC	2.99 ± 0.48	2.75 ± 0.45	2.28 ± 0.56
C-14	LSC	15.2 ± 1.8	<MDC	3.34 ± 0.85
Fe-55	LSC	<MDC	13.9 ± 7.8	16.8 ± 8.1
Ni-59	LSC	<MDC	<MDC	<MDC
Ni-63		2.8 ± 1.8	16.6 ± 3.7	18.0 ± 4.0
Po-210	Alpha spectroscopy	<MDC	<MDC	<MDC
Pu-241	LSC	<MDC	<MDC	<MDC
Plutonium Isotopes	Alpha spectroscopy	<MDC	<MDC	<MDC
Uranium Isotopes	Alpha spectroscopy	<MDC	<MDC	<MDC
Thorium Isotopes	Alpha spectroscopy	<MDC	<MDC	<MDC
Gamma Emitting Isotopes	Gamma spectroscopy			
Cs-137		<MDC	2.87 ± 0.46	3.88 ± 0.52
Co-60		3.65 ± 0.33	49.6 ± 3.3	57.8 ± 3.8
Eu-152		1.38 ± 0.31	12.3 ± 1.1	14.2 ± 1.4
K-40		<MDC	13.1 ± 2.3	17.0 ± 2.6

Notes:

LSC – Liquid Scintillation Counter

pCi/g – picoCuries per gram

MDC – Minimum Detectable Concentration

2.2 Activated Metal Analysis

There were several pieces of activated metal outside of the reactor pool available for sampling. These included stainless steel cables and aluminum cable clamps which had been used to suspend items in the reactor pool. Both the stainless steel and aluminum have elements and/or impurities capable of activation with the reactor. One sample of each of the cables and cable clamps were collected and analyzed to identify nuclides in the activated materials. The identification of the activated metals contained within samples of stainless steel and aluminum and their ratios will benefit future waste profiling needs and provide estimates of the activity of internal reactor components. Levels of activation isotopes such as cobalt-57 (Co-57), cobalt-60 (Co-60), and cesium-137 (Cs-137) can facilitate the calculation of other isotopes which may also be present.

TestAmerica analyzed the activated metal samples using gamma spectroscopy for identification of gamma-emitting isotopes including common activation products. Results are only approximate as the laboratory did not have a calibration standard for the specific geometry of each sample (approximated with air filter geometry). An accurate geometry assists the calculation of the specific gamma wavelength allowing a more complete isotope and activity

characterization. The laboratory was requested to maintain the samples in their inventory for further analysis as necessary. A summary of results are presented in Table 4; the complete results are provided in Appendix B.

Table 4. Activated Metal Analysis Results

Aluminum	
Isotope	Activity (pCi/g)
Cs-137	3.7 ± 1.2
Stainless Steel	
Isotope	Activity (pCi/g)
Cs-137	< MDC
Co-60	39.2 ± 3.3

Notes:

pCi/g – picoCuries per gram

MDC – Minimum Detectable Concentration

2.3 Surface Contamination Surveys

Another goal of the characterization effort was to determine the extent, if any, of total and removable surface contamination throughout the reactor facility area. Some data was available from the previous characterization, but during that event there were few removable contamination swipes analyzed for tritium (10%) and other HTD isotopes (0). During the current characterization, direct alpha/beta measurements were made and removable contamination swipes were collected across the floors of Rooms B526, B540, and B540A in 1-meter square grids. Room B535A (the walk-in cooler) was also surveyed after the removal of the cooler wall liner. This area was not previously characterized.

Swipes were also taken in other locations likely to accumulate contamination and in areas where the previous characterization efforts identified alpha or beta contamination. These locations included the following:

- Reactor pool covers
- Reactor bridge and bridge components
- Pneumatic transfer trench
- Trench surrounding top of reactor
- Cooling system “vault” floor

Total surface contamination measurements were made using 100 square centimeter (cm²) alpha/beta phoswich scintillation detectors. Direct measurements were collected using a 1-minute count time.

Floors swipe samples were collected from a 100 cm² area in low-dust areas. Dust can collect radon daughter products and dusty samples can result in cloudy scintillation fluid which can impact the analytical results. These swipes were analyzed for removable alpha and beta

activity using Ludlum Model 2929 scaler counters with 43-10-1 sample counting heads. Swipe samples were then analyzed for H-3, C-14, and other HTD isotopes using a Packard TriCabb 2100 TR liquid scintillation counter (LSC). This LSC is owned by the Omaha VAMC but was operated by an AECOM technician. Prior to use, a multi-point calibration with applicable quench standards was applied to the LSC.

Selected results are reported in Table 5 in units of disintegrations per minute (dpm) per 100 cm². These samples were the most active as well as those showing only background, allowing comparison along the entire range sampled. Of the estimated 800 swipes examined less than 1% had any results above background. These results can be compared to the free-release removable contamination criteria applied to the release of materials from the reactor facility (200 dpm for total beta and 1,000 dpm for tritium) (AECOM 2011). The complete survey results are included in Appendix C. Additionally, eight removable contamination sample vials were sent to the independent laboratory (New World Environmental) for quality verification. The duplicate results were within +/-10% of the field results obtained from the LSC at the VA facility.

Table 5. Surface Contamination Results of Interest (Floors)

Location	Direct		M2929	LSC		
	α^* (dpm)	β/γ^* (dpm)	β/γ^* (dpm)	Total β (dpm)	H-3 (dpm)	C-14 (dpm)
Blank	-	-	<MDC	42	7	13
Vault Floor 6	47	2157	<MDC	49	17	24
Vault Floor 1	47	2142	<MDC	51	6	22
B526 Floor C8	<MDC	<MDC	<MDC	337	326	31
B526 Floor D8	<MDC	<MDC	<MDC	463	464	11
B526 Floor D9	<MDC	<MDC	<MDC	813	816	26
B526 Floor B2	<MDC	709	<MDC	51	19	20
B526 Floor F4	<MDC	<MDC	<MDC	78	34	24
B540 Floor C2	36	<MDC	<MDC	63	38	12
B540 Floor B2	<MDC	<MDC	<MDC	50	15	27
B540A Floor C1	28	1984	<MDC	66	13	17
B540A Floor B2	<MDC	2543	<MDC	53	4	33
B535A Floor A1	69	1488	<MDC	42	10	14
B535A Floor D1	55	1843	<MDC	45	6	16
B535A Floor D4	40	1449	<MDC	71	1	22

Note:

* - MDCs were 8 dpm for direct α , approximately 450 dpm for direct β/γ , and 151 dpm for removable β/γ

The results provided in Table 5 demonstrate the following:

- There was no detectable removable contamination in the "vault" or "pit" area containing the reactor cooling system (swipes consistent with blank)
- Direct/total alpha and beta/gamma activity in the "vault" is above background levels. However, this activity could be a result of radon and radon daughter products as the vault is below grade and has limited ventilation.

- There is some measureable removable H-3 contamination on the floor in the reactor area. However, the removable contamination levels suggest that the contamination levels are well below the 1.2×10^8 dpm/100cm² screening level for H-3 in NUREG-1757, Volume 1, Appendix B (NRC 2006).
- There is some detectable direct/total alpha and beta/gamma activity on the floor in the reactor area (B526). However, these levels are below the general decommissioning release criteria (100 dpm/100cm² α and 5,000 dpm/100cm² β/γ). This activity could be a result of radon and radon daughter products as the basement floor is below grade.
- There may be some removable beta/gamma activity other than H-3 and C-14 that is detectable in the LSC that is not detectable with the 2929 scintillation detector. This could be indicative of low levels of low-energy beta emitters such as Ni-63 or Fe-55.

The LSC was unable to be calibrated to quantify Ni-63 activity as originally planned as the Ni-63 quench standards were not available. However, Ni-63 activity is included in the total beta (β) activity. It should be noted that the sum of the H-3 and C-14 samples collected at locations B526 Floor C8, D8, D9, and F4 are approximately equal to the total beta/gamma activity. For samples collected at B540A Floor C1 and B535A Floor D4, there may be other beta activity present.

2.4 Ductwork, Drain Lines, Pneumatic Tubing

Removable contamination swipes were collected from inside the air exhaust system that originates with the two vent hoods in the reactor area. The two fume hoods were discovered to have low levels of contamination in the 2003 characterization (Duratek 2003). It was recommended in the NRC RAI (NRC 2008) that the extent of the contaminants be quantified. In response, swipes were taken at multiple locations inside the hoods, at multiple locations inside the ventilation ducts prior to the point where they go vertical from the basement level (in room B526), and at access points in the roof-top penthouse immediately prior to discharge. All sampling access openings in the ductwork were closed following collection. Ductwork sample locations are shown in Figure 2 below. Complete sample results are included in Appendix C, Survey number ABJ-050.

Sanitary sewer drain lines in the reactor facility were surveyed and sampled through sink and floor drains and other access points both inside and outside the facility. Figure 3 shows the location of the approximate drain lines and sampling point inside the building. Access points outside the building including two locations to the west side of the building. Complete sample results for drain lines are included in Appendix C and D, Survey numbers ABJ-047, 048, and 058.

Pneumatic tubing formerly used for sample transport into the reactor vessel was likewise sampled at the open ends in room B533A. Pneumatic tubing sample results are shown in Appendix D, Survey number ABJ-033.

Sample technicians collected swipes of the pipe/tube interiors and analyzed the samples in a LSC as detailed in the previous section. Samples were also screened with hand-held instruments or using the Ludlum Model 2929 sample counter prior to placing them in the scintillation vials. No sufficient volume of sediment/sludge could be collected for testing from

either drain lines or sewer lines. Table 6 provides a range of the sample results that are indicative of the ductwork, drain line and pneumatic tubing survey. The size of all the piping sampled was documented along with the surveys and is presented in Appendix D.

Figure 2. Duct Sample Locations

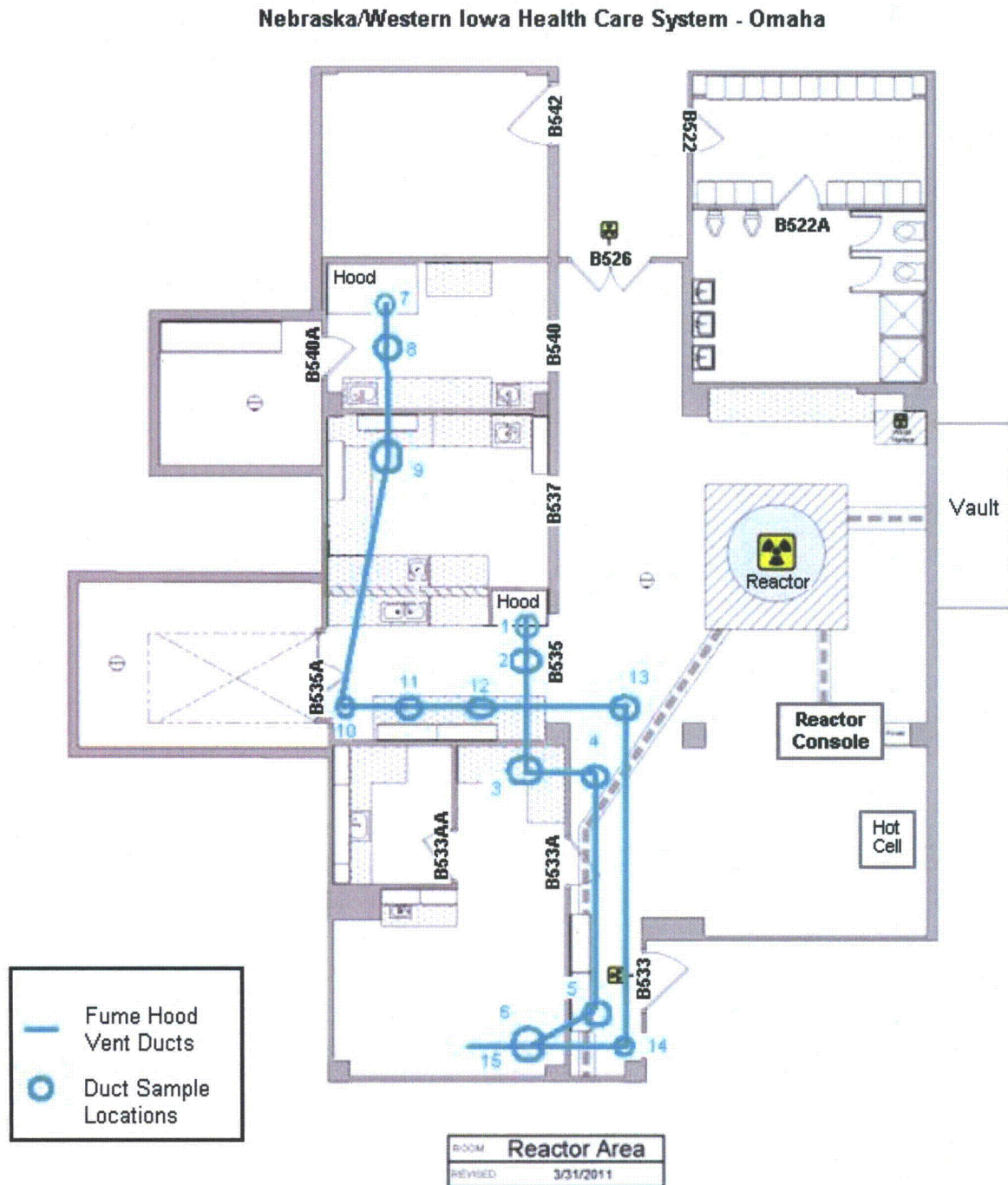


Figure 3. Drain Locations

Nebraska/Western Iowa Health Care System - Omaha

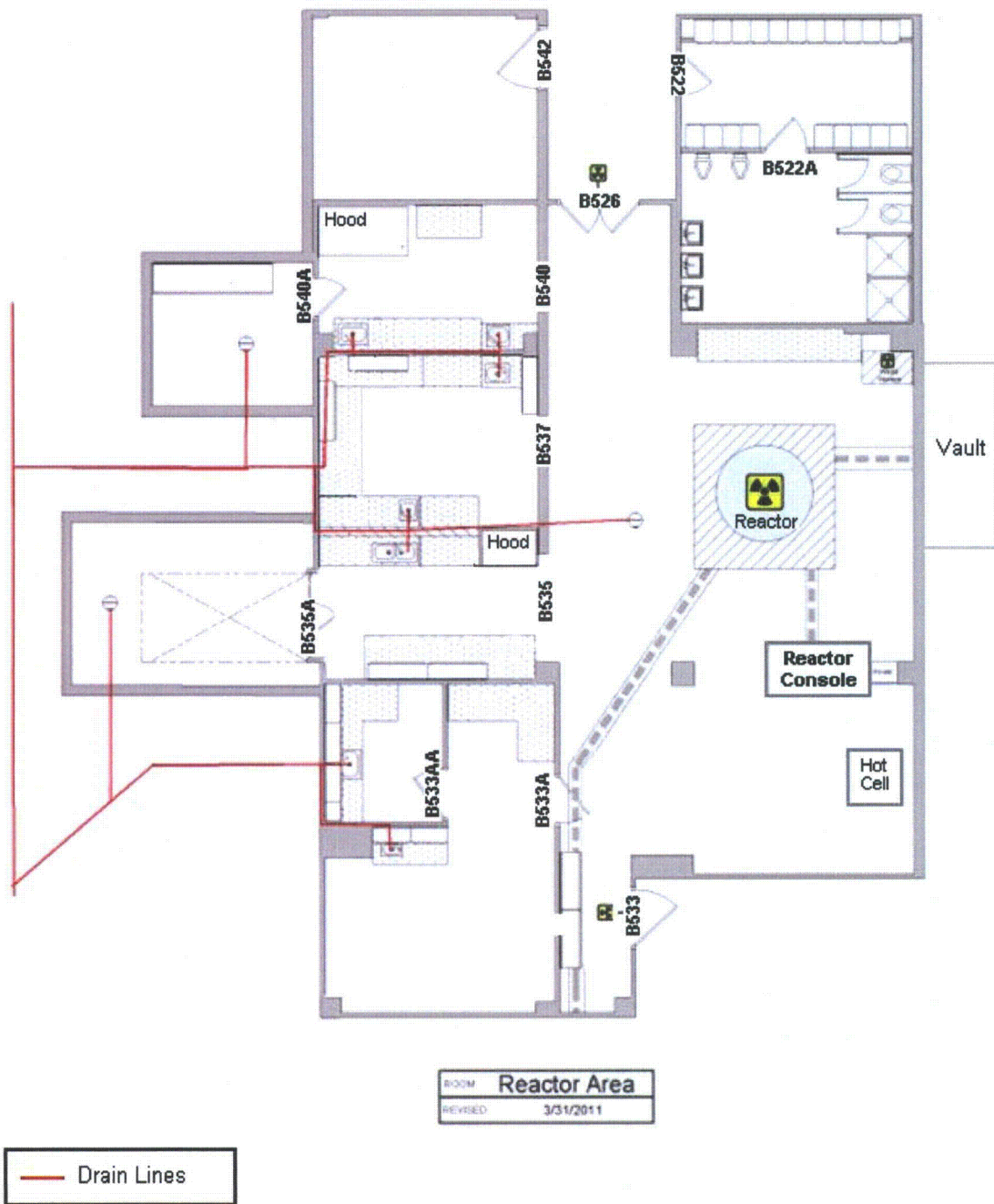


Table 6. Utility Removable Contamination Survey Results of Interest

Location	M2929		LSC		
	α^* (dpm)	β/γ^* (dpm)	Total β (dpm)	H-3 (dpm)	C-14 (dpm)
Blank	<MDC	<MDC	42	7	13
B535 Fume Hood Drain	<MDC	227	1179	0	1162
B540A Floor Drain	<MDC	<MDC	56	19	20
4" Sewer Inlet from ABJ Reactor	<MDC	<MDC	56	14	23
8" Pipe Inlet	<MDC	<MDC	62	0	19
Pneumatic Tube Interior	<MDC	<MDC	54	15	16
B535 Fume Hood Roof Duct	<MDC	<MDC	51	22	19
Fume Hood Duct B535	<MDC	<MDC	78	29	30

Note:

* - MDCs for M2929 were 151 dpm β/γ and 7 dpm α .

2.5 Soil

Previous characterization activities collected subsurface soil samples inside the reactor facility adjacent to and below the level of the reactor tank bottom by drilling through the concrete floor. While no radioactive contamination was identified in any of these samples (Duratek 2003), these samples were analyzed using only gamma spectroscopy which would not identify hard to detect beta-emitting isotopes such as H-3 and Ni-63. The additional characterization in 2011 collected subsurface soil samples outside the facility to determine if activity, including H-3 and HTD isotopes, had a significant impact of the facility. Seven soil samples were collected near the two "hatches" that provide access to the basement area. Analysis included isotopes and the isotope series provided in Table 7. No additional samples were collected adjacent to the reactor tanks.

The soil sample locations are provided in Figure 4. Actual sampling locations were finalized following utility clearance by the VA facilities personnel. Using direct-push sampling technology, two soil samples were collected from each of two locations on the west side of the building (marked on Figure 4 as soil sample locations 1 and 2). At each location, one sample consisted of a composite of the first 6 inches of soil. The second sample at each location was collected in the 2-foot interval that is at the level of either drain lines leaving the reactor area or just below the basement floor level (about 13 to 15 feet below ground surface). Groundwater was not encountered at these depths.

The remaining three samples were collected east of the building in the vicinity of the circulation equipment vault and cooling tower (marked on Figure 4 as soil sample locations 3 - 5). Each sample consisted of a composite of the first 6 inches of soil beneath the cement walkway. Deeper samples were not collected as there are no drains below the basement floor level on east side of the building.

A background sample was collected from surface soil at a nearby location (see Figure 4). This was analyzed in the same manner as the other seven soil samples.

Samples were analyzed for the isotopes listed in Table 2 using the stated analysis and equivalent methods. Analytical methods are based on potential contaminants and to confirm or dismiss uncertain results from the previous sampling effort. None of the soil sample results show any significant amount of contamination above background levels. Table 7 provides a summary of the soil sampling results showing the primary isotopes of interest. The complete soil sample results are provided in Appendix E.

Table 7. Summary of Soil Sampling Results

	Back-ground	Hole 1		Hole 2		Hole 3	Hole 4	Hole 5
Isotope	6in Depth	6in Depth	13-15ft Depth	6in Depth	13-15ft Depth	6in Depth	6in Depth	6in Depth
H-3	0.13 ± 0.11*	0.18 ± 0.12	0.26 ± 0.12	0.39 ± 0.16	0.12 ± 0.11*	0.13 ± 0.11*	-0.01 ± 0.07*	0.24 ± 0.12
C-14	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC
Fe-55	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC
Ni-59/63	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC
Cs-137	< MDC	0.27 ± 0.20	0.27 ± 0.20	< MDC	< MDC	< MDC	< MDC	< MDC
Po-210	1.15 ± 0.36	1.03 ± 0.43	1.16 ± 0.48	0.91 ± 0.37	1.18 ± 0.39	0.88 ± 0.35	1.12 ± 0.39	0.88 ± 0.30
U-238	1.10 ± 0.27	0.77 ± 0.21	0.85 ± 0.24	0.91 ± 0.24	0.70 ± 0.20	0.67 ± 0.20	0.89 ± 0.24	0.85 ± 0.23
Th-232	1.24 ± 0.26	1.17 ± 0.25	1.11 ± 0.25	1.19 ± 0.26	1.08 ± 0.24	1.27 ± 0.26	1.22 ± 0.26	1.03 ± 0.24
Pu-241	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC	< MDC

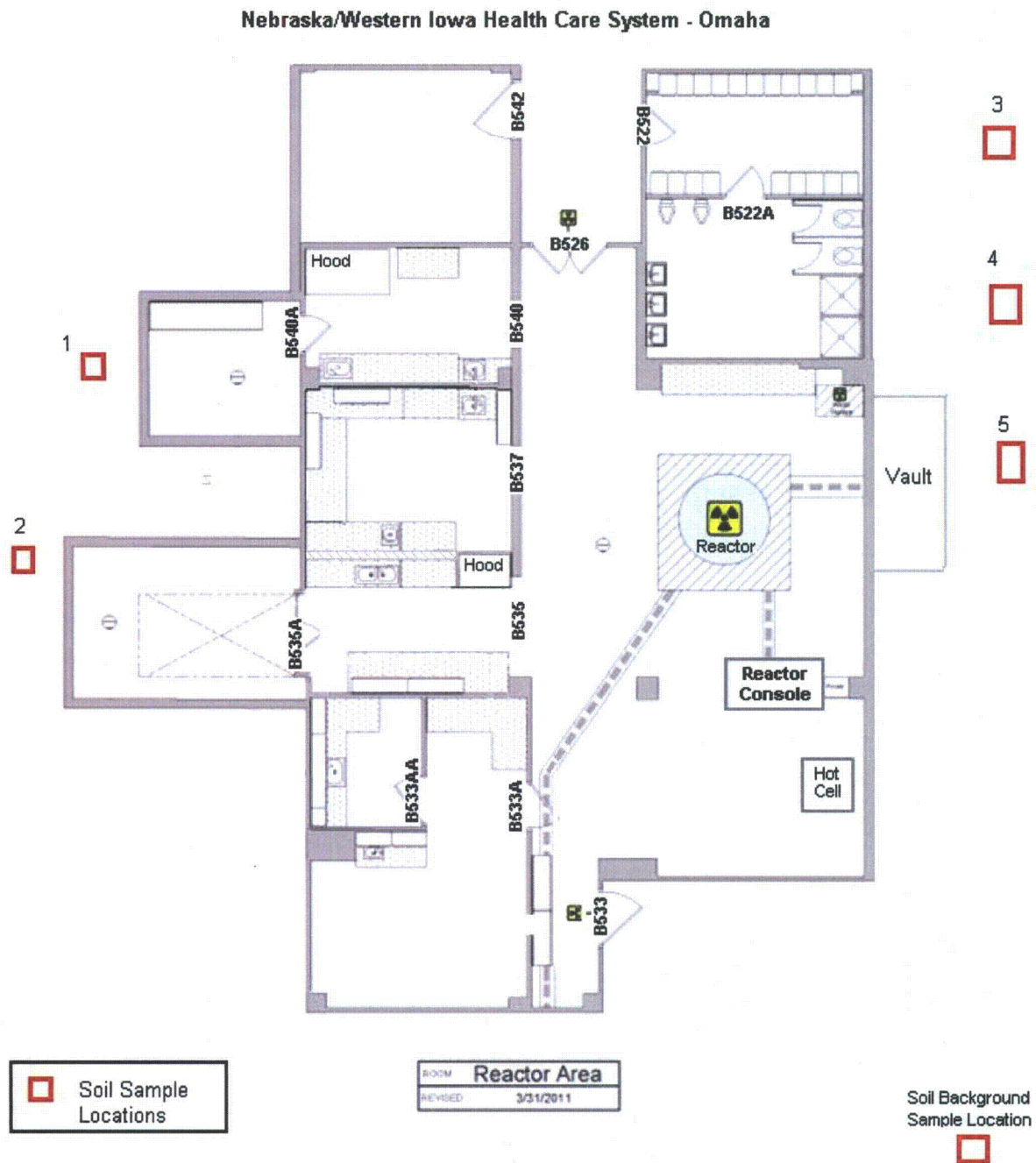
Notes:

* - Less than MDC

pCi/g – picoCuries per gram

MDC – Minimum Detectable Concentration

Figure 4. Soil Sample Locations



2.6 Instrumentation

Radiation survey instruments capable of detecting the alpha, beta, and gamma radiations to the standards set forth by the NRC Guide 1.86 were used during the operations and surveys. These instruments included gas proportional detectors, Geiger-Müller (GM) detectors, alpha beta (phoswich) detectors, gamma scintillation (NaI) detectors, and swipe/sample counters. All instruments used on-site were calibrated and managed according to AECOM standard operating procedures for radiological services SOP01 and SOP02. Records of calibration and instrument control logs were maintained. These daily logs confirm instrument accuracy relative to an acceptable response range. All instrument check and control logs and calibration records are in Appendix F.

