

**DR. MODESTO IRIARTE TECHNOLOGICAL  
MUSEUM (FORMER BONUS FACILITY)**

**2014 ANNUAL RADIOLOGICAL SURVEY REPORT**

**RINCON  
PUERTO RICO**

**FINAL  
November 2014**



**FOR THE PUERTO RICO ELECTRIC POWER AUTHORITY**

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**DR. MODESTO IRIARTE TECHNOLOGICAL MUSEUM**  
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RINCON, PUERTO RICO

November 2014

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Prepared for:

**Puerto Rico Electric Power Authority**

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Prepared by:

**URS Corporation**  
As Prime Contractor

And

**MMG, LLC**  
As Subcontractor

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## Acronyms and Abbreviations

CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
Dome	BONUS Enclosed Domed Building
dpm/100cm <sup>2</sup>	disintegrations per minute per 100 centimeters squared
Dup	Duplicate
MDA	Minimum Detectable Activity
MMG	MMG, LLC
NA	Not Applicable
QA	quality assurance
QC	quality control
RCM	Radiological Control Manager
rem	roentgen equivalent in man
RPD	Relative Percent Difference
RWP	Radiological Work Permit
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
μR/hour	micro-Roentgen per hour

## 1.0 INTRODUCTION

MMG, LLC (MMG) conducted the comprehensive annual survey at the Dr. Modesto Iriarte Technological Museum (former BONUS Facility) during the dates of 14 – 17 July 2014 with support from PREPA personnel. This survey was conducted in accordance with the Sampling and Analysis Plan (SAP) for the BONUS Facility prepared by the U.S. Department of Energy (DOE) (or DOE contractor) as amended by a 16 January 2001 Memorandum from Webb to Alvarado. The survey was also altered, as presented below in this report, in consideration of the covering of contamination areas/surfaces by paint and/or concrete, the shielding (concrete floor) placed on the Basement Level, the verification survey performed in January 2005 (refer to 22 February 2005 Memorandum entitled: *2004 Annual Survey and Verification Survey for Basement Floor*), and subsequent annual surveys. This report is organized in accordance with Section 6.2 of the SAP. The sampling and inspection results are discussed below.

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## **2.0 PURPOSE**

The purpose of this effort was to conduct an annual radiological 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.

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### 3.0 LOCATION

This sampling and inspection effort focused on the BONUS Enclosed Domed Building (Dome). Surveys and inspections were performed on the (1) exterior of the entombment (concrete monolith where the entombed reactor vessel resides), (2) Main Level, and (3) Basement Level. Table 1 provides a list of specific survey locations.

**Table 1. Survey Locations and Results**

Sampling Location	Sample Number	Dose Rate (μR/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	4	<MDA	<MDA	Monolith Top
Pipe Chase Face	2	4	<MDA	<MDA	Monolith Top
Pipe Chase Face	3	4	<MDA	<MDA	Monolith Top
Pipe Chase Face	4	4	<MDA	<MDA	Monolith Top
Top Plug Face #1	5	4	815	<MDA	Monolith Top
Top Plug Face #1	6	5	<MDA	<MDA	Monolith Top
Top Plug Face #1	7	5	1,038	<MDA	Monolith Top
Top Plug Face #2	8	4	<MDA	<MDA	Monolith Top
Top Plug Face #2	9	5	889	<MDA	Monolith Top
Top Plug Face #2	10	5	741	<MDA	Monolith Top
Top Plug Face #3	11	5	<MDA	<MDA	Monolith Top
Top Plug Face #3	12	5	<MDA	<MDA	Monolith Top
Top Plug Face #3	13	4	<MDA	<MDA	Monolith Top
Top Plug Face #4	14	4	<MDA	<MDA Dup=<MDA	Monolith Top
Top Plug Face #4	15	4	778	<MDA	Monolith Top
Top Plug Face #4	16	3	<MDA	<MDA	Monolith Top
Top Plug Top Surface	17	4	<MDA	<MDA	Monolith Top
Top Plug Top Surface	18	4	<MDA	<MDA	Monolith Top
Top Plug Top Surface	19	4	<MDA	<MDA	Monolith Top
Main Floor Water Column	20	4	<MDA	<MDA Dup=<MDA	Main Level-Controlled Area
Main Floor Water Column	21	4	<MDA	<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 #3	24	5	<MDA	<MDA	Main Level-Controlled Area
Pipe Chase Ext Hatch	25	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #4	26	5	<MDA	<MDA Dup=<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27	17	13,414	<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27A	4	<MDA	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif Floor, area	27B	4	<MDA	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif. Floor (CM005)	28	15 Dup=15	70,331 Dup=69,702	<MDA	Main Level-Controlled Area

**Table 1 (Continued)**

Sampling Location	Sample Number	Dose Rate ( $\mu\text{R}/\text{hour}$ )	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Routine Sampling (continued)</b>					
Side of Liq. Waste Ret. Tank #1	30	14	1,186	<MDA	Basement Level
Side of Liq. Waste Ret. Tank #2	31	14	1,630	<MDA Dup=<MDA	Basement Level
F.W. Heater Room (Wall)	40A	13 Dup=15	5,632 Dup=5,188	<MDA Dup=<MDA	Basement Level
F.W. Heater Room (Wall)	40B	15	<MDA	<MDA	Basement Level
Vapor Sphere Room	42	4	<MDA	<MDA	Basement Level
Vapor Sphere Room	43	4	<MDA	<MDA	Basement Level
Condenser Room Entry Wall (Block)	50A	4	1,038	<MDA	Basement Level
Condenser Room Entry Wall (Concrete)	50B	4	<MDA	<MDA	Basement Level
<b>Additional Sampling Locations</b>					
Main Floor-Zone 1	65	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 2	66	6	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 3	67	5 Dup=5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 4	68	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 5	69	4	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 6	72	4	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 7	73	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 8	74	4	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 9	75	4	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 10	76	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 11	77	4	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear

**Table 1 (Continued)**

Sampling Location	Sample Number	Dose Rate ( $\mu$ R/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Additional Sampling Locations (Continued)</b>					
Main Floor-Zone 12	78	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 14	79	5 Dup=5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 13	80	6	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Basement Floor-Zone 1	70	5	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 2	71	4	NA	<1000dpm/100cm <sup>2</sup> Dup=Same	Basement Level Masslin Smear
Basement Floor-Zone 3	81	5	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 4	89	5	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 5	90	4	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 6	91	5	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 7	92	4	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 8	93	5	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 9	94	3	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 10	95	5	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 11	96	4	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 12	97	4	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 13	98	4	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 14	99	4	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 15	100	5 Dup=5	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 16	101	3	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear
Basement Floor-Zone 17	102	5	NA	<1000dpm/100cm <sup>2</sup>	Basement Level Masslin Smear

**Table 1 (Continued)**

Sampling Location	Sample Number	Dose Rate ( $\mu\text{R}/\text{hour}$ )	Total Contamination ( $\text{dpm}/100\text{ cm}^2$ )	Removable Contamination ( $\text{dpm}/100\text{ cm}^2$ )	Comments
<b>Additional Sampling Locations (Continued)</b>					
Basement Floor-Zone 18	103	5 Dup=5	NA	<1000dpm/100cm <sup>2</sup> Dup=Same	Basement Level Masslin Smear

dpm/100 cm<sup>2</sup> = disintegrations per minute per 100 centimeters squared

Dup = Duplicate

Fig. = Figure

MDA = Minimum Detectable Activity

NA = Not Applicable

$\mu\text{R}/\text{hour}$  = micro-Roentgen per hour

## 4.0 PHYSICAL CONDITION

Appendix C provides a copy of the facility inspection checklist used during the annual survey. Findings and observations are provided below.

- **Site Surveillance Features:** Asphalt of the access road and parking area is in fair and usable condition. The entrance gate is manually operated by the attending guard (Appendix A, Figure 31). The security guard controlled access into the gated facility and kept log of visitors. The Dome monolith plaques were in fair condition. The fence surrounding the property is functional at controlling access and vegetation has been prevented from climbing the fence (Appendix A, Figure 26). No immediate action is necessary.
- **Dome-Entombed Concrete Monolith and Monolith Penetrations:** Inspection of the Concrete Monolith area revealed superficial cracks throughout the surface of the structure (Appendix A, Figure 4). Superficial cracks are also present along the base of the “top plug” of the concrete monolith top (Appendix A, Figure 1). All dose rate measurements taken around the structure were not significantly different from background measurements taken. No immediate action is necessary. Absorbent clothe has been placed to collect oil/grease dripping from the crane system above, however, a new leak was noted this year (Appendix A, Figures 2 and 3). Flaked paint (from the overhead crane and catwalk), which was noted in the 2013 Report, has been removed. It is recommended that absorbent clothes continue to be placed at those locations where oil/grease is accumulating on the Concrete Monolith.
- **Dome-External Piping Systems:** Inspection of accessible external piping systems revealed no significant indications of deterioration. No immediate action is necessary.
- **Dome-Basement Level:** Historically, corrosion was evident on all metal surfaces within approximately 6 in. of the floor, including contaminated surfaces. However, the concrete floor cover (installed in late 2004) covers all floor areas and bases of metallic structures/equipment where surface contamination was present, which is preventing contact with previously accessible contaminated and corroding surfaces. Surface fissures/cracks were noted in the concrete floor covering (Appendix A, Figure 20), but are not of concern.

