

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

**2019 ANNUAL RADIOLOGICAL SURVEY REPORT –  
REVISION 0**

**RINCON  
PUERTO RICO**

**December 2019**



**FOR THE PUERTO RICO ELECTRIC POWER AUTHORITY**

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**DR. MODESTO IRIARTE TECHNOLOGICAL MUSEUM  
2019 ANNUAL RADIOLOGICAL SURVEY REPORT - DRAFT**

**RINCON, PUERTO RICO**

**December 2019**

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Prepared for:

**Puerto Rico Electric Power Authority**

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As Prime Contractor

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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 20 – 22 November 2019 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.

### Action Levels/Limits

The following action levels/limits are referenced in the BONUS Radiological Control (RADCON) Manual and represent the most conservative, applicable limits:

- **Dose Limits:** The RADCON Manual references a Radiological Worker annual dose limit of 5 rem/year/worker, DOE Administrative Control Level of 2 rem/year/person, and the PREPA Administrative Control Level of 0.2 rem/year/person. For purposes of this Annual Report, an Administrative **Radiological Worker Level of 2 rem/year/worker** is used for evaluating dose rate measurements. This report also compares dose rate measurements in the Public Access Areas to the **Visitor Does Limit** for visitors of the BONUS Facility, which is limited to an annual radiation of **0.1 rem/year/person**.
- **Contamination Control Levels:** A surface at the BONUS Facility is considered contaminated if either the removable or total radioactivity detected is above the levels below.

Nuclide <sup>a</sup>	Contamination values	
	Removable <sup>b</sup> (dpm/ 100 cm <sup>2</sup> )	Total <sup>c</sup> (fixed + removable) (dpm/100 cm <sup>2</sup> )
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except <sup>90</sup> Sr and others noted above. Includes mixed fission products containing <sup>90</sup> Sr	<b>1,000 beta-gamma</b>	<b>5,000 beta-gamma</b>

<sup>a</sup>Values in this table apply to radioactive contamination deposited on, but not incorporated into, the interior of the contaminated item.

<sup>b</sup>The amount of removable radioactive material per 100 cm<sup>2</sup> of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency.

<sup>c</sup>Levels may be averaged over 1 m<sup>2</sup> provided the maximum activity in any area of 100 cm<sup>2</sup> is less than three times the values in this table.

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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. Surveys on the Basement Level were limited during 2019 Annual Survey due to accidental flooding, which occurred earlier during week of 18 December 2019, and created 1- to 2-inches of standing water on the 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	5	<MDA	<MDA	Monolith Top
Pipe Chase Face	2	5	<MDA	<MDA	Monolith Top
Pipe Chase Face	3	5	<MDA	<MDA	Monolith Top
Pipe Chase Face	4	5	<MDA	<MDA	Monolith Top
Top Plug Face #1	5	5	<MDA	<MDA	Monolith Top
Top Plug Face #1	6	5	<MDA	<MDA	Monolith Top
Top Plug Face #1	7	5 Dup=5	<MDA	<MDA	Monolith Top
Top Plug Face #2	8	6	<MDA	<MDA	Monolith Top
Top Plug Face #2	9	6	<MDA	<MDA	Monolith Top
Top Plug Face #2	10	6	<MDA	<MDA	Monolith Top
Top Plug Face #3	11	6	852	<MDA	Monolith Top
Top Plug Face #3	12	5	<MDA	<MDA	Monolith Top
Top Plug Face #3	13	5	<MDA	<MDA	Monolith Top
Top Plug Face #4	14	5	<MDA	<MDA	Monolith Top
Top Plug Face #4	15	5	<MDA	<MDA	Monolith Top
Top Plug Face #4	16	5	<MDA	<MDA Dup=<MDA	Monolith Top
Top Plug Top Surface	17	3	<MDA	<MDA	Monolith Top
Top Plug Top Surface	18	3	<MDA	<MDA	Monolith Top
Top Plug Top Surface	19	4	<MDA Dup=<MDA	<MDA	Monolith Top
Main Floor Water Column	20	5	<MDA	<MDA	Main Level-Controlled Area
Main Floor Water Column	21	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #1	22	3	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #2	23	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #3	24	3	<MDA	<MDA	Main Level-Controlled Area
Pipe Chase Ext Hatch	25	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #4	26	3	<MDA	<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27	16	11,673	<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.