3.0 Radioactive Material Storage

During pre-decommissioning activities, small amounts of radioactive materials were encountered. These materials include activated metal, items that could not be adequately surveyed (such as small diameter conduit), and items that did not meet free release criteria for removal from site. These materials were placed in a standard 96-cubic foot radioactive waste box (a B-25 box) dedicated to radioactive materials storage. The box was secured within the reactor area and a detailed inventory of items placed in the box was kept and attached to the box (Table 8). Disposition of this box will ultimately be managed by the reactor decommissioning contractor along with other materials destined for removal from site.

Contaminated lead was inventoried and stored separate from the clean lead and other radioactive materials. Contaminated lead, listed in Table 9, was placed in a 55-gallon drum. The lid was placed on the drum prior to demobilization and a radioactive materials tag was attached to the drum lid ring.

Table 8. Material in Radioactive Materials Storage Box

Quantity	Item
~50 feet	Conduit piping
9	55-gallon bags of investigation derived waste (in yellow "RAD" bags)
~20	Ceiling tiles
4	Plastic containers containing solidified concrete mix
3	Radioactive waste containers (yellow trash cans)
~20 feet	Miscellaneous wire
1	Source holder rod
1	Polonium-Beryllium (Po-Be) source (in its own separate retrievable container)

Table 9. Contaminated Lead

Quantity	Item
3	Small lead wall plugs from Room B540A
2	Large lead floor plugs from Room 540A
2	Lead discs from detector collimator from Room 526
1	Small lead pig from Room 526

4.0 Conclusion

All characterization activities outlined in the scope of work for the Blotcky Reactor were completed as planned except for quantification of Ni-63 in removable contamination samples. The following statements supported by the characterization data directly address the NRC's requests for additional information on the decommissioning plan (NRC 2008).

- Surface and subsurface soils collected near the reactor facility do not indicate the presence of reactor-related isotopes, including the hard-to-detect isotopes Ni-63 and Fe-55. While H-3 was detected in four of the six soil samples, concentrations are very low, less than 0.5 picocuries per gram (pCi/g) in each sample. The NRC's soil screening level for H-3 is 110 pCi/g (NRC 2006). The outside surface and subsurface soils of the reactor facility can be considered as non-impacted.
- Ni-63 and Fe-55 were confirmed as isotopes of concern in the reactor water filter resins. Therefore, these hard-to-detect isotopes are potentially present in activated materials and contaminated items. However, the easy-to-detect Co-60 was also present along with Ni-63 and Fe-55 at consistent ratios of about 3:1 and 3.5:1 respectively.
- The naturally occurring isotopes of Thorium 230, Pb-210, and Po-210 have been eliminated as contaminants of concern based on reactor water filter resin and soil samples. Direct alpha contamination surveys also indicate that alpha-emitting radionuclides are not a concern for surface contamination.
- Pu-241 has been eliminated as a contaminant of concern based on reactor water filter resin and soil samples and direct alpha surveys and alpha counting of removable contamination smears.
- Characterization data that was obtained from subsurface piping and pneumatic transfer lines indicate that, while there are detectable levels of H-3, C-14, and total beta activity, the activity in the embedded drain lines and pneumatic tubing is well below screening criteria (NRC 2006). Removal of embedded pipes is not expected to be required for decommissioning.
- Characterization of the accessible points of the ventilation system demonstrated that, while there may be detectable levels of removable H-3, C-14, and total beta activity, the activity is generally in the range of the blank samples and well below surface contamination screening criteria (NRC 2006). Removal of only the fume hoods is expected to be required for decommissioning. No removal of additional ventilation system equipment is expected to be required.
- No surveys to date have identified the presence of hot particles.

5.0 References

AECOM. 2011. Allen J Blotcky Reactor Facility Additional Characterization Work Plan. April.

Duratek, Inc. 2003. Allen J Blotcky Reactor Facility Omaha Veterans Administration Medical Center, Omaha, Nebraska, Characterization Survey Report. February.

US Department of Veterans Affairs (VA). 2004. Decommissioning and Decontamination Plan for the Allen J Blotcky Reactor Facility. March.

US Nuclear Regulatory Commission (NRC). 2008. Request for Additional Information Regarding Allen J Blotcky Reactor Facility Decommissioning Plan. May 13.

US Nuclear Regulatory Commission (NRC). 2006. Consolidate Decommissioning Guidance, Decommissioning Process for Materials Licensees. NUREG-1757, Volume 1. September.

Appendix A
Analytical Results from Resin Samples

AECOM Technical Services Inc.

Client Sample ID: RESIN TOP ABJ 001

Radiochemistry

Lab Sample ID: F1E260406-001
Work Order: MJRTM
Matrix: SOLID

Date Collected: 05/20/11 1000
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	2.99		0.48	2.00	0.20	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
Carbon 14	15.2		1.8	5.0	1.1	06/14/11	06/20/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	-0.24	U	0.69	5.00	1.4	06/09/11	06/21/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	0.005	U	0.029	1.00	0.068	06/09/11	06/14/11
Plutonium 239/40	-0.0108	U	0.0089	1.00	0.063	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	0.010	U	0.057	1.00	0.12	06/09/11	06/14/11
Thorium 230	0.045	U	0.065	1.00	0.11	06/09/11	06/14/11
Thorium 232	0.026	U	0.042	1.00	0.068	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.005	U	0.023	1.00	0.060	06/09/11	06/20/11
Uranium 235/236	0.015	U	0.041	1.00	0.085	06/09/11	06/20/11
Uranium 238	0.020	U	0.032	1.00	0.047	06/09/11	06/20/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	0.11	U	0.12	0.20	0.19	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Cobalt 60	3.65		0.33		0.13	06/02/11	06/13/11
Europium 152	1.38		0.31		0.57	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
Polonium 210	-0.03	U	0.12	0.50	0.25	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: RESIN MIDDLE ABJ 002

Radiochemistry

Lab Sample ID: F1E260406-002
Work Order: MJRTN
Matrix: SOLID

Date Collected: 05/20/11 1000
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	2.75		0.45	2.00	0.19	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
Carbon 14	0.91	U	0.66	5.00	1.0	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	0.03	U	0.86	5.00	1.6	06/09/11	06/21/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	0.005	U	0.033	1.00	0.078	06/09/11	06/14/11
Plutonium 239/40	0.009	U	0.022	1.00	0.047	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	0.144		0.094	1.00	0.099	06/09/11	06/14/11
Thorium 230	0.038	U	0.050	1.00	0.076	06/09/11	06/14/11
Thorium 232	-0.0092	U	0.0092	1.00	0.071	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.012	U	0.023	1.00	0.032	06/09/11	06/20/11
Uranium 235/236	0.0	U	0.013	1.00	0.039	06/09/11	06/20/11
Uranium 238	-0.0109	U	0.0098	1.00	0.072	06/09/11	06/20/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	2.87		0.46	0.20	0.37	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Cobalt 60	49.6		3.3		0.3	06/02/11	06/13/11
Europium 152	12.3		1.1		0.9	06/02/11	06/13/11
Potassium 40	13.1		2.3		1.5	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
Polonium 210	0.02	U	0.16	0.50	0.28	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: RESIN BOTTOM ABJ 003

Radiochemistry

Lab Sample ID: F1E260406-003
Work Order: MJRTP
Matrix: SOLID

Date Collected: 05/20/11 1000
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	2.28		0.56	2.00	0.70	06/14/11	06/20/11
Carbon 14 by EERF C-01-1							
Carbon 14	3.34		0.85	5.00	1.0	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	1.6	U	1.4	5.0	2.2	06/09/11	06/21/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	-0.032	U	0.019	1.00	0.12	06/09/11	06/14/11
Plutonium 239/40	0.009	U	0.030	1.00	0.070	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	0.039	U	0.079	1.00	0.14	06/09/11	06/14/11
Thorium 230	0.055	U	0.072	1.00	0.11	06/09/11	06/14/11
Thorium 232	-0.015	U	0.012	1.00	0.085	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.005	U	0.025	1.00	0.065	06/09/11	06/14/11
Uranium 235/236	-0.0028	U	0.0056	1.00	0.064	06/09/11	06/14/11
Uranium 238	0.012	U	0.024	1.00	0.032	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	3.88		0.52	0.20	0.37	06/02/11	06/14/11
--- Other Detected Radionuclides ---							
Cobalt 60	57.8		3.8		0.2	06/02/11	06/14/11
Europium 152	14.2		1.4		0.8	06/02/11	06/14/11
Potassium 40	17.0		2.6		1.7	06/02/11	06/14/11
PO-210 by Alpha Spectrometry							
Polonium 210	0.14	U	0.32	0.50	0.49	06/20/11	06/23/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

METHOD BLANK REPORT

Radiochemistry

Client Lot ID: F1E260406

Matrix: SOLID

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	MDC	Prep Date	Lab Sample ID Analysis Date
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	-0.003	U	0.068	0.200	0.12	06/06/11	F1F060000-050B
GROSS A/B BY GFPC SW846 9310 MOD							
Gross Alpha	5.8		4.2	10.0	5.8	06/02/11	F1F060000-214B
Gross Beta	2.3	U	2.2	10.0	3.4	06/02/11	06/08/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	-0.0038	U	0.0053	1.00	0.049	06/09/11	F1F090000-143B
Plutonium 239/40	-0.0038	U	0.0053	1.00	0.049	06/09/11	06/14/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	0.62	U	0.77	5.00	1.3	06/09/11	F1F090000-144B
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	0.039	U	0.061	1.00	0.10	06/09/11	F1F090000-145B
Thorium 230	0.098		0.075	1.00	0.071	06/09/11	06/14/11
Thorium 232	0.009	U	0.027	1.00	0.061	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.017	U	0.030	1.00	0.051	06/09/11	F1F090000-146B
Uranium 235/236	0.013	U	0.026	1.00	0.035	06/09/11	06/14/11
Uranium 238	0.0	U	0.0089	1.00	0.028	06/09/11	06/14/11
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.087	U	0.087	2.00	0.13	06/13/11	F1F130000-052B
Carbon 14 by EERF C-01-1							
Carbon 14	-0.25	U	0.58	5.00	1.0	06/14/11	F1F140000-213B
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.002	U	0.26	2.00	0.46	06/14/11	F1F140000-044B
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	-0.07	U	0.13	0.20	0.14	06/02/11	F1F020000-138B
PO-210 by Alpha Spectrometry							
Polonium 210	0.02	U	0.11	0.50	0.20	06/20/11	F1F170000-096B

Laboratory Control Sample Report

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Parameter	Spike Amount	Result	Total Uncert. (2 σ +/-)	MDC	% Yld	% Rec	Lab Sample ID QC Control Limits
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
		pCi/g		GA-01-R MOD			F1F020000-138C
Americium 241	98.8	104	8.3	1.2		105	(88 - 115)
Cesium 137	37.1	41.5	2.6	0.5		112	(90 - 115)
Cobalt 60	61.4	65.3	3.9	0.4		106	(90 - 110)
Batch #:	1153138				Analysis Date:	06/13/11	
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
		pCi/g		GA-01-R MOD			F1F060000-050C
Americium 241	933	955	76	7		102	(88 - 115)
Cesium 137	373	401	24	2		107	(90 - 115)
Cobalt 60	600	617	35	2		103	(90 - 110)
Batch #:	1157050				Analysis Date:	06/13/11	
GROSS A/B BY GFPC SW846 9310 MOD							
		pCi/g		9310 MOD			F1F060000-214C
Gross Alpha	34.0	23.3	7.0	6.4		68	(37 - 144)
Gross Beta	37.0	23.9	3.9	3.0		65	(36 - 126)
Batch #:	1157214				Analysis Date:	06/08/11	
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
		pCi/g		A-01-R			F1F090000-143C
Plutonium 238	6.12	5.78	0.69	0.05	87	94	(74 - 112)
Plutonium 239/40	6.61	6.26	0.73	0.04	87	95	(84 - 115)
Batch #:	1160143				Analysis Date:	06/14/11	
Plutonium-241 by Liquid Scintillation							
		pCi/g		STL-RC-0245			F1F090000-144C
Plutonium 241	14.1	13.3	2.2	1.4	0.0	94	(61 - 132)
Batch #:	1160144				Analysis Date:	06/21/11	
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
		pCi/g		A-01-R MOD			F1F090000-145C
Thorium 230	24.5	25.3	2.6	0.1	83	103	(81 - 123)
Batch #:	1160145				Analysis Date:	06/14/11	
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
		pCi/g		A-01-R MOD			F1F090000-146C
Uranium 234	6.53	6.37	0.74	0.06	86	98	(86 - 125)
Uranium 238	6.78	6.71	0.77	0.05	86	99	(85 - 125)
Batch #:	1160146				Analysis Date:	06/14/11	
Tritium by LSC by DOE H3-04-RC MOD.							
		pCi/g		H3-04-RC MOD			F1F130000-052C
Tritium	14.0	13.9	1.1	0.1		99	(75 - 104)
Batch #:	1164052				Analysis Date:	06/14/11	
Tritium by LSC by DOE H3-04-RC MOD.							
		pCi/g		H3-04-RC MOD			F1F140000-044C
Tritium	14.0	12.0	1.0	0.5		86	(75 - 104)
Batch #:	1165044				Analysis Date:	06/15/11	
Carbon 14 by EERF C-01-1							
		pCi/g		C-01-1			F1F140000-213C
Carbon 14	84.5	69.9	5.8	1.1		83	(62 - 109)
Batch #:	1165213				Analysis Date:	06/16/11	

Laboratory Control Sample Report

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Parameter	Spike Amount	Result	Total Uncert. (2 σ +/-)	MDC	% Yld	% Rec	Lab Sample ID QC Control Limits
PO-210 by Alpha Spectrometry			pCi/g	STL-RC-0210			F1F170000-096C
Polonium 210	63.5	57.1	8.3	0.2	59	90	(87 - 117)
	Batch #:	1168096		Analysis Date:	06/22/11		

NOTE(S)

MDC is determined by instrument performance only
Calculations are performed before rounding to avoid round-off error in calculated results

MATRIX SPIKE REPORT

Radiochemistry

Client Lot Id: F1E260406
Matrix: SOLID

Date Sampled: 05/20/11
Date Received: 05/25/11

Parameter	Spike Amount	Spike Result	Total Uncert. (2σ +/-)	Spike Yld.	Sample Result	Total Uncert. (2 σ +/-)	QC Sample ID		QC Control Limits
							%YLD	%REC	
Tritium by LSC by DOE H3-04-RC MOD.			pCi/g	H3-04-RC MOD			F1E260406-001		
Tritium	14.0	16.1	1.4		2.99	0.48	93		(62-129)
	Batch #:	1164052		Analysis Date:	06/14/11				
Carbon 14 by EERF C-01-1			pCi/g	C-01-1			F1E260406-001		
Carbon 14	82.8	86.6	7.0		15.2	1.8	86		(62-109)
	Batch #:	1165213		Analysis Date:	06/20/11				
Tritium by LSC by DOE H3-04-RC MOD.			pCi/g	H3-04-RC MOD			F1E260406-003		
Tritium	14.0	15.2	1.4		2.28	0.56	92		(62-129)
	Batch #:	1165044		Analysis Date:	06/20/11				

NOTE(S)

Data are incomplete without the case narrative.

Calculations are performed before rounding to avoid round-off errors in calculated results.

DUPLICATE EVALUATION REPORT

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Date Sampled: 05/20/11
Date Received: 05/25/11

Parameter	SAMPLE Result	Total Uncert. (2 σ +/-)	% Yld	DUPLICATE Result	Total Uncert. (2 σ +/-)	% Yld	QC Sample ID Precision
Tritium by LSC by DOE H3-04-RC MOD. pCi/g H3-04-RC MOD F1E260406-001							
Tritium	2.99	0.48		2.74	0.46		9 %RPD
	Batch #:	1164052 (Sample)		1164052 (Duplicate)			
Carbon 14 by EERF C-01-1 pCi/g C-01-1 F1E260406-001							
Carbon 14	15.2	1.8		7.3	1.1		70 %RPD
	Batch #:	1165213 (Sample)		1165213 (Duplicate)			
Tritium by LSC by DOE H3-04-RC MOD. pCi/g H3-04-RC MOD F1E260406-003							
Tritium	2.28	0.56		2.99	0.60		27 %RPD
	Batch #:	1165044 (Sample)		1165044 (Duplicate)			
Gamma Cs-137 & Hits by DOE GA-01-R MOD pCi/g GA-01-R MOD F1E260406-004							
Cesium 137	0.27	0.13		0.111	0.067		84 %RPD
---Other Dedected Radionuclides---							
Actinium 228	1.44	0.30		1.45	0.28		0.7 %RPD
Bismuth 214	1.54	0.31		1.47	0.25		5 %RPD
Lead 212	1.36	0.20		1.31	0.20		3 %RPD
Lead 214	1.60	0.28		1.64	0.23		3 %RPD
Potassium 40	19.6	3.1		20.7	2.4		5 %RPD
Thallium 208	0.46	0.13		0.409	0.095		11 %RPD
	Batch #:	1153138 (Sample)		1153138 (Duplicate)			
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R F1E260406-005							
Plutonium 238	0.007 U	0.023	83	0.009 U	0.023	81	28 %RPD
Plutonium 239/40	-0.0020 U	0.0041	83	-0.0021 U	0.0042	81	1 %RPD
	Batch #:	1160143 (Sample)		1160143 (Duplicate)			
Plutonium-241 by Liquid Scintillation pCi/g STL-RC-0245 F1E260406-006							
Plutonium 241	-0.21 U	0.79	0.0	-0.43 U	0.80	0.0	68 %RPD
	Batch #:	1160144 (Sample)		1160144 (Duplicate)			
Iso THORIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R MOD F1E260406-006							
Thorium 228	1.19	0.26	77	1.11	0.25	80	7 %RPD
Thorium 230	1.25	0.27	77	1.13	0.25	80	10 %RPD
Thorium 232	1.19	0.26	77	0.99	0.23	80	18 %RPD
	Batch #:	1160145 (Sample)		1160145 (Duplicate)			
Iso URANIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R MOD F1E260406-006							
Uranium 234	0.82	0.23	67	0.68	0.21	65	18 %RPD
Uranium 235/236	0.053	0.061	67	0.001 U	0.039	65	192 %RPD
Uranium 238	0.91	0.24	67	0.66	0.20	65	32 %RPD
	Batch #:	1160146 (Sample)		1160146 (Duplicate)			
PO-210 by Alpha Spectrometry pCi/g STL-RC-0210 F1E260406-007							
Polonium 210	1.18	0.39	52	0.99	0.40	47	18 %RPD
	Batch #:	1168096 (Sample)		1168096 (Duplicate)			

DUPLICATE EVALUATION REPORT

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Date Sampled: 05/23/11
Date Received: 05/25/11

Parameter	SAMPLE Result	Total Uncert. (2σ+/-)	% Yld	DUPLICATE Result	Total Uncert. (2σ+/-)	% Yld	QC Sample ID Precision
GROSS A/B BY GFPC SW846 9310 MOD			pCi/g	9310 MOD			F1E260406-024
Gross Alpha	5.2 U	4.8		2.1 U	3.6		83 %RPD
Gross Beta	8.3	2.7		6.8	2.5		20 %RPD
	Batch #:	1157214 (Sample)		1157214 (Duplicate)			
Gamma Cs-137 & Hits by DOE GA-01-R MOD			pCi/g	GA-01-R MOD			F1E260406-022
Cesium 137	3.7	1.2		4.1	1.4		11 %RPD
	Batch #:	1157050 (Sample)		1157050 (Duplicate)			

NOTE(S)

Data are incomplete without the case narrative.
Calculations are performed before rounding to avoid round-off error in calculated results

U Result is less than the sample detection limit.

Appendix B

Analytical Results (Gamma Spectroscopy) from Activated Metal Samples

AECOM Technical Services Inc.

Client Sample ID: ACTIVATED METAL ABJ 022

Radiochemistry

Lab Sample ID: F1E260406-022
Work Order: MJRVW
Matrix: SOLID

Date Collected: 05/20/11 0000
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Gamma Cs-137 & Hits by DOE GA-01-R MOD				pCi/g		Batch # 1157050	Yld %
Cesium 137	3.7		1.2	0.2	1	06/06/11	06/13/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

AECOM Technical Services Inc.

Client Sample ID: ACTIVATED METAL ABJ 023

Radiochemistry

Lab Sample ID: F1E260406-023
Work Order: MJRV1
Matrix: SOLID

Date Collected: 05/20/11 0000
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
<hr/>							
Gamma Cs-137 & Hits by DOE GA-01-R MOD				pCi/g		Batch # 1157050	Yld %
Cesium 137	0.36	U	0.89	0.20	1.5	06/06/11	06/13/11
--- Other Detected Radionuclides ---							
Cobalt 60	39.2		3.3		1.3	06/06/11	06/13/11
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NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

METHOD BLANK REPORT

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	MDC	Prep Date	Lab Sample ID Analysis Date
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	-0.003	U	0.068	0.200	0.12	06/06/11	F1F060000-050B
GROSS A/B BY GFPC SW846 9310 MOD							
Gross Alpha	5.8		4.2	10.0	5.8	06/02/11	F1F060000-214B
Gross Beta	2.3	U	2.2	10.0	3.4	06/02/11	06/08/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	-0.0038	U	0.0053	1.00	0.049	06/09/11	F1F090000-143B
Plutonium 239/40	-0.0038	U	0.0053	1.00	0.049	06/09/11	06/14/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	0.62	U	0.77	5.00	1.3	06/09/11	F1F090000-144B
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	0.039	U	0.061	1.00	0.10	06/09/11	F1F090000-145B
Thorium 230	0.098		0.075	1.00	0.071	06/09/11	06/14/11
Thorium 232	0.009	U	0.027	1.00	0.061	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.017	U	0.030	1.00	0.051	06/09/11	F1F090000-146B
Uranium 235/236	0.013	U	0.026	1.00	0.035	06/09/11	06/14/11
Uranium 238	0.0	U	0.0089	1.00	0.028	06/09/11	06/14/11
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.087	U	0.087	2.00	0.13	06/13/11	F1F130000-052B
Carbon 14 by EERF C-01-1							
Carbon 14	-0.25	U	0.58	5.00	1.0	06/14/11	F1F140000-213B
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.002	U	0.26	2.00	0.46	06/14/11	F1F140000-044B
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	-0.07	U	0.13	0.20	0.14	06/02/11	F1F020000-138B
PO-210 by Alpha Spectrometry							
Polonium 210	0.02	U	0.11	0.50	0.20	06/20/11	F1F170000-096B

Laboratory Control Sample Report

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Parameter	Spike Amount	Result	Total Uncert. (2 σ +/-)	MDC	% Yld	% Rec	Lab Sample ID QC Control Limits
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
		pCi/g		GA-01-R MOD			F1F020000-138C
Americium 241	98.8	104	8.3	1.2		105	(88 - 115)
Cesium 137	37.1	41.5	2.6	0.5		112	(90 - 115)
Cobalt 60	61.4	65.3	3.9	0.4		106	(90 - 110)
Batch #:	1153138				Analysis Date:	06/13/11	
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
		pCi/g		GA-01-R MOD			F1F060000-050C
Americium 241	933	955	76	7		102	(88 - 115)
Cesium 137	373	401	24	2		107	(90 - 115)
Cobalt 60	600	617	35	2		103	(90 - 110)
Batch #:	1157050				Analysis Date:	06/13/11	
GROSS A/B BY GFPC SW846 9310 MOD							
		pCi/g		9310 MOD			F1F060000-214C
Gross Alpha	34.0	23.3	7.0	6.4		68	(37 - 144)
Gross Beta	37.0	23.9	3.9	3.0		65	(36 - 126)
Batch #:	1157214				Analysis Date:	06/08/11	
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
		pCi/g		A-01-R			F1F090000-143C
Plutonium 238	6.12	5.78	0.69	0.05	87	94	(74 - 112)
Plutonium 239/40	6.61	6.26	0.73	0.04	87	95	(84 - 115)
Batch #:	1160143				Analysis Date:	06/14/11	
Plutonium-241 by Liquid Scintillation							
		pCi/g		STL-RC-0245			F1F090000-144C
Plutonium 241	14.1	13.3	2.2	1.4	0.0	94	(61 - 132)
Batch #:	1160144				Analysis Date:	06/21/11	
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
		pCi/g		A-01-R MOD			F1F090000-145C
Thorium 230	24.5	25.3	2.6	0.1	83	103	(81 - 123)
Batch #:	1160145				Analysis Date:	06/14/11	
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
		pCi/g		A-01-R MOD			F1F090000-146C
Uranium 234	6.53	6.37	0.74	0.06	86	98	(86 - 125)
Uranium 238	6.78	6.71	0.77	0.05	86	99	(85 - 125)
Batch #:	1160146				Analysis Date:	06/14/11	
Tritium by LSC by DOE H3-04-RC MOD.							
		pCi/g		H3-04-RC MOD			F1F130000-052C
Tritium	14.0	13.9	1.1	0.1		99	(75 - 104)
Batch #:	1164052				Analysis Date:	06/14/11	
Tritium by LSC by DOE H3-04-RC MOD.							
		pCi/g		H3-04-RC MOD			F1F140000-044C
Tritium	14.0	12.0	1.0	0.5		86	(75 - 104)
Batch #:	1165044				Analysis Date:	06/15/11	
Carbon 14 by EERF C-01-1							
		pCi/g		C-01-1			F1F140000-213C
Carbon 14	84.5	69.9	5.8	1.1		83	(62 - 109)
Batch #:	1165213				Analysis Date:	06/16/11	

Laboratory Control Sample Report

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Parameter	Spike Amount	Result	Total Uncert. (2 σ +/-)	MDC	Lab Sample ID		
			% Yld		% Rec	QC Control Limits	
PO-210 by Alpha Spectrometry			pCi/g	STL-RC-0210		F1F170000-096C	
Polonium 210	63.5	57.1	8.3	0.2	59	90 (87 - 117)	
Batch #:		1168096	Analysis Date: 06/22/11				

NOTE(S)

MDC is determined by instrument performance only
Calculations are performed before rounding to avoid round-off error in calculated results

MATRIX SPIKE REPORT

Radiochemistry

Client Lot Id: F1E260406
Matrix: SOLID

Date Sampled: 05/20/11
Date Received: 05/25/11

Parameter	Spike Amount	Spike Result	Total Uncert. (2σ +/-)	Spike Yld.	Sample Result	Total Uncert. (2 σ +/-)	QC Sample ID		QC Control Limits
							%YLD	%REC	
Tritium by LSC by DOE H3-04-RC MOD.			pCi/g	H3-04-RC MOD			F1E260406-001		
Tritium	14.0	16.1	1.4		2.99	0.48	93		(62-129)
	Batch #:	1164052		Analysis Date:	06/14/11				
Carbon 14 by EERF C-01-1			pCi/g	C-01-1			F1E260406-001		
Carbon 14	82.8	86.6	7.0		15.2	1.8	86		(62-109)
	Batch #:	1165213		Analysis Date:	06/20/11				
Tritium by LSC by DOE H3-04-RC MOD.			pCi/g	H3-04-RC MOD			F1E260406-003		
Tritium	14.0	15.2	1.4		2.28	0.56	92		(62-129)
	Batch #:	1165044		Analysis Date:	06/20/11				

NOTE(S)

Data are incomplete without the case narrative.