On the concrete flooring and structural steel near Sample Locations 50A and 50B, significant corrosion and concrete spalling is occurring (this is a repeat observation from 2013). This appears to be centered around the grounding wire in this location which is attached to a structural steel column and passes through the concrete flooring (Appendix A, Figure 22). It is recommended that an electrician be contacted to inspect the grounding of structural steel in the basement.

Control measures (fixed with paint and concrete layer in some places), which were previously implemented, were inspected (Appendix A, Figures 17 and 21). The yellow paint on the Liquid Water Retention Tanks is starting to show signs of thinning, but smears indicated no removable contamination at this time. Ongoing and routine assessment of accessible surfaces in the basement is recommended to evaluate the continued effectiveness of the concrete cover flooring and control measures (e.g., paint) emplaced on previous contamination areas. Although immediate action is not critical, it is recommended that yellow paint be re-applied to the three liquid water retention tanks

within the next two years (Appendix A, Figure 21). Access to areas with historical removable contamination is being effectively controlled.

- **Dome-Basement Level Flooding:** Inspection of this level revealed no standing water on the floors. Storm water drains appear to be functioning properly, but silt/mud remains in the sump from historical events (Appendix A, Figure 18). PREPA personnel indicate that water has historically accumulated in the sump, but evaporated leaving silt/mud behind. Sampling and removal of silt/mud should be planned within the next two years (repeat from 2013), which would increase the capacity of the sump to retain water until it evaporates.

The gasket around the exterior base of the Dome, which is at ceiling level of the basement, has been replaced and some subsequent “patches” have been placed at the north entrance (Appendix A, Figure 27). The large bay door at the Basement Level remains sealed with expanding foam to prevent rainwater infiltration into the Basement Level (Appendix A, Figures 14 and 15).

- **Dome-Main Level:** The Main Level (Controlled Area) is that portion of the Main Level that is not accessible to the public. The two historical contamination sites remain covered with floor tiles; the tile work is in good condition and is effective in reducing the dose levels. One area adjacent to the north side of the Monolith is also covered with lead bricks, which is 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. There is also no discernible evidence of work and/or damage affecting the control measures (floor tiles) on the Main Level, Museum Area (Appendix A, Figures 5 through 10), except for one area near the railing between the Controlled Area and Museum Area (Appendix A, Figure 30) where the tiles feel loose but no discernable cracks/failures are noticeable. The safety guard along the railing, which protects from falls to the Basement Level below, is in good condition and access control signs are properly placed along the railing. The pad lock on the gate within the railing system, which provides access from the Museum Area to the Controlled Area, was in place and locked. It is recommended that the tiles within the Museum Area continue to be evaluated during quarterly monitoring for signs of cracks/failures.
- **Dome-Mezzanine Level:** Access to ladders and stairways leading to the mezzanine level are being effectively maintained and controlled (Appendix A, Figures 11, 12, and 13). The structure appears sound and in good condition (Appendix A, Figure 24). No immediate action is necessary.
- **Dome-Exterior:** Inspection of the Dome structure did not reveal any significant structural discrepancies. The Dome structure exterior was re-sealed and painted since the last annual survey (Appendix A, Figure 23). Both entrance portals are in good condition.
- **Surrounding Land:** Inspection the surrounding land within approximately 0.25 miles of the site revealed no significant changing features or activities that might affect site security. The beach immediately adjacent to the site continues to be a popular surfing location. The adjacent lighthouse and surrounding scenic overlook continues to be a popular place for the local population and vacationers to watch the sun set. No immediate action is necessary.
- **General Site Upkeep:** The buildings and grounds appear well maintained. No immediate action is necessary.



- **Site Security:** A security guard was present at all times during the survey. No immediate action is necessary.
- **Erosion:** Inspection of the surrounding property and slopes to the beach revealed no significant changes or signs of excessive erosion. Dense vegetation on the slopes from the facility to the beach appears to be effectively controlling erosion. No immediate action is necessary.

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## 5.0 DIRECT RADIATION MONITORING

The Table 1 presents direct radiation monitoring results for this survey. Appendix B provides survey records and sketches depicting survey locations for the direct radiation monitoring conducted during this annual comprehensive survey. Direct radiation 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. Summary of Direct Radiation Monitoring Results**

Location	Dose Rate at 30 cm from Source ( $\mu\text{R}/\text{hour}$ )			Expected Exposure Rate <sup>a</sup>		Annual Dose Limits (rem/year)	
	Min. ( $\mu\text{R}/\text{hour}$ )	Ave. ( $\mu\text{R}/\text{hour}$ )	Max. ( $\mu\text{R}/\text{hour}$ )	Max. Exposure (hour/year)	Rate (rem/year)	Rad Worker	Visitor
Monolith Top	3	4.3	5	416	0.002	2	NA
Main Level (Controlled Area)	4	6.4	17	416	0.007	2	NA
Main Level (Public Access)	4	4.8	6	2,080 (employee)	0.012	2	NA
				832 (visitor)	0.005	NA	0.1
Basement Level	3	5.8	15	416	0.006	2	NA

rem = roentgen equivalent in man

<sup>a</sup>Based conservatively on the maximum-recorded dose rate at a conservative exposure scenario. For example, exposure level for the Monolith top would be  $5 \mu\text{R}/\text{hour} \times (1 \text{ rem}/1,000,000 \mu\text{R}) \times (8 \text{ hours}/1 \text{ week}) \times (52 \text{ weeks}/1 \text{ year}) = 0.002 \text{ rem}/\text{year}$ .

The results summarized in the Table 2 indicate that there are no Radiation Areas in the BONUS Facility as defined in Title 10 Part 835 of the Code of Federal Regulations (10 CFR 835), which is 0.005 rem/hour at 30 cm or 5,000  $\mu\text{R}/\text{hour}$  at 30 cm for the dose rate measurements conducted at BONUS). The highest dose rates recorded at 30 cm in the BONUS Facility are well below 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.

Instrument calibrations and daily response check records are maintained at the BONUS facility. Appendix D provides a copy of instrument calibration sheets. Duplicate field measurements were also made at a rate of 5% of the routine measurements and are summarized in Table 3. All quality assurance (QA)/quality control (QC) checks performed within acceptable limits.

**Table 3. Summary of Direct Radiation Monitoring Quality Control**

Location	Result (µR/hour)		RPD (%)	Comments
	Initial	Duplicate		
28	15	15	0	Very good
40A	13	15	14	Acceptable
67	5	5	0	Very good
79	5	5	0	Very good
100	5	5	0	Very good
103	5	5	0	Very good

RPD = Relative Percent Difference =  $[(\text{Sample} - \text{Duplicate}) / ((\text{Sample} + \text{Duplicate}) / 2)] \times 100$

## **6.0 CONTAMINATION LEVEL MONITORING**

Table 1 presents contamination level monitoring results for this survey. Appendix B 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.

### **Concrete Monolith**

There are no radioactive Contamination Areas (as defined in 10 CFR 835) associated with the exterior of the Concrete Monolith structure. Smear samples were collected from the surface of the Concrete Monolith to assess transferable or removable surface beta/gamma contamination. None of the smear samples exhibited removable contamination above the MDA. Five survey locations, 5, 7, 9, 10, and 15 exhibited total surface contamination levels above MDA, but well below the 5,000 dpm/100 cm<sup>2</sup> action level. All remaining survey locations exhibited total surface contamination levels below the MDA. It is recommended that the Concrete Monolith Top be designated as a Controlled Area due to the historical presence of slightly elevated fixed surface beta/gamma contamination levels and the need to ensure no intrusive work is conducted on the monolith without prior notice. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the Concrete Monolith surface) work is performed on this level without review and approval by the Radiological Control Manager (RCM). Job-specific Radiological Work Permits (RWPs) may be required for any future intrusive work on the Concrete Monolith Top.

### **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 (13,414 and 70,331 dpm/100 cm<sup>2</sup>, respectively). 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). Administrative procedures should be in place to ensure that no intrusive (disturbing the floor surface) work is performed in this area without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work in this 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 and previous

surveys 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. Masslin smear samples exhibited no removable contamination above MDA or 1,000 dpm/100 cm<sup>2</sup>. 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 (Appendix A, Figure 10). Despite the fact that fixed contamination has been shielded with 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. Job-specific RWPs may be required for any future intrusive work in this area.