**Table 1 (Continued)**

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 (Continued)</b>					
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	68,997 Dup=69,998	<MDA Dup=<MDA	Main Level-Controlled Area
Side of Liq. Waste Ret. Tank #1	30	15	1,186	<MDA	Basement Level
Side of Liq. Waste Ret. Tank #2	31	14 Dup=14	1,334	<MDA	Basement Level
F.W. Heater Room (Wall)	40A	13 Dup=13	5,299 Dup=5,484	<MDA Dup=<MDA	Basement Level
F.W. Heater Room (Wall)	40B	8	<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	5	<MDA	<MDA	Basement Level
Condenser Room Entry Wall (Concrete)	50B	5	<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	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 3	67	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	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 6	72	5	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	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zone 9	75	5	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	5	NA	<1000dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear

**Table 1 (Continued)**

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>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	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	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 2	71	4 Dup=4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 3	81	6	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 4	89	5	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 5	90	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 6	91	5	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 7	92	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 8	93	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 9	94	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 10	95	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 11	96	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 12	97	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 13	98	5	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 14	99	5	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 15	100	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 16	101	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 17	102	4	NA	Water-Not Accessible	Basement Level Masslin Smear
Basement Floor-Zone 18	103	4	NA	Water-Not Accessible	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  
 μR/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 remains in fair and usable condition. There is some broken asphalt, but it is still functional. The entrance gate's motor is not operational; however the gate is manually opened/closed by the attending guard (Appendix A, Figure 39). A single security guard controlled access into the gated facility on each day of the site visit and kept a sign-in log of visitors. The fence surrounding the property was damaged by falling trees during the 2017 hurricane season at approximately six locations totaling approximately 100-ft in length (Appendix A, Figure 36). Recommend removing fallen trees and engaging a fencing contractor to repair the sections of damaged fence (repeat from 2018 Annual Report). The Dome monolith plaques are in good condition – no change.
- **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 3) – no change from past inspections. Superficial cracks are also present along the base of the “top plug” of the concrete monolith top, but with no change from past inspections. All dose rate measurements taken around the structure were not significantly different from background measurements taken. No immediate action is necessary. Additional absorbent clothes have been placed to collect oil/grease dripping from the crane system above (Appendix A, Figures 1 and 2). It is recommended that absorbent clothes continue to be placed at those locations where oil/grease is accumulating on the Concrete Monolith and, especially, if/after the crane is moved. Moisture/standing water was observed on portions of the Monolith top on 20 November 2019, but were dry by 22 November 2019. This moisture was likely due to condensation dripping from the Dome structure due to increased humidity from the standing water in the Basement Level.
- **Dome-External Piping Systems:** Inspection of accessible external piping systems revealed no significant indications of deterioration. Outfall pipes on the west side of the property (on the beach outside of perimeter fence) were inspected (Appendix A, Figure 34). Outfall pipes on the south side of the property (outside of perimeter fence) could not be accessed due to overgrown vegetation. The drainage pipes on the west side, where it passes under the main access road, are relatively free of sand and debris (Appendix A, Figure 35).
- **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. On 20 November 2019 and upon beginning the annual survey, the survey team observed that 1- to 2-inches of standing water was present on the Basement Level and remained in that condition at the time the survey was concluded 22 November 2019. The flooding of the Basement Level was determined to be attributed to a renovation project of the bathrooms at the southern entrance to the Dome. When the water line leading to the bathrooms was

re-opened, closed valves leading to the Basement Level were breached and caused water to flood the Basement Level. The water line was closed and repairs were completed during the 2019 Annual Survey. The changed condition, which was noted during the 2019 survey at the location of Condensate Pump #1 and Condensate Pump #2 (Appendix A, Figure 31 and Appendix B, Basement Level Survey Sketch), is also partially under water. Loose debris/dust and oil-like substance, which had accumulated at the base of each pump, may migrate due to the flooding event. It is recommended that the floor and walls (within 6-inches of the floor) be re-surveyed during the 2020 Annual Survey after the water has been allowed to evaporate.

Control measures (fixed with paint and concrete layer in some places), which were previously implemented, were inspected (Appendix A, Figures 26, 28, 29, and 30). The yellow paint on the Liquid Water Retention Tanks is in fair condition. The concrete wall coating at Sample Locations 40A and 40B is showing signs of cracking and deterioration, but remains effective. 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 an additional layer of concrete be placed over Sample Locations 40A and 40B within the next year (Appendix A, Figure 28). Access to areas with historical removable contamination is being effectively controlled.