Calculations are performed before rounding to avoid round-off errors in calculated results.

DUPLICATE EVALUATION REPORT

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Date Sampled: 05/20/11
Date Received: 05/25/11

Parameter	SAMPLE Result	Total Uncert. (2σ +/-)	% Yld	DUPLICATE Result	Total Uncert. (2σ +/-)	% Yld	QC Sample ID Precision
Tritium by LSC by DOE H3-04-RC MOD. pCi/g H3-04-RC MOD F1E260406-001							
Tritium	2.99	0.48		2.74	0.46		9 %RPD
Batch #:	1164052 (Sample)			1164052 (Duplicate)			
Carbon 14 by EERF C-01-1 pCi/g C-01-1 F1E260406-001							
Carbon 14	15.2	1.8		7.3	1.1		70 %RPD
Batch #:	1165213 (Sample)			1165213 (Duplicate)			
Tritium by LSC by DOE H3-04-RC MOD. pCi/g H3-04-RC MOD F1E260406-003							
Tritium	2.28	0.56		2.99	0.60		27 %RPD
Batch #:	1165044 (Sample)			1165044 (Duplicate)			
Gamma Cs-137 & Hits by DOE GA-01-R MOD pCi/g GA-01-R MOD F1E260406-004							
Cesium 137	0.27	0.13		0.111	0.067		84 %RPD
---Other Dedected Radionuclides---							
Actinium 228	1.44	0.30		1.45	0.28		0.7 %RPD
Bismuth 214	1.54	0.31		1.47	0.25		5 %RPD
Lead 212	1.36	0.20		1.31	0.20		3 %RPD
Lead 214	1.60	0.28		1.64	0.23		3 %RPD
Potassium 40	19.6	3.1		20.7	2.4		5 %RPD
Thallium 208	0.46	0.13		0.409	0.095		11 %RPD
Batch #:	1153138 (Sample)			1153138 (Duplicate)			
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R F1E260406-006							
Plutonium 238	0.007 U	0.023	83	0.009 U	0.023	81	28 %RPD
Plutonium 239/40	-0.0020 U	0.0041	83	-0.0021 U	0.0042	81	1 %RPD
Batch #:	1160143 (Sample)			1160143 (Duplicate)			
Plutonium-241 by Liquid Scintillation pCi/g STL-RC-0245 F1E260406-006							
Plutonium 241	-0.21 U	0.79	0.0	-0.43 U	0.80	0.0	68 %RPD
Batch #:	1160144 (Sample)			1160144 (Duplicate)			
Iso THORIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R MOD F1E260406-006							
Thorium 228	1.19	0.26	77	1.11	0.25	80	7 %RPD
Thorium 230	1.25	0.27	77	1.13	0.25	80	10 %RPD
Thorium 232	1.19	0.26	77	0.99	0.23	80	18 %RPD
Batch #:	1160145 (Sample)			1160145 (Duplicate)			
Iso URANIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R MOD F1E260406-006							
Uranium 234	0.82	0.23	67	0.68	0.21	65	18 %RPD
Uranium 235/236	0.053	0.061	67	0.001 U	0.039	65	192 %RPD
Uranium 238	0.91	0.24	67	0.66	0.20	65	32 %RPD
Batch #:	1160146 (Sample)			1160146 (Duplicate)			
PO-210 by Alpha Spectrometry pCi/g STL-RC-0210 F1E260406-007							
Polonium 210	1.18	0.39	52	0.99	0.40	47	18 %RPD
Batch #:	1168096 (Sample)			1168096 (Duplicate)			

DUPLICATE EVALUATION REPORT

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Date Sampled: 05/23/11
Date Received: 05/25/11

Parameter	SAMPLE Result	Total Uncert. (2σ +/-)	% Yld	DUPLICATE Result	Total Uncert. (2 σ +/-)	% Yld	QC Sample ID Precision
<hr/>							
GROSS A/B BY GFPC SW846 9310 MOD			pCi/g	9310 MOD			F1E260406-024
Gross Alpha	5.2 U	4.8		2.1 U	3.6		83 %RPD
Gross Beta	8.3	2.7		6.8	2.5		20 %RPD
	Batch #:	1157214 (Sample)		1157214 (Duplicate)			
<hr/>							
Gamma Cs-137 & Hits by DOE GA-01-R MOD			pCi/g	GA-01-R MOD			F1E260406-022
Cesium 137	3.7	1.2		4.1	1.4		11 %RPD
	Batch #:	1157050 (Sample)		1157050 (Duplicate)			
<hr/>							

NOTE(S)

Data are incomplete without the case narrative.
Calculations are performed before rounding to avoid round-off error in calculated results

U Result is less than the sample detection limit.

Appendix C
Surface Contamination Survey Results

by: Ernie Wike
Print
Reviewer: Chris Higgins
Print

[Signature]
Sign
[Signature]
Sign

5/13/2011
Date
5/13/2011
Date

Survey Meters

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	245758	Instrument #	160029	Instrument #	245758	Instrument #	160029
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	245758	Meter Serial #	160029	Meter Serial #	245758	Meter Serial #	160029
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	263618	Detector Serial #	164053	Detector Serial #	263618	Detector Serial #	164053
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ε _d)	25%	Detector Efficiency (ε _d)	37%	Detector Efficiency (ε _d)	41%	Detector Efficiency (ε _d)	76%
Surface Efficiency (ε _s)	50%	Surface Efficiency (ε _s)	50%	Surface Efficiency (ε _s)	50%	Surface Efficiency (ε _s)	33%
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	3	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	3
Background Time (T _b) (min)	10	Background Time (T _b) (min)	10	Background Time (T _b) (min)	10	Background Time (T _b) (min)	10
BKG (R _b) (cpm)	236	BKG (R _b) (cpm)	63	BKG (R _b) (cpm)	0.5	BKG (R _b) (cpm)	0.3
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	441	MDC (dpm/100cm ²)	98	MDC (dpm/100cm ²)	26	MDC (dpm/100cm ²)	9
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	400			MDCR (gross cpm)	8		
ScanMDC (dpm/100cm ²)	1829			ScanMDC (dpm/100cm ²)	52		

ION: ABJ Reactor Top USE: Characterization Survey		Location	dpm/100cm ² β/γ - Total	dpm/100cm ² β/γ - Remov.	dpm/100cm ² α - Total	dpm/100cm ² α - Remov.
		1	<MDC	<MDC	<MDC	<MDC
		2	<MDC	<MDC	<MDC	<MDC
		3	<MDC	<MDC	<MDC	<MDC
		4	<MDC	<MDC	<MDC	<MDC
		5	<MDC	<MDC	<MDC	<MDC
		6	<MDC	<MDC	<MDC	<MDC
		7	<MDC	<MDC	<MDC	<MDC
		8	<MDC	<MDC	<MDC	<MDC
		9	2504	<MDC	<MDC	<MDC
		10	<MDC	<MDC	<MDC	<MDC
		11	<MDC	<MDC	<MDC	<MDC
		12	<MDC	<MDC	<MDC	<MDC
		13	<MDC	<MDC	<MDC	<MDC
		14	<MDC	<MDC	<MDC	<MDC
		15	<MDC	<MDC	<MDC	<MDC
		16	<MDC	<MDC	<MDC	<MDC
		17	<MDC	<MDC	31	<MDC
		18	1472	<MDC	<MDC	<MDC
Note: 1-6 on Cover, 7-11 on Bridge, 12-15 Reactor Top, 16-18 in Trench						

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_i)(A/100)} \right]$$

$$\epsilon_i = (\epsilon_d) * (\epsilon_s)$$

$$A/I = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

y Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ε _d) (Approximate)	14%	Detector Efficiency (ε _d) (Approximate)	25%	Detector Efficiency (ε _d) (Approximate)	39%	Detector Efficiency (ε _d)	NA
						Surface Efficiency (ε _s)	NA
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	NA
Background Time (T _b) (min)	10	Background Time (T _b) (min)	1	Background Time (T _b) (min)	1	Background Time (T _b) (min)	NA
BKG (R _b) (cpm)	45	BKG (R _b) (cpm)	8	BKG (R _b) (cpm)	12	BKG (R _b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

LOCATION: ABJ Reactor Top PURPOSE: Characterization Survey		Location	dpm/100cm ² β - Total	dpm/100cm ² β - H3	dpm/100cm ² β - C14	dpm/100cm ²
See pg 1 for smear locations Note: Raw Data Available		1	45	8	18	NA
		2	60	15	12	NA
		3	42	6	18	NA
		4	43	19	19	NA
		5	47	2	18	NA
		6	41	1	30	NA
		7	71	31	18	NA
		8	57	29	19	NA
		9	88	55	16	NA
		10	64	24	14	NA
		11	51	40	23	NA
		12	86	8	16	NA
		13	50	12	13	NA
		14	45	0	16	NA
		15	56	11	18	NA
		16	36	15	23	NA
		17	68	21	16	NA
		18	66	6	23	NA

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

$$AI = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

or: **Ernie Wike**

Print

Reviewer: **Chris Higgins**

[Print](#)

Sign

Sign

5/24/2011

Date _____

5/24/2011

Date _____

Survey Meters

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	245758	Instrument #	160029	Instrument #	245758	Instrument #	160029
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	245758	Meter Serial #	160029	Meter Serial #	245758	Meter Serial #	160029
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	263618	Detector Serial #	164053	Detector Serial #	263618	Detector Serial #	164053
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	37%	Detector Efficiency (ϵ_d)	41%	Detector Efficiency (ϵ_d)	76%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	249	BKG (R_b) (cpm)	71	BKG (R_b) (cpm)	0.2	BKG (R_b) (cpm)	0.3
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	452	MDC (dpm/100cm ²)	104	MDC (dpm/100cm ²)	22	MDC (dpm/100cm ²)	9
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	418			MDCR (gross cpm)	5		
ScanMDC (dpm/100cm ²)	1878			ScanMDC (dpm/100cm ²)	33		

[illegible]

Note: Not enough sludge for sample
Note: Approximately 30 ft due West from Sewar1.

$$DC = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

$$A / = R b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

or: **John Albright**

Print

Reviewer: **Chris Higgins**

Print

John P. Allen
Sign

Sign

5/23/2011

Date _____

5/23/2011

Date _____

Survey Meters

Total (Direct) γ		Removable $\beta \gamma$		Total (Direct) α		Removable α	
Instrument #	169659	Instrument #	160029	Instrument #	3634	Instrument #	160029
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	GR-135	Meter Model #	L2929
Meter Serial #	169659	Meter Serial #	160029	Meter Serial #	3634	Meter Serial #	160029
Detector Model #	NA	Detector Model #	43-10-1	Detector Model #	NA	Detector Model #	43-10-1
Detector Serial #	NA	Detector Serial #	164053	Detector Serial #	NA	Detector Serial #	164053
Cal Due	9/1/2011	Cal Due	9/24/2011	Cal Due	7/14/2011	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	100%	Detector Efficiency (ϵ_d)	40%	Detector Efficiency (ϵ_d)	100%	Detector Efficiency (ϵ_d)	62%
Surface Efficiency (ϵ_s)	NA	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	NA	Surface Efficiency (ϵ_s)	50%
Sample Time (T_s) (min)	NA	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	NA	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	NA	Background Time (T_b) (min)	10	Background Time (T_b) (min)	NA	Background Time (T_b) (min)	10
BKG (R_b) (μ R/hr)	13	BKG (R_b) (cpm)	74	BKG (R_b) (cpm)	NA	BKG (R_b) (cpm)	0.5
Probe Area (A) (cm)	NA	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	NA	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	NA	MDC (dpm/100cm ²)	99	MDC (dpm/100cm ²)	NA	MDC (dpm/100cm ²)	8
Release Limit (dpm/100cm ²)	NA	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	NA			Scan Rate (det. width/sec.)	NA		
MDCR (gross cpm)	NA			MDCR (gross cpm)	NA		
ScanMDC (dpm/100cm ²)	NA			ScanMDC (dpm/100cm ²)	NA		

ION: AJB Reactor PoBe Source
USE: Characterization Survey

[illegible]

Note: Distances not to scale

$$DC \approx \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

Al = Rb + ((guideline) (eff.))

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Survey Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ε _d) (Approximate)	14%	Detector Efficiency (ε _d) (Approximate)	25%	Detector Efficiency (ε _d) (Approximate)	39%	Detector Efficiency (ε _d)	NA
						Surface Efficiency (ε _s)	NA
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	NA
Background Time (T _b) (min)	10	Background Time (T _b) (min)	1	Background Time (T _b) (min)	1	Background Time (T _b) (min)	NA
BKG (R _b) (cpm)	45	BKG (R _b) (cpm)	8	BKG (R _b) (cpm)	12	BKG (R _b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

LOCATION: AJS Reactor PoBe Source		Location	dpm/100cm ² β - Total	dpm/100cm ² β - H3	dpm/100cm ² β - C14	dpm/100cm ²
PURPOSE: Characterization Survey		1	666	302	390	NA
See pg 1 for smear locations		2	96	14	28	NA
		3	109	5	26	NA
		4	66	7	17	NA
		5	70	18	17	NA
		6	68	0	30	NA
		7	111	36	60	NA
Note: Raw Data Available						

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_i)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

$$A = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Survey Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ϵ_d) (Approximate)	14%	Detector Efficiency (ϵ_d) (Approximate)	25%	Detector Efficiency (ϵ_d) (Approximate)	39%	Detector Efficiency (ϵ_d)	NA
						Surface Efficiency (ϵ_s)	NA
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	NA
Background Time (T_b) (min)	10	Background Time (T_b) (min)	1	Background Time (T_b) (min)	1	Background Time (T_b) (min)	NA
BKG (R_b) (cpm)	45	BKG (R_b) (cpm)	8	BKG (R_b) (cpm)	12	BKG (R_b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swlpte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

[illegible]

$$MDC = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

A1 \approx **Rb** + ((guideline) (cff.))

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Dr: Ernie Wike
Print

Reviewer: Chris Higgins
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5/17/2011
Date
5/17/2011
Date

Survey Meters

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	245758	Instrument #	160005	Instrument #	245758	Instrument #	160005
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	245758	Meter Serial #	160005	Meter Serial #	245758	Meter Serial #	160005
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	263618	Detector Serial #	164048	Detector Serial #	263618	Detector Serial #	164048
Cal Due	5/9/2012	Cal Due	8/5/2011	Cal Due	5/9/2012	Cal Due	8/5/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	39%	Detector Efficiency (ϵ_d)	41%	Detector Efficiency (ϵ_d)	69%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	243	BKG (R_b) (cpm)	49	BKG (R_b) (cpm)	0.2	BKG (R_b) (cpm)	0.2
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	447	MDC (dpm/100cm ²)	84	MDC (dpm/100cm ²)	22	MDC (dpm/100cm ²)	9
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (def. width/sec.)	1			Scan Rate (def. width/sec.)	1		
MDCR (gross cpm)	410			MDCR (gross cpm)	5		
ScanMDC (dpm/100cm ²)	1856			ScanMDC (dpm/100cm ²)	33		

[illegible]

$$DC = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

Al = Rb + ((guideline) (eff.))

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Survey Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ε _i) (Approximate)	14%	Detector Efficiency (ε _i) (Approximate)	25%	Detector Efficiency (ε _i) (Approximate)	39%	Detector Efficiency (ε _i)	NA
						Surface Efficiency (ε _s)	NA
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	NA
Background Time (T _b) (min)	10	Background Time (T _b) (min)	1	Background Time (T _b) (min)	1	Background Time (T _b) (min)	NA
BKG (R _b) (cpm)	45	BKG (R _b) (cpm)	8	BKG (R _b) (cpm)	12	BKG (R _b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

LOCATION: ABJ Reactor Vault Floor PURPOSE: Characterization Survey	Location	dpm/100cm ² β - Total	dpm/100cm ² β - H3	dpm/100cm ² β - C14	dpm/100cm ²
		1	2	3	4
See pg 1 for smear locations Note: Raw Data Available	1	51	6	22	NA
	2	50	3	24	NA
	3	53	3	15	NA
	4	44	5	23	NA
	5	55	4	16	NA
	6	49	17	24	NA
	7	64	16	17	NA
	8	48	11	21	NA

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_i)(A/100)} \right] \quad \epsilon_i = (\epsilon_i) * (\epsilon_s)$$

$$AI = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

or: **Ernie Wike**

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Reviewer: Chris Higgins

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Date _____

5/17/2011

Date _____

Survey Meters

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	245758	Instrument #	160029	Instrument #	245758	Instrument #	160029
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	245758	Meter Serial #	160029	Meter Serial #	245758	Meter Serial #	160029
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	263618	Detector Serial #	164053	Detector Serial #	263618	Detector Serial #	164053
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	37%	Detector Efficiency (ϵ_d)	41%	Detector Efficiency (ϵ_d)	76%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	243	BKG (R_b) (cpm)	64	BKG (R_b) (cpm)	0.2	BKG (R_b) (cpm)	0.3
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	447	MDC (dpm/100cm ²)	99	MDC (dpm/100cm ²)	22	MDC (dpm/100cm ²)	9
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	410			MDCR (gross cpm)	5		
ScanMDC (dpm/100cm ²)	1856			ScanMDC (dpm/100cm ²)	33		

The diagram illustrates the layout of the ABJ Reactor Sewer Lines. A central circular reactor tank is shown with six sampling locations marked by numbered circles (1-6) and corresponding pipe connections:

- Location 1:** 4 inch pipe inlet from ABJ Reactor (East)
- Location 2:** 4 inch pipe inlet from Bldg 5 (South-West)
- Location 3:** 8 inch pipe outlet (West)
- Location 4:** Internal sampling point (North-West)
- Location 5:** Internal sampling point (North-East)
- Location 6:** Internal sampling point (South-East)

Compass directions are indicated: North (top), South (bottom), East (right), and West (left).

Location	dpm/100cm ²	dpm/100cm ²	dpm/100cm ²	dpm/100cm ²
	B/y - Total	B/y - Remov.	α - Total	α - Remov.
1	<MDC	<MDC	<MDC	<MDC
2	877	<MDC	<MDC	<MDC
3	591	<MDC	23	<MDC
4	<MDC	<MDC	<MDC	<MDC
5	795	<MDC	<MDC	<MDC
6	465	<MDC	<MDC	<MDC

Note: Not enough sludge for sample

$$I_{DC} = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

Al = Rb + ((guideline) (off.))

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Survey Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ε _d) (Approximate)	14%	Detector Efficiency (ε _d) (Approximate)	25%	Detector Efficiency (ε _d) (Approximate)	39%	Detector Efficiency (ε _d)	NA
						Surface Efficiency (ε _s)	NA
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	NA
Background Time (T _b) (min)	10	Background Time (T _b) (min)	1	Background Time (T _b) (min)	1	Background Time (T _b) (min)	NA
BKG (R _b) (cpm)	45	BKG (R _b) (cpm)	8	BKG (R _b) (cpm)	12	BKG (R _b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

LOCATION: ABJ Reactor Sewer Lines PURPOSE: Characterization Survey	Location	dpm/100cm ² β - Total	dpm/100cm ² β - H3	dpm/100cm ² β - C14	dpm/100cm ²
		1	2	3	4
See pg 1 for smear locations	1	56	14	23	NA
	2	58	0	29	NA
	3	49	3	14	NA
	4	46	24	15	NA
	5	51	15	19	NA
	6	44	13	14	NA
Note: Raw Data Available					

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_i)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

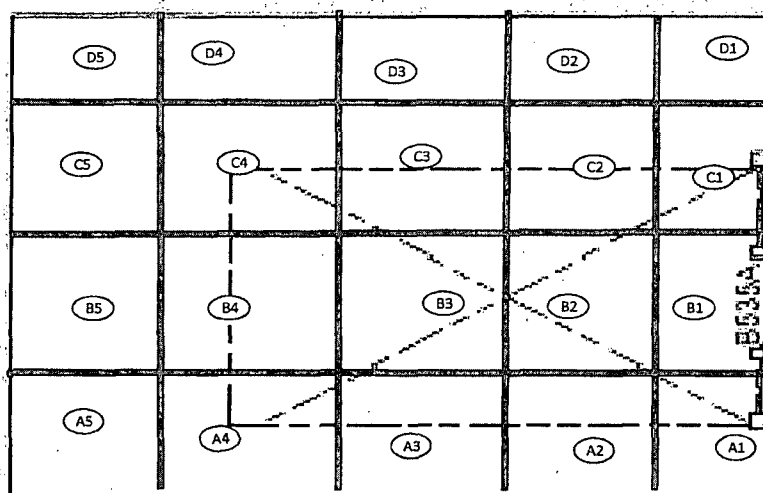
$$AI = Rb + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\epsilon_i/\beta) (\text{efficiency})}$$

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Date _____

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	193682	Instrument #	160005	Instrument #	193682	Instrument #	160005
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	193682	Meter Serial #	160005	Meter Serial #	193682	Meter Serial #	160005
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	200115	Detector Serial #	164048	Detector Serial #	200115	Detector Serial #	164048
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	39%	Detector Efficiency (ϵ_d)	42%	Detector Efficiency (ϵ_d)	69%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	289	BKG (R_b) (cpm)	52	BKG (R_b) (cpm)	0.5	BKG (R_b) (cpm)	0.2
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	486	MDC (dpm/100cm ²)	85	MDC (dpm/100cm ²)	26	MDC (dpm/100cm ²)	9
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	471			MDCR (gross cpm)	8		
ScanMDC (dpm/100cm ²)	2024			ScanMDC (dpm/100cm ²)	51		

[illegible]

$$DC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\varepsilon_i)(A/100)} \right] \quad \varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

Al = Rb + ((guideline) (eff.))