### **Basement Level**

Since the Basement Level floor has been covered with approximately 4-in of concrete, all floor sampling locations on this level were evaluated for transferable/removable surface contamination only (i.e., only smear samples/masslin were performed). Masslin samples (survey locations 70, 71, 81, and 89-103) were collected from the floor surface of the Basement Level to assess transferable or removable surface beta/gamma contamination. Masslin smear samples exhibited no removable contamination above MDA or 1,000 dpm/100 cm<sup>2</sup>. In addition to the masslin samples performed on the floor throughout the level, total and removable contamination was assessed on other surfaces (other than floor) that have been covered with paint and/or concrete due to historical removable contamination (survey locations 30, 31, 40A, 40B, 50A, and 50B). None of the smear samples from these locations exhibited removable contamination above MDA. However, one of these survey locations, 40A (Appendix A, Figure 9), had total surface beta/gamma contamination levels slightly above the 5,000 dpm/100 cm<sup>2</sup> action level (5,632 dpm/100 cm<sup>2</sup>). Three additional survey locations, 30, 31, and 50A exhibited a total surface contamination level above MDA, but well below the 5,000 dpm/100 cm<sup>2</sup> action level. Based on these results, there are no radioactive Contamination Areas associated with the Basement Level.

Two additional survey locations (42 and 43) were evaluated in the Vapor Sphere Room where a tank was historically used for radioactive waste/material storage (a sign indicating radioactive material storage was also present on the door). These survey locations were taken from on top of the newer concrete floor. Both removable and total surface readings at these two locations were below MDA.

Recommendations for access control and posting of this area are provided below:

- Proposed public access area in Basement Level – Despite the fact that fixed contamination has been shielded with the added concrete flooring in the basement, it is recommended that the proposed public access area in the Basement Level remain designated as 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. Job-specific RWPs may be required for any future intrusive work in this area.

- Proposed non-public access area in the Basement Level – Despite the fact that elevated removable surface contamination levels have been fixed through control measures, it is recommended that the proposed non-public access areas in the Basement Level remain designated as a controlled area and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4 (modify posting to avoid alarming visitors). The non-public access areas are those portions of the Liquid Waste Pump Room/F.W. Heater Room and Retention Tank Room that will be partitioned off as “no public access”. Those portions of these rooms that will allow public access will be controlled as stated in the previous bullet. Administrative procedures should be in place to ensure that no intrusive (disturbing the floor or wall surfaces) work is performed on this level without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work in this area.

### **Contamination Survey QA/QC**

Instrument calibration records and daily response check records (pre- and post-survey daily checks) are maintained at the BONUS facility. Appendix D provides a copy of instrument calibration records. Duplicate field measurements were also made at a rate of 5% and are summarized in Table 4.

**Table 4. Summary of Contamination Level Monitoring Quality Control**

Location	Result (dpm/100 cm <sup>2</sup> )		RPD (%)	Comments
	Initial	Duplicate		
14 (Removable)	<MDA	<MDA	NA	Good
20 (Removable)	<MDA	<MDA	NA	Good
26 (Removable)	<MDA	<MDA	NA	Good
28 (Total Surface)	70,331	69,702	1%	Good
31 (Removable)	<MDA	<MDA	NA	Good
40A (Total Surface)	5,632	5,188	8%	Good
Basement Zone 2 #71	<MDA	<MDA	NA	Good (Masslin)
Basement Zone 18 #103	<MDA	<MDA	NA	Good (Masslin)

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

Contamination survey QA/QC checks are acceptable.



## **7.0 LABORATORY DATA**

There were no radiological laboratory data generated to support this survey.

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## 8.0 SUMMARY OF RECOMMENDATIONS

Based on previous surveys and the 2014 Annual Survey results presented above, the following recommendations are provided:

- No “general” RWPs are required for non-intrusive, routine activities (surveys, tours, etc.) at the Facility. Activities that may disturb floors, walls, and/or other potentially contaminated surfaces should be written in a brief planning document and submitted to the RCM for review. As noted in the bullets below, job-specific RWPs may be required for any future intrusive work in the facility.
- Physical Condition:
  - Oil/grease continues to drip from the crane system onto the Concrete Monolith top at new locations (Appendix A, Figures 2 and 3). It is recommended that drip pans/pads continue to be placed at those locations where oil/grease is accumulating on the Concrete Monolith.
  - On the concrete flooring and structural steel near Sample Locations 50A and 50B, significant corrosion and concrete spalling is occurring (repeat from 2013). This appears to be caused by the grounding wire in this location which is attached to a structural steel column and passes through the concrete flooring (Appendix A, Figure 22). It is recommended that an electrician be contacted to inspect the grounding of structural steel in the basement.
  - Control measures (fixed with paint and concrete layer in some places), which were previously implemented, were inspected and do not require maintenance at this time (Appendix A, Figures 17 and 21). Although no immediate action is necessary, it is recommended that yellow paint be re-applied to the three liquid water retention tanks within the next two years (Appendix A, Figure 21).
  - Storm water drains appear to be functioning properly in the Basement Level, but the sump has filled with silt/mud (Appendix A, Figure 18) from past events. Sampling and removal of silt/mud should be planned within the next two years.
- Concrete Monolith: It is recommended that the Concrete Monolith Top remain designated as a controlled area due to the historical presence of elevated fixed surface beta/gamma contamination levels and the need to protect the integrity of the monolith structure. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the Concrete Monolith surface) work is performed on this level without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work on the Concrete Monolith Top.
- Main Level (non-public access area): 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). 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. Job-specific RWPs may be required for any future intrusive work in this area.

- Main Level (public access area): Despite the fact that fixed contamination has been shielded with 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. Job-specific RWPs may be required for any future intrusive work in this area.
- Proposed public access area in Basement Level: Despite the fact that fixed contamination has been shielded with the added concrete flooring in the basement, it is recommended that the proposed public access area in the Basement Level remain designated as 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. Job-specific RWPs may be required for any future intrusive work in this area.
- Proposed non-public access area in the Basement Level – Despite the fact that elevated removable surface contamination levels have been fixed through control measures, it is recommended that the non-public access areas in the Basement Level remain designated as a controlled area and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4 (modify posting to avoid alarming visitors). The non-public access areas are those portions of the Liquid Waste Pump Room/F.W. Heater Room and Retention Tank Room that will be partitioned off as “no public access”. Those portions of these rooms that will allow public access will be controlled as stated in the previous bullet. Administrative procedures should be in place to ensure that no intrusive (disturbing the floor surface or control measures) work is performed on this level without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work in this area.
- Per SOP PBR-11.1.4, routine surveys are required to ensure removable contamination remains below action levels. For this purpose, it is recommended that the annual comprehensive survey and quarterly surveys continue to be repeated. Quarterly surveys should focus on public access areas in close proximity to historical removable contamination areas (F.W. Heater Room/Liquid Waste Pump Room and Retention Tank Room).

**APPENDIX A**  
**PHOTOS**

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**Figure 1. Entombment Top (Top Plug, South Side) – Sampling Point 16 and Surface Cracks (Typical)**



**Figure 2. Entombment Top (Crane) – Absorbent Pads Placed to Contain Oil/Lubricant Drips from Overhead Crane Equipment**