Access to stairways leading to the Basement Level is being effectively maintained and controlled (Appendix A, Figure 13). No action is necessary.

- **Dome-Basement Level Flooding:** See previous bullet regarding the accidental flooding during the week of 18 November 2019, which resulted in 1- to 2-inches of standing water. Storm water drains appear to be functioning properly, but silt/mud remains in the sump from historical events (Appendix A, Figure 27).

The gasket around the exterior base of the Dome, which is at ceiling level of the basement, remains intact and effective (Appendix A, Figure 25). The gasket is showing signs of weathering and surficial cracks (repeat from 2016 and 2018) in the low areas of the gasket where it holds rain water and dries in the sun (Appendix A, Figure 37). The drains in the trough below the gasket are clear and draining rain water properly (Appendix A, Figure 38). The large bay door at the Basement Level remains sealed with expanding foam to prevent rainwater infiltration into the Basement Level. It is recommended that, when the gasket around the base of the Dome is replaced, the gasket is installed in a manner that does not retain rain water.

- **Dome-Main Level:** The Main Level (Controlled Area) is that portion of the Main Level that is not accessible to the public (Appendix A, Figures 16 through 20). 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 (Appendix A, Figure 21). 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 4 through 10). The safety guard along the railing (Appendix A, Figure 11), 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 (Appendix A, Figure 15). The PREPA team will continue to monitor the tiles within the Museum Area for signs of cracks/failures.

Evidence of termites (additional possible termite frass) was observed on the east side of Main Level (Museum Area) where plywood walls were constructed in recent years (Appendix A, Figure 22). However, no new termite tunnels were observed in the area. No immediate action is necessary.

Fire extinguishers throughout the Main Level were inspected and appear to have out-of-date inspections and/or need to be replaced (Appendix A, Figure 23). It is recommended that all fire extinguishers throughout the facility be inspected and corrective actions taken, as necessary (repeat from 2018).

- **Dome-Mezzanine Level:** Access to ladders and stairways leading to the mezzanine level are being effectively maintained and controlled (Appendix A, Figures 12 and 13). The structure appears sound and in good condition. 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 before the 2015 annual survey. This coating appears to have suffered some damage on the south side due to the 2017 hurricane season (Appendix A, Figure 32), but is functional. Both entrance portals are in good condition. During the time of the 2019 Annual Survey, a renovation project at the southern entrance was underway and includes the bathroom facilities in that area.
- **Surrounding Land:** 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. The surrounding land uses have not significantly changed and do not appear to be a site security/access issue to the BONUS Facility. No immediate action is necessary.
- **General Site Upkeep:** Improvements to the Theatre Building have been made and renovation of the southern entrance continues. The general condition of the remaining ancillary buildings has not significantly changed. It is recommended that pest control inspection/treatment and roof repairs continue to be administered, as needed, at the BONUS Facility and ancillary buildings.
- **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. However, the fence on the fence-side of the property was severely damaged in 2017 (see bullet above, Site Surveillance Features). No immediate action is necessary.

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## 5.0 DIRECT RADIATION MONITORING

Table 1 (Section 3) 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	4	4.9	6	416	<u>0.0025</u>	<u>2</u>	NA
Main Level (Controlled Area)	3	5.9	16	416	<u>0.007</u>	<u>2</u>	NA
Main Level (Public Access)	5	5.1	6	2,080 (employee)	<u>0.012</u>	<u>2</u>	NA
				832 (visitor)	<u>0.005</u>	NA	<u>0.1</u>
Basement Level	4	5.6	15	416	<u>0.006</u>	<u>2</u>	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  $6 \mu\text{R}/\text{hour} \times (1 \text{ rem}/1,000,000 \mu\text{R}) \times (8 \text{ hours}/1 \text{ week}) \times (52 \text{ weeks}/1 \text{ year}) = 0.0025 \text{ rem}/\text{year}$ .

