



LTSM013198

**URS**

# Memorandum

Date: 8 July 2002

To: José Alvarado, BONUS Facility Manager

Copy: BONUS File

From: Chad Webb, BONUS RADCON Manager

Subject: **Sampling and Inspection Report for the BONUS Reactor – 2002 Annual Survey**

URS Corporation conducted the second comprehensive annual survey at the BONUS Reactor on 12–14 and 20 June 2002 with support from PREPA personnel. This survey was conducted in accordance with the Sampling and Analysis Plan (SAP) for the BONUS Reactor prepared by the U.S. Department of Energy (DOE) (or DOE contractor) as amended by a 16 January 2001 Memorandum from Webb to Alvarado. This report is organized in accordance with Section 6.2 of the SAP. The sampling and inspection results are discussed below.

## PURPOSE

**Date:** 12–14 and 20 June 2002

**Purpose:** Conduct 2002 annual survey - to ensure that exposure to employees, the public, and the environment to levels of ionizing radiation are as low as reasonably achievable and demonstrate that levels of radioactivity at the facility remain within the criteria that support the basis for continued use as a museum.

## LOCATION

This sampling and inspection effort focused on the BONUS Reactor Building. Surveys and inspections were performed on the (1) exterior of the entombment, (2) Main Level, and (3) Basement Level. Air sampling in the Main Level and Basement Level breathing zones was also performed. A list of specific survey locations is provided in Table 1.

## PHYSICAL CONDITION

**Primary Reactor Building Structure (Dome):** Inspection of the primary reactor building structure did not reveal any significant discrepancies, although in the basement minor corrosion was noted around the entire base of the dome. Ongoing and routine assessment of the dome is recommended. No immediate action is necessary.

**Entombment:** Inspection of the entombment area revealed superficial cracks throughout the surface of the structure. All dose rate measurements taken around the structure were not significantly different from background measurements taken. Ongoing and routine assessment of the entombment is recommended. No immediate action is necessary.

**Table 1**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Routine Sampling</b>					
Pipe Chase Face	1	3	<MDA	<MDA	Entombment Top
Pipe Chase Face	2	4	<MDA	<MDA	Entombment Top
Pipe Chase Face	2 Dup	NA	<MDA	NA	Duplicate
Pipe Chase Face	3	3.5	<MDA	<MDA	Entombment Top
Pipe Chase Face	4	4	<MDA	<MDA	Entombment Top
Top Plug Face #1	5	5	<MDA	<MDA	Entombment Top
Top Plug Face #1	6	5	<MDA	<MDA	Entombment Top
Top Plug Face #1	7	4	<MDA	<MDA	Entombment Top
Top Plug Face #2	7 Dup	NA	<MDA	NA	Duplicate
Top Plug Face #2	8	4	<MDA	<MDA	Entombment Top
Top Plug Face #2	9	5	1,460	<MDA	Entombment Top
Top Plug Face #2	10	5	1,022	<MDA	Entombment Top
Top Plug Face #3	11	4	1,508	<MDA	Entombment Top
Top Plug Face #3	12	4	1,168	<MDA	Entombment Top
Top Plug Face #3	12 Dup	4	NA	NA	Duplicate
Top Plug Face #3	13	3.5	<MDA	<MDA	Entombment Top
Top Plug Face #3	13 Dup	NA	NA	<MDA	Duplicate
Top Plug Face #4	14	3	<MDA	<MDA	Entombment Top
Top Plug Face #4	15	3.5	<MDA	<MDA	Entombment Top
Top Plug Face #4	16	4	<MDA	<MDA	Entombment Top
Top Plug Top Surface	17	2	<MDA	<MDA	Entombment Top
Top Plug Top Surface	18	2	<MDA	<MDA	Entombment Top
Top Plug Top Surface	19	2	<MDA	<MDA	Entombment Top
Main Floor Water Column	20	4	<MDA	<MDA	Main Level-Controlled Area
Main Floor Water Column	21	4	1,168	<MDA	Main Level-Controlled Area
Instrument Thimble #1	22	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #2	23	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #2	23 Dup	4	NA	NA	Duplicate
Instrument Thimble #3	24	4	<MDA	<MDA	Main Level-Controlled Area
Pipe Chase Ext Hatch	25	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #4	26	4	<MDA	<MDA	Main Level-Controlled Area
Fuel Pool Purif Floor, area	27	21	28,418	<MDA	Main Level-Controlled Area
Fuel Pool Purif Floor, area	27A	6	1,460	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif Floor, area	27B	5	1,460	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif. Floor (CM005)	28	27	9,976	<MDA	Main Level-Controlled Area
Pre heater Room Moat Surface	29	7	<MDA	<MDA	Basement Level
Pre heater Room Moat Surface	29A	8	1,752	<MDA	Basement Level
Liq. Waste Ret. Tank Floor	30	17	<MDA	<MDA	Basement Level
Liq. Waste Ret. Tank Floor (Near Wall)	30A	40	2,141	<MDA	Basement Level

**Table 1 (Continued)**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Routine Sampling (continued)</b>					
Liquid Waste Ret. Tank Floor	31	19	<MDA	<MDA	Basement Level
Corridor Moat Surface	32	9	924	<MDA	Basement Level
Corridor Moat Surface	33	11	7,591	<MDA	Basement Level
Corridor Moat Surface	34	10	4,234	<MDA	Basement Level
Corridor Moat Surface	35	15	26,472	<MDA	Basement Level
Corridor Moat Surface	36	5	<MDA	<MDA	Basement Level
Corridor Moat Surface	37	5	<MDA	<MDA	Basement Level
Liquid Waste Pumb Room (B003)	38	15	10,073	<MDA	Basement Level
F.W. Heater Room Floor	39	8	1,849	<MDA	Basement Level
F.W. Heater Room Floor (B017)	40	9	<MDA	<MDA	Basement Level
F.W. Heater Room (Wall)	40A	29	312,506	1,139	Appears to be B017 hot spot referenced in the historical survey (not location 40)
F.W. Heater Room (Wall)	40A Dup	29	293,090	NA	Duplicate
F.W. Heater Room (Floor)	40B	28	36,204	409	Basement Level
F.W. Heater Room (Floor)	40B Dup	NA	NA	358	Duplicate
F.W. Heater Room Floor	41	10	<MDA	<MDA	Basement Level
Vapor Sphere Room	42	5	<MDA	<MDA	Basement Level
Vapor Sphere Room	43	6	<MDA	<MDA	Basement Level
Vapor Sphere Room	43 Dup	NA	NA	<MDA	Duplicate
Air Ejector Room Floor	44	9	<MDA	<MDA	Basement Level
Air Ejector Room Floor	45	NA	NA	NA	Under Water
Condensate Pump room Floor	46	13	1226	<MDA	Basement Level
Hogging Pump Room Floor	47	15	3,260	<MDA	Basement Level
Hogging Pump Room Floor	48	8	<MDA	<MDA	Basement Level
Condenser Room Floor	49	10	7,056	<MDA	Basement Level
Condenser Room Floor	50	9	<MDA	<MDA	Basement Level
Condenser Room Entry Wall (Block)	50A	6	41,508	<MDA	Basement Level
Condenser Room Entry Wall (Concrete)	50B	6	45,937	<MDA	Basement Level
Cond. Purif. Floor Area	51	12	<MDA	<MDA	Basement Level
Cond. Purif. Floor Area	51 Dup	NA	NA	<MDA	Duplicate
Cond. Purif. Floor Area	52	7	<MDA	<MDA	Basement Level
Cond. Resin Regen. (B023)	53	14	24,136	248	Basement Level
Cond. Resin Regeneration	54	14	3,358	<MDA	Basement Level
Reactor Water Purification	55	6	973	<MDA	Basement Level
Reactor Water Purification	56	5	<MDA	<MDA	Basement Level

**Table 1 (Continued)**

<b>Sampling Location</b>	<b>Sample Number</b>	<b>Dose Rate (uR/hour)</b>	<b>Total Contamination (dpm/100 cm<sup>2</sup>)</b>	<b>Removable Contamination (dpm/100 cm<sup>2</sup>)</b>	<b>Comments</b>
<b>Additional Sampling Locations</b>					
Reactor Top (MEZI) Fuel Transfer Assembly Track	57	NA	NA	NA	Item removed prior to this survey
Monitoring Well 1	58	NA	NA	NA	No longer included in survey
Monitoring Well 2	59	NA	NA	NA	No longer included in survey
Monitoring Well 3	60	NA	NA	NA	No longer included in survey
Soil Sample 1-North entrance	61	NA	NA	NA	No longer included in survey
Soil Sample 2-South entrance	62	NA	NA	NA	No longer included in survey
Soil Sample 3-Surface composite adjacent to facility	63	NA	NA	NA	No longer included in survey
Composite Dust Sample	64	NA	NA	NA	No longer included in survey
<b>Random Sampling (Specify Location)</b>					
Main Floor-Zone 1	65	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 2	66	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 3	67	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 4	68	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 5	69	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Basement-Liquid Retention Tank #1	70	NA	NA	>MDA	Basement Level. Masslin Smear
Basement-Liquid Retention Tank #2	71	NA	NA	>MDA	Basement Level. Masslin Smear
<b>Other Special Readings (As Required) Specify Location</b>					
Main Floor-Zone 6	72	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 7	73	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 8	74	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 9	75	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 10	76	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 11	77	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 12	78	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 13	79	NA	NA	<MDA	Main Level-Public Access. Masslin Smear
Main Floor-Zone 14	80	NA	NA	<MDA	Main Level-Public Access. Masslin Smear

**Table 1 (Continued)**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Other Special Readings (Continued)</b>					
Basement-Liquid Retention Tank #3	81	NA	NA	>MDA	Basement Level. Masslin Smear
Basement-Neutralization Tank	81A	NA	NA	<MDA	Basement Level. Masslin Smear
Basement-Area to left of stairs	82	14	<u>21,411</u>	<MDA	Basement Level
Basement (Near 40A)	83	27	Skipped	Skipped	Known removable contamination – avoided
Decontamination Room, Decontamination Sink Pipe	84	5	<u>10,365</u>	<MDA	Basement Level
Decontamination Room, Decontamination Sink Pipe	84 Dup	5	<u>10,365</u>	NA	Duplicate
Sink	85	12	<u>70,754</u>	161	Basement Level
Sump Pump #1	86	11	<u>28,905</u>	<MDA	Basement Level
Inlet Air Plenum Room Drain	87	15	<u>5,255</u>	<MDA	Basement Level
Inlet Air Plenum Room Floor area	88	14	<u>11,192</u>	<MDA	Basement Level

NA = Not Applicable      MDA = Minimum Detectable Activity

**Main Level (Controlled Area):** Inspection of the main level revealed that the two historical contamination sites had been covered with floor tiles; the tile work is in excellent condition and is effective in reducing the dose levels. One area adjacent to the north side of the entombment is also covered with lead bricks, which is also effective in reducing elevated dose rate levels in this area. Ongoing and routine assessment of the floor tile and lead bricks in this area is recommended. No immediate action is necessary.