**Figure 3. Entombment Top – Oil Leaking from Overhead Crane (Near Sampling Points 1, 2, 3, and 4)**



**Figure 4. Entombment Top – Surficial Cracks (Typical)**





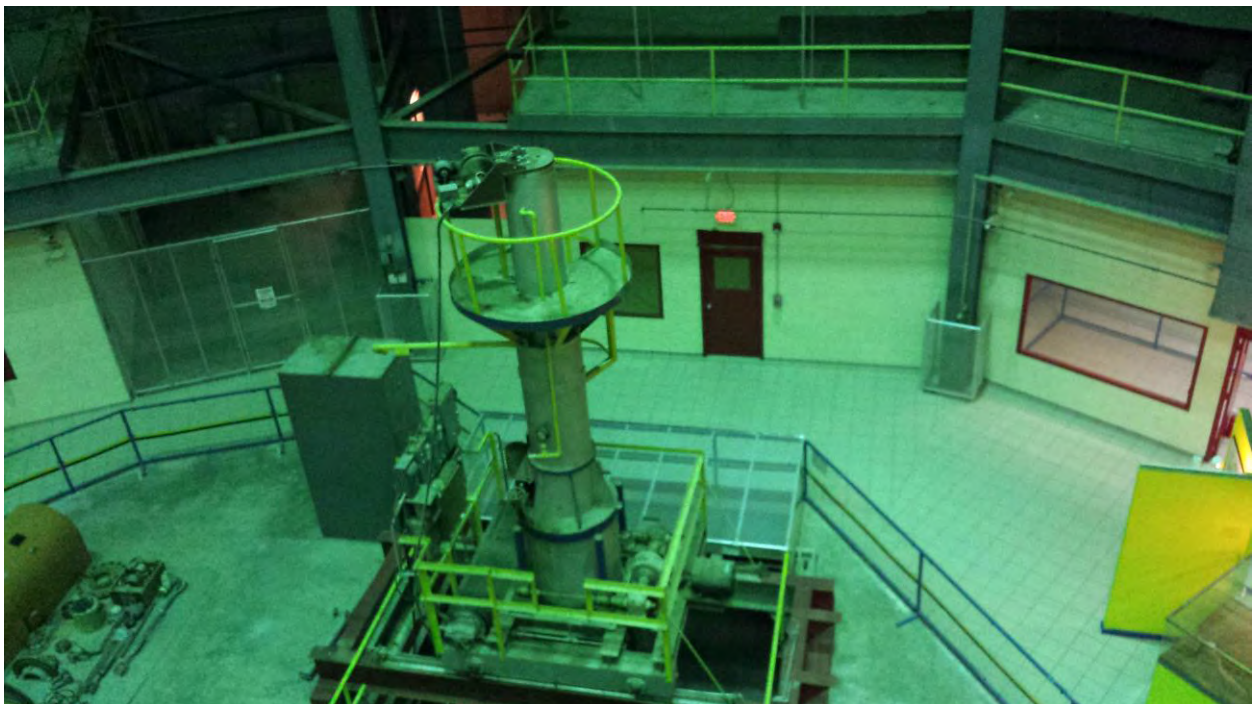
**Figure 5. Main Level (Southwest Side) – Overhead View**



**Figure 6. Main Level (South Side) – Overhead View**



**Figure 7. Main Level (Southeast Side) – Overhead View**



**Figure 8. Main Level (East Side) – Overhead View**





**Figure 9. Main Level (North/Northeast Side) – Overhead View**



**Figure 10. Main Level (North/Northwest Side) – Overhead View**



**Figure 11. Main Level – Locked and Controlled Access to East Mezzanine and Electrical Panels**



**Figure 12. Main Level – Locked and Controlled Access to South Mezzanine**





**Figure 13. Main Level (Museum Area) – Locked and Controlled Access to Basement Level (Left) and Mezzanine (Right)**



**Figure 14. Basement Level – Bay Door (No Signs of Rain Water Infiltration)**



**Figure 15. Basement Level (Exterior) – Bay Door Sealed with Expanding Foam to Prevent Rain Water Infiltration**



**Figure 16. Basement Level – Beneath North Entrance Air Lock (No Signs of Recent Water Infiltration – Older Stains Persist)**





**Figure 17. Basement Level – Concrete Filled Sink**



**Figure 18. Basement Level – Lowest Point in Basement with No Standing Water**



**Figure 19. Basement Level – Sample Locations 40A and 40B Covered by Engineering Control (~1/2 Inch Concrete) with Caution Sign Reading “Controlled Area – Hand and Foot Frisking Required Upon Exit”**



**Figure 20. Basement Level – Engineering Control (~6 Inch Concrete Floor Covering) with Surficial Cracks (Typical)**





**Figure 21. Basement Level – Liquid Water Retention Tanks #1, #2, and #3 with Engineering Control (Yellow Paint) Starting to Show Signs of Thinning**



Electrical Ground Cable from  
Structural Steel through Concrete  
Pad

Corrosion and Possible Reduction  
in Water Content of Concrete In the  
Area Where the Grounding Wire  
Passes Through the Basement  
Concrete Floor

**Figure 22. Basement Level – Corrosion Issues on Concrete Floor near Sample Locations 50A and 50B**



**Figure 23. Dome Structure – Exterior With New Protective Coating and Paint**





**Figure 24. Dome Structure – Interior with Fire Suppression Piping**



**Figure 25. Dome Structure – Drainage Outfall Points and Ditches**





**Figure 26. Fence –Fencing and Perimeter has been Maintained**





**Figure 27. Dome Structure – Flexible Gasket/Seal – North Entrance Air Lock (Several Repairs have been Made)**



**Figure 28. Ancillary Buildings and Structures**



**Figure 29. Basement Level – Oil Leaking on Basement Floor from Overhead Machinery**





**Figure 30. Main Level (Museum Area) – Some Tiles Starting to Loosen**



**Figure 31. Security – Main Gate in Good Working Condition (Manual Open/Close)**



**Figure 32. Personnel Performing Beta/Gamma Scan of Masslin**

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**APPENDIX B**  
**ANNUAL SURVEY CONTAMINATION SURVEY FORMS AND SKETCHES**

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/14/14 1435 hrs Task Number —

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 2014 Comprehensive 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 (cpm)	MDA* dpm/100cm <sup>2</sup>
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	1012	62	771
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		β Removable	β Total	β Removable	β Total
1	North Side	NA	52	NA	<MDA
2	North Side	NA	49	NA	<MDA
3	North Side	NA	40	NA	<MDA
4	North Side	NA	46	NA	<MDA
24	North Side	NA	32	NA	<MDA
26	North Side	NA	33	NA	<MDA
NA	NA	NA	NA	NA	NA

Survey Technician: [Signature]

Reviewed By: [Signature]

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

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building Time: 1435 hrs Date: Yr 2014 Mo 7 Dy 14

Task: Comprehensive Survey RWP: NA

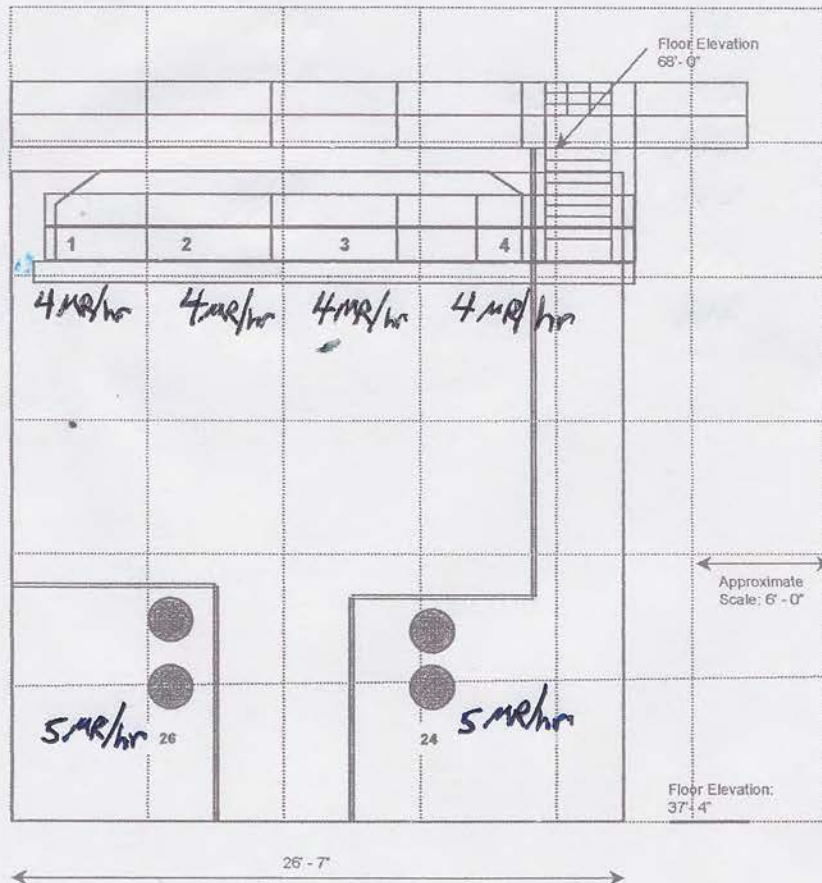
Map key:  $\circ$  = Sample Location  $\square$  = Air Sampler Location  $\_$  = Core Sample

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

1 = Sample Locations



Instruments (Model and Serial Numbers): 19 (148190)

Survey Technician(s) [Signature] C. Will



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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/15/14 0830hrs Task Number —

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

Purpose of Survey: Year 2014 Comprehensive 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 (cpm)	MDA dpm/100cm <sup>2</sup>
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	10/2	45	655
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

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
5	Top Plug Face	NA	67	NA	815
6	Top Plug Face	NA	62	NA	<MDA
7	Top Plug Face	NA	73	NA	1,038
8	Top Plug Face	NA	49	NA	<MDA
9	Top Plug Face	NA	69	NA	889
10	Top Plug Face	NA	65	NA	741
11	Top Plug Face	NA	62	NA	<MDA
12	Top Plug Face	NA	59	NA	<MDA
13	Top Plug Face	NA	49	NA	<MDA
14	Top Plug Face	NA	47	NA	<MDA
15	Top Plug Face	NA	66	NA	778
16	Top Plug Face	NA	43	NA	<MDA
17	Top Plug – Top Surface	NA	61	NA	<MDA
18	Top Plug – Top Surface	NA	49	NA	<MDA
19	Top Plug – Top Surface	NA	55	NA	<MDA
NA	NA	NA	NA	NA	NA