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 also provides a copy of instrument calibration sheets and relevant daily response checks. 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		
7	5	5	0	Very good
28	15	15	0	Very good
31	14	14	0	Very good
40A	13	13	0	Very good
71	4	4	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 (Section 3) 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. Survey Location 11 exhibited a 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 MDA, both of which were above the 5,000 dpm/100 cm<sup>2</sup> total surface action level (11,673 and 68,997 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. Prior to collecting masslin samples, smear samples were also collected from the floor surface of the Main Level (public access area) at five Quarterly Survey locations (Locations 65-Q through 69-Q). Masslin and 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, Figures 4 through 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 to be evaluated for transferable/removable surface contamination only (i.e., only smear samples/masslin were planned to be performed). Masslin samples (survey locations 42, 43, 70, 71, 81, and 89-103), which were planned to be collected from the floor surface of the Basement Level to assess transferable or removable surface beta/gamma contamination, could not be collected due to 1- to 2-inches of standing water on the Basement 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 (planned 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, had total surface beta/gamma contamination levels above the 5,000 dpm/100 cm<sup>2</sup> action level (5,299 dpm/100 cm<sup>2</sup>). Additionally, two survey locations, 30 and 31, exhibited a total surface contamination level above MDA, but well below the 5,000 dpm/100 cm<sup>2</sup> action level.

The changed condition involving Condensate Pumps #1 and #2, which was observed during the 2018 Annual Survey, could not be re-assessed due to the presence of standing water. The loose contaminated material does not appear to have migrated significantly due to the standing water based on visual inspection. The area immediately surrounding the condensate pumps must be re-surveyed during the 2020 Annual Survey to determine if loose/removable contamination has migrated due to the accidental flooding of the Basement Level.

Recommendations for access control and posting of the Basement Level are provided below:

- All areas of the Basement Level – Conditions at Condensate Pumps #1 and #2, which were previously noted during the 2018 Annual Survey, and the accidentally flooding of this level during the week of 18 November 2019, warrant posting the entire Basement Level as a Controlled Area (temporary posting was accomplished via signage during the 2019 Annual Survey [Appendix A, Figure 13]). It is recommended that a RWP be prepared for general entry/exit of the area for visual inspection and performing survey measurements. Administrative procedures should be in place to ensure that no other work (beyond the activities covered under the general access RWP) is performed on this level without

review and approval by the RCM. Job-specific RWP's will be required for any future intrusive work in this area until the potential spread of removable contamination can be re-assessed. It is further recommended that U.S. Department of Energy responsible persons be engaged to address the condition associated with Condensate Pumps #1 and #2 (e.g., removal/disposal of loose debris and entombment of the pumps).

**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 also provides a copy of instrument calibration records and relevant daily response checks. Duplicate field measurements were also made at a rate of 5% and are summarized in Table 4. All QA/QC checks performed within acceptable limits.

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

Location	Result (dpm/100 cm <sup>2</sup> )		RPD (%)	Comments
	Initial	Duplicate		
16 (Removable)	<MDA	<MDA	NA	Good
19 (Total Surface)	<MDA	<MDA	NA	Good
28 (Total Surface)	68,997	69,998	1.4%	Good
28 (Removable)	<MDA	<MDA	NA	Good
40A (Total Surface)	5,299	5,484	3.4%	Good
40A (Removable)	<MDA	<MDA	NA	Good