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

or: John Albright
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Reviewer: Chris Higgins
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5/17/2011
Date
5/17/2011
Date

Survey Meters

Total (Direct) β y		Removable β y		Total (Direct) α		Removable α	
Instrument #	245758	Instrument #	160029	Instrument #	245758	Instrument #	160029
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	245758	Meter Serial #	160029	Meter Serial #	245758	Meter Serial #	160029
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	263618	Detector Serial #	164053	Detector Serial #	263618	Detector Serial #	164053
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	37%	Detector Efficiency (ϵ_d)	41%	Detector Efficiency (ϵ_d)	76%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	243	BKG (R_b) (cpm)	70	BKG (R_b) (cpm)	0.2	BKG (R_b) (cpm)	0.1
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	447	MDC (dpm/100cm ²)	103	MDC (dpm/100cm ²)	22	MDC (dpm/100cm ²)	7
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	410			MDCR (gross cpm)	5		
ScanMDC (dpm/100cm ²)	1856			ScanMDC (dpm/100cm ²)	33		

ION: ABJ B540A Floor JSE: Characterization Survey		Location	dpm/100cm ² β/γ - Total	dpm/100cm ² β/γ - Remov.	dpm/100cm ² α - Total	dpm/100cm ² α - Remov.
		A1	1543	<MDC	<MDC	<MDC
		A2	2031	<MDC	28	<MDC
		A3	2417	<MDC	<MDC	<MDC
		A4	1551	<MDC	<MDC	<MDC
		B1	1402	<MDC	<MDC	<MDC
		B2	2543	<MDC	<MDC	<MDC
		B3	2315	<MDC	<MDC	<MDC
		B4	1528	<MDC	<MDC	<MDC
		C1	1984	<MDC	28	<MDC
		C2	1339	<MDC	<MDC	<MDC
		C3	1830	<MDC	<MDC	<MDC
		C4	1504	<MDC	<MDC	<MDC
<p>Note: Floor is concrete Note: Grids are 1 meter square (not to Scale)</p>						

$$DC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

$$A I = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

y Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ε _d) (Approximate)	14%	Detector Efficiency (ε _d) (Approximate)	25%	Detector Efficiency (ε _d) (Approximate)	39%	Detector Efficiency (ε _d)	NA
						Surface Efficiency (ε _s)	NA
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	NA
Background Time (T _b) (min)	10	Background Time (T _b) (min)	1	Background Time (T _b) (min)	1	Background Time (T _b) (min)	NA
BKG (R _b) (cpm)	45	BKG (R _b) (cpm)	8	BKG (R _b) (cpm)	12	BKG (R _b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	NA

LOCATION: ABJ B540A Floor			dpm/100cm ²	dpm/100cm ²	dpm/100cm ²	dpm/100cm ²
PURPOSE: Characterization Survey		Location	β - Total	β - H3	β - C14	
See pg 1 for smear locations		A1	60	12	33	NA
		A2	86	10	28	NA
		A3	58	1	16	NA
		A4	52	14	28	NA
		B1	74	25	17	NA
		B2	53	4	33	NA
		B3	64	26	27	NA
		B4	52	16	12	NA
		C1	66	13	17	NA
		C2	62	26	16	NA
		C3	63	0	23	NA
		C4	54	18	15	NA
Note: Raw Data Available						

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

$$A/I = R_b + ((\text{guideline}) (\text{cff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

or: Wiley Smith
Print
Reviewer: Chris Higgins
Print

Wiley Smith
Sign
Chris Higgins
Sign

5/11/2011
Date
5/11/2011
Date

Survey Meters

Total (Direct) $\beta \gamma$		Removable $\beta \gamma$		Total (Direct) α		Removable α	
Instrument #	193682	Instrument #	160005	Instrument #	193682	Instrument #	160005
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	193682	Meter Serial #	160005	Meter Serial #	193682	Meter Serial #	160005
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	200115	Detector Serial #	164048	Detector Serial #	200115	Detector Serial #	164048
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	39%	Detector Efficiency (ϵ_d)	42%	Detector Efficiency (ϵ_d)	69%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	289	BKG (R_b) (cpm)	59	BKG (R_b) (cpm)	0.5	BKG (R_b) (cpm)	0.1
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	486	MDC (dpm/100cm ²)	151	MDC (dpm/100cm ²)	26	MDC (dpm/100cm ²)	18
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	471			MDCR (gross cpm)	8		
ScanMDC (dpm/100cm ²)	2024			ScanMDC (dpm/100cm ²)	51		

ION: ABJ B526 Floor. JSE: Characterization Survey	Location	dpm/100cm ² $\beta \gamma$ - Total	dpm/100cm ² $\beta \gamma$ - Remov.	dpm/100cm ² α - Total	dpm/100cm ² α - Remov.
		$\beta \gamma$ - Total	$\beta \gamma$ - Remov.	α - Total	α - Remov.
Please See Cover Page for Map	A1	<MDC	<MDC	<MDC	<MDC
	A2	<MDC	<MDC	<MDC	<MDC
	A3	<MDC	<MDC	<MDC	<MDC
	B1	<MDC	<MDC	<MDC	<MDC
	B2	709	<MDC	<MDC	<MDC
	B3	<MDC	<MDC	<MDC	<MDC
	C1	<MDC	<MDC	<MDC	<MDC
	C2	<MDC	<MDC	<MDC	<MDC
	C3	<MDC	<MDC	<MDC	<MDC
	C5	<MDC	<MDC	<MDC	<MDC
	C6	<MDC	<MDC	<MDC	<MDC
	C7	<MDC	<MDC	<MDC	<MDC
	C8	<MDC	<MDC	<MDC	<MDC
	D1	<MDC	<MDC	<MDC	<MDC
	D2	<MDC	<MDC	<MDC	<MDC
	D3	<MDC	<MDC	<MDC	<MDC
	D4	<MDC	<MDC	<MDC	<MDC
	D5	<MDC	<MDC	<MDC	<MDC
	D6	<MDC	<MDC	<MDC	<MDC
	D7	<MDC	<MDC	<MDC	<MDC
	D8	<MDC	<MDC	<MDC	<MDC
	D9	<MDC	<MDC	<MDC	<MDC
	E1	<MDC	<MDC	<MDC	<MDC
	E2	<MDC	<MDC	<MDC	<MDC
	E3	<MDC	<MDC	<MDC	<MDC
	E4	<MDC	<MDC	<MDC	<MDC
	E5	<MDC	<MDC	<MDC	<MDC
	E6	<MDC	<MDC	<MDC	<MDC
	E7	<MDC	<MDC	<MDC	<MDC
	E8	<MDC	<MDC	<MDC	<MDC
	E9	<MDC	<MDC	<MDC	<MDC

$$DC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

$$AI = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

y Meters							
Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	193682	Instrument #	160005	Instrument #	193682	Instrument #	160005
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	193682	Meter Serial #	160005	Meter Serial #	193682	Meter Serial #	160005
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	200115	Detector Serial #	164048	Detector Serial #	200115	Detector Serial #	164048
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ε _d)	25%	Detector Efficiency (ε _d)	39%	Detector Efficiency (ε _d)	42%	Detector Efficiency (ε _d)	69%
Surface Efficiency (ε _s)	50%	Surface Efficiency (ε _s)	50%	Surface Efficiency (ε _s)	50%	Surface Efficiency (ε _s)	33%
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1
Background Time (T _b) (min)	10	Background Time (T _b) (min)	10	Background Time (T _b) (min)	10	Background Time (T _b) (min)	10
BKG (R _b) (cpm)	289	BKG (R _b) (cpm)	59	BKG (R _b) (cpm)	0.5	BKG (R _b) (cpm)	0.1
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	486	MDC (dpm/100cm ²)	151	MDC (dpm/100cm ²)	26	MDC (dpm/100cm ²)	18
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	471			MDCR (gross cpm)	8		
ScanMDC (dpm/100cm ²)	2024			ScanMDC (dpm/100cm ²)	51		

LOCATION: ABJ B526 Floor		Location		dpm/100cm ²	dpm/100cm ²	dpm/100cm ²	dpm/100cm ²
PURPOSE: Characterization Survey				β/γ - Total	β/γ - Remov.	α - Total	α - Remov.
Please See Cover Page for Map		F1		<MDC	<MDC	<MDC	<MDC
		F2		<MDC	<MDC	<MDC	<MDC
		F3		<MDC	<MDC	<MDC	<MDC
		F4		<MDC	<MDC	<MDC	<MDC
		F7		<MDC	<MDC	<MDC	<MDC
		F8		<MDC	<MDC	<MDC	<MDC
		F9		<MDC	<MDC	<MDC	<MDC
		G1		<MDC	<MDC	<MDC	<MDC
		G2		<MDC	<MDC	<MDC	<MDC
		G3		<MDC	<MDC	<MDC	<MDC
		G4		<MDC	<MDC	<MDC	<MDC
		G5		<MDC	<MDC	<MDC	<MDC
		G7		<MDC	<MDC	<MDC	<MDC
		G8		<MDC	<MDC	<MDC	<MDC
		G9		<MDC	<MDC	<MDC	<MDC
		H1		<MDC	<MDC	<MDC	<MDC
		H2		<MDC	<MDC	<MDC	<MDC
		H3		<MDC	<MDC	<MDC	<MDC
		H4		<MDC	<MDC	<MDC	<MDC
		H7		<MDC	<MDC	<MDC	<MDC
		H8		<MDC	<MDC	<MDC	<MDC
		H9		<MDC	<MDC	<MDC	<MDC
		I1		<MDC	<MDC	<MDC	<MDC
		I2		<MDC	<MDC	<MDC	<MDC
		I3		<MDC	<MDC	<MDC	<MDC
		I4		<MDC	<MDC	<MDC	<MDC
		I5		<MDC	<MDC	<MDC	<MDC
		I6		<MDC	<MDC	<MDC	<MDC
		I7		<MDC	<MDC	<MDC	<MDC
		I8		<MDC	<MDC	<MDC	<MDC
		I9		<MDC	<MDC	<MDC	<MDC
						<MDC	

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_d) * (\epsilon_s)$$

$$A1 = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

y Meters

Total (Direct) β y		Removable β y		Total (Direct) α		Removable α	
Instrument #	193682	Instrument #	160005	Instrument #	193682	Instrument #	160005
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	193682	Meter Serial #	160005	Meter Serial #	193682	Meter Serial #	160005
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	200115	Detector Serial #	164048	Detector Serial #	200115	Detector Serial #	164048
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	39%	Detector Efficiency (ϵ_d)	42%	Detector Efficiency (ϵ_d)	69%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	289	BKG (R_b) (cpm)	59	BKG (R_b) (cpm)	0.5	BKG (R_b) (cpm)	0.1
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	486	MDC (dpm/100cm ²)	151	MDC (dpm/100cm ²)	26	MDC (dpm/100cm ²)	18
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	471			MDCR (gross cpm)	8		
ScanMDC (dpm/100cm ²)	2024			ScanMDC (dpm/100cm ²)	51		

LOCATION: ABJ B526 Floor			dpm/100cm ²	dpm/100cm ²	dpm/100cm ²	dpm/100cm ²
PURPOSE: Characterization Survey		Location	β y - Total	β y - Remov.	α - Total	α - Remov.
Please See Cover Page for Map		J1	<MDC	<MDC	<MDC	<MDC
		J2	<MDC	<MDC	<MDC	<MDC
		J3	<MDC	<MDC	<MDC	<MDC
		J4	<MDC	<MDC	<MDC	<MDC
		J5	<MDC	<MDC	<MDC	<MDC
		J6	<MDC	<MDC	<MDC	<MDC
		J7	<MDC	<MDC	<MDC	<MDC
		J8	<MDC	<MDC	<MDC	<MDC
		J9	<MDC	<MDC	<MDC	<MDC
		K1	<MDC	<MDC	<MDC	<MDC
		K2	<MDC	<MDC	<MDC	<MDC
		K3	<MDC	<MDC	<MDC	<MDC
		K4	<MDC	<MDC	<MDC	<MDC
		K5	<MDC	<MDC	<MDC	<MDC
		K6	<MDC	<MDC	<MDC	<MDC
		K7	<MDC	<MDC	<MDC	<MDC
		K8	<MDC	<MDC	<MDC	<MDC
		K9	<MDC	<MDC	<MDC	<MDC
		L1	<MDC	<MDC	<MDC	<MDC
		L2	<MDC	<MDC	<MDC	<MDC
		L3	<MDC	<MDC	<MDC	<MDC
		L4	<MDC	<MDC	<MDC	<MDC
		L5	<MDC	<MDC	<MDC	<MDC
		L6	<MDC	<MDC	<MDC	<MDC
		L7	<MDC	<MDC	<MDC	<MDC
		L8	<MDC	<MDC	<MDC	<MDC
		L9	<MDC	<MDC	<MDC	<MDC
		M1	<MDC	<MDC	<MDC	<MDC
		M2	<MDC	<MDC	<MDC	<MDC
		M3	<MDC	<MDC	<MDC	<MDC
		M4	<MDC	<MDC	<MDC	<MDC
		M5	<MDC	<MDC	<MDC	<MDC
		M6	<MDC	<MDC	<MDC	<MDC
		M7	<MDC	<MDC	<MDC	<MDC
		M8	<MDC	<MDC	<MDC	<MDC
		M9	<MDC	<MDC	<MDC	<MDC

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

$$MDC = R_b + ((\text{guideline}) (eff.))$$

$$dpm / 100cm^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

y Meters

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	193682	Instrument #	160005	Instrument #	193682	Instrument #	160005
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	193682	Meter Serial #	160005	Meter Serial #	193682	Meter Serial #	160005
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	200115	Detector Serial #	164048	Detector Serial #	200115	Detector Serial #	164048
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	39%	Detector Efficiency (ϵ_d)	42%	Detector Efficiency (ϵ_d)	69%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	289	BKG (R_b) (cpm)	59	BKG (R_b) (cpm)	0.5	BKG (R_b) (cpm)	0.1
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm2)	486	MDC (dpm/100cm2)	151	MDC (dpm/100cm2)	26	MDC (dpm/100cm2)	18
Release Limit (dpm/100cm2)	1000	Release Limit (dpm/100cm2)	200	Release Limit (dpm/100cm2)	100	Release Limit (dpm/100cm2)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	471			MDCR (gross cpm)	8		
ScanMDC (dpm/100cm2)	2024			ScanMDC (dpm/100cm2)	51		

[illegible]

$$\lambda_{MDC} = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

AI = Rb + ((guideline) (eff.))

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Survey Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ϵ_i) (Approximate)	14%	Detector Efficiency (ϵ_i) (Approximate)	25%	Detector Efficiency (ϵ_i) (Approximate)	39%	Detector Efficiency (ϵ_i)	NA
						Surface Efficiency (ϵ_s)	NA
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	NA
Background Time (T_b) (min)	10	Background Time (T_b) (min)	1	Background Time (T_b) (min)	1	Background Time (T_b) (min)	NA
BKG (R_b) (cpm)	45	BKG (R_b) (cpm)	8	BKG (R_b) (cpm)	12	BKG (R_b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

LOCATION: ABJ B526 Floor		Location	dpm/100cm ² β - Total	dpm/100cm ² β - H3	dpm/100cm ² β - C14	dpm/100cm ²
PURPOSE: Characterization Survey		A1	54	39	24	NA
See pg 1 for smear locations		A2	57	16	27	NA
		A3	40	1	13	NA
		B1	49	0	9	NA
		B2	51	19	20	NA
		B3	48	14	11	NA
		C1	52	6	16	NA
		C2	53	19	25	NA
		C3	55	16	8	NA
		C5	58	19	20	NA
		C6	79	22	32	NA
		C7	82	15	53	NA
		C8	337	326	31	NA
		D1	57	14	14	NA
		D2	49	23	23	NA
		D3	54	22	21	NA
		D4	54	26	18	NA
		D5	69	25	20	NA
		D6	79	28	21	NA
		D7	78	37	16	NA
		D8	463	464	11	NA
		D9	813	816	26	NA
		E1	70	29	14	NA
		E2	67	47	22	NA
		E3	83	37	14	NA
		E4	62	15	17	NA
		E5	75	23	13	NA
		E6	67	49	8	NA
		E7	83	33	15	NA
		E8	104	93	26	NA
		E9	100	69	18	NA
Note: Raw Data Available						

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s / T_b)}}{(T_s)(\epsilon_i)(A/100)} \right]$$

$$\epsilon_i = (\epsilon_i) * (\epsilon_s)$$

$$AI = Rb + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Survey Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ϵ_d) (Approximate)	14%	Detector Efficiency (ϵ_d) (Approximate)	25%	Detector Efficiency (ϵ_d) (Approximate)	39%	Detector Efficiency (ϵ_d)	NA
						Surface Efficiency (ϵ_s)	NA
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	NA
Background Time (T_b) (min)	10	Background Time (T_b) (min)	1	Background Time (T_b) (min)	1	Background Time (T_b) (min)	NA
BKG (R_b) (cpm)	45	BKG (R_b) (cpm)	8	BKG (R_b) (cpm)	12	BKG (R_b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

LOCATION: ABJ B526 Floor		Location	dpm/100cm ² β - Total	dpm/100cm ² β - H3	dpm/100cm ² β - C14	dpm/100cm ²
PURPOSE: Characterization Survey		F1	70	11	12	NA
See pg 1 for smear locations		F2	46	17	17	NA
		F3	70	19	11	NA
		F4	78	34	24	NA
		F7	62	7	19	NA
		F8	65	10	22	NA
		F9	67	10	22	NA
		G1	51	16	27	NA
		G2	59	12	18	NA
		G3	76	4	23	NA
		G4	64	21	15	NA
		G5	57	41	23	NA
		G7	49	15	21	NA
		G8	68	28	12	NA
		G9	51	0	20	NA
		H1	77	11	14	NA
		H2	61	11	16	NA
		H3	43	24	13	NA
		H4	56	12	18	NA
		H7	48	20	21	NA
		H8	70	21	23	NA
		H9	47	19	18	NA
		I1	64	6	24	NA
		I2	62	0	24	NA
		I3	61	20	21	NA
		I4	56	15	20	NA
		I5	55	0	18	NA
		I6	54	28	19	NA
		I7	51	26	9	NA
		I8	57	25	16	NA
		I9	61	37	19	NA
Note: Raw Data Available						

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

$$AI = Rb + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Survey Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ε _d) (Approximate)	14%	Detector Efficiency (ε _d) (Approximate)	25%	Detector Efficiency (ε _d) (Approximate)	39%	Detector Efficiency (ε _d)	NA
						Surface Efficiency (ε _s)	NA
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	NA
Background Time (T _b) (min)	10	Background Time (T _b) (min)	1	Background Time (T _b) (min)	1	Background Time (T _b) (min)	NA
BKG (R _b) (cpm)	45	BKG (R _b) (cpm)	8	BKG (R _b) (cpm)	12	BKG (R _b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

LOCATION: ABJ B526 Floor PURPOSE: Characterization Survey	Location	dpm/100cm ² β - Total	dpm/100cm ² β - H3	dpm/100cm ² β - C14	dpm/100cm ²
		β - Total	β - H3	β - C14	
See pg 1 for smear locations Note: Raw Data Available	J1	39	9	14	NA
	J2	66	18	20	NA
	J3	68	28	19	NA
	J4	56	15	10	NA
	J5	56	14	18	NA
	J6	80	5	21	NA
	J7	57	31	12	NA
	J8	64	32	20	NA
	J9	52	32	19	NA
	K1	53	23	16	NA
	K2	62	9	27	NA
	K3	59	23	19	NA
	K4	50	10	22	NA
	K5	70	39	23	NA
	K6	80	4	15	NA
	K7	61	14	22	NA
	K8	52	4	28	NA
	K9	52	8	14	NA
	L1	48	14	18	NA
	L2	49	1	30	NA
	L3	54	14	16	NA
	L4	67	0	31	NA
	L5	54	0	24	NA
	L6	56	7	26	NA
	L7	60	25	18	NA
	L8	72	0	24	NA
	L9	60	14	18	NA
	M1	59	0	16	NA
	M2	51	17	19	NA
	M3	49	19	13	NA
	M4	48	11	25	NA
	M5	65	25	25	NA
	M6	65	14	25	NA
	M7	54	16	18	NA
	M8	59	14	12	NA
	M9	69	9	18	NA

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)} \right]$$

$$\epsilon_t = (\epsilon_i) * (\epsilon_s)$$

$$AI = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Appendix D
Survey Results from Duct, Drain Line, and Tubing

Ernie Wike
Print
Chris Higgins
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5/13/2011

Date _____

5/13/2011

Date _____

Survey Meters

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	245758	Instrument #	160029	Instrument #	245758	Instrument #	160029
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	245758	Meter Serial #	160029	Meter Serial #	245758	Meter Serial #	160029
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	263618	Detector Serial #	164053	Detector Serial #	263618	Detector Serial #	164053
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	37%	Detector Efficiency (ϵ_d)	41%	Detector Efficiency (ϵ_d)	76%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	236	BKG (R_b) (cpm)	63	BKG (R_b) (cpm)	0.5	BKG (R_b) (cpm)	0.3
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	441	MDC (dpm/100cm ²)	98	MDC (dpm/100cm ²)	26	MDC (dpm/100cm ²)	9
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	400			MDCR (gross cpm)	8		
ScanMDC (dpm/100cm ²)	1829			ScanMDC (dpm/100cm ²)	52		

[illegible]

$$DC = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\varepsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

$$Al \approx Rb + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

by Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ε _i) (Approximate)	14%	Detector Efficiency (ε _i) (Approximate)	25%	Detector Efficiency (ε _i) (Approximate)	39%	Detector Efficiency (ε _i)	NA
						Surface Efficiency (ε _s)	NA
Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	1	Sample Time (T _s) (min)	NA
Background Time (T _b) (min)	10	Background Time (T _b) (min)	1	Background Time (T _b) (min)	1	Background Time (T _b) (min)	NA
BKG (R _b) (cpm)	45	BKG (R _b) (cpm)	8	BKG (R _b) (cpm)	12	BKG (R _b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

LOCATION: ABJ Reactor Pneumatic Tubes		dpm/100cm ²			
PURPOSE: Characterization Survey		Location	β - Total	β - H3	β - C14
See pg 1 for smear locations		1	63	21	24
		2	55	9	19
		3	54	15	16
		4	57	22	17
Note: Raw Data Available					

$$MDC = \left[\frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_i)(A/100)} \right] \quad \epsilon_i = (\epsilon_i) * (\epsilon_s)$$

$$AI = R_b + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

or: Ernie Wike

Print

Reviewer: Chris Higgins

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5/17/2011

Date _____

5/17/2011

Date _____

Survey Meters

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	245758	Instrument #	160029	Instrument #	245758	Instrument #	160029
Meter Model #	L2360	Meter Model #	L2929	Meter Model #	L2360	Meter Model #	L2929
Meter Serial #	245758	Meter Serial #	160029	Meter Serial #	245758	Meter Serial #	160029
Detector Model #	43-93	Detector Model #	43-10-1	Detector Model #	43-93	Detector Model #	43-10-1
Detector Serial #	263618	Detector Serial #	164053	Detector Serial #	263618	Detector Serial #	164053
Cal Due	5/9/2012	Cal Due	9/24/2011	Cal Due	5/9/2012	Cal Due	9/24/2011
Detector Efficiency (ϵ_d)	25%	Detector Efficiency (ϵ_d)	37%	Detector Efficiency (ϵ_d)	41%	Detector Efficiency (ϵ_d)	76%
Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	243	BKG (R_b) (cpm)	64	BKG (R_b) (cpm)	0.2	BKG (R_b) (cpm)	0.3
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	447	MDC (dpm/100cm ²)	99	MDC (dpm/100cm ²)	22	MDC (dpm/100cm ²)	9
Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	100	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	1			Scan Rate (det. width/sec.)	1		
MDCR (gross cpm)	410			MDCR (gross cpm)	5		
ScanMDC (dpm/100cm ²)	1856			ScanMDC (dpm/100cm ²)	33		

Nebraska/Western Iowa Health Care System-Omaha

Location	B/y - Total dpm/100cm ²	B/y - Remov. dpm/100cm ²	α - Total dpm/100cm ²	α - Remov. dpm/100cm ²
1	<MDC	<MDC	<MDC	<MDC
2	646	<MDC	<MDC	<MDC
3	<MDC	<MDC	<MDC	<MDC
4	<MDC	<MDC	<MDC	<MDC
5	764	<MDC	<MDC	<MDC
6	49913	227	202	<MDC
7	<MDC	<MDC	<MDC	<MDC
8	<MDC	<MDC	<MDC	<MDC
9	<MDC	<MDC	<MDC	<MDC
10	<MDC	<MDC	<MDC	<MDC
11	1402	<MDC	23	<MDC

Note: 5 and 11 are concrete and 6 in 'Hot' fume hood

Note: 5 and 11 are concrete and 6 in 'Hot' fume hood

$$\Delta C = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_f)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

$$AI = Rb + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

y Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ϵ_d) (Approximate)	14%	Detector Efficiency (ϵ_d) (Approximate)	25%	Detector Efficiency (ϵ_d) (Approximate)	39%	Detector Efficiency (ϵ_d)	NA
						Surface Efficiency (ϵ_s)	NA
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	NA
Background Time (T_b) (min)	10	Background Time (T_b) (min)	1	Background Time (T_b) (min)	1	Background Time (T_b) (min)	NA
BKG (R_b) (cpm)	45	BKG (R_b) (cpm)	8	BKG (R_b) (cpm)	12	BKG (R_b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

[illegible]

$$MDC = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\varepsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_s)$$

$$A1 = Rb + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

For: **Wiley Smith**

[Print](#)

Reviewer: Chris Higgins

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5/17/2011

Date _____

5/17/2011

Date _____

Survey Meters

Total (Direct) β γ		Removable β γ		Total (Direct) α		Removable α	
Instrument #	NA	Instrument #	160005	Instrument #	NA	Instrument #	160005
Meter Model #	NA	Meter Model #	L2929	Meter Model #	NA	Meter Model #	L2929
Meter Serial #	NA	Meter Serial #	160005	Meter Serial #	NA	Meter Serial #	160005
Detector Model #	NA	Detector Model #	43-10-1	Detector Model #	NA	Detector Model #	43-10-1
Detector Serial #	NA	Detector Serial #	164048	Detector Serial #	NA	Detector Serial #	164048
Cal Due	NA	Cal Due	8/5/2011	Cal Due	NA	Cal Due	8/5/2011
Detector Efficiency (ϵ_d)	NA	Detector Efficiency (ϵ_d)	39%	Detector Efficiency (ϵ_d)	NA	Detector Efficiency (ϵ_d)	69%
Surface Efficiency (ϵ_s)	NA	Surface Efficiency (ϵ_s)	50%	Surface Efficiency (ϵ_s)	NA	Surface Efficiency (ϵ_s)	33%
Sample Time (T_s) (min)	NA	Sample Time (T_s) (min)	3	Sample Time (T_s) (min)	NA	Sample Time (T_s) (min)	3
Background Time (T_b) (min)	NA	Background Time (T_b) (min)	10	Background Time (T_b) (min)	NA	Background Time (T_b) (min)	10
BKG (R_b) (cpm)	NA	BKG (R_b) (cpm)	49	BKG (R_b) (cpm)	NA	BKG (R_b) (cpm)	0.2
Probe Area (A) (cm)	NA	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	NA	Swipte Area (A) (cm)	100
MDC (dpm/100cm ²)	NA	MDC (dpm/100cm ²)	84	MDC (dpm/100cm ²)	NA	MDC (dpm/100cm ²)	9
Release Limit (dpm/100cm ²)	NA	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA	Release Limit (dpm/100cm ²)	20
Scan Rate (det. width/sec.)	NA			Scan Rate (det. width/sec.)	NA		
MDCR (gross cpm)	NA			MDCR (gross cpm)	NA		
ScanMDC (dpm/100cm ²)	NA			ScanMDC (dpm/100cm ²)	NA		

[illegible]

$$DC = \frac{3 + 3.29 \sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)}$$

$$\varepsilon_i = (\varepsilon_i) * (\varepsilon_i)$$

A1 = Rb + ((guideline) (eff.))