Survey Technician: [Signature]

Reviewed By: [Signature]

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

DPM <sup>cpm</sup> 62 cpm - 63 cpm

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building Time: 0830 hrs Date: Yr 14 Mo 7 Dy 15

Task: Comprehensive Survey RWP: NA

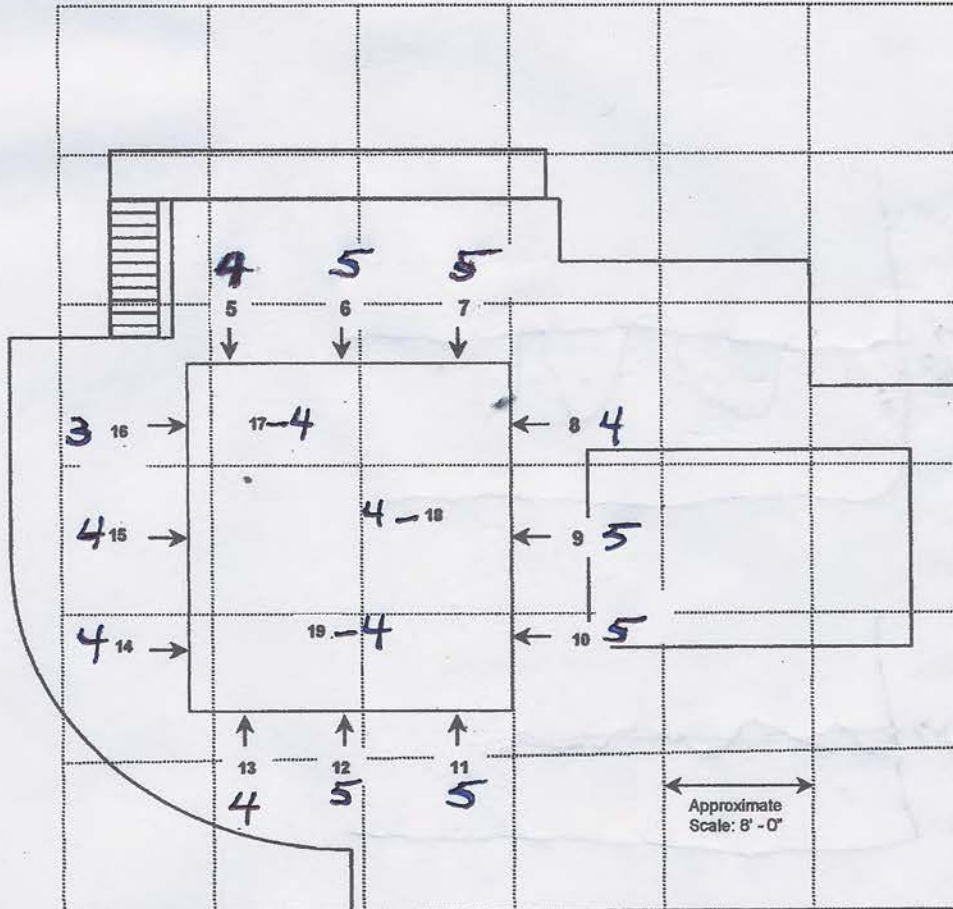
Map key: ° = Sample Location □ = Air Sampler Location \_ = Core Sample

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

Building: Entombed Reactor Building Location: Entombment System - Top (Plan View)

Sketch:

1 = Sample Locations



Instruments (Model and Serial Numbers): 19/148190

Survey Technician(s): [Signature] 7/15/14

ALL AND WOOD

[Signature]



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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/14/14 1400hrs Task Number —

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 2014 Comprehensive 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* dpm/100cm <sup>2</sup>
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	1012	62	<del>777</del> 756
NA	NA	NA	NA	NA	NA	NA %	NA	NA	cw 7/14/14

SURVEY DATA		Survey Map Attached <input checked="" 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	Main Floor	NA	45	NA	<MDA
21	Main Floor	NA	62	NA	<MDA
27	Main Floor	NA	424	NA	13,414
28	Main Floor	NA	1960	NA	70,331
27A	Main Floor	NA	77	NA	<MDA
27B	Main Floor	NA	61	NA	<MDA
28 Dup	Main Floor	NA	1943	NA	69,702
NA	NA	NA	NA	NA	NA

Survey Technician: [Signature]  
 Reviewed By: [Signature]

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

cw 7/14/14  
 MDA<sub>cpm</sub> = 83 cpm  
 ~ 82-83 cpm

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/15/14 1430 hrs Task Number 1

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 2014 Comprehensive 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 (cpm)	MDA*
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	1011	40	NA
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

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
65	Main Floor-Masslin (Zone 1)	58	NA	<MDA	NA
66	Main Floor-Masslin (Zone 2)	45	NA	<MDA	NA
67	Main Floor-Masslin (Zone 3)	43	NA	<MDA	NA
68	Main Floor-Masslin (Zone 4)	51	NA	<MDA	NA
69	Main Floor-Masslin (Zone 5)	49	NA	<MDA	NA
72	Main Floor-Masslin (Zone 6)	39	NA	<MDA	NA
73	Main Floor-Masslin (Zone 7)	48	NA	<MDA	NA
74	Main Floor-Masslin (Zone 8)	38	NA	<MDA	NA
75	Main Floor-Masslin (Zone 9)	56	NA	<MDA	NA
76	Main Floor-Masslin (Zone 10)	45	NA	<MDA	NA
77	Main Floor-Masslin (Zone 11)	38	NA	<MDA	NA
78	Main Floor-Masslin (Zone 12)	38	NA	<MDA	NA
79	Main Floor-Masslin (Zone 14)	38	NA	<MDA	NA
80	Main Floor-Masslin (Zone 1B)	32	NA	<MDA	NA

Survey Technician: [Signature]  
 Reviewed By: [Signature]

\*MDA < 200 dpm/100cm<sup>2</sup> (cannot be quantified due to large area survey).

At 200 dpm/100cm<sup>2</sup>  
 MDA<sub>cpm</sub> = 76 cpm



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

**RADIOLOGICAL SURVEY REPORT (MAP)**

SITE: Entombed Reactor Building Time: 1430 hrs Date: Yr 14 Mo 7 Dy 15  
Time: 7:15 7/15/14

Task: Comprehensive Survey RWP: NA

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

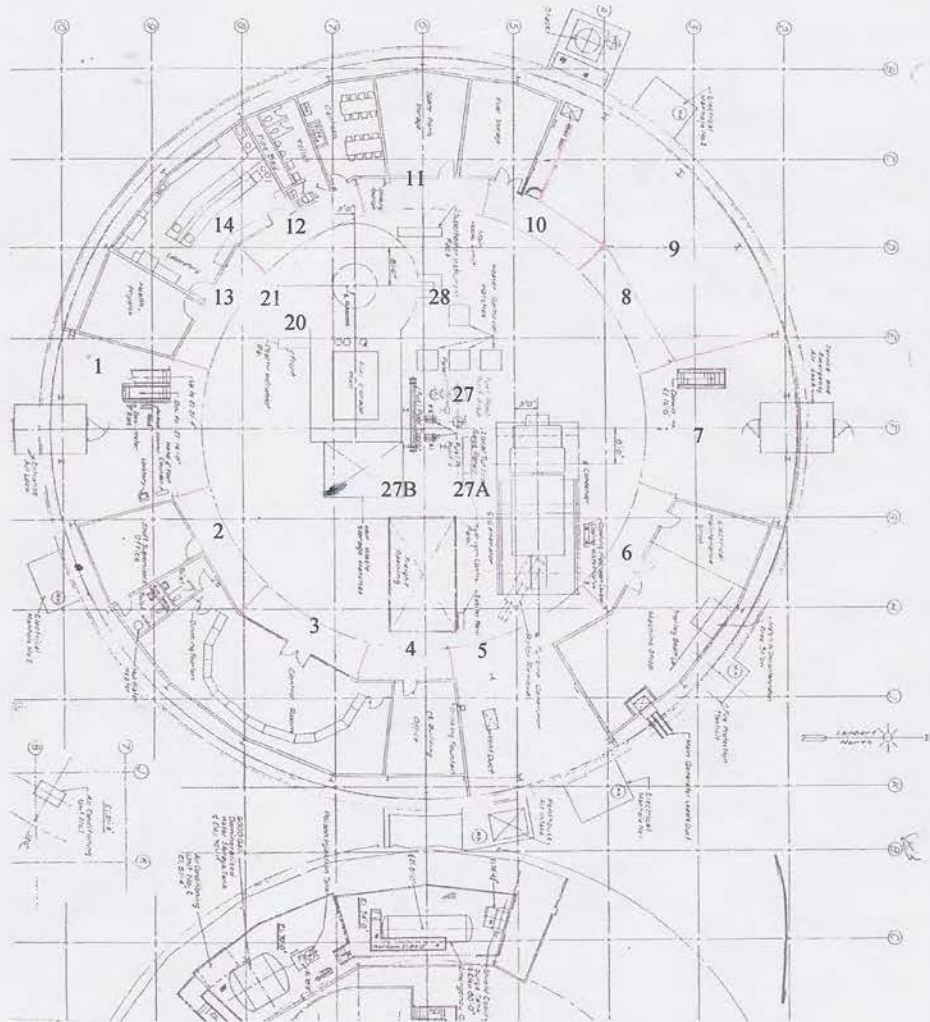
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