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

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## **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 2019 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, except for the Basement Level. Any 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. Job-specific RWP>s may be required for any future intrusive work in the facility.
- Physical Condition:
  - Falling trees damaged the fence surrounding the property during the 2017 hurricane season at approximately six locations totaling approximately 100-ft in length (Appendix A, Figure 36). Recommend removing fallen trees and engaging a fencing contractor to repair the sections of damaged fence (repeat from 2018).
  - It is recommended that absorbent clothes continue to be placed at those locations where oil/grease is accumulating on the Concrete Monolith and, especially, if/after the crane is moved.
  - Although immediate action is not critical, it is recommended that an additional layer of concrete be placed over Sample Locations 40A and 40B within the next year (Appendix A, Figure 28).
  - It is recommended that, when the gasket around the base of the Dome is replaced, the gasket be installed in a manner that does not retain rainwater.
  - Fire extinguishers throughout the Main Level were inspected and appear to have out-of-date inspections and/or need to be replaced (Appendix A, Figure 23). It is recommended that all fire extinguishers throughout the facility be inspected and corrective actions taken, as necessary (repeat from 2018).
  - It is recommended that pest control inspection/treatment and roof repairs continue to be administered, as needed, at the BONUS Facility and ancillary buildings.
- 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 RWP>s 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.
- Basement Level: Conditions at Condensate Pumps #1 and #2, which were previously noted during the 2018 Annual Survey, and the accidentally flooding of this level during the week of 18 November 2019, warrant posting the entire Basement Level as a Controlled Area (temporary posting was accomplished via signage during the 2019 Annual Survey [Appendix A, Figure 13]). It is recommended that a RWP be prepared for general entry/exit of the area for visual inspection and performing survey measurements. Administrative procedures should be in place to ensure that no other work (beyond the activities covered under the general access RWP) is performed on this level without review and approval by the RCM. Job-specific RWPs will be required for any future intrusive work in this area until the potential spread of removable contamination can be re-assessed. It is further recommended that U.S. Department of Energy responsible persons be engaged to address the condition associated with Condensate Pumps #1 and #2 (e.g., removal/disposal of loose debris and entombment of the pumps). Public access is not permitted on the Basement Level. Posting of the Basement Level and/or within portions of the Basement Level will be updated after the water has evaporated and the area immediately surrounding Condensate Pumps #1 and #2 has been re-surveyed.
- Per SOP PBR-11.1.4, routine surveys are required to ensure removable contamination remains below action levels. For this purpose and since a changed condition was noted during the 2018 and 2019 surveys, 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).

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**APPENDIX A  
PHOTOS**

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**Figure 1. Entombment Top (Top Plug, Northwest Side) – Oil Pads Due to Overhead Crane**

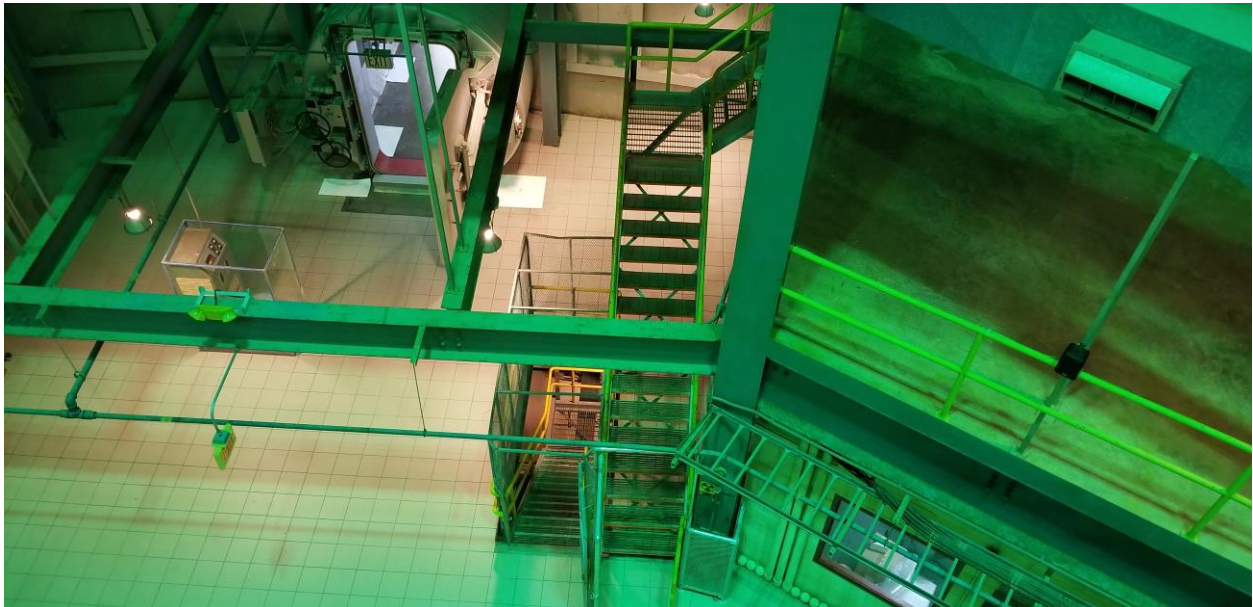


**Figure 2. Entombment Top – Pad has been Placed to Address Oil Leaking from Overhead Crane (Near Sampling Points 1, 2, 3, and 4)**