**Basement Level:** Inspection of the basement indicated the area had been flooded since the last inspection (January 2001). Corrosion is evident on all surfaces within approximately 6 in. of the floor, including contaminated surfaces. Ongoing and routine assessment of contaminated surfaces in the basement is recommended to determine whether contamination is becoming removable.

**DIRECT RADIATION MONITORING**

Table 1 presents direct radiation monitoring results for this survey. Attachment 1 provides survey records and sketches depicting survey locations for the direct radiation monitoring conducted during this annual comprehensive survey. Measurements were taken with a Ludlum Micro-R Meter, Model 19, at 30 cm from the source or survey location. Table 2 summarizes these results.

**Table 2**

Location	Dose Rate at 30 cm from Source (uR/hour)			Expected Exposure Rate <sup>a</sup>		Annual Dose Limits (rem/year)	
	Min. (uR/hour)	Ave. (uR/hour)	Max. (uR/hour)	Max. Exposure (hour/year)	Rate (rem/year)	Rad Worker	Visitor
Entombment Top	2	3.7	5	416	0.002	2	NA
Main Level (Controlled Area)	4	7.9	27	416	0.01	2	NA
Main Level (Public Access)	4	5	6	2,080 (employee)	0.01	2	NA
				832 (visitor)			
Basement Level	4	12.2	40	416	0.02	2	NA

<sup>a</sup>Based conservatively on the maximum-recorded dose rate at a conservative exposure scenario. For example, exposure level for the entombment top would be 5 uR/hour × (1 rem/1,000,000 uR) × (8 hours/1 week) × (52 weeks/1 year) = 0.002 rem/year.

The results summarized in the table above indicate that there are no radiation areas as defined in 40 CFR 835 (0.005 rem/hour at 30 cm or 5,000 uR/hour at 30 cm for the dose rate measurements conducted at BONUS) in the BONUS Reactor facility. The highest dose rate recorded at 30 cm in the BONUS facility (40 uR/hour) is less than 1% of the limit defining a radiation area. The radiation levels exhibited throughout the facility do not approach annual dose limits for radiological workers or site visitors based on conservative exposure scenarios summarized in the table above. It is recommended, however, that the Main Level (Controlled Area), Entombment Top, and Basement Level remain designated as controlled areas (as defined in 40 CFR 835) due to the presence of elevated dose rate areas.

Instrument calibration records and daily response check records are provided in Attachment 2 to provide documentation pertaining to quality instrument performance. Duplicate field measurements were also made at a rate of 5% and are summarized in Table 3.

**Table 3**

Location	Result (uR/hour)		RPD (%)	Comments
	Initial	Duplicate		
12	4	4	0	Very good
23	4	4	0	Very good
40A	29	29	0	Very good
84	5	5	0	Very good

$$RPD = [(Sample - Duplicate) / ((Sample + Duplicate) / 2)] \times 100$$

All quality assurance (QA)/quality control (QC) checks performed within limits.

**CONTAMINATION LEVEL MONITORING**

Table 1 presents contamination level monitoring results for this survey. Attachment 1 provides contamination survey records and sketches depicting survey locations for the surface contamination measurements conducted during this annual comprehensive survey. Measurements were taken with a Ludlum 44-9 probe coupled to a Ludlum 2221 Scaler/Ratemeter. Total surface and removable contamination surveys were conducted in accordance with Standard Operating Procedures (SOPs) PBR-11.3.1 and 11.4.1. Contamination level results are summarized below.

### **Entombment**

There are no radioactive contamination areas (as defined in 10 CFR 835) associated with the exterior of the entombment structure. Smear samples were collected from the surface of the entombment to assess transferable or removable surface beta/gamma contamination. None of the smear samples exhibited removable contamination above the minimum detectable activity (MDA). Four survey locations exhibited total surface contamination levels above the MDA. Survey locations 9, 10, 11, and 12 had total surface beta/gamma contamination levels ranging from 1,022 to 1,508 disintegrations per minute (dpm)/100 cm<sup>2</sup>. These values are approximately twice background values, but are well below the survey action level for total surface beta/gamma contamination (5,000 dpm/100 cm<sup>2</sup>). It is recommended that the Entombment Top be designated as a controlled area due to the presence of elevated fixed surface beta/gamma contamination levels. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the entombment surface) work is performed on this level without review and approval by the RCM.

### **Main Level (Controlled Area)**

There are no radioactive contamination areas associated with the controlled area (inside the railing and Plexiglas) of the Main Level. Smear samples were collected from the floor surface of the Main Level (controlled area) to assess transferable or removable surface beta/gamma contamination. None of the smear samples exhibited removable contamination above MDA. However, two planned survey locations, 27 and 28, had total surface beta/gamma contamination levels above the 5,000 dpm/100 cm<sup>2</sup> action level (28,418 and 9,976 dpm/100 cm<sup>2</sup>, respectively). Two additional survey locations, 27A and 27B, were added to the sampling locations in 2001 and assessed to determine the extent of the surface contamination (refer to survey sketch in Attachment 1). One other planned survey location, 21, exhibited total surface contamination levels above MDA, but below the 5,000 dpm/100 cm<sup>2</sup> action level. It is recommended that the Main Level (controlled area) remain designated as a controlled area due to the presence of elevated fixed surface beta/gamma contamination and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4 (modify posting to avoid alarming visitors – current posting is acceptable). Minimum entry/exit requirements for this area should include signing a log-in/log-out sheet and frisking feet, as well as other areas/equipment that contacted area surfaces, upon exit from the area.

### **Main Level (Public Access Area)**

The Main Level (public access area) was evaluated for transferable/removable surface contamination only (i.e., only smear samples were performed). These results indicate that there are no radioactive contamination areas associated with the public access area (outside the railing and Plexiglas) of the Main Level. Masslin samples (survey locations 65–69 and 72–80) were collected from the floor surface of the Main Level (public access area) to assess transferable or removable surface beta/gamma contamination. None of the smear samples exhibited removable contamination above MDA. Historically, fixed surface contamination does exist on the concrete floor of the Main Level (public access area), but has been shielded by the placement of tiles in this area. Due to the presence of fixed contamination beneath the floor tiles, it is recommended that this area remain a controlled area. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the floor surface) work is performed on this level without review and approval by the RCM.

### Basement Level

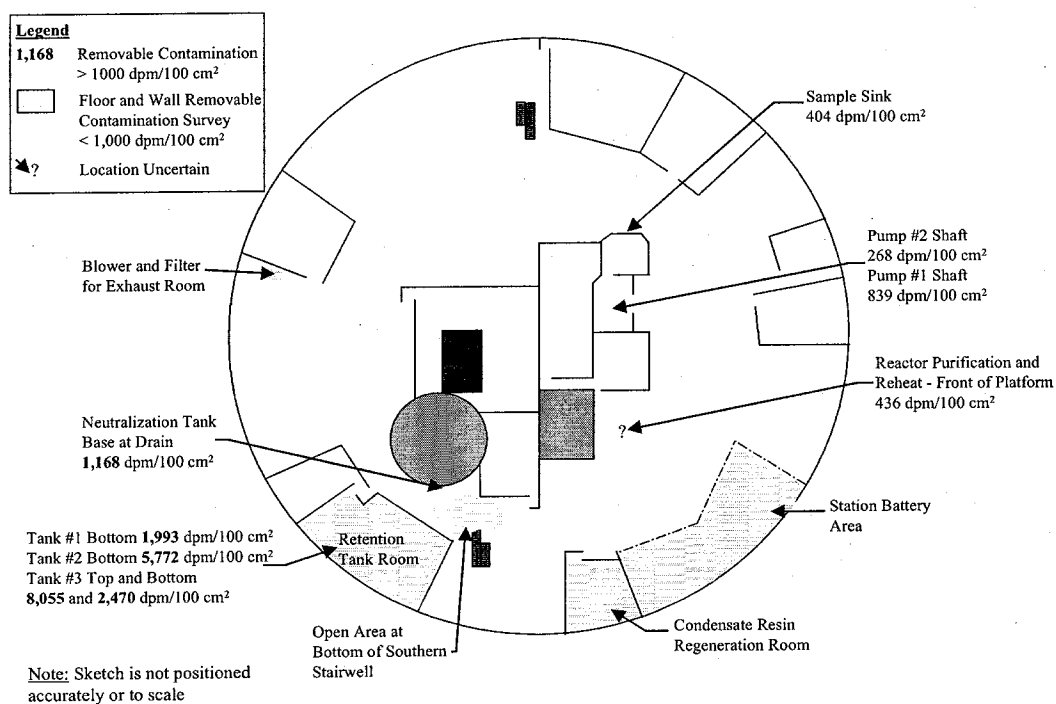
Table 1 indicates several total and removable surface contamination areas above action levels in the Basement Level. Historically, removable surface contamination in the Basement Level has been detected on floors and process equipment. Figure 1 shows past results of masslin smears performed on floor surfaces, which were determined during historical surveys to have removable contamination above MDA, but below the 1,000 dpm/100 cm<sup>2</sup> action level. Figure 1 also provides a summary of 100 cm<sup>2</sup> smear samples collected during previous surveys on equipment located in the basement. Historically, two of the locations (Neutralization Tank and Retention Tank Room) were above the 1,000 dpm/100cm<sup>2</sup> action level.

Survey locations were added to the Retention Tank Room to further assess this area. A masslin smear was collected from all four tanks in this room (Liquid Retention Tanks 1, 2, and 3 and Neutralization Tank). All three liquid retention tanks exhibited removable contamination above MDA, but the Neutralization Tank masslin smear was below MDA. Additional masslin smears were collected from Tank 1 Zones 1, 2, 3, 4, and tank top. Each of these masslin smears had results greater than MDA. Following the masslin smears, four traditional smear samples were collected from Liquid Retention Tank 1 and ranged from 285 to 5,416 dpm/100 cm<sup>2</sup>. These results indicate that removable contamination is persistent on the liquid retention tanks.