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Survey Meters

Total (Direct) β		H-3 β		C-14 β		Removable α	
Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	Packard LSC	Instrument #	NA
Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	2100TR	Meter Model #	NA
Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA	Meter Serial #	NA
Detector Model #	NA	Detector Model #	NA	Detector Model #	NA	Detector Model #	NA
Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA	Detector Serial #	NA
Cal Due	NA	Cal Due	NA	Cal Due	NA	Cal Due	NA
Detector Efficiency (ϵ_d) (Approximate)	14%	Detector Efficiency (ϵ_d) (Approximate)	25%	Detector Efficiency (ϵ_d) (Approximate)	39%	Detector Efficiency (ϵ_d)	NA
						Surface Efficiency (ϵ_s)	NA
Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	1	Sample Time (T_s) (min)	NA
Background Time (T_b) (min)	10	Background Time (T_b) (min)	1	Background Time (T_b) (min)	1	Background Time (T_b) (min)	NA
BKG (R_b) (cpm)	45	BKG (R_b) (cpm)	8	BKG (R_b) (cpm)	12	BKG (R_b) (cpm)	NA
Probe Area (A) (cm)	100	Swipte Area (A) (cm)	100	Probe Area (A) (cm)	100	Swipte Area (A) (cm)	NA
Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	1000	Release Limit (dpm/100cm ²)	200	Release Limit (dpm/100cm ²)	NA

[illegible]

$$MDC = \frac{3 + 3.29\sqrt{(R_b)(T_s)(1 + T_s/T_b)}}{(T_s)(\epsilon_t)(A/100)}$$

$$\mathcal{E}_l = (\mathcal{E}_j) * (\mathcal{E}_s)$$

$$A1 = Rh + ((\text{guideline}) (\text{eff.}))$$

$$\text{dpm} / 100\text{cm}^2 = \frac{\text{gross cpm} - \text{bkg cpm}}{(\text{efficiency})}$$

Appendix E
Analytical Results from Soil Samples

AECOM Technical Services Inc.

Client Sample ID: SOIL BACKGROUND ABJ 011

Radiochemistry

Lab Sample ID: F1E260406-011
Work Order: MJRT7
Matrix: SOLID

Date Collected: 05/20/11 1100
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
				pCi/g		Batch # 1164052	Yld %
Tritium	0.13	U	0.11	2.00	0.15	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
				pCi/g		Batch # 1165213	Yld %
Carbon 14	-0.13	U	0.59	5.00	1.0	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
				pCi/g		Batch # 1160144	Yld % 0.0
Plutonium 241	1.2	U	1.0	5.0	1.6	06/09/11	06/22/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
				pCi/g		Batch # 1160143	Yld % 78
Plutonium 238	-0.0064	U	0.0074	1.00	0.061	06/09/11	06/14/11
Plutonium 239/40	0.0	U	0.0098	1.00	0.031	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
				pCi/g		Batch # 1160145	Yld % 83
Thorium 228	1.24		0.26	1.00	0.07	06/09/11	06/14/11
Thorium 230	1.20		0.26	1.00	0.03	06/09/11	06/14/11
Thorium 232	1.24		0.26	1.00	0.07	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
				pCi/g		Batch # 1160146	Yld % 61
Uranium 234	0.78		0.23	1.00	0.09	06/09/11	06/14/11
Uranium 235/236	-0.0034	U	0.0068	1.00	0.078	06/09/11	06/14/11
Uranium 238	1.10		0.27	1.00	0.04	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
				pCi/g		Batch # 1153138	Yld %
Cesium 137	-0.04	U	0.14	0.20	0.21	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Actinium 228	1.34		0.31		0.26	06/02/11	06/13/11
Bismuth 214	1.47		0.28		0.18	06/02/11	06/13/11
Lead 212	1.18		0.22		0.20	06/02/11	06/13/11
Lead 214	1.39		0.27		0.21	06/02/11	06/13/11
Potassium 40	20.3		3.0		1.1	06/02/11	06/13/11
Thallium 208	0.41		0.13		0.12	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
				pCi/g		Batch # 1168096	Yld % 68
Polonium 210	1.15		0.36	0.50	0.17	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: SOIL, HOLE 1 6" ABJ 004

Radiochemistry

Lab Sample ID: F1E260406-004
Work Order: MJRTQ
Matrix: SOLID

Date Collected: 05/20/11 1100
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.18		0.12	2.00	0.15	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
Carbon 14	0.14	U	0.61	5.00	1.0	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	0.45	U	0.80	5.00	1.4	06/09/11	06/21/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	-0.020	U	0.013	1.00	0.080	06/09/11	06/14/11
Plutonium 239/40	0.011	U	0.021	1.00	0.028	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	0.96		0.23	1.00	0.11	06/09/11	06/14/11
Thorium 230	1.02		0.23	1.00	0.08	06/09/11	06/14/11
Thorium 232	1.17		0.25	1.00	0.03	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.64		0.19	1.00	0.04	06/09/11	06/14/11
Uranium 235/236	0.047	U	0.058	1.00	0.071	06/09/11	06/14/11
Uranium 238	0.77		0.21	1.00	0.04	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	0.27		0.13	0.20	0.20	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Actinium 228	1.44		0.30		0.27	06/02/11	06/13/11
Bismuth 214	1.54		0.31		0.20	06/02/11	06/13/11
Lead 212	1.36		0.20		0.15	06/02/11	06/13/11
Lead 214	1.60		0.28		0.26	06/02/11	06/13/11
Potassium 40	19.6		3.1		1.2	06/02/11	06/13/11
Thallium 208	0.46		0.13		0.12	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
Polonium 210	1.03		0.43	0.50	0.29	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: SOIL HOLE 1 13-15' ABJ 005

Radiochemistry

Lab Sample ID: F1E260406-005
Work Order: MJRTT
Matrix: SOLID

Date Collected: 05/20/11 1100
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.26		0.12	2.00	0.15	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
Carbon 14	-0.01	U	0.60	5.00	1.0	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	0.62	U	0.83	5.00	1.4	06/09/11	06/21/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	0.019	U	0.030	1.00	0.045	06/09/11	06/14/11
Plutonium 239/40	0.0	U	0.0091	1.00	0.028	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	1.24		0.27	1.00	0.1	06/09/11	06/14/11
Thorium 230	1.27		0.27	1.00	0.06	06/09/11	06/14/11
Thorium 232	1.11		0.25	1.00	0.06	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.66		0.21	1.00	0.08	06/09/11	06/14/11
Uranium 235/236	0.024	U	0.057	1.00	0.11	06/09/11	06/14/11
Uranium 238	0.85		0.24	1.00	0.08	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	-0.04	U	0.15	0.20	0.24	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Actinium 228	1.25		0.36		0.53	06/02/11	06/13/11
Bismuth 214	1.74		0.35		0.24	06/02/11	06/13/11
Lead 212	1.39		0.23		0.19	06/02/11	06/13/11
Lead 214	1.77		0.28		0.25	06/02/11	06/13/11
Potassium 40	20.6		3.3		1.3	06/02/11	06/13/11
Thallium 208	0.60		0.17		0.15	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
Polonium 210	1.16		0.48	0.50	0.35	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: SOIL HOLE 2 6" ABJ 006

Radiochemistry

Lab Sample ID: F1E260406-006
Work Order: MJRTV
Matrix: SOLID

Date Collected: 05/20/11 1100
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.39		0.16	2.00	0.14	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
Carbon 14	-0.06	U	0.60	5.00	1.0	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	-0.21	U	0.79	5.00	1.5	06/09/11	06/21/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	0.007	U	0.023	1.00	0.054	06/09/11	06/14/11
Plutonium 239/40	-0.0020	U	0.0041	1.00	0.047	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	1.19		0.26	1.00	0.09	06/09/11	06/14/11
Thorium 230	1.25		0.27	1.00	0.06	06/09/11	06/14/11
Thorium 232	1.19		0.26	1.00	0.03	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.82		0.23	1.00	0.11	06/09/11	06/14/11
Uranium 235/236	0.053		0.061	1.00	0.048	06/09/11	06/14/11
Uranium 238	0.91		0.24	1.00	0.07	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	-0.02	U	0.12	0.20	0.21	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Actinium 228	1.62		0.37		0.19	06/02/11	06/13/11
Bismuth 214	1.90		0.34		0.22	06/02/11	06/13/11
Lead 212	1.33		0.24		0.21	06/02/11	06/13/11
Lead 214	1.64		0.27		0.21	06/02/11	06/13/11
Potassium 40	22.3		3.4		1.2	06/02/11	06/13/11
Thallium 208	0.60		0.15		0.11	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
Polonium 210	0.91		0.37	0.50	0.15	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: SOIL HOLE 2 13-15' ABJ 007

Radiochemistry

Lab Sample ID: F1E260406-007
Work Order: MJRTW
Matrix: SOLID

Date Collected: 05/20/11 1100
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
				pCi/g		Batch # 1164052	Yld %
Tritium	0.12	U	0.11	2.00	0.15	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
				pCi/g		Batch # 1165213	Yld %
Carbon 14	0.03	U	0.61	5.00	1.1	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
				pCi/g		Batch # 1160144	Yld % 0.0
Plutonium 241	0.10	U	0.82	5.00	1.5	06/09/11	06/22/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
				pCi/g		Batch # 1160143	Yld % 87
Plutonium 238	-0.0059	U	0.0068	1.00	0.056	06/09/11	06/14/11
Plutonium 239/40	-0.0059	U	0.0068	1.00	0.056	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
				pCi/g		Batch # 1160145	Yld % 84
Thorium 228	1.05		0.23	1.00	0.09	06/09/11	06/14/11
Thorium 230	1.16		0.25	1.00	0.07	06/09/11	06/14/11
Thorium 232	1.08		0.24	1.00	0.06	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
				pCi/g		Batch # 1160146	Yld % 73
Uranium 234	0.94		0.24	1.00	0.04	06/09/11	06/14/11
Uranium 235/236	0.033	U	0.047	1.00	0.045	06/09/11	06/14/11
Uranium 238	0.70		0.20	1.00	0.08	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
				pCi/g		Batch # 1153138	Yld %
Cesium 137	0.06	U	0.12	0.20	0.23	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Actinium 228	1.60		0.34		0.29	06/02/11	06/13/11
Bismuth 214	1.55		0.32		0.23	06/02/11	06/13/11
Lead 212	1.25		0.22		0.19	06/02/11	06/13/11
Lead 214	2.00		0.29		0.24	06/02/11	06/13/11
Potassium 40	19.8		3.2		1.3	06/02/11	06/13/11
Thallium 208	0.47		0.14		0.12	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
				pCi/g		Batch # 1168096	Yld % 52
Polonium 210	1.18		0.39	0.50	0.12	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: SOIL HOLE 3 6" ABJ 008

Radiochemistry

Lab Sample ID: F1E260406-008
Work Order: MJRT2
Matrix: SOLID

Date Collected: 05/20/11 1100
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.13	U	0.11	2.00	0.15	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
Carbon 14	-0.32	U	0.58	5.00	1.1	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	1.31	U	0.99	5.00	1.5	06/09/11	06/22/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	-0.0059	U	0.0069	1.00	0.057	06/09/11	06/14/11
Plutonium 239/40	-0.0079	U	0.0079	1.00	0.061	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	1.12		0.25	1.00	0.11	06/09/11	06/14/11
Thorium 230	1.14		0.24	1.00	0.05	06/09/11	06/14/11
Thorium 232	1.27		0.26	1.00	0.05	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.82		0.22	1.00	0.07	06/09/11	06/14/11
Uranium 235/236	0.126		0.095	1.00	0.081	06/09/11	06/14/11
Uranium 238	0.67		0.20	1.00	0.07	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	0.076	U	0.088	0.200	0.18	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Actinium 228	1.99		0.43		0.29	06/02/11	06/13/11
Bismuth 214	1.60		0.32		0.23	06/02/11	06/13/11
Lead 212	1.44		0.21		0.16	06/02/11	06/13/11
Lead 214	1.55		0.24		0.22	06/02/11	06/13/11
Potassium 40	18.1		2.8		1.1	06/02/11	06/13/11
Thallium 208	0.58		0.13		0.09	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
Polonium 210	0.88		0.35	0.50	0.21	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: SOIL HOLE 4 6" ABJ 009

Radiochemistry

Lab Sample ID: F1E260406-009
Work Order: MJRT3
Matrix: SOLID

Date Collected: 05/20/11 1100
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	-0.005	U	0.070	2.00	0.15	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
Carbon 14	-0.13	U	0.60	5.00	1.1	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	0.19	U	0.79	5.00	1.4	06/09/11	06/22/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	0.013	U	0.030	1.00	0.059	06/09/11	06/14/11
Plutonium 239/40	-0.0019	U	0.0038	1.00	0.043	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	1.24		0.26	1.00	0.09	06/09/11	06/14/11
Thorium 230	1.09		0.24	1.00	0.08	06/09/11	06/14/11
Thorium 232	1.22		0.26	1.00	0.03	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.78		0.22	1.00	0.08	06/09/11	06/14/11
Uranium 235/236	-0.0032	U	0.0065	1.00	0.073	06/09/11	06/14/11
Uranium 238	0.89		0.24	1.00	0.07	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	0.148	U	0.096	0.200	0.17	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Actinium 228	1.63		0.38		0.16	06/02/11	06/13/11
Bismuth 214	1.52		0.31		0.22	06/02/11	06/13/11
Lead 212	1.37		0.21		0.16	06/02/11	06/13/11
Lead 214	1.45		0.25		0.21	06/02/11	06/13/11
Potassium 40	22.0		3.1		1.0	06/02/11	06/13/11
Thallium 208	0.43		0.12		0.10	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
Polonium 210	1.12		0.39	0.50	0.21	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

AECOM Technical Services Inc.

Client Sample ID: SOIL HOLE 5 6" ABJ 010

Radiochemistry

Lab Sample ID: F1E260406-010
Work Order: MJRT6
Matrix: SOLID

Date Collected: 05/20/11 1100
Date Received: 05/25/11 0725

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	mdc	Prep Date	Analysis Date
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.24		0.12	2.00	0.15	06/13/11	06/14/11
Carbon 14 by EERF C-01-1							
Carbon 14	-0.31	U	0.56	5.00	1.0	06/14/11	06/16/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	0.06	U	0.83	5.00	1.6	06/09/11	06/22/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	0.005	U	0.024	1.00	0.062	06/09/11	06/14/11
Plutonium 239/40	0.011	U	0.023	1.00	0.031	06/09/11	06/14/11
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	1.19		0.26	1.00	0.07	06/09/11	06/14/11
Thorium 230	1.19		0.26	1.00	0.03	06/09/11	06/14/11
Thorium 232	1.03		0.24	1.00	0.05	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.64		0.20	1.00	0.07	06/09/11	06/14/11
Uranium 235/236	0.032	U	0.051	1.00	0.075	06/09/11	06/14/11
Uranium 238	0.85		0.23	1.00	0.06	06/09/11	06/14/11
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	0.02	U	0.10	0.20	0.19	06/02/11	06/13/11
--- Other Detected Radionuclides ---							
Actinium 228	1.45		0.31		0.30	06/02/11	06/13/11
Bismuth 214	1.31		0.27		0.19	06/02/11	06/13/11
Lead 212	1.33		0.20		0.15	06/02/11	06/13/11
Lead 214	1.43		0.23		0.19	06/02/11	06/13/11
Potassium 40	19.5		3.0		1.3	06/02/11	06/13/11
Thallium 208	0.45		0.11		0.08	06/02/11	06/13/11
PO-210 by Alpha Spectrometry							
Polonium 210	0.88		0.30	0.50	0.17	06/20/11	06/22/11

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.

Bold results are greater than the MDC.

U Result is less than the sample detection limit.

METHOD BLANK REPORT

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Parameter	Result	Qual	Total Uncert. (2 σ +/-)	RL	MDC	Prep Date	Lab Sample ID Analysis Date
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	-0.003	U	0.068	0.200	0.12	06/06/11	F1F060000-050B
GROSS A/B BY GFPC SW846 9310 MOD							
Gross Alpha	5.8		4.2	10.0	5.8	06/02/11	F1F060000-214B
Gross Beta	2.3	U	2.2	10.0	3.4	06/02/11	06/08/11
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD							
Plutonium 238	-0.0038	U	0.0053	1.00	0.049	06/09/11	F1F090000-143B
Plutonium 239/40	-0.0038	U	0.0053	1.00	0.049	06/09/11	06/14/11
Plutonium-241 by Liquid Scintillation							
Plutonium 241	0.62	U	0.77	5.00	1.3	06/09/11	F1F090000-144B
Iso THORIUM (SHORT CT) DOE A-01-R MOD							
Thorium 228	0.039	U	0.061	1.00	0.10	06/09/11	F1F090000-145B
Thorium 230	0.098		0.075	1.00	0.071	06/09/11	06/14/11
Thorium 232	0.009	U	0.027	1.00	0.061	06/09/11	06/14/11
Iso URANIUM (SHORT CT) DOE A-01-R MOD							
Uranium 234	0.017	U	0.030	1.00	0.051	06/09/11	F1F090000-146B
Uranium 235/236	0.013	U	0.026	1.00	0.035	06/09/11	06/14/11
Uranium 238	0.0	U	0.0089	1.00	0.028	06/09/11	06/14/11
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.087	U	0.087	2.00	0.13	06/13/11	F1F130000-052B
Carbon 14 by EERF C-01-1							
Carbon 14	-0.25	U	0.58	5.00	1.0	06/14/11	F1F140000-213B
Tritium by LSC by DOE H3-04-RC MOD.							
Tritium	0.002	U	0.26	2.00	0.46	06/14/11	F1F140000-044B
Gamma Cs-137 & Hits by DOE GA-01-R MOD							
Cesium 137	-0.07	U	0.13	0.20	0.14	06/02/11	F1F020000-138B
PO-210 by Alpha Spectrometry							
Polonium 210	0.02	U	0.11	0.50	0.20	06/20/11	F1F170000-096B

Laboratory Control Sample Report

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Parameter	Spike Amount	Result	Total Uncert. (2 σ +/-)	MDC	% Yld	% Rec	Lab Sample ID QC Control Limits
Gamma Cs-137 & Hits by DOE GA-01-R MOD			pCi/g	GA-01-R MOD			F1F020000-138C
Americium 241	98.8	104	8.3	1.2		105	(88 - 115)
Cesium 137	37.1	41.5	2.6	0.5		112	(90 - 115)
Cobalt 60	61.4	65.3	3.9	0.4		106	(90 - 110)
Batch #:			1153138	Analysis Date: 06/13/11			
Gamma Cs-137 & Hits by DOE GA-01-R MOD			pCi/g	GA-01-R MOD			F1F060000-050C
Americium 241	933	955	76	7		102	(88 - 115)
Cesium 137	373	401	24	2		107	(90 - 115)
Cobalt 60	600	617	35	2		103	(90 - 110)
Batch #:			1157050	Analysis Date: 06/13/11			
GROSS A/B BY GFPC SW846 9310 MOD			pCi/g	9310 MOD			F1F060000-214C
Gross Alpha	34.0	23.3	7.0	6.4		68	(37 - 144)
Gross Beta	37.0	23.9	3.9	3.0		65	(36 - 126)
Batch #:			1157214	Analysis Date: 06/08/11			
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD			pCi/g	A-01-R			F1F090000-143C
Plutonium 238	6.12	5.78	0.69	0.05	87	94	(74 - 112)
Plutonium 239/40	6.61	6.26	0.73	0.04	87	95	(84 - 115)
Batch #:			1160143	Analysis Date: 06/14/11			
Plutonium-241 by Liquid Scintillation			pCi/g	STL-RC-0245			F1F090000-144C
Plutonium 241	14.1	13.3	2.2	1.4	0.0	94	(61 - 132)
Batch #:			1160144	Analysis Date: 06/21/11			
Iso THORIUM (SHORT CT) DOE A-01-R MOD			pCi/g	A-01-R MOD			F1F090000-145C
Thorium 230	24.5	25.3	2.6	0.1	83	103	(81 - 123)
Batch #:			1160145	Analysis Date: 06/14/11			
Iso URANIUM (SHORT CT) DOE A-01-R MOD			pCi/g	A-01-R MOD			F1F090000-146C
Uranium 234	6.53	6.37	0.74	0.06	86	98	(86 - 125)
Uranium 238	6.78	6.71	0.77	0.05	86	99	(85 - 125)
Batch #:			1160146	Analysis Date: 06/14/11			
Tritium by LSC by DOE H3-04-RC MOD.			pCi/g	H3-04-RC MOD			F1F130000-052C
Tritium	14.0	13.9	1.1	0.1		99	(75 - 104)
Batch #:			1164052	Analysis Date: 06/14/11			
Tritium by LSC by DOE H3-04-RC MOD.			pCi/g	H3-04-RC MOD			F1F140000-044C
Tritium	14.0	12.0	1.0	0.5		86	(75 - 104)
Batch #:			1165044	Analysis Date: 06/15/11			
Carbon 14 by EERF C-01-1			pCi/g	C-01-1			F1F140000-213C
Carbon 14	84.5	69.9	5.8	1.1		83	(62 - 109)
Batch #:			1165213	Analysis Date: 06/16/11			

Laboratory Control Sample Report

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Parameter	Spike Amount	Result	Total Uncert. (2 σ +/-)	MDC	% Yld	% Rec	Lab Sample ID	QC Control Limits
PO-210 by Alpha Spectrometry			pCi/g	STL-RC-0210			F1F170000-096C	
Polonium 210	63.5	57.1	8.3	0.2	59	90		(87 - 117)
	Batch #:	1168096		Analysis Date:	06/22/11			

NOTE(S)

MDC is determined by instrument performance only
Calculations are performed before rounding to avoid round-off error in calculated results

MATRIX SPIKE REPORT

Radiochemistry

Client Lot Id: F1E260406
Matrix: SOLID

Date Sampled: 05/20/11
Date Received: 05/25/11

Parameter	Spike Amount	Spike Result	Total Uncert. (2σ +/-)	Spike Yld.	Sample Result	Total Uncert. (2σ +/-)	QC Sample ID		QC Control Limits
							%YLD	%REC	
Tritium by LSC by DOE H3-04-RC MOD.			pCi/g	H3-04-RC MOD			F1E260406-001		
Tritium	14.0	16.1	1.4		2.99	0.48		93	(62-129)
	Batch #:	1164052		Analysis Date:		06/14/11			
Carbon 14 by EERF C-01-1			pCi/g	C-01-1			F1E260406-001		
Carbon 14	82.8	86.6	7.0		15.2	1.8		86	(62-109)
	Batch #:	1165213		Analysis Date:		06/20/11			
Tritium by LSC by DOE H3-04-RC MOD.			pCi/g	H3-04-RC MOD			F1E260406-003		
Tritium	14.0	15.2	1.4		2.28	0.56		92	(62-129)
	Batch #:	1165044		Analysis Date:		06/20/11			

NOTE(S)

Data are incomplete without the case narrative.