**Figure 3. Entombment Top – Surficial Cracks (Typical)**



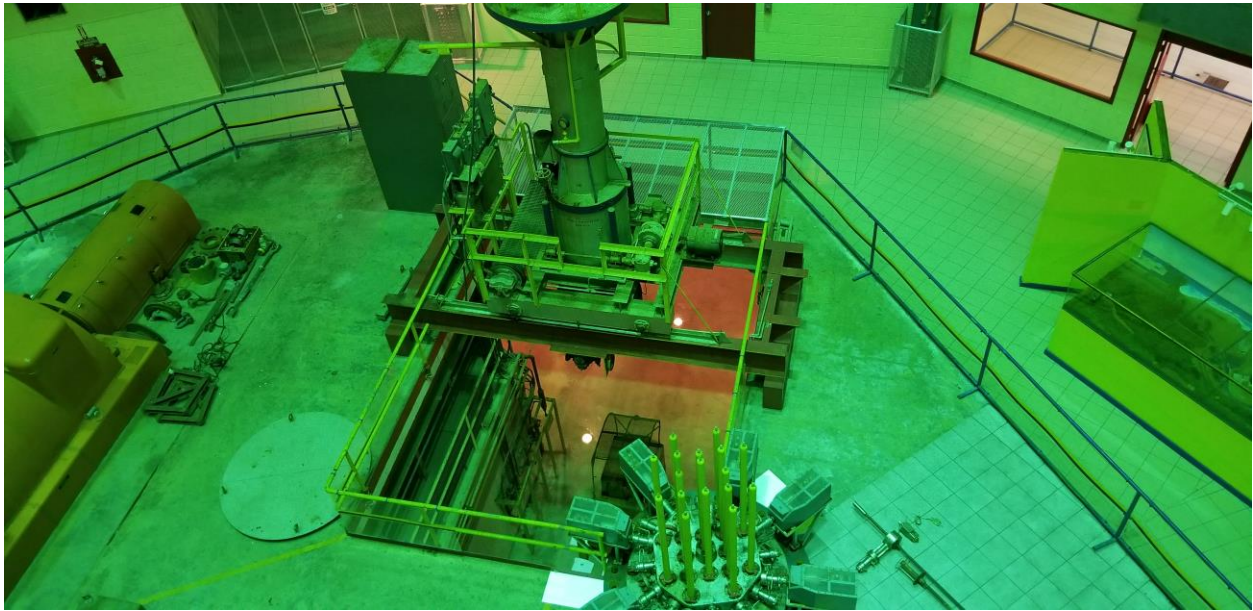
**Figure 4. Main Level (Southwest Side) – Overhead View**



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



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



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



**Figure 8. Main Level (North/Northeast Side) – Overhead View**



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



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



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



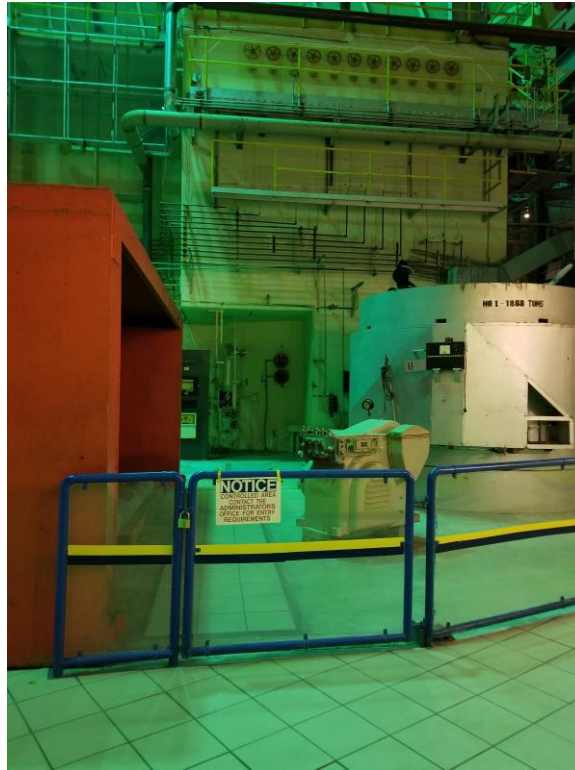
**Figure 12. Main Level – Locked and Controlled Access to South Mezzanine**