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 <u>H=dup</u>	<u>5</u>
Zone <u>NA</u>	<u>NA</u>
20	4
21	4
27	17
28	15
27A	4
27B	4

28dup = 15  
67dup = 5



Instruments (Model and Serial Numbers): 19/148190

Survey Technician(s): AI/AL/LOCO 7/15/14

*Carl Webb*

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 2/15/14 1105 hrs Task Number —

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

Purpose of Survey: Year 2014 Comprehensive 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 (cpm)	MDA* dpm/100cm <sup>2</sup>
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	1012	62	756
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

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
22	South Side	NA	37	NA	< MDA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: [Signature]

Reviewed By: [Signature]

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

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building Time: 1105 hrs Date: Yr 14 Mo 7 Dy 15

Task: Comprehensive Survey RWP: NA

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

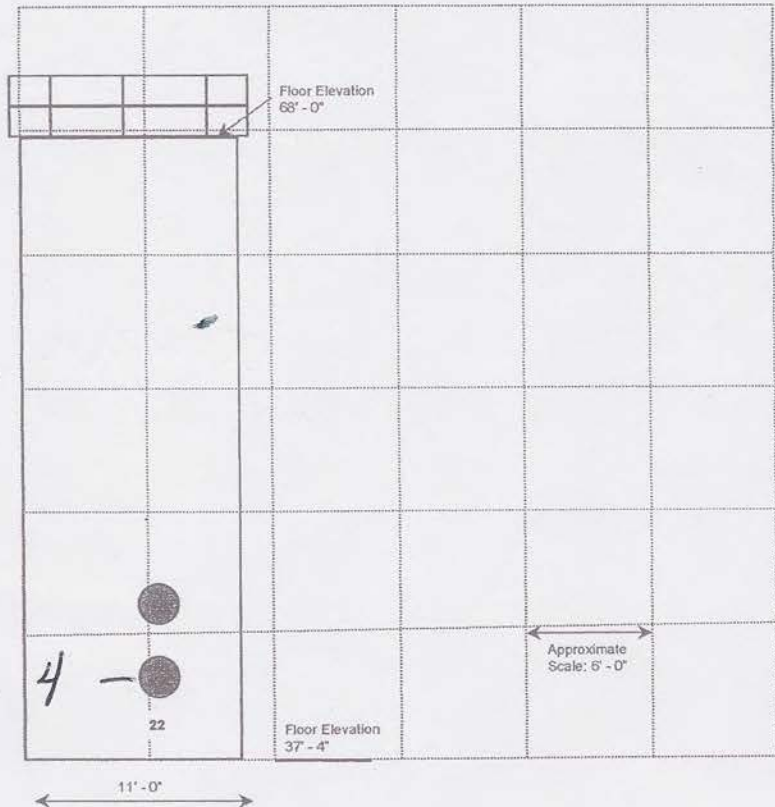
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: South Side

Sketch:

Entombment System - South View

1 = Sample Locations



Instruments (Model and Serial Numbers): 19/148190

Survey Technician(s): Alfonso Lopez 7/15/14

*Carroll*



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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/15/14 1100hrs Task Number —

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

Purpose of Survey: Year 2014 Comprehensive 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 (cpm)	MDA* dpm/100cm <sup>2</sup>
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18%	1012	62	756
NA	NA	NA	NA	NA	NA	NA%	NA	NA	NA

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
23	SouthWest Side	NA	39	NA	<MDA
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	

Survey Technician: [Signature]  
 Reviewed By: \_\_\_\_\_

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

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building Time: 1100 hrs Date: Yr 14 Mo 7 Dy 15

Task: Comprehensive Survey RWP: NA

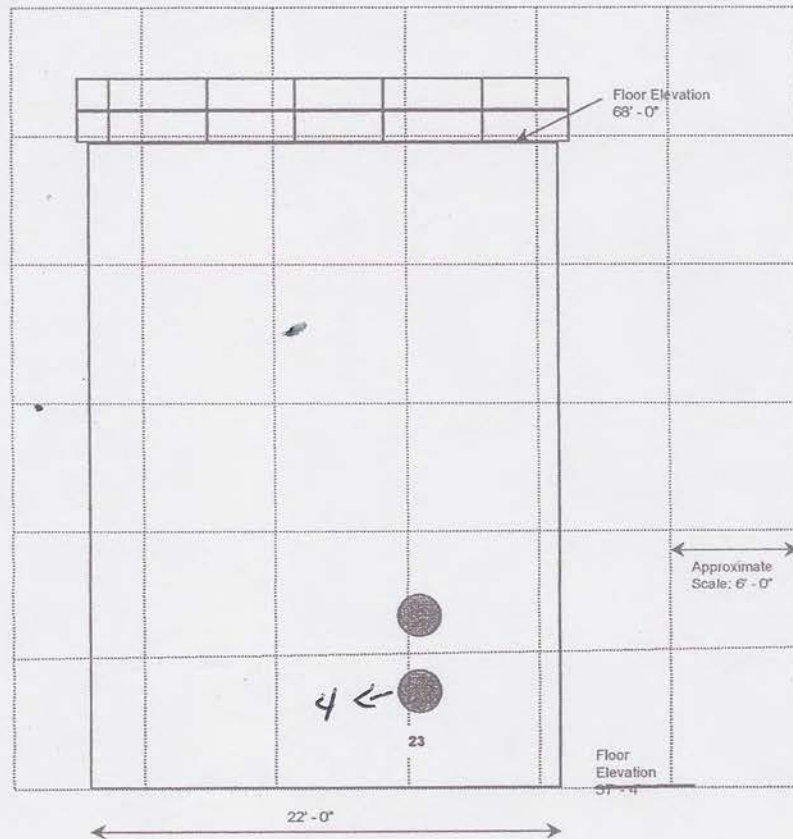
Map key: ° = Sample Location □ = Air Sampler Location \_ = Core Sample

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**

1 = Sample Locations



Instruments (Model and Serial Numbers): 19/148190

Survey Technician(s): ALAN LOCCA 7/15/14

*ca w/h*

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/14/14 1425 hrs Task Number —

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

Purpose of Survey: Year 2014 Comprehensive 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 (cpm)	MDA* dpm/100cm <sup>2</sup>
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	1012	62	771
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		βγ Removable	βγ Total	βγ Removable	βγ Total
25	NorthWest Side	NA	41	NA	<MDA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: [Signature]

Reviewed By: \_\_\_\_\_

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



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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building Time: 1425 hrs Date: Yr 14 Mo 7 Dy 14

Task: Comprehensive Survey RWP: NA

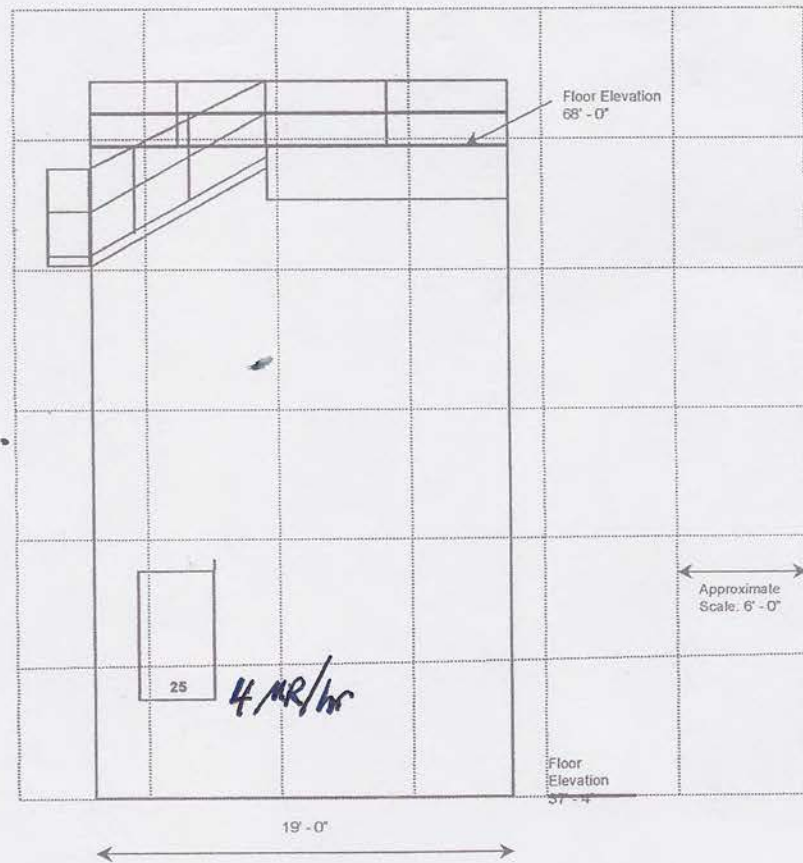
Map key: ° = Sample Location □ = Air Sampler Location \_ = Core Sample