The area associated with historical survey location number B017 (survey locations 40A and 83) was also further assessed to define the area with removable contamination. Initially, two masslin smears were performed in the area with elevated total surface contamination and the area just outside elevated total surface readings, 40AMAS1 and 40AMAS2, respectively (refer to sketch in Attachment 1). As expected, 40AMAS1 exhibited removable contamination levels above MDA and 40AMAS2 below MDA for the masslin smears collected. Following the masslin smears, seven traditional smears (40A through 40G) were collected in this area (refer to sketch in attachment 1). The results of the smear counting ranged from less than MDA to 372 dpm/100 cm<sup>2</sup>. Note, however, that the original smear sample for 40A in Table 1 resulted in 1,139 dpm/100 cm<sup>2</sup>. This area will continue to be monitored and considered a contamination area.

Total beta/gamma surface contamination levels throughout the Basement Level were also elevated. The results of the total surface contamination survey for the basement are summarized in Table 4.





**Figure 1. Basement Level: Historical Removable Contamination Survey Results**  
(Source: Jacobs EM Team, February 1998)

**Table 4**

Total Surface Contamination (dpm/100 cm <sup>2</sup> )	Survey Location(s) <sup>a</sup>	Low (dpm/100 cm <sup>2</sup> )	Average (dpm/100 cm <sup>2</sup> )	High (dpm/100 cm <sup>2</sup> )
< MDA	29,30, 31, 36, 37, 40, 41, 42, 43, 44, 48, 50, 51, 52, and 56	< MDA	< MDA	< MDA
MDA - 5,000	29A, 30A, 32, 34, 39, 46, 47, 54, and 55	924 (Loc. 32)	2,191	4,234 (Loc. 34)
5,001 – 50,000	33, 35, 38, 40B, 49, 50A, 50B, 53, 82, 84, 86, 87, and 88	5,255 (Loc. 87)	21,239	45,937 (Loc. 50B)
> 50,000	40A and 85	70,754 (Loc. 85)	191,630	312,506 (Loc. 40A)

<sup>a</sup>Contamination survey was not performed at planned locations 45 and 83. There was standing water over location 45, and since location 83 is a known removable contamination area, this location was skipped to reduce contaminated waste.

Due to the presence of elevated total surface contamination levels throughout the basement area, it is recommended that the Basement Level be designated as a controlled area and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4. All areas with fixed contamination should be marked as “CAUTION, FIXED CONTAMINATION.” Entry points to the Basement Level should be posted as “RWP REQUIRED FOR ALL OPERATIONS LIKELY TO RELEASE CONTAMINATION AFFIXED TO SURFACES.” Minimum entry/exit requirements for the Basement Level should include signing a log-in/log-out sheet (see Attachment 3), frisking station, and rubber over-shoes or booties. In addition, the following areas should be posted as contamination areas in accordance with Section 6.6 of SOP PBR-11.1.4:

- Room labeled on some drawings as “Area for Reactor LGV Station” (refer to survey locations 40A and 83), and
- Retention Tank Room due to 2002 annual and historical survey results.

**Contamination Survey QA/QC**

Instrument calibration records and daily response check records are provided in Attachment 2 to provide documentation pertaining to quality instrument performance. Duplicate field measurements were also made at a rate of 5% and are summarized in Table 5.

**Table 5**

Location	Result (dpm/100 cm <sup>2</sup> )		RPD (%)	Comments
	Initial	Duplicate		
13	<MDA	<MDA	0	Good
40B	409	358	13.3	Good
43	<MDA	<MDA	0	Good
51	<MDA	<MDA	0	Good
2	<MDA	<MDA	0	Good
7	<MDA	<MDA	0	Good
40A	312,506	293,090	6.4	Good
84	10,365	10,365	0	Good

RPD = [(Sample – Duplicate) / ((Sample + Duplicate) / 2)] × 100

All QA/QC checks performed within limits.

**LABORATORY DATA**

None.

**RECOMMENDATIONS**

The recommendations provided throughout this report are summarized below:

- It is recommended that the Entombment Top be designated as a controlled area due to the presence of elevated fixed surface beta/gamma contamination and exposure rate levels. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the entombment surface) work is performed on this level without review and approval by the RCM.
- It is recommended that the Main Level (controlled area) remain designated as a controlled area due to the presence of elevated fixed surface beta/gamma contamination and exposure rates and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4 (modify posting to avoid alarming visitors – current posting is acceptable). Minimum entry/exit requirements for this area should include signing a log-in/log-out sheet (see Attachment 3) and frisking feet, as well as other areas/equipment that contact area surfaces, upon exit from the area.
- Due to the presence of fixed contamination beneath the floor tiles, it is recommended that the Main Level (public access area) remain a controlled area. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the floor surface) work is performed on this level without review and approval by the RCM.
- Due to the presence of elevated total surface contamination levels throughout the basement area, it is recommended that the Basement Level be designated as a controlled area and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4. The entire Basement Level should be marked as “CAUTION, FIXED CONTAMINATION.” Entry points to the Basement Level should be posted as “RWP REQUIRED FOR ALL OPERATIONS LIKELY TO RELEASE CONTAMINATION AFFIXED TO SURFACES.” Minimum entry/exit requirements for the Basement Level should include signing a log-in/log-out sheet (see Attachment 3), frisking station, and rubber over-shoes or booties. Note that an RWP is not required for the general basement level for activities that are non-intrusive. In addition, the following areas should be posted as contamination areas in accordance with Section 6.6 of SOP PBR-11.1.4:
  - Room labeled on some drawings as “Area for Reactor LGV Station” (refer to survey locations 40A and 83), and
  - Retention Tank Room.

Figure 2 depicts the posting recommendations graphically.

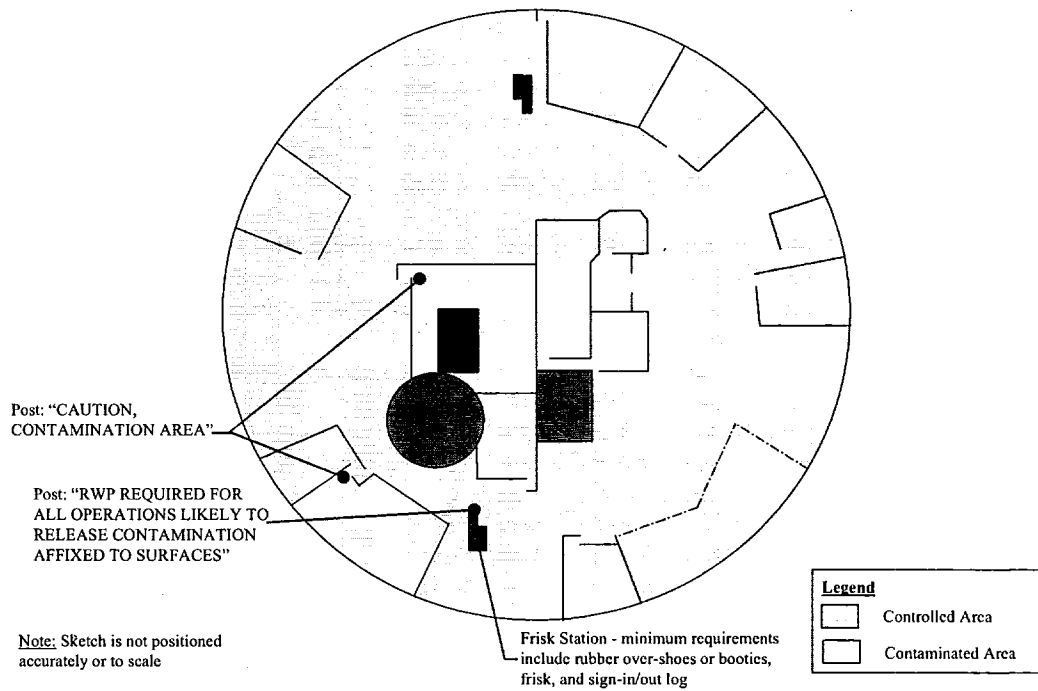


Figure 2. Basement Level: Recommended Posted Areas

**Attachment 1**  
**Contamination Survey Forms and Sketches**

TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BBAUCHAMP (former BONUS REACTOR FACILITY)  
Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS Date/Time 6/2/02 Task Number NA  
 Specific Area of Survey: Entombed Building- Elevation 68 ft. MDA= $((2.71/Tbkg + 3.3\sqrt{(Bkg/Tbkg+Bkg/Ts)})/E) \times CF$   
 Purpose of Survey: Year 2002 Annual Survey A= $(Sample-Bkg)/E \times CF$

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA'
Ludlum 2221	<del>154535</del> 149917	615103	44-9	154535	615103	13.7%	512	3335	Dpm/100cm <sup>2</sup> 749
		1 1			1 1	%	1		

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No							
No.	Description/Location	Gross Counts In CPM				Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	α Removable	α Total	By Removable	By Total	α Removable	α Total
5	Top Plug Face #1	smears	50	NA	NA	NA	<MDA	NA	NA
6	Top Plug Face #1	will be	47				<MDA		
7	Top Plug Face #1	counted	53/8				<MDA		
8	Top Plug Face #2	cooler	50				<MDA		
9	Top Plug Face #2	in	65				1460		
10	Top Plug Face #2	another	56				1022		
11	Top Plug Face #3	location	66				1508		
12	Top Plug Face #3		59				1168		
13	Top Plug Face #3		44				<MDA		
14	Top Plug Face #4		50				<MDA		
15	Top Plug Face #4		43				<MDA		
16	Top Plug Face #4		41				<MDA		
17	Top Plug Top Surface		38				<MDA		
18	Top Plug Top Surface		34				<MDA		
19	Top Plug Top Surface		45				<MDA		