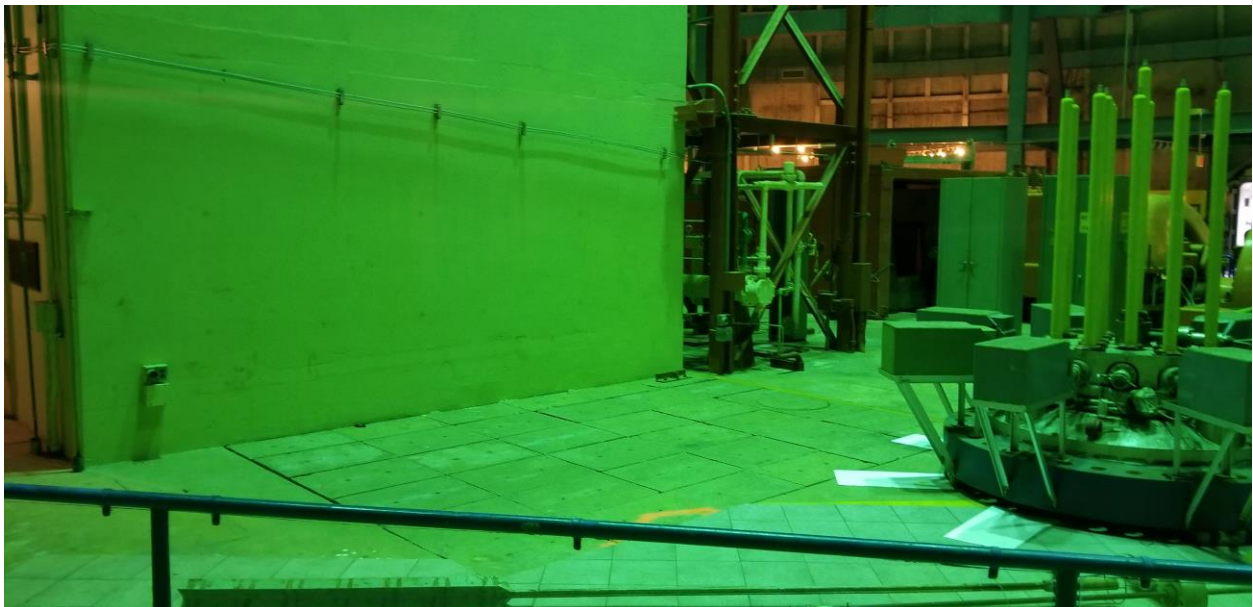
**Figure 13. Main Level (Museum Area) – Locked and Controlled Access to South Side of Basement Level (Left) and Mezzanine (Right)**



**Figure 14. Main Level (Museum Area) – Locked and Controlled Access to Machine Shop (Left) and Electrical Shop (Right) Former File Storage**



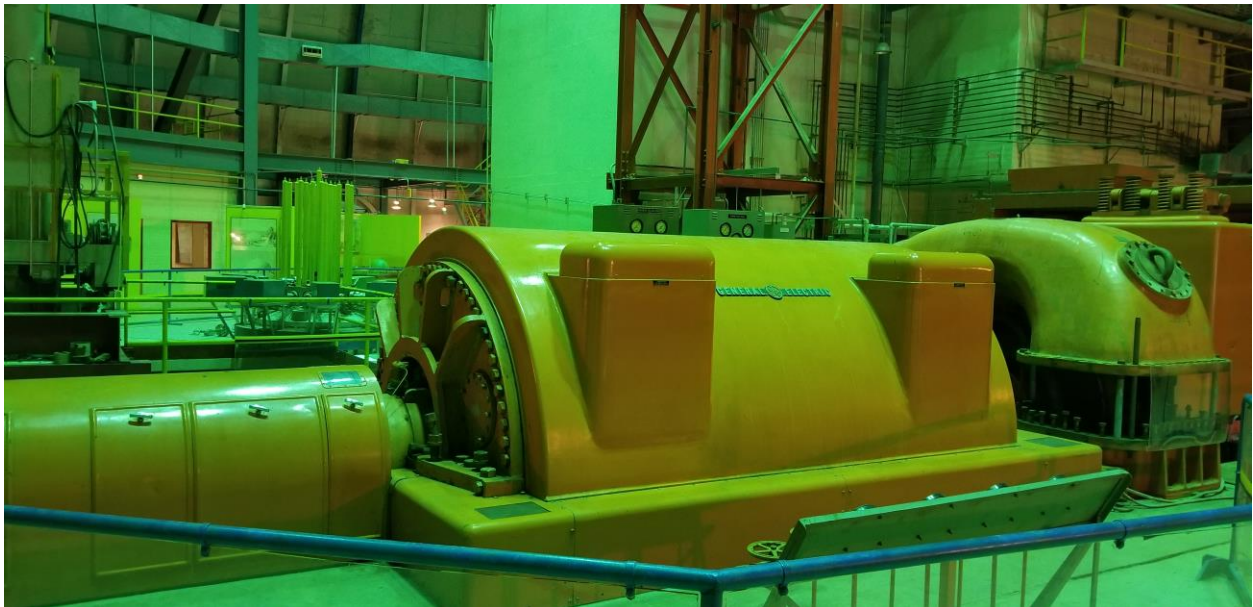
**Figure 15. Main Level (Controlled Area) – Locked Access from Museum Area to Controlled Area**