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

Building: Entombed Reactor Building Location: NorthWest Side

Sketch: Entombment System - Northwest View

1 = Sample Locations



Instruments (Model and Serial Numbers): 19/148190

Survey Technician(s): [Signature]

[Signature]

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

**Rincón, Puerto Rico**

**CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 7/16/14 0900hrs 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 2014 Comprehensive 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 (cpm)	MDA* dpm/100cm <sup>2</sup>
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	511	41	878
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

**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
30	Basement Floor-Side of Tank #1	NA	73	NA	1,186
31	Basement Floor-Side of Tank #2	NA	85	NA	1,630
40A	Basement Floor-Wall (4" from floor)	NA	193	NA	5,632
40B	Basement Floor-Wall (4" from floor)	NA	55	NA	<MDA
42	Basement Floor	NA	34	NA	<MDA
43	Basement Floor	NA	45	NA	<MDA
50A	Basement Floor-Wall (block)	NA	58	NA	<MDA
50B	Basement Floor-Wall (concrete)	NA	62	NA	<MDA
40A Dup	Basement Floor-Wall (4" from floor)	NA	181	NA	5,188
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: [Signature]  
 Reviewed By: [Signature]

\*MDA is 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 - MMG Date/Time 7/16/14 1100hrs 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 2014 Comprehensive 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 (cpm)	MDA*
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	1011	44	NA
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA		Survey Map Attached <input checked="" 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
70	Masslin - Zone 1	35	NA	<MDA	NA
71	Masslin - Zone 2	57	NA	<MDA	NA
81	Masslin - Zone 3	40	NA	<MDA	NA
89	Masslin - Zone 4	41	NA	<MDA	NA
90	Masslin - Zone 5	29	NA	<MDA	NA
91	Masslin - Zone 6	36	NA	<MDA	NA
92	Masslin - Zone 7	39	NA	<MDA	NA
93	Masslin - Zone 8	47	NA	<MDA	NA
94	Masslin - Zone 9	37	NA	<MDA	NA
95	Masslin - Zone 10	50	NA	<MDA	NA
96	Masslin - Zone 11	36	NA	<MDA	NA
97	Masslin - Zone 12	44	NA	<MDA	NA
98	Masslin - Zone 13	47	NA	<MDA	NA

Survey Technician: [Signature]  
 Reviewed By: [Signature]

\*MDA < 200 dpm/100 cm<sup>2</sup> (cannot be quantified due to large area survey).

At 200 dpm/100 cm<sup>2</sup>  
 MDA<sub>cpm</sub> ≈ 80cpm

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/16/14 1130 hrs 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 2014 Comprehensive 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 (cpm)	MDA*
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	1011	44	NA
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

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
99	Masslin - Zone 14	48	NA	<MDA	NA
100	Masslin - Zone 15	35	NA	<MDA	NA
101	Masslin - Zone 16	53	NA	<MDA	NA
102	Masslin - Zone 17	53	NA	<MDA	NA
103	Masslin - Zone 18	40	NA	<MDA	NA
71 Dup	NA	56	NA	<MDA	NA
103 Dup	NA	56	NA	<MDA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: [Signature]  
 Reviewed By: [Signature]

\*MDA < 200 dpm/100 cm<sup>2</sup> (cannot be quantified due to large area survey).



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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building Time: 0900hrs Date: Yr 2014 Mo 7 Dy 16

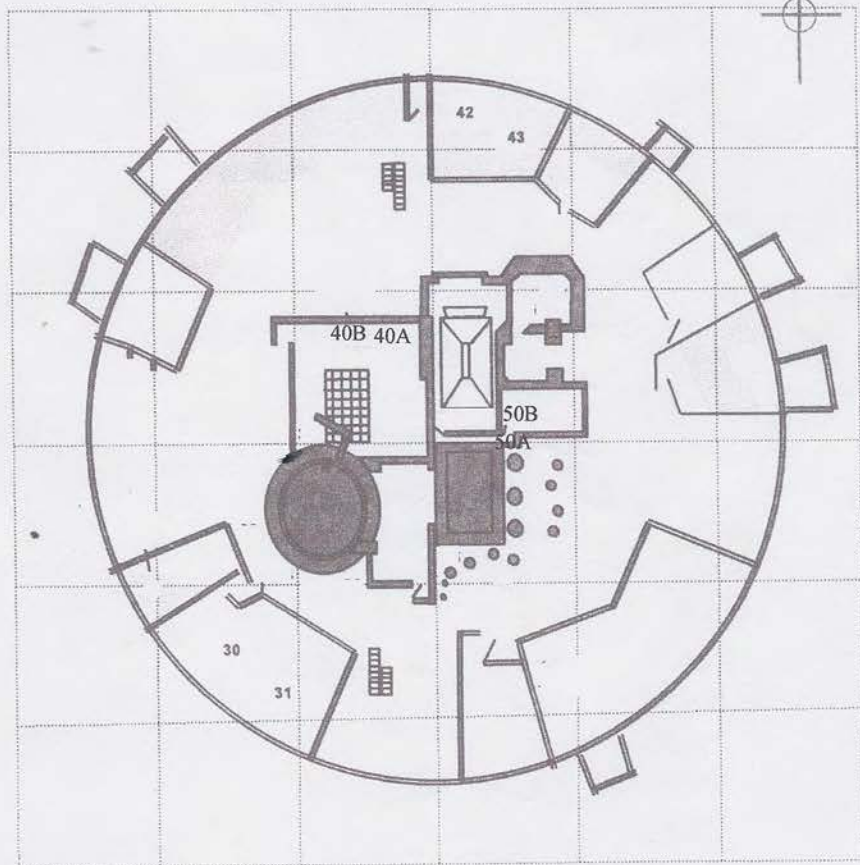
Task: Comprehensive Survey RWP: NA

Building: Entombed Reactor Building Location: Basement Floor

Sketch:

No.	$\mu\text{R/hr}$
Zone 1 = 71	5
Zone 2 = 80	4
Zone 3 = 81	5
Zone 4 = 89	5
Zone 5 = 90	4
Zone 6 = 91	5
Zone 7 = 92	4
Zone 8 = 93	3
Zone 9 = 94	3
Zone10 = 95	5
Zone11 = 96	4
Zone12 = 97	4
Zone13 = 98	4
Zone14 = 99	4
Zone15 = 100	5
Zone16 = 101	3
Zone17 = 102	5
Zone18 = 103	5
30	14
31	14
40A	13
40A Dup	15
40B	15
7/16/14 42	4
43	4
50A	4
50B	4
100 Dup	5
103 Dup	5

1 = Sample Locations



= SCM Survey Above 100 cm² limit

Instruments (Model and Serial Numbers): 191148190

Survey Technician(s): Alfonso Lopez 7/16/14

*ca 2014*

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/15/14 1015 hrs Task Number ---

Specific Area of Survey: Smears MDA= $((2.71/Tbkg + 3.3\sqrt{(Bkg/Tbkg+Bkg/Ts)})/E$

Purpose of Survey: Year 2014 Comprehensive Survey A=(Sample-Bkg)/E

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA*
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18%	1011	40	123
NA	NA	NA	NA	NA	NA	NA%	NA	NA	NA

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
1	NA	58	NA	<MDA	NA
2	NA	29	NA	<MDA	NA
3	NA	39	NA	<MDA	NA
4	NA	36	NA	<MDA	NA
5	NA	44	NA	<MDA	NA
6	NA	48	NA	<MDA	NA
7	NA	42	NA	<MDA	NA
8	NA	43	NA	<MDA	NA
9	NA	43	NA	<MDA	NA
10	NA	37	NA	<MDA	NA
11	NA	42	NA	<MDA	NA
12	NA	29	NA	<MDA	NA
13	NA	31	NA	<MDA	NA
14	NA	51	NA	<MDA	NA
14a	NA	47	NA	<MDA	NA
15	NA	42	NA	<MDA	NA
16	NA	35	NA	<MDA	NA

Survey Technician: [Signature]

Reviewed By: [Signature] 7/15/14

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

MDA ≈ 62-63 cpm





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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 7/16/14 1000hrs Task Number     