Calculations are performed before rounding to avoid round-off errors in calculated results.

DUPLICATE EVALUATION REPORT

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Date Sampled: 05/20/11
Date Received: 05/25/11

Parameter	SAMPLE Result	Total Uncert. (2σ +/-)	% Yld	DUPLICATE Result	Total Uncert. (2σ +/-)	% Yld	QC Sample ID Precision
Tritium by LSC by DOE H3-04-RC MOD. pCi/g H3-04-RC MOD F1E260406-001							
Tritium	2.99	0.48		2.74	0.46		9 %RPD
	Batch #:	1164052 (Sample)		1164052 (Duplicate)			
Carbon 14 by EERF C-01-1 pCi/g C-01-1 F1E260406-001							
Carbon 14	15.2	1.8		7.3	1.1		70 %RPD
	Batch #:	1165213 (Sample)		1165213 (Duplicate)			
Tritium by LSC by DOE H3-04-RC MOD. pCi/g H3-04-RC MOD F1E260406-003							
Tritium	2.28	0.56		2.99	0.60		27 %RPD
	Batch #:	1165044 (Sample)		1165044 (Duplicate)			
Gamma Cs-137 & Hits by DOE GA-01-R MOD pCi/g GA-01-R MOD F1E260406-004							
Cesium 137	0.27	0.13		0.111	0.067		84 %RPD
---Other Dedected Radionuclides---							
Actinium 228	1.44	0.30		1.45	0.28		0.7 %RPD
Bismuth 214	1.54	0.31		1.47	0.25		5 %RPD
Lead 212	1.36	0.20		1.31	0.20		3 %RPD
Lead 214	1.60	0.28		1.64	0.23		3 %RPD
Potassium 40	19.6	3.1		20.7	2.4		5 %RPD
Thallium 208	0.46	0.13		0.409	0.095		11 %RPD
	Batch #:	1153138 (Sample)		1153138 (Duplicate)			
Iso PLUTONIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R F1E260406-006							
Plutonium 238	0.007 U	0.023	83	0.009 U	0.023	81	28 %RPD
Plutonium 239/40	-0.0020 U	0.0041	83	-0.0021 U	0.0042	81	1 %RPD
	Batch #:	1160143 (Sample)		1160143 (Duplicate)			
Plutonium-241 by Liquid Scintillation pCi/g STL-RC-0245 F1E260406-006							
Plutonium 241	-0.21 U	0.79	0.0	-0.43 U	0.80	0.0	68 %RPD
	Batch #:	1160144 (Sample)		1160144 (Duplicate)			
Iso THORIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R MOD F1E260406-006							
Thorium 228	1.19	0.26	77	1.11	0.25	80	7 %RPD
Thorium 230	1.25	0.27	77	1.13	0.25	80	10 %RPD
Thorium 232	1.19	0.26	77	0.99	0.23	80	18 %RPD
	Batch #:	1160145 (Sample)		1160145 (Duplicate)			
Iso URANIUM (SHORT CT) DOE A-01-R MOD pCi/g A-01-R MOD F1E260406-006							
Uranium 234	0.82	0.23	67	0.68	0.21	65	18 %RPD
Uranium 235/236	0.053	0.061	67	0.001 U	0.039	65	192 %RPD
Uranium 238	0.91	0.24	67	0.56	0.20	65	32 %RPD
	Batch #:	1160146 (Sample)		1160146 (Duplicate)			
PO-210 by Alpha Spectrometry pCi/g STL-RC-0210 F1E260406-007							
Polonium 210	1.18	0.39	52	0.99	0.40	47	18 %RPD
	Batch #:	1168096 (Sample)		1168096 (Duplicate)			

DUPLICATE EVALUATION REPORT

Radiochemistry

Client Lot ID: F1E260406
Matrix: SOLID

Date Sampled: 05/23/11
Date Received: 05/25/11

Parameter	SAMPLE Result	Total Uncert. (2 σ +/-)	% Yld	DUPLICATE Result	Total Uncert. (2 σ +/-)	% Yld	QC Sample ID Precision
<hr/>							
GROSS A/B BY GFPC SW846 9310 MOD			pCi/g	9310 MOD			F1E260406-024
Gross Alpha	5.2 U	4.8		2.1 U	3.6		83 %RPD
Gross Beta	8.3	2.7		6.8	2.5		20 %RPD
	Batch #:	1157214 (Sample)		1157214 (Duplicate)			
<hr/>							
Gamma Cs-137 & Hits by DOE GA-01-R MOD			pCi/g	GA-01-R MOD			F1E260406-022
Cesium 137	3.7	1.2		4.1	1.4		11 %RPD
	Batch #:	1157050 (Sample)		1157050 (Duplicate)			
<hr/>							

NOTE(S)

Data are incomplete without the case narrative.
Calculations are performed before rounding to avoid round-off error in calculated results

U Result is less than the sample detection limit.

Appendix F
Instrument Calibration Records and Check Logs



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-93 PROBE # PR197407

Owner: GI

DATE: 03/08/11
TECH: Joanne GlennLOCATION: Griffin Inst
DATE LAST CAL EXPIRES:

REASON FOR CALIBRATION:

☐ Due For Calibration ☒ Repair (See Remarks) ☐ Other (See Remarks) ☐ Due and Repair

CABLE LENGTH: 39"

INPUT SENSITIVITY: dual

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2360 SERIAL #: 145762 CAL. DUE: 03/08/12

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
00TC470-0654	Tc99 SS	17,300 dpm	06/15/09	10,800 cpm
94TH470-1593	Th230	16,700 dpm	06/16/09	8,170 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm

Efficiencies from last cal.:

Condition: ☒ Sat ☐ UnsatPu: Th: Sr: Tc ss: C14: Tc Ni:

As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
N/A											

Net A to B Xtalk: <10%	B to A Xtalk: <1%
	<1%

	<u>Pu239</u>	<u>Tc99 Ni</u>	<u>Tc99 ss</u>	<u>Th-230</u>	<u>Sr90</u>	<u>C-14</u>
AF CPM:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
AF 4 pi eff:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
AF 2 pi eff:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Is as found efficiency within 20% of the efficiency from the last cal?

☐ Yes ☒ No (See Remarks)

Note: If the as found data is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the plateau section and go directly to remarks.

GRIFFIN INSTRUMENTS

PROBE #: PR197407

Date: 03/08/11

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
800	23	1773	9.6%	3646	336	19.7%	2	110	5.8%	<1%
850	18	2615	14.1%	4018	403	21.7%	0	171	5.5%	<1%
875	24	2893	15.5%	4244	495	22.9%	1	205	6.4%	<1%
										<1%
										<1%
										<1%

Alpha / Beta Bkg (cpm)		1	190			
HV / Vernier	Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90
875 / N/A	CPM: 4309		2942	3408		3481
4 pi AL Efficiencies:	23.29%		15.91%	20.40%		35.16%
2 pi AL Efficiencies:	45.88%		25.48%	41.70%		50.28%

REMARKS: Meter returned from rent. Replaced PM Tube.

Does Instrument Meet Final Acceptance Criteria?: ☒ Yes ☐ No

Calibration Sticker Attached?: ☒ Yes ☐ No

Date Instrument is Due For Next Calibration: 03/08/12

INSTRUMENT MARRIED WITH

2360

245762

Performed/Reviewed by:

Donna Glenn

Date: 3/8/2011

Entered by: *JP* Initials

2 pi efficiencies denoted in Italics.

Calibrations performed to ANSI N323A-1997 standards.

Location ABJ Omamha

Model:	L2360	Serial #	245762	Cal Due	4/29/12
--------	-------	----------	--------	---------	---------

Source Check Location: Blotcky Lab

Background Location: Blotcky Lab

Probe Model #:	43-93	Serial #	197407	Cal Due:	4/29/12
Probe Description:	Alpha Beta Scintillator				
Threshold	30	HV	1400	Response Switch	Slow
Area Correction Factor:					
Type of Source	Serial #	Isotope	Source Date	uCi	dpm
α Source ID #		Th-230			21,900
β Source ID #		Tc-99			34,600
β, γ Source ID #					

10 Source Measurements													Type of Survey (Circle One)	
Alpha	297	326	173	300	195	270	150	301	269	249	Average			253
Beta / Gamma	3812	3390	3553	3960	3273	3168	3029	3375	3733	3132	3443			
10 Bkgd Measurements													Alpha + Beta	
Alpha	1	1	1	5	2	2	1	2	3	3	Average			2
Beta / Gamma	320	247	288	291	281	271	269	308	279	260	281			
Radiation Type		Alpha	St. Dev.	2 σ	3 σ	Radiation Type		Beta	St. Dev.	2 σ	3 σ			
Source Average		253	60	121	181	Source Average		3443	313	625	938			
Source Range (+/- 2sig)		132	to	374		Source Range(+/- 2sig)		2817	to	4068				
Bkgd Average		2	1.3	2.6	3.9	Bkgd Average		281	22	43	65			
Bkgd Range (+/- 2sig)		-2	to	6		Bkgd Range (+/- 2sig)		225	to	338				

Daily Instrument Backgrounds and Source Check

Date: 5/6/2011

Description	Type	S/N
Instrument:	L2360	245762
Probe:	43-93	197407
Range:	2817	4068
Source:	Tc-99	LH558
Initial Readings	Background (cpm)	Source (cpm)
1	320	3812
2	247	3390
3	288	3553
4	291	3960
5	281	3273
6	271	3168
7	269	3029
8	308	3375
9	279	3733
10	260	3132

Description	Type	S/N
Instrument:	L2360	245762
Probe:	43-93	197407
Range:	132	374
Source:	Th-230	1646
Initial Readings	Background (cpm)	Source (cpm)
1	1	297
2	1	326
3	1	173
4	5	300
5	2	195
6	2	270
7	1	150
8	2	301
9	3	269
10	3	249

[illegible][illegible]



CERTIFICATE OF CALIBRATION

Order Number:	ADR0002985	Customer Name:	SOLUTIENT
Certificate Number:	1507105634	Procedure:	423071
Model:	GR-135	Calibration Date:	14 JULY 10
Serial Number:	5634	Calibration Cycle:	1 Year
Software Version:	4V02.05	Due Date:	14 JULY 11

Received Condition:	Within tolerance <input checked="" type="checkbox"/>	Out of tolerance <input type="checkbox"/>	Not applicable, new product <input type="checkbox"/>
Action Taken:	None taken <input checked="" type="checkbox"/>	Adjusted <input type="checkbox"/>	Repaired <input type="checkbox"/> Upgrade <input type="checkbox"/>
Completed Condition:	Full calibration <input checked="" type="checkbox"/>	Limited use <input type="checkbox"/>	Custom <input type="checkbox"/>
Environmental Conditions:	Humidity: N/A	Temperature: 20°C	Local background: <100 nS/h
Remarks:			

CALIBRATION STANDARD

Calibrated with a Cs-137 NIST traceable source. The radiation intensity (output) of the calibration source is measured by NIST traceable ion chambers. The procedures are described in NIST reports DG 8639/87 and DG 8640/87.

ENERGY CALIBRATION TEST

Isotope:	Cs-137	Am-241	Co-60	Th-232
Identification:	Passed <input checked="" type="checkbox"/>	Passed <input checked="" type="checkbox"/>	Passed <input checked="" type="checkbox"/>	Passed <input checked="" type="checkbox"/>

DOSE RATE CALIBRATION TEST

Detector Range	Measurement Point	Expected Dose Rate	Acceptable Dose Rate Range (+/-20%)	Measured Dose Rate	Calibration
Nal: 0 - 50 μ Sv/h	40% *	19.8 μ Sv/h	17.8 - 21.8 μ Sv/h *	18.9 μ Sv/h	OK <input checked="" type="checkbox"/>
Nal: 0 - 50 μ Sv/h	80%	40.4 μ Sv/h	32.3 - 48.5 μ Sv/h	38.0 μ Sv/h	OK <input checked="" type="checkbox"/>
GM: 50 μ Sv/h - 10 mSv/h	20%*	2.14 mSv/h	1.93 - 2.35 mSv/h	2.1 mSv/h	OK <input checked="" type="checkbox"/>
GM: 50 μ Sv/h - 10 mSv/h	80%	9.32 mSv/h	7.4 - 11.2 mSv/h	8.8 mSv/h	OK <input checked="" type="checkbox"/>

* Base calibration point, acceptable Dose Rate range +/- 3%

NEUTRON DETECTOR VERIFICATION

Expected Count Rate	Measured Count Rate	Calibration
Greater than 3 cps	N/A cps	OK <input type="checkbox"/> N/A <input checked="" type="checkbox"/>

Calibration Technician:

Jose Mendez

Quality Assurance:

Sandra Wilson

This Certificate shall not be reproduced except in full, without the written approval of SAIC

2985 Scott St., Vista, CA 92081


```

          23      PROTOCOL Name =      H3/C14 DPM serv
Half Life ?      A: 0.00      B: 0.00
  Ref Date ?      A: 01/01/1993      B: 01/01/1993
  Ref Time ?      A: 00:00      B: 00:00
Single Photon Count ?      no
Colored Samples ?      no
RS232 Computer Output ?      no
Luminescence Correction ?      yes

Data/Application Drive & Path ?
  Save Data ?
  Save Spectrum ?      no
  Run User Application ?      no
  File Name ?
  Command String ?
Static controller ?      on

```

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DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD6
Please enter Half life (hours) in the range of 0.01 to 999999 (0 = off)
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
F1-EXIT EDIT  F2-CLEAR ENTRY  F3-PRINT PROTOCOL

```

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PRINT FORMAT      IDLE      10-May-2011 10:45
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
Protocol #: 23      Name: H3/C14 DPM serv
Additional Heading?

C#  Name      Format      C#  Name      Format      C#  Name      Format      Equation
0  CRLF
1  PID      BX
2  S#      BX
3  TIME      BXXX.
4  CPMA      BXXXX.
5  A:2S%      BXX.
6  A:%REF      BXXX.
7  CPMB      BXXXX.
8  B:2S%      BXX.
9  B:%REF      BXXX.
10 CPMC      BXXXX.
11 C:2S%      BXX.
12 C:%REF      BXXX.
13 SIS      BXX.X
14 DPM1      BXXXX.
15 DPM2      BXXXX.
16 ELTIME      BXXXX
17 FLAG      BXX
18 BLANK      BBBB
19 tSIE      B.X
20 %LUM      BX
21 A:%CV      BXXX.
22 B:%CV      BXXX.
23 TOD      BXXXXXXXXX
24
25
26
27
28
29
30
31

Define Cell #? 1      Name?      Format?      BXXX
Equation?      (Operators: +,-,*,/,SQR,LN)
Print Cells? 2 3 4 7 14 15 13 19 17 20 0
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD6
Additional heading (50 chars)
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
F1-EXIT EDIT  F2-CLEAR ENTRY  F3-PRINT PROTOCOL

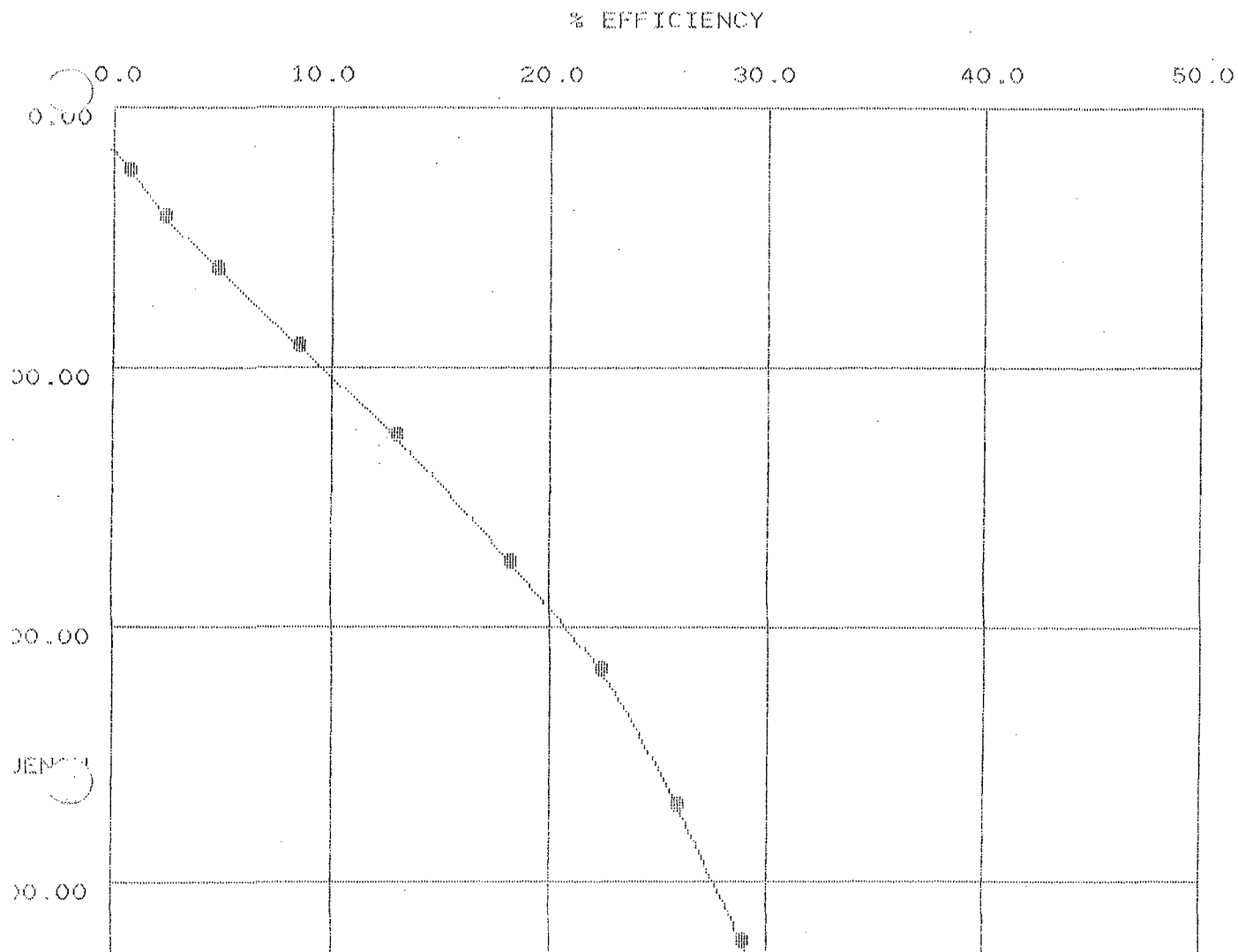
```

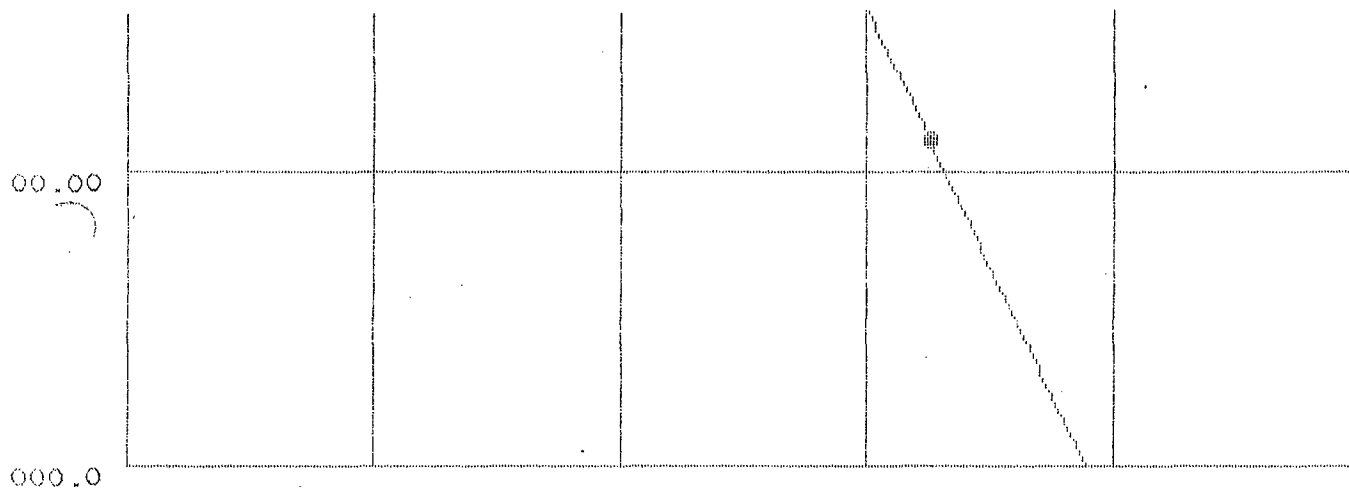
Pol #:11 Name:H3C14Ni63 05-May-2011 14:26
Region A: LL-UL= 0.0-19.0 Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Region B: LL-UL=19.0-66.0 Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Region C: LL-UL=66.0-157. Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Time = 1.00 QIP = tSIE/AEC ES Terminator = Count
Conventional DPM
Slide 1 = 0

SH	TIME	CPMA	SIS	DPM1 FLAG
1	1.00	91222.5	17.273	

rc pol #:11 Name:H3C14Ni63 05-May-2011 14:31
 egion A: LL-UL= 0.0-19.0 Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
 egion B: LL-UL=19.0-66.0 Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
 egion C: LL-UL=66.0-157. Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
 ime = 1.00 QIP = tsIE/AEC ES Terminator = Count
 onventional DPM
 uclide 1 = 280100

S#	TIME	CPMA	SIS	DPM1	FLAG
1	1.00	91592.6	17.263		L
2	1.00	81037.9	15.281		L
3	1.00	72757.9	13.797		L
4	1.00	62771.1	12.335		L
5	1.00	51145.3	11.081		L
6	1.00	36542.3	9.713		L
7	1.00	24065.4	8.567		L
8	1.00	13538.7	7.680		L
9	1.00	6808.52	7.037		L
10	1.00	2177.75	6.449		L





QUENCH	ELA
47.52	0.78
184.37	8.59
433.86	22.41
777.91	32.70

QUENCH	ELA
83.53	2.43
255.81	13.05
538.30	25.98

QUENCH	ELA
123.20	4.83
349.52	18.26
645.10	28.93

EnergySolutions Services, Inc.