Survey Technician: Allan Lucca  
 Reviewed By: C. Lucca

7 Dup Top Plug Face #1 MDA is removable/total in dpm/100 cm<sup>2</sup> <MDA

$$749 = \frac{512 - 35}{.137} \times 6.67$$

MDA ≈ 50 cpm

$$A = \frac{Sample - Bkg}{E} \times \frac{100}{15}$$

@ 749 =

**ATTACHMENT III  
RADIOLOGICAL SURVEY REPORT (MAP)**

**TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)  
Rincón, Puerto Rico**

**RADIOLOGICAL SURVEY REPORT (MAP)**

SITE: Entombed Reactor Building Time: 14:10 Date: Yr 02 Mo 6 Dy 12

Task: Annual Survey RWP: NA

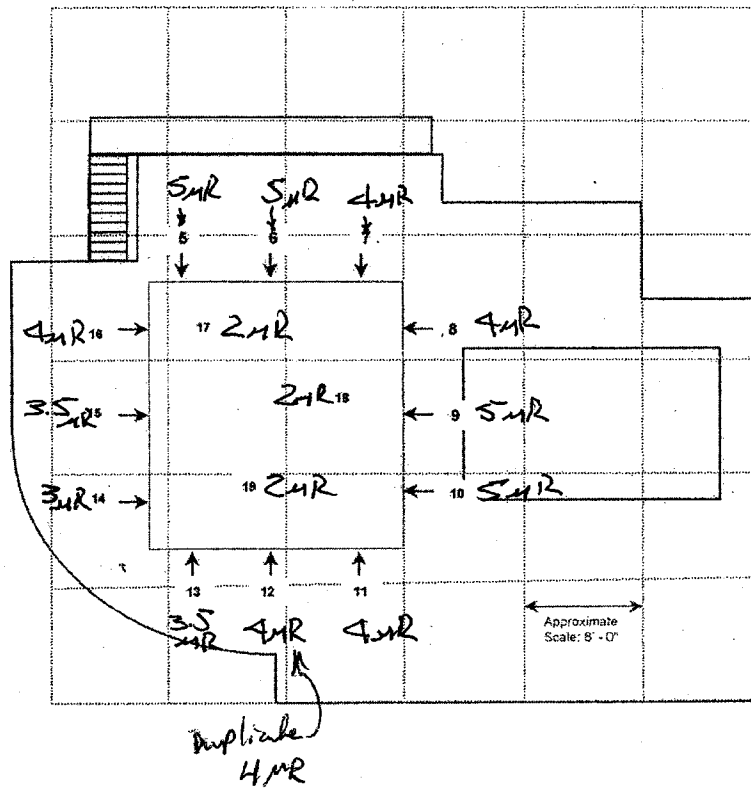
Map key: ° = Sample Location □ = Air Sampler Location \_ = Core Sample

Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: Elevation 68 ft.

Sketch:

1 = Sample Locations



Entombment System - Plan at Elevation 68'-0"

Instruments (Model and Serial Numbers): 19 - 148190

Survey Technician(s): Jimmy Reyes CW 6/12/02





## ATTACHMENT III RADIOLOGICAL SURVEY REPORT (MAP)

TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)  
Rincón, Puerto Rico

### RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building Time: 0945 Date: Yr 02 Mo 6 Dy 14

Task: Annual Survey RWP: NA

Map key: ° = Sample Location □ = Air Sampler Location \_ = Core Sample

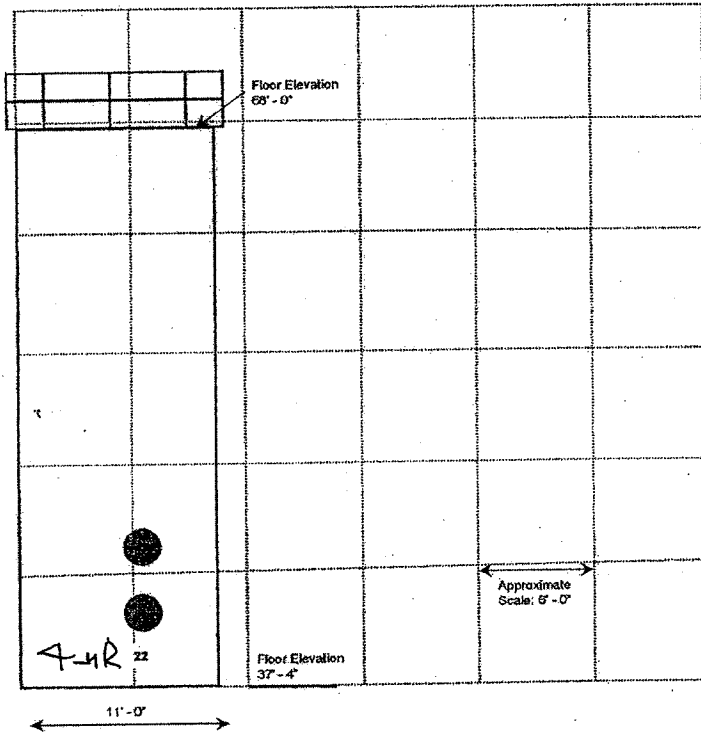
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: South Side

Sketch:

Entombment System - South View

° = Sample Locations



Instruments (Model and Serial Numbers): 19-148190

Survey Technician(s): Stanny Reyes



**ATTACHMENT III  
RADIOLOGICAL SURVEY REPORT (MAP)**

**TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)  
Rincón, Puerto Rico**

**RADIOLOGICAL SURVEY REPORT (MAP)**

SITE: Entombed Reactor Building

Time: 0950

Date: Yr 02 Mo 6 Dy 14

Task: Annual Survey

RWP: NA

Map key: ° = Sample Location   □ = Air Sampler Location   \_ = Core Sample

Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

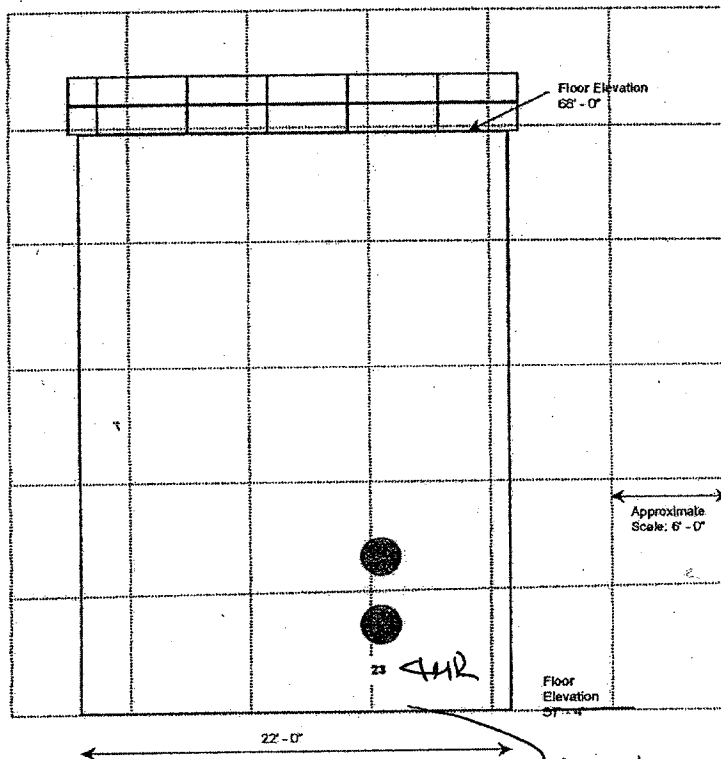
Building: Entombed Reactor Building

Location: SouthWest Side

Sketch:

**Entombment System - Southwest View**

• = Sample Locations



Instruments (Model and Serial Numbers): 1948/90

*Duplicate  
3 uR/hr*

Survey Technician(s): Jimmy Reyes



**ATTACHMENT III  
RADIOLOGICAL SURVEY REPORT (MAP)**

<b>TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY) Rincón, Puerto Rico</b>		
<b>RADIOLOGICAL SURVEY REPORT (MAP)</b>		
SITE: <u>Entombed Reactor Building</u>	Time: <u>1005</u>	Date: Yr <u>02</u> Mo <u>6</u> Dy <u>14</u>
Task: <u>Annual Survey</u>		RWP: <u>NA</u>
Map key: ° = Sample Location   □ = Air Sampler Location   _ = Core Sample Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area Building: <u>Entombed Reactor Building</u> Location: <u>NorthWest Side</u> Sketch: <u>Entombment System - Northwest View</u>		
] = Sample Locations		
Instruments (Model and Serial Numbers): <u>19-148190</u>		
Survey Technician(s): <u>Jimmy Reyes</u>		

TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)  
 Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: Bonus Date/Time 6/12/02 Task Number NA  
1500  
 Specific Area of Survey: Entombed Building-North Side  $MDA = ((2.71/Tbkg + 3.3\sqrt{(Bkg/Tbkg + Bkg/Ts)})/E) \times CF$   
 Purpose of Survey: Year 2002 Annual Survey  $A = (Sample - Bkg)/E \times CF$

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA <sup>a</sup> MDA/100cm <sup>2</sup>
Ludlum 2221	149991	615103	44-9	154535	615103	13.7%	1012	35	749
		1 1			1 1	%	1		

SURVEY DATA									
Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No									
No.	Description/Location	Gross Counts in CPM				Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	$\alpha$ Removable	$\alpha$ Total	By Removable	By Total	$\alpha$ Removable	$\alpha$ Total
1	North Side	Scissors	47	NA	NA	NA	EMDA	NA	NA
2	North Side	Will be	42				EMDA		
3	North Side	counted	26				EMDA		
4	North Side	in another	33				EMDA		
24	North Side	location	19				EMDA		
26	North Side		20				EMDA		
2 D&D	North Side		40				EMDA		
Survey Technician: <u>Allan Lucca</u>									
Reviewed By: <u>C. Webb</u>									

MDA is removable/total in dpm/100 cm<sup>2</sup>

## ATTACHMENT III RADIOLOGICAL SURVEY REPORT (MAP)

TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)  
Rincón, Puerto Rico

### RADIOLOGICAL SURVEY REPORT (MAP)

SITE: <u>Entombed Reactor Building</u>	Time: <u>14:22</u>	Date: Yr. <u>02</u> Mo. <u>6</u> Dy. <u>12</u>
Task: <u>Annual Survey</u>	RWP: <u>NA</u>	

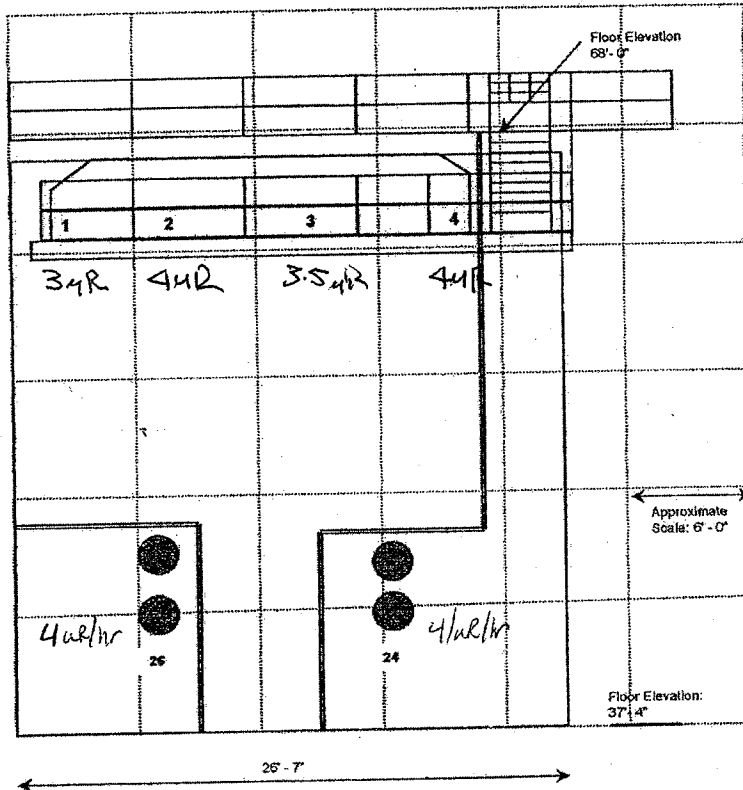
Map key: ° = Sample Location   □ = Air Sampler Location   \_\_ = Core Sample

Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building      Location: North Side

Sketch: **Entombment System - North View**

• = Sample Locations



Instruments (Model and Serial Numbers): 19-198190

Survey Technician(s): JIMMY ROYES





**ATTACHMENT III  
RADIOLOGICAL SURVEY REPORT (MAP)**

**TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)**  
Rincón, Puerto Rico

**RADIOLOGICAL SURVEY REPORT (MAP)**

SITE: Entombed Reactor Building Time: 1600 Date: Yr 02 Mo 6 Dy 12

Task: Annual Survey RWP: NA

Map key: ° = Sample Location □ = Air Sampler Location \_ = Core Sample  
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area  
Building: Entombed Reactor Building Location: Main Floor

Sketch:

No.	µR/hr
Zone 1= 65	_____
Zone 2= 66	_____
Zone 3= 67	_____
Zone 4= 68	_____
Zone 5= 69	_____
Zone 6= 72	_____
Zone 7= 73	_____
Zone 8= 74	_____
Zone 9= 75	_____
Zone 10= 76	_____
Zone 11= 77	_____
Zone 12= 78	_____
Zone 13= 80	_____
Zone 14= 79	_____
Zone __=	_____
Zone __=	_____

NS=not swiped

RAS-Air Sample

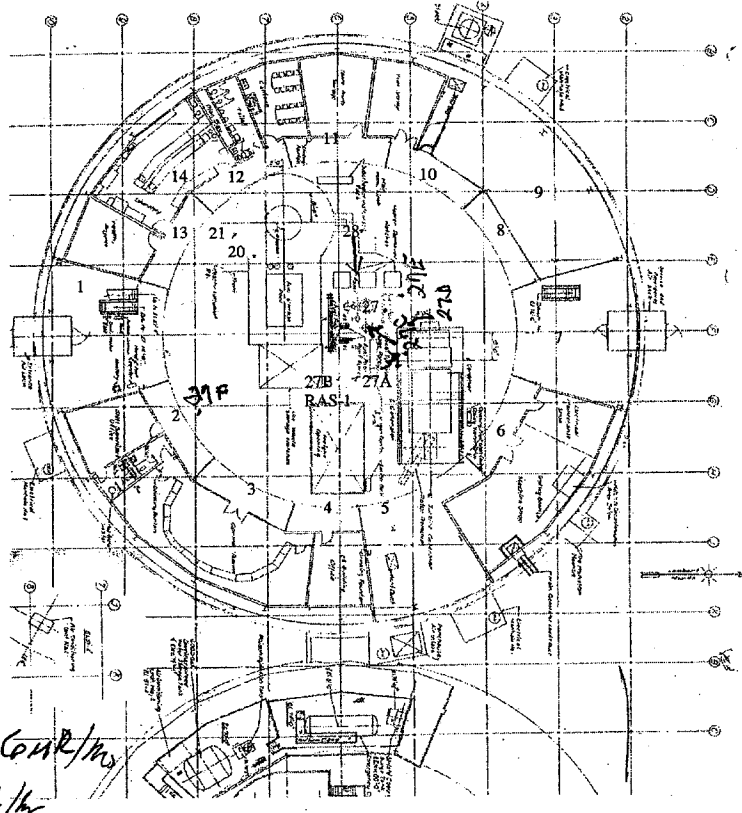
- #27D = 10 µR/hr
- #27B = 5 µR/hr
- #20 = 4 µR/hr
- #21 = 4 µR/hr
- #27 = 21 µR/hr
- #27A = ~~10~~ 6 µR/hr
- #27C = 16 µR/hr

UNDER PP  
2-2 →

Instruments (Model and Serial Numbers): 19-148190

#28 = 27 µR

Survey Technician(s): JIMMY REYES



PBR-36  
27F = 11 µR/hr

TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BOMB Date/Time 6/13/02 Task Number NA  
0930

Specific Area of Survey: Entombed Building-Main Floor MDA= $((2.71/Tbkg + 3.3\sqrt{(Bkg/Tbkg+Bkg/Ts)})/E) \times CF$

Purpose of Survey: Year 2002 Annual Survey A=(Sample-Bkg)/E x CF

Inst. Type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading CPM	MDA
Ludlum 2221	149971	6/5/03	44-9	154535	6/5/03	13.7%	1011	4060	NA MB
		1/1			1/1	%	1	ω 6/13/02	

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM				Contamination in dpm/100 cm <sup>2</sup>			
		β <sub>r</sub> Removable	β <sub>t</sub> Total	α Removable	α Total	β <sub>r</sub> Removable	β <sub>t</sub> Total	α Removable	α Total
65	Main Floor-Maslim	<40cpm				<MDA			
66	Main Floor-Maslim	<40cpm				<MDA			
67	Main Floor-Maslim	<40cpm				<MDA			
68	Main Floor-Maslim	<40cpm				<MDA			
69	Main Floor-Maslim	<40cpm				<MDA			
72	Main Floor-Maslim	<40cpm				<MDA			
73	Main Floor-Maslim	<40cpm				<MDA			
74	Main Floor-Maslim	<40cpm				<MDA			
75	Main Floor-Maslim	<40cpm				<MDA			
76	Main Floor-Maslim	<40cpm				<MDA			
77	Main Floor-Maslim	<40cpm				<MDA			
78	Main Floor-Maslim	<40cpm				<MDA			
79	Main Floor-Maslim	<40cpm				<MDA			
80	Main Floor-Maslim	<40cpm				<MDA			

Survey Technician: Corbett, Valerie  
 Reviewed By: C. Webb

\*MDA is removable/total in dpm/100 cm<sup>2</sup>



TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)  
 Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS Date/Time 6/13/02 0925 Task Number NA  
 Specific Area of Survey: Entombed Building-Basement Floor MDA= $((2.71/Tbkg + 3.3\sqrt{(Bkg/Tbkg+Bkg/Ts)})/E) \times CF$   
 Purpose of Survey: Year 2002 Annual Survey A= $(Sample-Bkg)/E \times CF$

Inst. Type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA' <i>cpm/100cm<sup>2</sup></i>
Ludlum 2221	14999/	615103	44-9	154535	615103	13.7%	1012	48	875
		1 1			1 1	%	1		

**SURVEY DATA** Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM				Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	a Removable	a Total	By Removable	By Total	a Removable	a Total
29	Basement Floor	counted	46	NA	NA	NA	<MDA	NA	NA
<del>29A</del>	<del>Basement Floor</del>	<del>later</del>	<del>67</del>				924		
32	Basement Floor		204				7591		
33	Basement Floor		135				4234		
34	Basement Floor		592				26472		
35	Basement Floor		56				<MDA		
36	Basement Floor		56				<MDA		
37	Basement Floor		64				<MDA		
30	Basement Floor-Between Tk. 1-2		92				2141		
30A	Basement Floor-Near wall		65				<MDA		
31	Basement Floor-Between Tk. 2-3		255				10073		
38	Basement Floor-Between pedestals		86				1849		
39	Basement Floor		61				<MDA		
40	Basement Floor		51				<MDA		
40A-D	Basement Floor-Wall (4" from floor)		6470				312506		
40A-D2	Basement Floor-Wall (4" from floor)		6071				29392		
40B	Basement Floor		72				36204		
<del>30A</del>	<del>Basement Floor - against wall</del>		<del>42</del>				<del>2157</del>		

Survey Technician: Allan Lucca  
 Reviewed By: Chad Webb

9  
 29A  
 31  
 30

29A Basement Floor MDA is removable/total in dpm/100 cm<sup>2</sup> 8981 1752  
 31 65 <MDA  
 30 64 <MDA  
 Page 1 of 1 PBR-35 Rev. 1 (6/02)

$$875 = \frac{MDA_{cpm} - Bk(48)}{.137} \times 6.67$$

$$MDA (cpm) = 66 \text{ cpm or Higher}$$

TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)  
 Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: Bonus Date/Time 6/13/02 0930 Task Number NA  
 Specific Area of Survey: Entombed Building-Basement Floor MDA= $((2.71/Tbkg + 3.3\sqrt{(Bkg/Tbkg+Bkg/Ts)})/E) \times CF$   
 Purpose of Survey: Year 2002 Annual Survey A=(Sample-Bkg)/E x CF

Inst. Type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA*
Ludlum 2221	149991	6 1 5 103	44-9	154535	6 1 5 103	13.7 %	10 12	48	875
		1 1			1 1	%	1		

**SURVEY DATA** Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM				Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	α Removable	α Total	By Removable	By Total	α Removable	α Total
42	Basement Floor	Counted	42	NA	NA	NA	MDA	NA	NA
43	Basement Floor	Water	48				MDA		
44	Basement Floor	1	47				MDA		
45	Basement Floor		Under water						
46	Basement Floor		64				MDA		
47	Basement Floor		115				3260		
48	Basement Floor		61				MDA		
49	Basement Floor		139				7056		
50	Basement Floor		39				MDA		
50A	Basement Floor-Wall (block)		901				41508		
50B	Basement Floor-Wall (concrete)		992				45837		
51	Basement Floor		49				MDA		
52	Basement Floor		44				MDA		
56	Basement Floor		38				MDA		
55	Basement Floor		68				973		
53	Basement Floor		544				24136		
54	Basement Floor		117				3358		

Survey Technician: Allen Lucca  
 Reviewed By: C. Webb

\*MDA is removable/total in dpm/100 cm<sup>2</sup>



TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)  
 Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS Date/Time 6/13/02 0950 Task Number \_\_\_\_\_  
 Specific Area of Survey: Entombed Building-Basement Floor  $MDA = ((2.71/Tbkg + 3.3\sqrt{(Bkg/Tbkg+Bkg/Ts)})/E \times CF$   
 Purpose of Survey: Year 2002 Annual Survey  $A = (Sample-Bkg)/E \times CF$