Specific Area of Survey: Smears MDA= $((2.71/Tbkg + 3.3\sqrt{(Bkg/Tbkg+Bkg/Ts)})/E$

Purpose of Survey: Year 2014 Comprehensive Survey A= $(Sample-Bkg)/E$

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA*
Ludlum 2221	149991	3/11/15	44-9	154535	3/11/15	18 %	1011	44	129
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input checked="" 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
30	NA	40	NA	<MDA	NA
31	NA	50	NA	<MDA	NA
31 Dup	NA	34	NA	<MDA	NA
40A	NA	37	NA	<MDA	NA
40A Dup	NA	50	NA	<MDA	NA
40B	NA	46	NA	<MDA	NA
42	NA	54	NA	<MDA	NA
43	NA	32	NA	<MDA	NA
50A	NA	55	NA	<MDA	NA
50B	NA	40	NA	<MDA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: [Signature]  
 Reviewed By: [Signature]

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

**APPENDIX C**  
**PHYSICAL CONDITION – INSPECTION CHECKLIST**

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## Inspection Checklist

### BONUS Decommissioned Facility, Rincón, Puerto Rico

Date of This Inspection/Revision:

16-17 July 2014

Last Inspection:

23 August 2013

Inspectors:

C. Webb

and

A. Luca

Next Inspection (Planned):

Summer 2015

No.	Item	Issue	Action
1	Specific site surveillance features	See attached table.	Inspect. <i>See page 3 of 3.</i>
2	Dome—entombed concrete monolith and monolith penetrations	Structural defects or degradation can result in loss of containment of radioactive materials.	Inspect for possible indications of structural problems, such as cracking, staining, and spalling. Notes: <i>No change - Minor superficial cracks.</i>
3	Dome—external piping systems	Systems were flushed during decommissioning. Incidental contamination remains, which may be released if systems corrode or otherwise fail.	Inspect for possible indications of deterioration, such as peeling and blistering paint, staining, and flaking. Notes: <i>No noticeable change. No signs of leak or discharge.</i>
4	Dome—Basement Level	Some areas contain radiological contamination in excess of DOE standards; the general public is not allowed access to contaminated areas.	Note condition of access control barricades. Notes: <i>Access control is in good condition and maintained.</i>
5	Dome—Basement Level flooding	Water accumulating in Basement Level may mobilize and redistribute surface contamination.	Inspect for gasket and storm water drains. Notes: <i>New gasket is in place. Minor repairs have been made at the north entrance. This is to address water leaking into the basement beneath north entrance.</i>
6	Dome—Main Level	Some areas contain radiological contamination in excess of DOE standards; the general public is not allowed access to contaminated areas.	Note condition of access control barricades, ceramic floor tile, and lead blocks; note general housekeeping. Notes: <i>Controls are in good condition and maintained.</i>

7	Dome—Mezzanine Level	Some areas contain radiological contamination in excess of DOE standards; the general public is not allowed access to contaminated areas.	Note condition of access control to mezzanine; note general housekeeping. Notes: <i>All access gates were locked and controlled.</i>
8	Dome—exterior	Building should appear well maintained	Visually inspect. Notes: <i>Dome exterior paint looks excellent.</i>
9	Surrounding land	New or changing features or activities adjacent to the site may affect site security.	Note changes within 0.25 mile (400 m) of site. Notes: <i>None.</i>
10	General site upkeep	Building should appear well maintained.	Observe and evaluate changes in site conditions. Notes: <i>Some minor repairs have been made to prevent rain water infiltration.</i>
11	Site security	Security guard should be stationed at site at all times.	Ensure security guard is present. Notes: <i>Guard present. ✓</i>
12	Erosion	Ensure that hill slopes and beach adjacent to site are not actively eroding in a way that could adversely affect the Facility.	Evaluate erosional features on adjacent slopes and beach. Notes: <i>No visible erosion on beach-side of property.</i>

**Checklist Of Site Specific Surveillance Features  
BONUS Decommissioned Facility, Rincón, Puerto Rico**

Feature	Comment
Access road and parking area	Asphalt - No significant changes - Some broken asphalt, but functional
Entrance gate	Motor-operated - Motor is not operational, but guard was present and maintained lock/key for gate.
Access through security gate	Note security of site; sign-in required on log sheet Guard required sign-in on log sheet and recorded pertinent information.
Security fence	Chain-link, topped with three strands of barbed wire Additional repairs have been made and fence is in good shape.
Dome—monolith plaques	Visually inspect No change, monolith structural integrity and plaques are in good condition. Superficial cracks on monolith, but nothing significant.

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**APPENDIX D**  
**CALIBRATION SHEETS**



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Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street  
325-235-5494  
Sweetwater, TX 79556, U.S.A.

10744 Dutchtown Road  
865-392-4601  
Knoxville, TN 37932, U.S.A.

CUSTOMER PUERTO RICO ELECTRIC PWR AUTH

ORDER NO. 20240692/403523

Ludlum Measurements, Inc. Model 2221 Serial No. 149991

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

Cal. Date 11-Mar-14 Cal Due Date 11-Mar-15 Cal. Interval 1 Year Meterface 202-159

Check mark  Applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 29 % Alt 690.8 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) 4.4 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 Dial Ratio 100 = 10 mV

HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1990 V

COMMENTS:

Cs137 ≈ 1 µCi check source SN 2008 reads ≈ 32225 cpm with label side of source placed against protective screen of 44-9.

SrY90 ≈ 61100 dpm check source SN 3432-09 reads ≈ 22113 cpm with check source placed against protective screen of 44-9, label side up.

Firmware: 261010

Calibrated with WIN in OUT position.

Window set at 2X threshold.

See attachment for efficiencies.

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 1K	400 kcpm	400	400
X 1K	100 kcpm	100	100
X 100	40 kcpm	400	400
X 100	10 kcpm	100	100
X 10	4 kcpm	400	400
X 10	1 kcpm	100	100
X 1	400 cpm	400	400
X 1	100 cpm	100	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 kcpm	40040(0)	40040(0)	500 kcpm	500K	500K
40 kcpm	4004	4004	50 kcpm	50K	50K
4 kcpm	400	400	5 kcpm	5K	5K
400 cpm	40	40	500 cpm	500	500
40 cpm	4	4	50 cpm	50	50

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 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.

Our 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 S/N:  059  280  720  734  781  1131  1616  1696  1909  1916CP  5105  5717CO  5719CO

80646  70897  73410  E552  G112  M565  S-394  S-1054  T879  T10081  T10082 Neutron Am-241 Be S/N:  T-304 Ra-226 S/N:  Y982

Alpha S/N  Beta S/N  Other

m 500 S/N 251106  Oscilloscope S/N  Multimeter S/N 15060230

Calibrated By: James McBeath Date 11 MAR 14

Reviewed By: [Signature] Date 12 MAR 14

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





Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

### CERTIFICATE OF CALIBRATION

### LUDLUM MEASUREMENTS, INC.

501 Oak Street  
325-235-5494  
Sweetwater, TX 79556, U.S.A.

10744 Dutchtown Road  
865-392-4601  
Knoxville, TN 37932, U.S.A.

CUSTOMER PUERTO RICO ELECTRIC PWR AUTH ORDER NO. 20240692/403523

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

Cal. Date 11-Mar-14 Cal Due Date 11-Mar-15 Cal. Interval 1 Year Meterface 202-016

Check mark  applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 29 % Alt 690.8 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 525 V Input Sens. 33 mV Det. Oper. \_\_\_\_\_ V at \_\_\_\_\_ mV Threshold Dial Ratio \_\_\_\_\_ = \_\_\_\_\_ mV

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

#### COMMENTS:

Cs137 ~ 1 µCi check source SN 2008 reads ~ 230 µR/hr with label side of source placed against dimple on front of Model 19.

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	3800	4000
5000	1000 µR/hr	950	1000
500	400 µR/hr = 72000 cpm	460	400
500	100 µR/hr	100	100
250	200 µR/hr = 36000 cpm	200	200
250	100 µR/hr	100	100
50	7200 cpm	40	40
50	1800 cpm	10	10
25	3600 cpm	20	20
25	900 cpm	5	5

50, 25 Range(s) Calibrated Electronically

\*Uncertainty: Alpha ± 10% C.F. (cpm) = 20%

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. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 S/N:  059  280  720  734  781  1131  1616  1696  1909  1916CP  5105  5717CO  5719CO

60646  70897  73410  E552  G112  M565  S-394  S-1054  T879  T10081  T10082 Neutron Am-241 Ba S/N:  T-304 Ra-226 S/N:  Y982

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

m 500 S/N 251106  Oscilloscope S/N \_\_\_\_\_  Multimeter S/N 15060230

Calibrated By: James M. Bell Date 11 MAR 14

Reviewed By: [Signature] Date 12 MAR 14

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc. FORM C22A 11/22/2013 Page 1 of 1

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