28 Gallaher Road

Kingston, TN 37763

Phone: (877) 462-4873

Fax: (865) 376-8331

**CALIBRATION
CERTIFICATE**

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION			INSTRUMENT INFORMATION		
Customer Name: Griffin Instruments			Manufacturer: Ludlum		
Contact Name: Joanne Glenn			Model: 9		
Address: 977 Hamilton Lane, Kingston, TN 37763			Serial Number: 179295		
Customer Purchase Order Number: Credit Card		Work Order Number: 2011-11443	Calibration Method: Source		
INSTRUMENT CALIBRATION INFORMATION					
Instrument Range	Calibration Standard Value	Instrument Response (mR/hr)		Comments	
		Before Calibration	After Calibration	Calibrated in accordance with OEM Technical Manual.	
X1	1.0 mR/hr	1.00	1.00	DVM: 88020324 Cal Due: 12/19/11	
X1	2.5 mR/hr	2.50	2.50	D-812: 3314 Cal Due: 06/29/11	
X1	4.0 mR/hr	4.00	4.00	Humidity: 958670 Cal Due: 06/10/11	
X10	10 mR/hr	11	10.0		
X10	25 mR/hr	26.0	25.0		
X10	40 mR/hr	43.0	40.0	Temperature: 22.8 °C	
X100	100 mR/hr	105	100	Pressure: 740 mmHg	
X100	250 mR/hr	280	250	Humidity: 46 %	
X100	400 mR/hr	460	395		
X1000	1,000 mR/hr	1150	1000	* Replaced Desiccant and cycle in drying oven	
X1000	2,500 mR/hr	3,000	2,500		
X1000	4,000 mR/hr	4,800	3,800	Sources Used:	
				Cs-137 #019701	Cert Date: 08/05/10
				Cs-137 #049711	Cert Date: 07/09/10
Mechanical Zero	0	0	0	U-238 #129680	Cert Date: 06/21/95
Other Tests		BCF Information		As Found	As Left
Geotropism	Sat (✓) Unsat ()	Window Open		55 mRad/hr	50 mRad/hr
Desiccant *	Sat (✓) Unsat ()	Window Closed		8 mRad/hr	7 mRad/hr
Batteries	Sat (✓) Unsat ()	Beta Correction		5.04	5.51
Over Range Test	Sat (✓) Unsat ()	$BCF = \frac{1}{WO - WC} (I = \text{Source Dose Rate (mRad/hr)})$			
Audio	Sat (✓) Unsat ()				
Reset	Sat (✓) Unsat ()				
STATEMENT OF CERTIFICATION					
We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).					
Instrument		Reviewed By: <i>Jeff Dubois</i>		Date: 5/3/11	
Calibrated By: <i>[Signature]</i>		Calibration Date: 05/03/2011		Calibration Due: 05/03/2012	

EnergySolutions Calibration/Repair Checklist

Form CP-IN-PR-106-F3
Rev. 0

ENERGYSOLUTIONS



Received

Shipped

Equipment ID:

9# 179295

See Attached Packing List

General Condition:

Sat ✓ N/A ✓ Verified by: MC

Sat ✓ N/A ✓ Verified by: MC

Battery Status:

✓ ✓ MC

✓ ✓ MC

Calibration Sticker:
Attached with correct ID number
and current calibration date)

N/A N/A N/A

✓ ✓ MC

Calibration Certificate:
(included with correct ID number)

N/A N/A N/A

✓ ✓ MC

Cables/Cords:

✓ ✓ MC

✓ ✓ MC

Number of Cables

✓ ✓ MC

✓ ✓ MC

Accessories:

✓ ✓ MC

✓ ✓ MC

5/3/11

Comments:

W/B - 2011-11443

CR. P. 11



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

2360

SERIAL#

193682

Owner: GI

DATE: 05/09/11

LOCATION:

Griffin Inst

TECH: Joanne Glenn

DATE LAST CAL EXPIRES:

04/19/11

Reason For Calibration:

☒ Due For Calibration☐ Repair (See Remarks)☐ Other (See Remarks)☐ Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500

SERIAL #: 114512

CAL. DUE: 07/28/11

☒ Audio Response☒ Geotropism

CABLE LENGTH: 39"

CONDITION: Sat

AF MECHANICAL ZERO: 0

AL MECHANICAL ZERO: 0

NEW BATTERIES:

☒ Yes ☐ No

BATTERY CHECK: Sat

HV (+/-10%)	AS FOUND HV	AS LEFT HV	WINDOW SETTINGS:	A.F.	A.L.
500 V:	500	A.F.	BT (3.5 mV +/- 1 mV):	3.4	A.F.
1000 V:	1000	A.F.	BW (30 mV +/- 3 mV):	30	A.F.
1500 V:	1500	A.F.	AT (120 mV +/- 10 mV):	120	A.F.

RATE METER

SCALER

SCALE RATE CPM AS FOUND % ERROR AS LEFT % ERROR AS FOUND % ERROR AS LEFT % ERROR

x.1 or x1	100	100	0.0%	A.F.		250	0.0%	A.F.	
	250	250	0.0%	A.F.					
	400	400	0.0%	A.F.					
x1 or x10	1000	1000	0.0%	A.F.					
	2500	2500	0.0%	A.F.					
	4000	4000	0.0%	A.F.					
x10 or x100	10K	10 K	0.0%	A.F.					
	25K	25 K	0.0%	A.F.					
	40K	40 K	0.0%	A.F.					
x100 or x1000	100K	100 K	0.0%	A.F.					
	250K	250 K	0.0%	A.F.					
	400K	400 K	0.0%	A.F.					

Is the As Found Data Within 20% of the Set Point?:

☒ Yes ☐ NoOverload Light: ☒ Adjusted ☐ Not Adj.

REMARKS:

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes ☐ No

Calibration Sticker Attached?:

☒ Yes ☐ No

Date Instrument is Due For Next Calibration:

05/09/12

INSTRUMENT MARRIED WITH

43-93

PR200115

Performed/Reviewed by:

Joanne Glenn

Date: 5/9/2011

Entered by: *[Signature]* Initials

Header 1: John Q Public
Header 2: Serial#193682
Header 3: DetSer#PR200115
Header 4: Site:Building 1
Header 5: Room 7 EastWall
Header 6: More Comments?
Location: Table 007

Calibration Due Date: 05/09/2012
Model 2360 Date: 05/09/2011
Model 2360 Time: 09:12:02 AM

Logged Samples: 0

User PC Scaler Count Time: 0.1 minutes

Alpha Ratemeter Alarm Setpoint: 999999
Beta Ratemeter Alarm Setpoint: 999999
Alpha + Beta Ratemeter Alarm Setpoint: 999999

Alpha Scaler Alarm Setpoint: 999999
Beta Scaler Alarm Setpoint: 999999
Alpha + Beta Scaler Alarm Setpoint: 999999



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-93 PROBE # PR200115

Owner: GI

DATE: 05/09/11
TECH: Joanne Glenn

LOCATION: Griffin Inst
DATE LAST CAL EXPIRES: 04/19/11

REASON FOR CALIBRATION:

☒ Due For Calibration ☐ Repair (See Remarks) ☐ Other (See Remarks) ☐ Due and Repair

CABLE LENGTH: 39"

INPUT SENSITIVITY: dual

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2360 SERIAL #: 193682 CAL. DUE: 05/09/12

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
00TC470-0654	Tc99 SS	17,300 dpm	06/15/09	10,800 cpm
94TH470-1593	Th230	16,700 dpm	06/16/09	8,170 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm

Efficiencies from last cal.:

Condition: ☒ Sat ☐ Unsat

Pu: 22.96% Th: 21.98% Sr: 33.72%
Tc ss: 16.46% C14: Tc Ni:

As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
700 / N/A				4299	576	23.22%	3	202	2	2945	15.86%

Net A to B Xtalk: <10%	B to A Xtalk: <1%
8.0%	<1%

	Pu239	Tc99 Ni	Tc99 ss	Th-230	Sr90	C-14
AF CPM:	4299		2945	3468	3404	
AF 4 pi eff:	23.22%		15.86%	20.75%	34.34%	
AF 2 pi eff:	45.85%		25.40%	42.41%	49.12%	

Is as found efficiency within 20% of the efficiency from the last cal? ☒ Yes ☐ No (See Remarks)

Note: If the as found data is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the plateau section and go directly to remarks.

GRIFFIN INSTRUMENTS

PROBE #: PR200115

Date: 05/09/11

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
N/A										

Alpha / Beta Bkg (cpm)		3	202			
HV / Vernier	Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90
700 / N/A	CPM: 4299		2945	3468		3404
4 pi AL Efficiencies:	23.22%		15.86%	20.75%		34.34%
2 pi AL Efficiencies:	45.75%		25.40%	42.41%		49.12%

REMARKS:

Does Instrument Meet Final Acceptance Criteria? ☒ Yes ☐ No

Calibration Sticker Attached? ☒ Yes ☐ No

Date Instrument is Due For Next Calibration: 05/09/12

INSTRUMENT MARRIED WITH 2360 # 193682

Performed/Reviewed by:

James Ghann

Date: 5/9/2011

Entered by: *[Signature]* Initials

2 pi efficiencies denoted in Italics.

Calibrations performed to ANSI N323A-1997 standards.

Packing List for GI

09-May-11

From: Griffin Instruments, 977 Hamilton Lane, Kingston, TN 37763

SERIAL #	MODEL	BARCODE #	LOCATION	SPEC LOCATION	OWNER	CAL DUE
193682	2360		SOLUTIENT		GI	05/09/12
PR200115	43-93		SOLUTIENT		GI	05/09/12

Physical Condition SAT / UNSAT

Calibration Stickers SAT / UNSAT

Proper Packaging SAT / UNSAT

Calibration Certificates SAT / UNSAT

1 39" Cables N/A 5' Cables

N Regulators

N Software

/ Floor Monitor Cart access., straps, tygon, 6' cable

/ Download Cables

A Manuals

A Power Cables

Other: (1) Probe Cover

Person Inspecting/Transferring Signature [Signature] Date: 5/9/11

Person Accepting Signature _____ Date: _____

Location ABJ Omamha

Model:	L2360	Serial #	193682	Cal Due	5/9/12
--------	-------	----------	--------	---------	--------

Source Check Location: Blotcky Lab

Background Location: Blotcky Lab

Probe Model #:	43-93	Serial #	200116	Cal Due:	5/9/12
Probe Description:	Alpha Beta Scintillator				
Threshold	30	HV	1400	Response Switch	Slow
Area Correction Factor:					
Type of Source	Serial #	Isotope	Source Date	uCi	dpm
α Source ID #		Th-230			21,900
β Source ID #		Tc-99			34,600
β, γ Source ID #					

10 Source Measurements													Type of Survey (Circle One)
1	2	3	4	5	6	7	8	9	10	Average			
Alpha	331	436	452	309	528	442	414	514	318	449	419		
Beta / Gamma	3970	3811	3286	3089	3729	3778	3177	3815	3833	3942	3643		
10 Bkgd Measurements													
1	2	3	4	5	6	7	8	9	10	Average			
Alpha	4	1	3	3	5	1	3	2	5	4	3		
Beta / Gamma	269	247	268	269	270	232	260	262	263	271	261		
Radiation Type	Alpha	St. Dev.	2 σ	3 σ	Radiation Type	Beta	St. Dev.	2 σ	3 σ				
Source Average	419	77	155	232	Source Average	3643	328	656	984				
Source Range (+/- 2sig)	265	to	574		Source Range (+/- 2sig)	2987	to	4299					
Bkgd Average	3	1.4	2.9	4.3	Bkgd Average	261	12	25	37				
Bkgd Range (+/- 2sig)	-1	to	7		Bkgd Range (+/- 2sig)	209	to	313					

Daily Instrument Backgrounds and Source Check

Date: 5/10/2011

Description	Type	S/N
Instrument:	L2360	193682
Probe:	43-93	200115
Range:	2987	4299
Source:	Tc-99	LH558
Initial Readings	Background (cpm)	Source (cpm)
1	269	3970
2	247	3811
3	268	3286
4	269	3089
5	270	3729
6	232	3778
7	260	3177
8	262	3815
9	263	3833
10	271	3942

10 min

1 min

[illegible]

Description	Type	S/N
Instrument:	L2360	193682
Probe:	43-93	200115
Range:	265	574
Source:	Th-230	1646
Initial Readings	Background (cpm)	Source (cpm)
1	4	331
2	1	436
3	3	452
4	3	309
5	5	528
6	1	442
7	3	414
8	2	514
9	5	318
10	4	449

10 min

1 min

[illegible]



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 GRIFFIN INSTRUMENTS ORDER NO. 20160219/354135

Ludlum Measurements, Inc. Model 19 Serial No. 169659

Model _____ Serial No. _____

Cal. Date 1-Sep-10 Cal Due Date 1-Sep-11 Cal. Interval 1 Year Meterface 202-016

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 43 % Alt 700.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. $\pm 10\%$ ☐ 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 500 V Input Sens. 32 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. 500 / _____ V Ref./Inst. 1000 / _____ V

COMMENTS:

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*
5000	4000 uR/hr	<i>MA</i>	4000
5000	1000 uR/hr		1000
500	400 uR/hr = <u>7500 cpm</u>		400
500	100 uR/hr		100
250	200 uR/hr = <u>3700 cpm</u>		200
250	100 uR/hr		100
50	<u>7500</u> cpm		40
50	<u>1875</u> cpm		10
25	<u>3700</u> cpm		20
25	<u>925</u> cpm		5

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

50, 25 Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	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 calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

m 500 S/N 125489 ☐ Oscilloscope S/N _____ ☒ Multimeter S/N 68260348

Calculated By: V. Alvarez Date 1 Sep 10

Reviewed By: Rhonda Harris Date 2 Sep 10

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C22A 03/11/2010 Page 1 of 1

AC Inst. ☐ Passed Dielectric (Hi-Pot) and Continuity Test
Only ☐ Failed: _____

9/7/10

Daily Instrument Backgrounds and Source Check

Date: 5/10/2011

Description	Type	S/N
Instrument:	M19	169659
Probe:	NA	NA
Range:	51	76
Source:	C0-60	
Initial Readings	Background (cpm)	Source (cpm)
1	11	60
2	12	65
3	11	60
4	12	60
5	13	70
6	13	65
7	11	60
8	11	65
9	12	60
10	12	65

Description	Type	S/N
Instrument:		
Probe:		
Range:		
Source:		
Initial Readings	Background (cpm)	Source (cpm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

[illegible][illegible]



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

2929

SERIAL#

160005

Owner: GI

DATE: 08/05/10

LOCATION:

Griffin Inst

TECH: Joanne Glenn

DATE LAST CAL EXPIRES:

07/10/10

Reason For Calibration:

☒ Due For Calibration☐ Repair (See Remarks)

CABLE LENGTH: 39"

☐ Other (See Remarks)☐ Due and Repair (See Remarks)NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500

SERIAL #: 114512

CAL. DUE: 07/28/11

MODEL:

SERIAL #:

CAL DUE:

Condition: ☒ Sat ☐ Unsat

AF Mechanical Zero: 0

AL Mechanical Zero: 0

Scaler Function Check

As Found

As Left

Beta Channel Window (4-50 mV):

4.49

A.F.

Alpha Channel Window (175 mV, 120 for 3030):

175

A.F.

Alpha Counts w/Pulser @ 10,000 CPM:

9,988

A.F.

% Error: 0.1%

Beta Counts w/Pulser @ 10,000 CPM:

10,000

A.F.

% Error: 0.0%

HIGH VOLTAGE POWER SUPPLY CAL. (2929 only)

KV Reading (R-5 on HV Board):

1

A.F.

Max HV (1500 V +):

☒ Sat ☐ Unsat

REMARKS:

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes☐ No

Calibration Sticker Attached?:

☒ Yes☐ No

Date Instrument is Due For Next Calibration:

08/05/11

INSTRUMENT MARRIED WITH

43-10-1

PR164048

Performed/Reviewed by:

Date: 8/5/2010

Entered by: Initials



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-10-1 PROBE # PR164048

Owner: GI

DATE: 08/05/10
TECH: Joanne Glenn

LOCATION: Griffin Inst
DATE LAST CAL EXPIRES: 07/10/10

REASON FOR CALIBRATION:

☒ Due For Calibration ☐ Repair (See Remarks) ☐ Other (See Remarks) ☐ Due and Repair

CABLE LENGTH: 39"

INPUT SENSITIVITY: dual

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2929 SERIAL #: 160005 CAL. DUE: 08/05/11

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
00TC470-0654	Tc99 SS	17,300 dpm	06/15/09	10,800 cpm
94TH470-1593	Th230	16,700 dpm	06/16/09	8,170 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm
PX 726	C14	48,780 dpm	01/21/08	18,660 cpm

Efficiencies from last cal.:

Condition: ☒ Sat ☐ Unsat

Pu: 35.65% Th: 34.20% Sr: 47.07%

Tc ss: 23.05% C14: 9.02% Tc Ni:

As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
825 / 3.44				6643	582	35.91%	0	41	0	4210	24.10%

Net A to B
Xtalk: <10%

B to A Xtalk:
<1%

7.5% <1%

	<u>Pu239</u>	<u>Tc99 Ni</u>	<u>Tc99 ss</u>	<u>Th-230</u>	<u>Sr90</u>	<u>C-14</u>
AF CPM:	6643		4210	5665	4173	4838
AF 4 pi eff:	35.91%		24.10%	33.92%	43.52%	9.83%
AF 2 pi eff:	70.90%		38.60%	69.34%	62.25%	25.71%

Is as found efficiency within 20% of the efficiency from the last cal? ☒ Yes ☐ No (See Remarks)

Note: If the as found data is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the plateau section and go directly to remarks.

GRIFFIN INSTRUMENTS

PROBE #: **PR164048**

Date: 08/05/10

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
N/A										

Alpha / Beta Bkg (cpm)		0	41			
HV / Vernier	Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90
825 / 3.44	CPM: 6643		4210	5665	4838	4173
4 pi AL Efficiencies:	35.91%		24.10%	33.92%	9.83%	43.52%
2 pi AL Efficiencies:	70.75%		38.60%	69.34%	25.71%	62.25%

REMARKS:

Does Instrument Meet Final Acceptance Criteria?: ☒ Yes ☐ No

Calibration Sticker Attached?: ☒ Yes ☐ No

Date Instrument is Due For Next Calibration: 08/05/11

INSTRUMENT MARRIED WITH 2929 # 160005

Performed/Reviewed by: Joanne Glavin Date: 8/5/2010 Entered by: JP Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.

Location ABJ Omamha

Model:	L2360	Serial #	160005	Cal Due	8/5/11
--------	-------	----------	--------	---------	--------

Source Check Location: Blotcky Lab

Background Location: Blotcky Lab

Probe Model #:	43-10-1	Serial #	164048	Cal Due:	8/5/11
Probe Description:	Alpha Beta Scintillator				
Threshold	30	HV	1400	Response Switch	Slow
Area Correction Factor:					
Type of Source	Serial #	Isotope	Source Date	uCi	dpm
α Source ID #		Th-230			21,900
β Source ID #		Th-230			21,900
β, γ Source ID #					

10 Source Measurements		1	2	3	4	5	6	7	8	9	10	Average		Type of Survey (Circle One)
Alpha		6774	6817	6475	7755	6794	6830	7026	6997	6759	6474	6870		
Beta / Gamma		1085	1139	1296	1144	1105	1239	1060	978	1078	1117	1124		Alpha + Beta
10 Bkgd Measurements		1	2	3	4	5	6	7	8	9	10	Average		
Alpha		0	0	3	0	0	0	1	1	0	0	1		
Beta / Gamma		54	45	48	61	37	56	63	64	49	40	52		
														</

Daily Instrument Backgrounds and Source Check

Date: 5/2/2011

Description	Type	S/N
Instrument:	L2929	160005
Probe:	43-10-1	164048
Range:	944	1304
Source:	Th-230	1646
Initial Readings	Background (Betacpm)	Source (cpm)
1	54	1085
2	45	1139
3	48	1296
4	61	1144
5	37	1105
6	56	1239
7	63	1060
8	64	978
9	49	1078
10	40	1117

Description	Type	S/N
Instrument:	L2929	160005
Probe:	43-10-1	164048
Range:	6150	7591
Source:	Th-230	1646
Initial Readings	Background (Alphacpm)	Source (cpm)
1	0	6774
2	0	6817
3	3	6475
4	0	7755
5	0	6794
6	0	6830
7	1	7026
8	1	6997
9	0	6759
10	0	6474

10 min (round up)		1 min
Date / Day	Background(Betacpm)	Source (cpm)
5/3/2011	52	1260
5/4/2011	43	1171
5/5/2011	48	1183
5/6/2011	51	1041
5/8/2011	54	1096
5/10/2011	59	1092
5/11/2011	43	1020
5/12/2011	43	989
5/13/2011	49	992
5/16/2011	58	980
5/17/2011	49	1010
5/18/2011	52	1020
5/19/2011	54	983
5/20/2011	52	1017
5/23/2011	Shipped	

[illegible]



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

12 NS

SERIAL#

167193

Owner: SOLUTIENT TECHNOLOGIES

1809

DATE: 04/29/11

LOCATION:

Griffin Inst

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

Reason For Calibration:

☐ Due For Calibration☐ Repair (See Remarks)☒ Other (See Remarks)☐ Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500

SERIAL #: 134715

CAL. DUE: 04/13/12

MODEL:

SERIAL #:

CAL DUE:

☒ Fast/Slow Switch working properly☒ Audio Response☒ Geotropism

CABLE LENGTH 39"

CONDITION: Sat

AF MECHANICAL ZERO: 0

AL MECHANICAL ZERO: 0

NEW BATTERIES: ☐ Yes ☒ No

BATTERY CHECK: Sat

HV RANGE 400 - 1500 VOLTS

☒ N/A ☐ Sat ☐ Unsat

HV (+/-10%)

AS FOUND HV

AS LEFT HV

500 V:

500

A.F.

1250 V: 1000 V for 177s

1250

A.F.

2000 V: 1500 V for 177s

2000

A.F.

AF INPUT SENSITIVITY (mV): 34

AL INPUT SENSITIVITY (mV): A.F.

RATE METER

SCALER

SCALE RATE CPM AS FOUND % ERROR AS LEFT % ERROR AS FOUND % ERROR AS LEFT % ERROR

x.1 or x1	100	100	0.0%	A.F.					
	250	250	0.0%	A.F.					
	400	400	0.0%	A.F.					
x1 or x10	1000	1000	0.0%	A.F.					
	2500	2500	0.0%	A.F.					
	4000	4000	0.0%	A.F.					
x10 or x100	10K	10 K	0.0%	A.F.					
	25K	25 K	0.0%	A.F.					
	40K	40 K	0.0%	A.F.					
x100 or x1000	100K	100 K	0.0%	A.F.					
	250K	250 K	0.0%	A.F.					
	400K	400 K	0.0%	A.F.					

Is the As Found Data Within 20% of the Set Point?:

☒ Yes☐ No

REMARKS: No previous data.

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes☐ No

Calibration Sticker Attached?:

☒ Yes☐ No

Date Instrument is Due For Next Calibration:

04/29/12

INSTRUMENT MARKED WITH

#

formed/Reviewed by:

E.C.
E.M. Glenn

Date: 4/29/2011

Entered by: *EC* Initials

Calibrations performed to ANSI N323A-1997 standards.



GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 44-9 PROBE # PR150691
1828

Owner: SOLUTIENT TECHNOLOGIES

DATE: 04/29/11
TECH: E.M. GlennLOCATION: Griffin Inst
DATE LAST CAL EXPIRES:

REASON FOR CALIBRATION:

☐ Due For Calibration ☐ Repair (See Remarks) ☒ Other (See Remarks) ☐ Due and Repair

CABLE LENGTH: 39"

INPUT SENSITIVITY: 35mV

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: 2221 SERIAL #: 183997 CAL. DUE: 09/01/11

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
00TC470-0654	Tc99 SS	17,300 dpm	06/15/09	10,800 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm

PHYSICAL CONDITION: Sat EFF. FROM LAST CAL.: BKG: 43 HV 900V

AF CPM Tc99: 2402 2364 2399 AVG: 2388.3 AF Sr90 CPM: 2755

Tc99 4 pi EFF: 13.56%

Sr90 4 pi EFF: 29.03%

Tc99 2 pi EFF: 21.72%

Sr90 2 pi EFF: 41.52%

AL CPM Tc99:

AVG:

AL Sr90 CPM:

TC-99 4 pi EFF:

Sr90 4 pi EFF:

Tc99 2 pi EFF:

Sr90 2 pi EFF:

Is the as found efficiency within 20% of eff. from last cal.?

☐ Yes☒ No *See Remarks

Saturation Test Satisfactory

☒ Yes☐ No

Reproducibility: Are the individual counts within 10% of the average?

☒ Yes☐ No

Does the probe meet final acceptance criteria?

☒ Yes☐ No

Calibration sticker attached?

☒ Yes☐ No

Remarks: No previous data.

DATE PROBE IS DUE FOR NEXT CALIBRATION:

04/29/12

INSTRUMENT MARRIED WITH

#

Performed/Reviewed by:

Date: 4/29/2011

Entered by: Initials

Geometry: Flat surface unless otherwise noted.