Inst. Type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA <i>dpm/100cm<sup>2</sup></i>
Ludlum 2221	149991	615 103	44-9	154535	615 103	13.7%	1012	48	875
		1 1			1 1	%	1		

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM				Contamination in dpm/100 cm <sup>2</sup>			
		βγ Removable	βγ Total	α Removable	α Total	βγ Removable	βγ Total	α Removable	α Total
82	Basement Floor	NA	488	NA	NA	NA	21411	NA	NA
83	Near 40A	count later	SKIP				SKIP		
84	Decontamination Room-Sink Pipe	~500cpm	261				10365		
84D	Decontamination Room-Sink Pipe		261				10365		
85	Sink-Loose debris		1502				70254		
86	Sump Pump 1		642				28908		
87	Inlet Air Plenum Room Drain		156				5255		
88	Inlet Air Plenum Room Floor		278	278			8759	1192	
	<del>Example Theater</del>		42				4141		


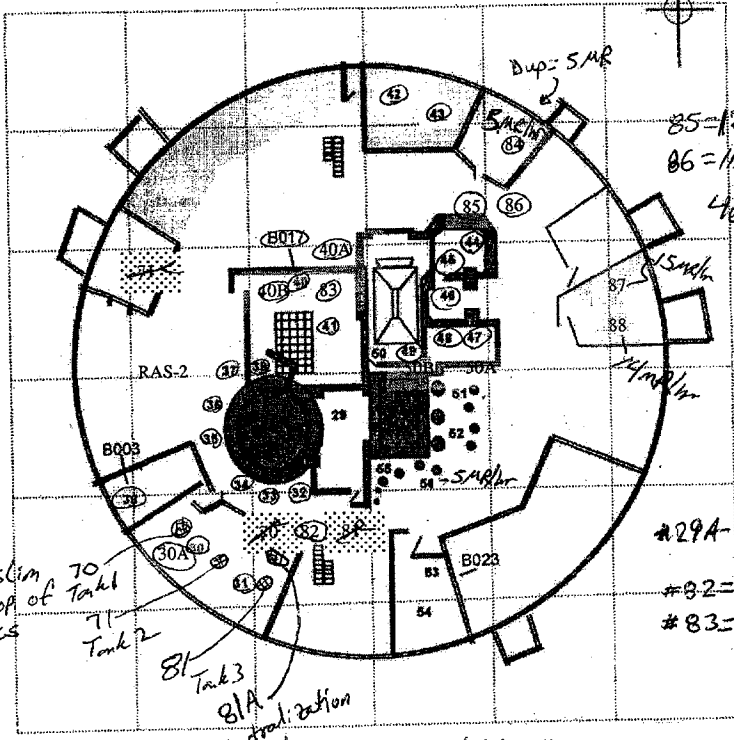
CW  
6/19/02

Survey Technician: A. Lucea  
 Reviewed By: C. Webb





## ATTACHMENT III RADIOLOGICAL SURVEY REPORT (MAP)

<b>TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)</b> Rincón, Puerto Rico																																									
<b>RADIOLOGICAL SURVEY REPORT (MAP)</b>																																									
SITE: <u>Entombed Reactor Building</u>	Time: <u>0720</u>	Date: Yr <u>02</u> Mo <u>6</u> Dy <u>13</u>																																							
Task: <u>Annual Survey</u>	RWP: <u>NA</u>																																								
Map key: ○ = Sample Location   □ = Air Sampler Location   _ = Core Sample Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area Building: <u>Entombed Reactor Building</u> Location: <u>Basement Floor</u>																																									
Sketch:																																									
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: right;">No.</td> <td style="width: 10%; text-align: right;">μR/hr</td> <td style="width: 80%;"></td> </tr> <tr> <td>Zone 1=</td> <td>71</td> <td>_____</td> </tr> <tr> <td>Zone 2=</td> <td>80</td> <td>_____</td> </tr> <tr> <td>Zone 3=</td> <td>81</td> <td>_____</td> </tr> <tr> <td>Zone _=</td> <td></td> <td>_____</td> </tr> <tr> <td>Zone _=</td> <td></td> <td>_____</td> </tr> <tr> <td>Zone _=</td> <td></td> <td>_____</td> </tr> <tr> <td>Zone _=</td> <td></td> <td>_____</td> </tr> <tr> <td>Zone _=</td> <td></td> <td>_____</td> </tr> <tr> <td colspan="3">NS=not swiped</td> </tr> </table>	No.	μR/hr		Zone 1=	71	_____	Zone 2=	80	_____	Zone 3=	81	_____	Zone _=		_____	Zone _=		_____	Zone _=		_____	Zone _=		_____	Zone _=		_____	NS=not swiped			<table style="width: 100%; border-collapse: collapse;"> <tr> <td>○ = Sample Locations</td> </tr> <tr> <td>□ = New Locations</td> </tr> </table>	○ = Sample Locations	□ = New Locations	<div style="text-align: center;">  </div>							
No.	μR/hr																																								
Zone 1=	71	_____																																							
Zone 2=	80	_____																																							
Zone 3=	81	_____																																							
Zone _=		_____																																							
Zone _=		_____																																							
Zone _=		_____																																							
Zone _=		_____																																							
Zone _=		_____																																							
NS=not swiped																																									
○ = Sample Locations																																									
□ = New Locations																																									
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 100px;">RAS-Air Sample</td> <td style="width: 100px;">#29A-8MR</td> </tr> <tr> <td></td> <td>#82=14MR</td> </tr> <tr> <td></td> <td>#83=27MR</td> </tr> </table>	RAS-Air Sample	#29A-8MR		#82=14MR		#83=27MR																																			
RAS-Air Sample	#29A-8MR																																								
	#82=14MR																																								
	#83=27MR																																								
Instruments (Model and Serial Numbers): <u>19-148190</u>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td>#29-7MR</td> <td>#29A-7MR</td> <td>#50-9MR</td> </tr> <tr> <td>#30-17MR</td> <td>#40A-29MR</td> <td>#51-12MR</td> </tr> <tr> <td>#30A-40AR</td> <td>#40AD-27MR</td> <td>#52-7MR</td> </tr> <tr> <td>#31-19MR</td> <td>#40B-28MR</td> <td>#53-14MR</td> </tr> <tr> <td>#32-9MR</td> <td>#41-10MR</td> <td>#54-14MR</td> </tr> <tr> <td>#33-11MR</td> <td>#42-SMR</td> <td>#55-6MR</td> </tr> <tr> <td>#34-10MR</td> <td>#43-6MR</td> <td></td> </tr> <tr> <td>#35-15MR</td> <td>#44-9MR</td> <td></td> </tr> <tr> <td>#36-SMR</td> <td>#45-9MR (water)</td> <td></td> </tr> <tr> <td>#37-5MR</td> <td>#47-15MR</td> <td></td> </tr> <tr> <td>#38-15MR</td> <td>#48-8MR</td> <td></td> </tr> <tr> <td>#39-8MR</td> <td>#49-10MR</td> <td></td> </tr> <tr> <td>#40-9MR</td> <td></td> <td></td> </tr> </table>		#29-7MR	#29A-7MR	#50-9MR	#30-17MR	#40A-29MR	#51-12MR	#30A-40AR	#40AD-27MR	#52-7MR	#31-19MR	#40B-28MR	#53-14MR	#32-9MR	#41-10MR	#54-14MR	#33-11MR	#42-SMR	#55-6MR	#34-10MR	#43-6MR		#35-15MR	#44-9MR		#36-SMR	#45-9MR (water)		#37-5MR	#47-15MR		#38-15MR	#48-8MR		#39-8MR	#49-10MR		#40-9MR		
#29-7MR	#29A-7MR	#50-9MR																																							
#30-17MR	#40A-29MR	#51-12MR																																							
#30A-40AR	#40AD-27MR	#52-7MR																																							
#31-19MR	#40B-28MR	#53-14MR																																							
#32-9MR	#41-10MR	#54-14MR																																							
#33-11MR	#42-SMR	#55-6MR																																							
#34-10MR	#43-6MR																																								
#35-15MR	#44-9MR																																								
#36-SMR	#45-9MR (water)																																								
#37-5MR	#47-15MR																																								
#38-15MR	#48-8MR																																								
#39-8MR	#49-10MR																																								
#40-9MR																																									
Survey Technician(s): <u>Jimmy Reyes</u>	#29A-8MR #82=14MR #83=27MR																																								

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: BONUS Time: 7:30 Date: Yr 02 Mo 6 Dy 20

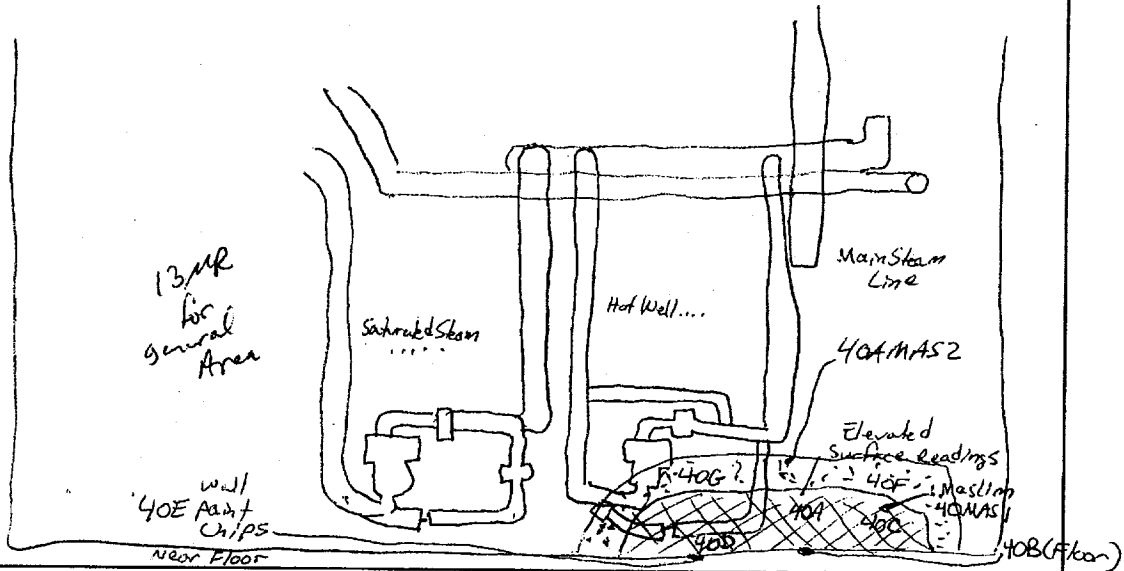
Task: Year 2002 Annual Survey RWP: 02-06-18-01

Map key: ○ = Sample Location □ = Air Sampler Location △ = Core Sample

Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: BONUS Location: Reactor LGV Station

Sketch:



Instruments (Model and Serial Numbers): 19-148190

Survey Technician(s): Carlos Lopez Reviewer: C. Webb

\* 40A-40G  
Smears  
Collected  
following  
Maslim

Maslim Areas:  
☒ 40A MAS1  
☐ 40A MAS2  
Performed before  
smears

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/13/02 Task Number NA  
1600 hrs

Specific Area of Survey: Smears

Purpose of Survey: Year 2002 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Depth/Scal/ Ct. time	Bkgd	MDA*
Wdham 2221	149991	615103	44-9	154535	615163	13.7%	5mm/1min	35	160+
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
8	Smear	20	NA	LMDA	NA
7	"	27		LMDA	
6	"	31		LMDA	
5	"	27		LMDA	
4	"	33		LMDA	
3	"	26		LMDA	
2	"	28		LMDA	
1	"	25		LMDA	
54	"	20		LMDA	
55	"	24		LMDA	
56	"	35		LMDA	
88	"	35		LMDA	

Survey Technician: Carlos V.  
Reviewed By: C. Webb

\*MDA is removable/total in dpm/100 cm<sup>2</sup>

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/13/02 Task Number NA  
 Specific Area of Survey: Smears 1535 hrs  
 Purpose of Survey: Year 2002 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Bkg. Count/Cl. time	Bkgd	MDA
Model 2221	149991	615103	44-9	154535	615103	13.7%	5m/1hr	35	160
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
19	Smear	33	NA	<MDA	NA
18	"	25		<MDA	
17	"	25		<MDA	
16	"	29		<MDA	
15	"	29		<MDA	
14	"	36		<MDA	
13	"	30		<MDA	
13 Dup	"	40		<MDA	
12	"	29		<MDA	
11	"	31		<MDA	
10	"	36		<MDA	
9	"	22		<MDA	

Survey Technician: Carlos V.  
 Reviewed By: C. Webb

MDA is removable total in dpm/100 cm<sup>2</sup>

Check source  
at 9658 cpm

$$MDA = \frac{2.71}{E} + 3.3 \sqrt{\frac{Bkg}{T_B} + \frac{Bkg}{T_S}}$$

$$A = \frac{Sample - Bkg}{E}$$

= 160 <sub>counts</sub> dpm/100cm<sup>2</sup>

or → MDA cpm ≈ 57 or higher

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/14/02 Task Number NA

Specific Area of Survey: Smears

Purpose of Survey: Year 2002 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Bkgd / Sample Ct. time	Bkgd	MDA
Kudlm 2221	149991	615 103	44-9	154535	615 103	13.7%	Smear/1m, 3	31	151 + e
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
20	Smears	37	NA	< MDA	NA
21	Smears	28		< MDA	
22	Smears	32		< MDA	
23	Smears	33		< MDA	
24	Smears	29		< MDA	
25	Smears	28		< MDA	
26	Smears	33		< MDA	
27	Smears	37		< MDA	
27A	Smears	26		< MDA	
27B	Smears	26		< MDA	
28	Smears	38		< MDA	

Survey Technician: \_\_\_\_\_  
Reviewed By: \_\_\_\_\_

MDA is removable/total in dpm/100 cm<sup>2</sup>

$$MDA = \frac{2.71}{T_B} + 3.3 \sqrt{\frac{B_{ck}}{T_B} + \frac{B_{ck}}{T_S}}$$

E

$$A = \frac{S_{avg} - B_{ck}}{E}$$

$$MDA (cpm) = \frac{52}{T} \text{ or higher}$$

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/15/02 Task Number NA  
 Specific Area of Survey: Smears  
 Purpose of Survey: Year 2002 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Bkgd	MDA
Ludlum 2221	149991	61 5 103	44-9	154535	61 5 103	13.7%	35	160 + a
		1 1			1 1	%		1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
82	Smear	35	NA	<MDA	NA
84	"	23		<MDA	
33	"	33		<MDA	
41	"	38		<MDA	
* 40B	"	91		409	
* 40B2nd	"	84		358	
* 40A	"	191		1139	
40	"	31		<MDA	
39	"	39		<MDA	
38	"	47		<MDA	
36A	"	26		<MDA	
30	"	36		<MDA	

Survey Technician: Carlos V.  
 Reviewed By: C. Webb

MDA is removable/total in dpm/100 cm<sup>2</sup>

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS Date/Time 6/13/02 Task Number NA

Specific Area of Survey: Smears 1715

Purpose of Survey: Year 2002 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	ack 15mp Ct. time	Bkgd	MDA
Widom 2221	149991	61 S 103	44-9	154535	61 S 103	13.7 %	Smn/1mm	35	160 +e
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
51	Smear	29	NA	<MDA	NA
51 Dup	"	26	}	<MDA	}
29A	Paint Chips on smear	32		<MDA	
34	Paint Chips	30		<MDA	

Survey Technician: Carlos V.  
Reviewed By: C. Webb

MDA is removable ~~total~~ in dpm/100 cm<sup>2</sup>

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/3/02 Task Number NA

Specific Area of Survey: Smears 1630 hrs

Purpose of Survey: Year 2002 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Sc. Cl. time	Bkgd	MDA
<u> Ludlum 2221</u>	<u>149991</u>	<u>615 103</u>	<u>44-9</u>	<u>154535</u>	<u>615 103</u>	<u>13.7 %</u>	<u>5 min / 1 hr</u>	<u>35</u>	<u>160 + 2</u>
		<u>1 1</u>			<u>1 1</u>	<u>%</u>			<u>1</u>

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
<u>53</u>	<u>Smear</u>	<u>69</u>	<u>NA</u>	<u>248</u>	<u>NA</u>
<u>52</u>	<u>"</u>	<u>30</u>		<u>LMDA</u>	
<u>87</u>	<u>"</u>	<u>25</u>		<u>LMDA</u>	
<u>31</u>	<u>"</u>	<u>33</u>		<u>LMDA</u>	
<u>44</u>	<u>"</u>	<u>31</u>		<u>LMDA</u>	
<u>86</u>	<u>"</u>	<u>35</u>		<u>LMDA</u>	
<u>42</u>	<u>"</u>	<u>31</u>		<u>LMDA</u>	
<u>35</u>	<u>"</u>	<u>39</u>		<u>LMDA</u>	
<u>34</u>	<u>"</u>	<u>51</u>		<u>LMDA</u>	
<u>43</u>	<u>"</u>	<u>40</u>		<u>LMDA</u>	
<u>43 Dup</u>	<u>"</u>	<u>35</u>		<u>LMDA</u>	
<u>36</u>	<u>"</u>	<u>21</u>		<u>LMDA</u>	

Survey Technician: Carlos V.  
Reviewed By: C. Webb

MDA is removable/total in dpm/100 cm<sup>2</sup>



BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/13/02 Task Number NA  
 Specific Area of Survey: Smears  
 Purpose of Survey: Year 2002 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	149991	615103	44-9	154535	615103	13.7%	Small/lum	35	160 $\mu$ e
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
85	smear	57	NA	161	NA
32	"	24		<MDA	
37	"	24		<MDA	
29	"	27		<MDA	
29A	"	30		<MDA	
46	"	37		<MDA	
47	"	37		<MDA	
50	"	21		<MDA	
48	"	31		<MDA	
49	"	29		<MDA	
50A	"	32		<MDA	
50B	"	36		<MDA	

Survey Technician: Carls V.  
 Reviewed By: C. Webb

MDA is removable total in dpm/100 cm<sup>2</sup>





**Attachment 2  
Instrument Calibration  
and Response Check Forms**



Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**  
POST OFFICE BOX 810 PH. 915-235-5494  
501 OAK STREET FAX NO. 915-235-4672  
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER PUERTO RICO ELECTRIC POWER ORDER NO. 280769/264221

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 149991

Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR154535

Cal. Date 5-Jun-02 Cal Due Date 5-Jun-03 Cal. Interval 1 Year Meterface 202-159

check mark  applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 39 % Alt 696.8 mm Hg

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

Mechanical ck.  Meter Zeroed  Background Subtract  Input Sens. Linearity

F/S Resp. ck.  Reset ck.  Window Operation  Geotropism

Audio ck.  Alarm Setting ck.  Batt. ck. (Min. Volt) 5.0 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 900 V Input Sens. 50 mV Det. Oper. 900 V at 50 mV Threshold 100 = 10 mV  
Dial Ratio

HV Readout (2 points) Ref./Inst. 502 / 500 V Ref./Inst. 2000 / 2000 V

**COMMENTS:**  
*9 cw 6/13/02 per telecon w/ Ludlum*  
rY-90 source s/n:0465 reads 2016cpm @ 1/4" from the probe surface.  
Cs-137 (gamma) efficiency is 11.6% (4 pi) source size:28,627 dpm source count:3,482 cpm background:163cpm s/n:0886  
rY-90 efficiency is 31.0% (4 pi) source size:45,946 dpm source count:14,453 cpm background:163cpm s/n:4016  
Bi-214 efficiency is .06% (4 pi) source size:298,539 dpm source count:358 cpm background:163cpm s/n:4017  
Cs-137 (gamma) efficiency is 0.11% (4 pi) source size:2,359,041 source count:2,664cpm background:163 cpm s/n:0155  
Cs-137 (beta) efficiency is 17.25% (4 pi) source size:7,697 source count:1,491cpm background:163 cpm s/n:158-112  
All efficiencies taken at 1/4" from protective screen of 44-9 *All efficiencies 1/4" from Probe*  
Firmware Version: 2.6.10.10  
Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 1000	400 Kcpm		400
X 1000	100 Kcpm		100
X 100	40 Kcpm		400
X 100	10 Kcpm		100
X 10	4 Kcpm		400
X 10	1 Kcpm		100
X 1	400 cpm		400
X 1	100 cpm		100

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

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400 K cpm		39897(0)	500 K cpm		450 K
40 K cpm		3992(0)	50 K cpm		50 K
4 K cpm	N/A	399(0)	5 K cpm	N/A	5 K
400 cpm		40(0)	500 cpm		500
40 cpm		4(0)	50 cpm		50

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. A calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:  
Cs-137 Gamma S/N  1162  G112  M565  5105  T1008  T879  E552  E551  Neutron Am-241 Be S/N T-304

Alpha S/N  Beta S/N  Other

m 500 S/N 81094  Oscilloscope S/N  Multimeter S/N 80040300

Calibrated By: Michael J Thomas Date 5-June-02

Reviewed By: Rhonda Harris Date 5-Jun-02

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc. FORM CZA 10/31/2001

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



Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

**LUDLUM MEASUREMENTS, INC.**  
POST OFFICE BOX 810 PH. 915-235-5494  
501 OAK STREET FAX NO. 915-235-4672  
SWEETWATER, TEXAS 79556, U.S.A.