Calibrations performed to ANSI N323A-1997 standards

Location ABJ Omamha

Model:	12	Serial #	167193	Cal Due	4/29/12
--------	----	----------	--------	---------	---------

Source Check Location: Biotcky Lab

Background Location: Biotcky Lab

Probe Model #:	44-9	Serial #	150691	Cal Due:	4/29/12
Probe Description:	Pancake				
Threshold	35	HV	900	Response Switch	Slow
Area Correction Factor:					
Type of Source	Serial #	Isotope	Source Date	uCi	dpm
α Source ID #					
β Source ID #		Tc-99			34,600
β, γ Source ID #					

10 Source Measurements												Type of Survey (Circle One)
Alpha												
Beta / Gamma	1700	1400	1800	1650	1900	1400	1700	1500	1600	1900	1655	
10 Bkgd Measurements												
Alpha												
Beta / Gamma	70	120	40	60	120	40	100	80	20	80	73	
Radiation Type												
Source Average	0	#DIV/0!	#DIV/0!	#DIV/0!	Source Average	1655	183	367	550			
Source Range (+/- 2sig)	#DIV/0!	to	#DIV/0!	#DIV/0!	Source Range (+/- 2sig)	1288	to	2022				
Bkgd Average	0	#DIV/0!	#DIV/0!	#DIV/0!	Bkgd Average	73	34	88	102			
Bkgd Range (+/- 2sig)	#DIV/0!	to	#DIV/0!	#DIV/0!	Bkgd Range (+/- 2sig)	58	to	88				

Daily Instrument Backgrounds and Source Check

Date: 5/2/2011

Description	Type	S/N
Instrument:	M12	63747
Probe:	44-9	154567
Range:	1353	1897
Source:	Tc-99	LH558
Initial Readings	Background (cpm)	Source (cpm)
1	40	1650
2	55	1400
3	30	1700
4	25	1450
5	55	1800
6	40	1750
7	20	1600
8	35	1650
9	60	1750
10	45	1500

Description	Type	S/N
Instrument:	M12	167193
Probe:	44-9	150691
Range:	1288	2022
Source:	Tc-99	LH558
Initial Readings	Background (cpm)	Source (cpm)
1	70	1700
2	120	1400
3	40	1800
4	60	1650
5	120	1900
6	40	1400
7	100	1700
8	80	1500
9	20	1600
10	80	1900

Date / Day	Background (cpm)	Source (cpm)
5/3/2011	40	1600
5/4/2011	40	1700
5/5/2011	50	1600
5/6/2011	40	1600
5/8/2011	50	1800
5/10/2011	50	1800
5/11/2011	40	1800
5/12/2011	50	1800
5/13/2011	40	1700
5/16/2011	40	1600
5/17/2011	70	1700
5/18/2011	60	1800
5/19/2011	40	1800
5/20/2011	50	1800
5/23/2011	Shipped	

Date / Day	Background (cpm)	Source (cpm)
5/3/2011	60	1700
5/4/2011	40	1900
5/5/2011	50	1600
5/6/2011	40	1900
5/9/2011	60	1900
5/10/2011	75	2000
5/11/2011	50	1700
5/12/2011	40	2000
5/13/2011	50	1900
5/16/2011	60	2000
5/17/2011	50	1900
5/18/2011	40	1900
5/19/2011	40	1900
5/20/2011	40	1900
5/23/2011	Shipped	



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

12 NS

SERIAL#

63747

Owner: SOLUTIENT TECHNOLOGIES

1807

DATE: 04/29/11

LOCATION:

Griffin Inst

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

Reason For Calibration:

☐ Due For Calibration

☐ Repair (See Remarks)

☒ Other (See Remarks)

☐ Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500

SERIAL #: 134715

CAL. DUE: 04/13/12

MODEL:

SERIAL #:

CAL DUE:

☒ Fast/Slow Switch working properly

☒ Audio Response

☒ Geotropism

CABLE LENGTH 39"

CONDITION: Sat

AF MECHANICAL ZERO: 0

AL MECHANICAL ZERO: 0

NEW BATTERIES: ☐ Yes ☒ No

BATTERY CHECK: Sat

HV RANGE 400 - 1500 VOLTS

☒ N/A ☐ Sat ☐ Unsat

HV (+/-10%)

AS FOUND HV

AS LEFT HV

500 V:

500

A.F.

1250 V: 1000 V for 177s

1250

A.F.

2000 V: 1500 V for 177s

2000

A.F.

AF INPUT SENSITIVITY (mV):

35

AL INPUT SENSITIVITY (mV):

A.F.

RATE METER

SCALER

SCALE RATE CPM AS FOUND % ERROR AS LEFT % ERROR AS FOUND % ERROR AS LEFT % ERROR

x.1 or x1	100	100	0.0%	A.F.					
	250	250	0.0%	A.F.					
	400	395	1.3%	A.F.					
x1 or x10	1000	1000	0.0%	A.F.					
	2500	2500	0.0%	A.F.					
	4000	4000	0.0%	A.F.					
x10 or x100	10K	10	K	0.0%	A.F.				
	25K	25	K	0.0%	A.F.				
	40K	40	K	0.0%	A.F.				
x100 or x1000	100K	100	K	0.0%	A.F.				
	250K	250	K	0.0%	A.F.				
	400K	400	K	0.0%	A.F.				

Is the As Found Data Within 20% of the Set Point?:

☒ Yes

☐ No

REMARKS: No previous data.

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes

☐ No

Calibration Sticker Attached?:

☒ Yes

☐ No

Date Instrument is Due For Next Calibration:

04/29/12

INSTRUMENT MARRIED WITH

#

Performed/Reviewed by:

E.M. Glenn

Date: 4/29/2011

Entered by: *EG* Initials

Calibrations performed to ANSI N323A-1997 standards.



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 44-9 PROBE # PR154567

1826

Owner: SOLUTIENT TECHNOLOGIES

DATE: 04/29/11
TECH: E.M. GlennLOCATION: Griffin Inst
DATE LAST CAL EXPIRES:

REASON FOR CALIBRATION:

☐ Due For Calibration ☐ Repair (See Remarks) ☒ Other (See Remarks) ☐ Due and Repair

CABLE LENGTH: 39"

INPUT SENSITIVITY: 35mV

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: 2221 SERIAL #: 183997 CAL. DUE: 09/01/11

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
00TC470-0654	Tc99 SS	17,300 dpm	06/15/09	10,800 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm

PHYSICAL CONDITION: Sat EFF. FROM LAST CAL.: BKG: 40 HV 900V

AF CPM Tc99: 2180 2204 2247 AVG: 2210.3 AF Sr90 CPM: 2511

Tc99 4 pi EFF: 12.55%

Sr90 4 pi EFF: 26.45%

Tc99 2 pi EFF: 20.10%

Sr90 2 pi EFF: 37.83%

AL CPM Tc99:

AVG:

AL Sr90 CPM:

TC-99 4 pi EFF:

Sr90 4 pi EFF:

Tc99 2 pi EFF:

Sr90 2 pi EFF:

Is the as found efficiency within 20% of eff. from last cal.?

☐ Yes ☒ No *See Remarks

Saturation Test Satisfactory

☒ Yes ☐ No

Reproducibility: Are the individual counts within 10% of the average?

☒ Yes ☐ No

Does the probe meet final acceptance criteria?

☒ Yes ☐ No

Calibration sticker attached?

☒ Yes ☐ No

Remarks: No previous data.

DATE PROBE IS DUE FOR NEXT CALIBRATION:

04/29/12

INSTRUMENT MARRIED WITH

#

Performed/Reviewed by:

Date: 4/29/2011

Entered by: Initials

Geometry: Flat surface unless otherwise noted.

Calibrations performed to ANSI N323A-1997 standards

Location ABJ Omaha

Model:	12	Serial #	63747	Cal Due	4/29/12
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Source Check Location: Biotcky Lab

Background Location: Biotcky Lab

Probe Model #:	44-9	Serial #	154567	Cal Due:	4/29/12
Probe Description:	Pancake				
Threshold	35	HV	900	Response Switch	Slow
Area Correction Factor:					
Type of Source	Serial #	Isotope	Source Date	uCi	dpm
α Source ID #					
β Source ID #		Tc-99			34,600
β, γ Source ID #					

10 Source Measurements	1	2	3	4	5	6	7	8	9	10	Average		Type of Survey (Circle One)
Alpha													
Beta / Gamma	1650	1400	1700	1450	1800	1750	1600	1650	1750	1500	1625		Beta
10 Bkgd Measurements	1	2	3	4	5	6	7	8	9	10	Average		
Alpha													
Beta / Gamma	40	55	30	25	55	40	20	35	60	45	41		
Radiation Type	Alpha	St. Dev.	2 σ	3 σ	Radiation Type	Beta	St. Dev.	2 σ	3 σ				
Source Average	0	#DIV/0!	#DIV/0!	#DIV/0!	Source Average	1625	138	272	408				
Source Range (+/- 2sig)	#DIV/0!	to	#DIV/0!	#DIV/0!	Source Range (+/- 2sig)	1353	to	1897					
Bkgd Average	0	#DIV/0!	#DIV/0!	#DIV/0!	Bkgd Average	41	13	27	40				
Bkgd Range (+/- 2sig)	#DIV/0!	to	#DIV/0!	#DIV/0!	Bkgd Range (+/- 2sig)	32	to	49					

Daily Instrument Backgrounds and Source Check

Date: 5/2/2011

Description	Type	S/N
Instrument:	M12	63747
Probe:	44-9	154567
Range:	1353	1897
Source:	Tc-99	LH558
Initial Readings	Background (cpm)	Source (cpm)
1	40	1650
2	55	1400
3	30	1700
4	25	1450
5	55	1800
6	40	1750
7	20	1600
8	35	1650
9	60	1750
10	45	1500

Description	Type	S/N
Instrument:	M12	167193
Probe:	44-9	150691
Range:	1288	2022
Source:	Tc-99	LH558
Initial Readings	Background (cpm)	Source (cpm)
1	70	1700
2	120	1400
3	40	1800
4	60	1650
5	120	1900
6	40	1400
7	100	1700
8	80	1500
9	20	1600
10	80	1900

Date / Day	Background (cpm)	Source (cpm)
5/3/2011	40	1600
5/4/2011	40	1700
5/5/2011	50	1600
5/6/2011	40	1600
5/8/2011	50	1800
5/10/2011	50	1800
5/11/2011	40	1800
5/12/2011	50	1800
5/13/2011	40	1700
5/16/2011	40	1600
5/17/2011	70	1700
5/18/2011	60	1800
5/19/2011	40	1800
5/20/2011	50	1800
5/23/2011	Shipped	

Date / Day	Background (cpm)	Source (cpm)
5/3/2011	60	1700
5/4/2011	40	1900
5/5/2011	50	1600
5/6/2011	40	1900
5/9/2011	60	1900
5/10/2011	75	2000
5/11/2011	50	1700
5/12/2011	40	2000
5/13/2011	50	1900
5/16/2011	60	2000
5/17/2011	50	1900
5/18/2011	40	1900
5/19/2011	40	1900
5/20/2011	40	1900
5/23/2011	Shipped	



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

2929

SERIAL#

160029

Owner: GI

DATE: 09/24/10

LOCATION:

Griffin Inst

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

10/02/10

Reason For Calibration:

☒ Due For Calibration☐ Repair (See Remarks)

CABLE LENGTH: 39"

☐ Other (See Remarks)☐ Due and Repair (See Remarks)NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500

SERIAL #: 42386

CAL. DUE: 04/21/11

MODEL:

SERIAL #:

CAL DUE:

Condition: ☒ Sat ☐ Unsat

AF Mechanical Zero: 0

AL Mechanical Zero: 0

Scaler Function Check

As Found

As Left

Beta Channel Window (4-50 mV):

4-50

A.F.

Alpha Channel Window (175 mV, 120 for 3030):

175

A.F.

Alpha Counts w/Pulser @ 10,000 CPM:

9,996

A.F.

% Error: 0.0%

Beta Counts w/Pulser @ 10,000 CPM:

9,996

A.F.

% Error: 0.0%

HIGH VOLTAGE POWER SUPPLY CAL. (2929 only)

1 KV Reading (R-5 on HV Board):

1

A.F.

Max HV (1500 V +):

☒ Sat ☐ Unsat

REMARKS:

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes☐ No

Calibration Sticker Attached?:

☒ Yes☐ No

Date Instrument is Due For Next Calibration:

09/24/11

INSTRUMENT MARKED WITH

43-10-1

PR164053

Performed/Reviewed by:

E.G.
E.M. Glenn

Date: 9/24/2010

Entered by: E.G. Initials



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-10-1 PROBE # PR164053

Owner: GI

DATE: 09/24/10
TECH: E.M. GlennLOCATION: Griffin Inst
DATE LAST CAL EXPIRES: 10/02/10

REASON FOR CALIBRATION:

☐ Due For Calibration ☐ Repair (See Remarks) ☐ Other (See Remarks) ☒ Due and Repair

CABLE LENGTH: 39"

INPUT SENSITIVITY: dual

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2929 SERIAL #: 160029 CAL. DUE: 09/24/11

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
00TC470-0654	Tc99 SS	17,300 dpm	06/15/09	10,800 cpm
94TH470-1593	Th230	16,700 dpm	06/16/09	8,170 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm
PX 726	C14	48,780 dpm	01/21/08	18,660 cpm

Efficiencies from last cal.:

Condition: ☒ Sat ☐ Unsat

Pu: 38.38% Th: 36.38% Sr: 43.70%

Tc ss: 22.58% C14: 8.11% Tc Ni:

As Found (AF) Efficiencies:

HV / Vernier: Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
850 / 3.42										

Net A to B B to A Xtalk:
Xtalk: <10% <1%

Pu239

Tc99 Ni

Tc99 ss

Th-230

Sr90

C-14

AF CPM:

AF 4 pi eff:

AF 2 pi eff:

Is as found efficiency within 20% of the efficiency from the last cal?

☐ Yes ☒ No (See Remarks)

Note: If the as found data is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the plateau section and go directly to remarks.



GRIFFIN INSTRUMENTS



PROBE #: PR164053

Date: 09/24/10

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
700 / 2.84	1	1603	9.1%	5647	317	30.5%	1	27	4.9%	<1%
750 / 3.03	1	2342	13.3%	6577	235	35.5%	1	33	3.0%	<1%
800 / 3.26	0	3235	18.5%	7120	194	38.5%	1	42	2.1%	<1%
850 / 3.45	0	3969	22.6%	7148	201	38.6%	0	60	1.9%	<1%
900 / 3.64	1	4717	26.9%	7226	411	39.1%	0	71	4.5%	<1%
950 / 3.84							0	97		

Alpha / Beta Bkg (cpm)		0	58			
HV / Vernier	Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90
850 / 3.45	CPM: 7108		4047	6009	4470	4145
4 pi AL Efficiencies:	38.42%		23.06%	35.98%	9.04%	43.14%
2 pi AL Efficiencies:	75.70%		36.94%	73.55%	23.64%	61.70%

REMARKS: Replaced torn mylar.

Does Instrument Meet Final Acceptance Criteria?: • Yes No

Calibration Sticker Attached?: • Yes No

Date Instrument is Due For Next Calibration: 09/24/11

INSTRUMENT MARRIED WITH 2929 # 160029

Performed/Reviewed by:

E.G.
E. M. Glau

Date: 9/24/2010

Entered by: *E.G.* Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.

Location ABJ Omamha

Model:	L2360	Serial #	160029	Cal Due	9/24/11
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Source Check Location: Biotcky Lab

Background Location: Biotcky Lab

Probe Model #:	43-10-1	Serial #	164053	Cal Due:	9/24/11
Probe Description: Alpha Beta Scintillator					
Threshold	30	HV	1400	Response Switch	Slow
Area Correction Factor:					
Type of Source	Serial #	Isotope	Source Date	uCi	dpm
α Source ID #		Th-230			21,900
β Source ID #		Th-230			21,900
β, γ Source ID #					

10 Source Measurements												Type of Survey (Circle One)
Alpha	6973	7438	7323	7279	7520	7150	7080	6921	7161	7428	7227	
Beta / Gamma	796	808	988	695	779	721	678	742	844	767	782	
10 Bkgd Measurements												Type of Survey (Circle One)
Alpha	0	0	0	0	2	0	1	0	0	1	0	
Beta / Gamma	54	70	68	78	70	56	69	61	76	52	65	
Radiation Type		Alpha	St. Dev.	2 σ	3 σ	Radiation Type		Beta	St. Dev.	2 σ	3 σ	Type of Survey (Circle One)
Source Average		7227	204	407	611	Source Average		782	89	178	267	
Source Range (+/- 2sigma)		6820	to	7634		Source Range (+/- 2sigma)		604	to	960		
Bkgd Average		0	0.7	1.4	2.1	Bkgd Average		65	9	18	27	
Bkgd Range (+/- 2sigma)		-2	to	2		Bkgd Range (+/- 2sigma)		52	to	78		

Daily Instrument Backgrounds and Source Check

Date: 5/2/2011

Description	Type	S/N
Instrument:	L2929	160029
Probe:	43-10-1	164053
Range:	604	960
Source:	Th-230	1646
Initial Readings	Background (cpm)	Source (cpm)
1	54	796
2	70	808
3	68	988
4	78	695
5	70	779
6	56	721
7	69	678
8	61	742
9	76	844
10	52	767

10 min (round up)

Date / Day	Background (cpm)	Source (cpm)
5/3/2011	68	798
5/4/2011	61	761
5/5/2011	63	772
5/6/2011	59	784
5/8/2011	65	802
5/10/2011	50	758
5/11/2011	70	825
5/12/2011	49	829
5/13/2011	63	768
5/16/2011	60	808
5/17/2011	64	830
5/18/2011	70	850
5/19/2011	67	820
5/20/2011	62	760
5/23/2011	74	825
5/24/2011	71	827
5/25/2011		

Description	Type	S/N
Instrument:	L2929	1640029
Probe:	43-10-1	164053
Range:	6820	7634
Source:	Th-230	1646
Initial Readings	Background (cpm)	Source (cpm)
1	0	6973
2	0	7438
3	0	7323
4	0	7279
5	2	7520
6	0	7150
7	1	7080
8	0	6921
9	0	7161
10	1	7428

10 min (round up)

Date / Day	Background (cpm)	Source (cpm)
5/3/2011	0.1	7316
5/4/2011	0	6890
5/5/2011	0	7405
5/6/2011	0.1	7449
5/8/2011	0.2	7375
5/10/2011	0.2	7330
5/11/2011	0	7270
5/12/2011	0	7292
5/13/2011	0.3	7303
5/16/2011	0.1	7346
5/17/2011	0.3	7420
5/18/2011	0.1	7500
5/19/2011	0.2	7570
5/20/2011	0.5	7570
5/23/2011	0.5	7517
5/24/2011	0.3	7614



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

2360

SERIAL#

245758

Owner: GI

DATE: 03/08/11

LOCATION:

Griffin Inst

TECH: Joanne Glenn

DATE LAST CAL EXPIRES:

10/06/10

Reason For Calibration:

☒ Due For Calibration☐ Repair (See Remarks)☐ Other (See Remarks)☐ Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500

SERIAL #: 114512

CAL. DUE: 07/28/11

☒ Audio Response☒ Geotropism

CABLE LENGTH: 39"

CONDITION: Sat

AF MECHANICAL ZERO: 0

AL MECHANICAL ZERO: 0

NEW BATTERIES:

☐ Yes ☒ No

BATTERY CHECK: Sat

HV (+/-10%)	AS FOUND HV	AS LEFT HV	WINDOW SETTINGS:	A.F.	A.L.
500 V:	510	A.F.	BT (3.5 mV +/- 1 mV):	3.4	3.5
1000 V:	1000	A.F.	BW (30 mV +/- 3 mV):	31	30
1500 V:	1495	A.F.	AT (120 mV +/- 10 mV):	120	A.F.

RATE METER

SCALER

SCALE RATE CPM AS FOUND % ERROR AS LEFT % ERROR AS FOUND % ERROR AS LEFT % ERROR

x.1 or x1	100	100	0.0%	A.F.					
	250	250	0.0%	A.F.		250	0.0%	A.F.	
	400	400	0.0%	A.F.					
x1 or x10	1000	1000	0.0%	A.F.					
	2500	2500	0.0%	A.F.					
	4000	4000	0.0%	A.F.					
x10 or x100	10K	10	K	0.0%	A.F.				
	25K	25	K	0.0%	A.F.				
	40K	40	K	0.0%	A.F.				
x100 or x1000	100K	100	K	0.0%	A.F.				
	250K	250	K	0.0%	A.F.				
	400K	400	K	0.0%	A.F.				

Is the As Found Data Within 20% of the Set Point?:

☒ Yes ☐ No

Overload Light:

☒ Adjusted ☐ Not Adj.

REMARKS:

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes ☐ No

Calibration Sticker Attached?:

☒ Yes ☐ No

Date Instrument is Due For Next Calibration:

03/08/12

INSTRUMENT MARKED WITH

43-93

PR263618

Performed/Reviewed by:

Joanne Glenn

Date: 3/8/2011

Entered by: *[Signature]* Initials

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 43-93 PROBE # PR263618

Owner: GI

DATE: 03/08/11

LOCATION: Griffin Inst

TECH: Joanne Glenn

DATE LAST CAL EXPIRES:

REASON FOR CALIBRATION:

• Due For Calibration Repair (See Remarks) Other (See Remarks) Due and Repair

CABLE LENGTH: 39"

INPUT SENSITIVITY: dual

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2360 SERIAL #: 245758 CAL. DUE: 03/08/12

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
00TC470-0654	Tc99 SS	17,300 dpm	06/15/09	10,800 cpm
94TH470-1593	Th230	16,700 dpm	06/16/09	8,170 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm

Efficiencies from last cal.:

Condition: • Sat Unsat Pu: Th: Sr:
Tc ss: C14: Tc Ni:

As Found (AF) Efficiencies:

HV / Vernier: Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
N/A										

Net A to B B to A Xtalk:
Xtalk: <10% <1%

Pu239 Tc99 Ni Tc99 ss Th-230 Sr90 C-14

AF CPM:

AF 4 pi eff:

AF 2 pi eff:

Is as found efficiency within 20% of the efficiency from the last cal? Yes • No (See Remarks)

Note: If the as found data is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the plateau section and go directly to remarks.

GRIFFIN INSTRUMENTS

PROBE #: PR263618

Date: 03/08/11

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
600	13	1629	8.9%	3643	257	19.7%	0	87	4.5%	<1%
650	12	2815	15.1%	4161	383	22.5%	0	199	4.2%	<1%
675				4236	821	22.9%	0	209	12.6%	
700							6	287		

Alpha / Beta Bkg (cpm)		1	184			
HV / Vernier	Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90
650 / N/A	CPM: 4175		2773	3438		3339
4 pi AL Efficiencies:	22.56%		14.97%	20.58%		33.70%
2 pi AL Efficiencies:	44.45%		23.97%	42.07%		48.20%

REMARKS: Returned from rental. Re-calibrated.

Does Instrument Meet Final Acceptance Criteria?: • Yes No

Calibration Sticker Attached?: • Yes No

Date Instrument is Due For Next Calibration: 03/08/12

INSTRUMENT MARRIED WITH 2360 # 245758

Performed/Reviewed by: *James Gibson*

Date: 3/8/2011

Entered by: *[Signature]* Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.

Packing List for GI

09-May-11

From: Griffin Instruments, 977 Hamilton Lane, Kingston, TN 37763

SERIAL #	MODEL	BARCODE #	LOCATION	SPEC LOCATION	OWNER	CAL DUE
193682	2360		SOLUTIENT		GI	05/09/12
245758	2360 No 9 pin cover		SOLUTIENT	2507	GI	03/08/12
PR200145	43-93		SOLUTIENT		GI	05/09/12
PR263618	43-93		SOLUTIENT	2507	GI	03/08/12

Physical Condition SAT / UNSAT

Calibration Stickers SAT / UNSAT

Proper Packaging SAT / UNSAT

Calibration Certificates SAT / UNSAT

1 39" Cables N/A 5' Cables

N/A Regulators

N/A Software

1 Floor Monitor Cart access., straps, tygon, 6' cable

1 Download Cables

N/A Manuals

N/A Power Cables

Other: (1) Broken Probe protector,

Person Inspecting/Transferring Signature [Signature] Date: 5/9/11

Person Accepting Signature _____ Date: _____

Location ABJ Omaha

Model:	L2360	Serial #	245758	Cal Due	5/9/12
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Source Check Location: Blotcky Lab

Background Location: Blotcky Lab

Probe Model #:	43-93	Serial #	263618	Cal Due:	5/9/12
Probe Description: Alpha Beta Scintillator					
Threshold	30	HV	1400	Response Switch	Slow
Area Correction Factor:					
Type of Source	Serial #	Isotope	Source Date	uCi	dpm
α Source ID #		Th-230			21,900
β Source ID #		Tc-99			34,600
β, γ Source ID #					

10 Source Measurements													Type of Survey (Circle One)
Alpha	409	308	419	381	411	298	473	379	430	415	392		
Beta / Gamma	3927	3287	4032	3918	3283	3075	3689	3794	4082	3776	3686		
10 Bkgd Measurements													
Alpha	0	0	0	0	0	0	1	0	0	2	0		
Beta / Gamma	226	236	237	206	218	255	239	245	214	220	230		
Radiation Type	Alpha	St. Dev.	2 σ	3 σ	Radiation Type	Beta	St. Dev.	2 σ	3 σ				
Source Average	392	54	108	162	Source Average	3686	350	700	1050				
Source Range (+/- 2sig)	285	to	500		Source Range (+/- 2sig)	2986	to	4387					
Bkgd Average	0	0.7	1.3	2.0	Bkgd Average	230	15	31	46				
Bkgd Range (+/- 2sig)	-2	to	2		Bkgd Range (+/- 2sig)	184	to	276					

Daily Instrument Backgrounds and Source Check

Date: 5/10/2011

Description	Type	S/N
Instrument:	L2360	245758
Probe:	43-93	263618
Range:	2986	4387
Source:	Tc-99	LH558
Initial Readings	Background (cpm)	Source (cpm)
1	226	3927
2	236	3287
3	237	4032
4	206	3918
5	218	3283
6	255	3075
7	239	3689
8	245	3794
9	214	4082
10	220	3776

10 min

1 min

[illegible]

Description	Type	S/N
Instrument:	L2360	245758
Probe:	43-93	263618
Range:	285	500
Source:	Th-230	1646
Initial Readings	Background (cpm)	Source (cpm)
1	0	409
2	0	308
3	0	419
4	0	381
5	0	411
6	0	298
7	1	473
8	0	379
9	0	430
10	2	415

10 min

1 min

[illegible]