CONVERSION CHART

Customer PUERTO RICO ELECTRIC POWER Date 5-Jun-02 Order #. 280769/264221

Model 2221 Serial No. 149991 Detector Model 44-9 Serial No. 154535

Source Cs-137 194.6 mCi Cs-137 20 mCi High Voltage 900 V  
Input Sensitivity 50 mV

Reference Point	"As Found" Readings (CPM):		After Adjustment Readings (CPM):	
	Analog	Range/Scale	Analog	Range/Scale
150 mR/hr			310	X1K
50		N/A	<del>3100</del>	
15			140	X1K
5			40	X1K
1.5			160	X100
1			50	X100
			30	X100

Reference Point	"As Found" Readings:		After Adjustment Readings:	
	Digital	Count Time	Digital	Count Time
150 mR/hr			31072	6 sec
50		N/A	14125	
15			4717	
5			1621	
1.5			502	
1			323	

Signature: Michael J Thomas Date 5-June-02



Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**  
POST OFFICE BOX 810 PH. 915-235-5494  
501 OAK STREET FAX NO. 915-235-4672  
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER PUERTO RICO ELECTRIC POWER ORDER NO. 280796/264221

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 148190

Mfg. \_\_\_\_\_ Model \_\_\_\_\_ Serial No. \_\_\_\_\_

Cal. Date 4-Jun-02 Cal Due Date 4-Jun-03 Cal. Interval 1 Year Meterface 202-016

check mark  applies to applicable Instr. and/or detector IAW mfg. spec. T. 73 °F RH 39 % Alt 696.8 mm Hg

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

Mechanical ck.  Meter Zeroed  Background Subtract  Input Sens. Linearity

F/S Resp. ck  Reset ck.  Window Operation  Geotropism

Audio ck.  Alarm Setting ck.  Batt. ck. (Min. Volt) 2.2 VDC

Calibrated in accordance with LMI SOP 14.8 rev 12/05/89.  Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 850 V Input Sens. 34 mV Det. Oper. \_\_\_\_\_ V at \_\_\_\_\_ mV Threshold \_\_\_\_\_ mV  
Dial Ratio \_\_\_\_\_ = \_\_\_\_\_

HV Readout (2 points) Ref./Inst. \_\_\_\_\_ / \_\_\_\_\_ V Ref./Inst. \_\_\_\_\_ / \_\_\_\_\_ V

COMMENTS: Cs-137 check source S/n: 2008 ≈ luCi reads ≈ 280<sup>mTR</sup> μR/hr when placed label down & centered on front dimple of m-19 can

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 μR/hr	3500	4000
5000	1000 μR/hr	900	1000
500	400 μR/hr = 72,500 cpm	400	400
500	100 μR/hr	110	110
250	200 μR/hr = 36,300 cpm	200	200
250	100 μR/hr	110	110
50	<sup>mTR</sup> 72,750 cpm	40	40
50	1810 cpm	10	10
25	3630 cpm	21	20
25	907 cpm	5	5

\*Uncertainty within ± 10% C.F. within ± 20% 50, 25 Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

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. A calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N  T1162  G112  M565  S105  T1008  T879  E562  E561  Neutron Am-241 Be S/N T-304

Alpha S/N \_\_\_\_\_  Beta S/N \_\_\_\_\_  Other \_\_\_\_\_

m 500 S/N 81084  Oscilloscope S/N \_\_\_\_\_  Multimeter S/N 80040300

Calibrated By: Michael J Shouse Date: 4-June-02

Reviewed By: Rhonda Hamis Date: 5 June 02

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc. FORM C22A 10/31/2001

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



Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**  
POST OFFICE BOX 810 PH. 915-235-5494  
501 OAK STREET FAX NO. 915-235-4672  
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER PUERTO RICO ELECTRIC POWER ORDER NO. 280769/264221

Mfg. Ludlum Measurements, Inc. Model 3 Serial No. 147811

Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR154536

Cal. Date 5-Jun-02 Cal Due Date 5-Jun-03 Cal. Interval 1 Year Meterface 202-608

check mark  applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 39 % Alt 696.8 mm Hg

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

Mechanical ck.  Meter Zeroed  Background Subtract  Input Sens. Linearity

F/S Resp. ck.  Reset ck.  Window Operation  Geotrolpsm

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 900 V Input Sens. 34 mV Det. Oper. 900 V at 34 mV Threshold Dial Ratio \_\_\_\_\_ = \_\_\_\_\_ mV

HV Readout (2 points) Ref./Inst. \_\_\_\_\_ / \_\_\_\_\_ V Ref./Inst. \_\_\_\_\_ / \_\_\_\_\_ V

**COMMENTS:**  
3rY-90 source s/n:0465 reads 0.25 mR/hr @ x 10 (2.5 mR/hr) @ 1/4" from the probe surface.  
20-60 efficiency is 12.4% (4 pi) source size:28,627 dpm source count:3,600cpm background:50cpm s/n:0886  
3rY-90 efficiency is 33.38% (4 pi) source size:45,946 dpm source count:16,000cpm background:50cpm s/n:4016  
2s-137 efficiency is 0.13% (4 pi) source size:298,539dpm source count:450cpm background:50cpm s/n:4017  
2s-137 (gamma) efficiency is 0.13% (4 pi) source size:2,359,041dpm source count:3000cpm background:50cpm s/n:0155  
2s-137 (beta) efficiency is 20.14% (4 pi) source size:7,697dpm source count:1600cpm background:50cpm s/n:158-112

*All efficiencies 1/4" from Probe*  
Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 100	150 mR/hr	1.7	1.5
X 100	50 mR/hr	0.6	0.49
X 10	15 mR/hr	1.45	1.5
X 10	5 mR/hr	0.5	0.5
X 1	1.5 mR/hr = 4420 cpm	1.4	1.5
X 1	1.0 mR/hr	1	1
X 0.1	442 cpm	1.4	1.5
X 0.1	147 cpm	0.5	0.5

*Uncertainty within ± 10% C.F. within ± 20%			X0.1 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/NCS. Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

**Reference Instruments and/or Sources:**  
Cs-137 Gamma S/N  1162  G112  M565  5105  T1008  T879  E552  E551  Neutron Am-241 Be S/N T-304

Alpha S/N \_\_\_\_\_  Beta S/N \_\_\_\_\_  Other \_\_\_\_\_

m 500 S/N 81084  Oscilloscope S/N \_\_\_\_\_  Multimeter S/N 80040300

Calibrated By: Michael J Thomas Date 5-June-02

Reviewed By: Rhonda Hami Date 5 Jun 02

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc. FORM C22A 10/31/2001

AC Inst. Only  Passed Dielectric (Hi-Pot) and Continuity Test  Fail:





Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**  
POST OFFICE BOX 810 PH. 915-235-5494  
501 OAK STREET FAX NO. 915-235-4672  
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER PUERTO RICO ELECTRIC POWER ORDER NO. 280769/264221

Mfg. Ludlum Measurements, Inc. Model 3 Serial No. 150960

Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR154511

Cal. Date 5-Jun-02 Cal Due Date 5-Jun-03 Cal. Interval 1 Year Meterface 202-608

check mark  applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 39 % Alt 696.8 mm Hg

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

Mechanical ck.  Meter Zeroed  Background Subtract  Input Sens. Linearity

F/S Resp. ck.  Reset ck.  Window Operation  Geotropism

Audio ck.  Alarm Setting ck.  Batt. ck. (Min. Volt) 2.2 VDC

Calibrated in accordance with LMI SOP 14.8 rev 12/05/89.  Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 900 V Input Sens. 34 mV Det. Oper. 900 V at 34 mV Threshold Dial Ratio = \_\_\_\_\_ mV

HV Readout (2 points) Ref./Inst. \_\_\_\_\_ / \_\_\_\_\_ V Ref./Inst. \_\_\_\_\_ / \_\_\_\_\_ V

COMMENTS:

IrY-90 source s/n:0465 reads 0.3 mR/hr @x 10 (3 mR/hr) @ 1/4" from the probe surface.  
 Cs-137 efficiency is 12.4% (4 pi) source size:28,627 dpm source count:3,482cpm background:50cpm s/n:0886  
 IrY-90 efficiency is 36.8% (4 pi) source size:45,946 dpm source count:14,453cpm background:50cpm  
 s/n:4016  
 Cs-137 efficiency is 0.10% (4 pi) source size:298,539dpm source count:350cpm background:50cpm s/n:4017  
 Cs-137 (gamma) efficiency is 0.13% (4 pi) source size:2,359,041dpm source count:3000cpm background:50cpm  
 s/n:0155  
 Cs-137 (beta) efficiency is 20.14% (4 pi) source size:7,697dpm source count:1600cpm background:50cpm  
 s/n:158-112

*All efficiencies 1/4" from Probe*

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 100	150 mR/hr	1.25	1.5
X 100	50 mR/hr	0.4	0.5
X 10	15 mR/hr	1.5	1.5
X 10	5 mR/hr	0.5	0.5
X 1	1.5 mR/hr = 4,490 cpm	1.45	1.5
X 1	1.0 mR/hr	0.95	1
X 0.1	449 cpm	1.4	1.5
X 0.1	150 cpm	0.49	0.5

\*Uncertainty within ± 10% C.F. within ± 20%

X0.1 Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

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

Reference Instruments and/or Sources:

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

Alpha S/N \_\_\_\_\_  Beta S/N \_\_\_\_\_  Other \_\_\_\_\_

m 500 S/N 81084  Oscilloscope S/N \_\_\_\_\_  Multimeter S/N 80040300

Calibrated By: Michael J Thomas Date 4 Jun  
5-June-02

Reviewed By: Rhonda Hammi Date 5 June 02

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc. FORM C22A 10/31/2001

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



Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

**LUDLUM MEASUREMENTS, INC.**  
POST OFFICE BOX 810 PH. 915-235-5494  
501 OAK STREET FAX NO. 915-235-4672  
SWEETWATER, TEXAS 79556, U.S.A.

*Functional Check*

Customer PUERTO RICO ELECTRIC POWER

Order #. 280769/264221

This Certifies that Ludlum Model 180-2 Serial No. 141329 has been functionally checked.  
Refer to applicable instrument manuals for specific operating instructions.

Check performed by

Date 05 Jun 02

**Attachment 3**  
**Access Control Form**