**Figure 16. Main Level (Controlled Area) – Southeast Side**



**Figure 17. Main Level (Controlled Area) – East Side**



**Figure 18. Main Level (Controlled Area) –Northeast Side**





**Figure 19. Main Level (Controlled Area) – North Side**



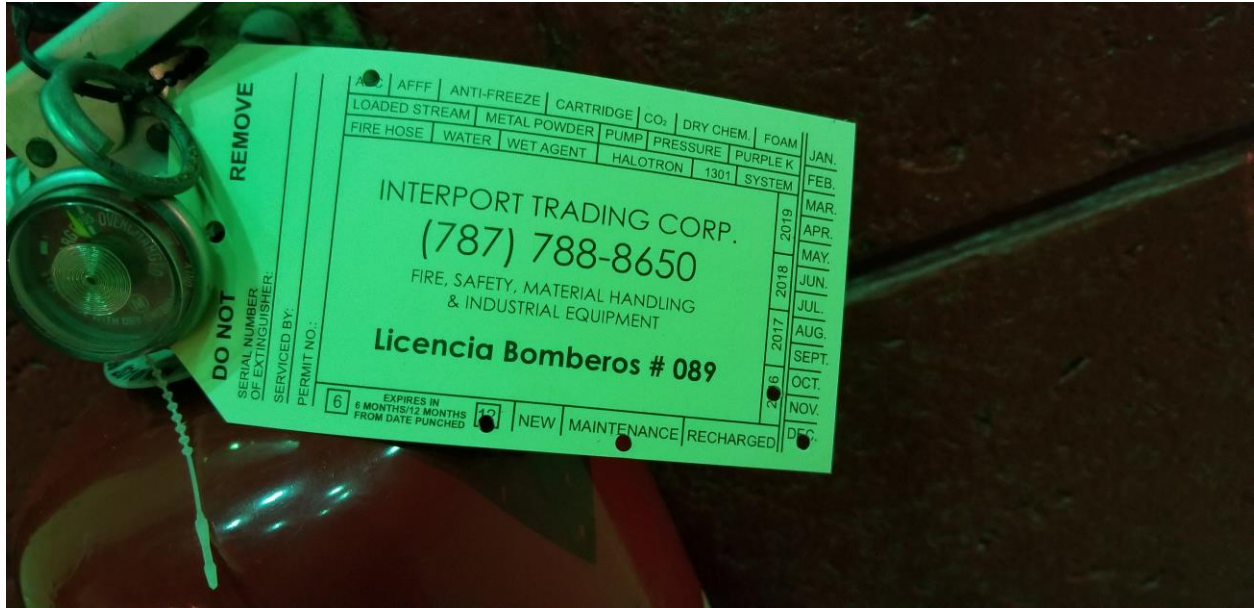
**Figure 20. Main Level (Controlled Area) – Northwest Side**



**Figure 21. Main Level (Controlled Area) – Engineering Controls (Concrete, Tiles, and Lead Bricks) in Good Condition**



**Figure 22. Main Level (Museum Area) – Wood Paneling with Past Evidence of Termites (East Side)**



**Figure 23. Main Level (Museum and Controlled Areas) – Fire Extinguisher Inspections Out of Date**



**Figure 24. Basement Level – Oil/Lubricant Spots on Basement Floor from Overhead Equipment (1- to 2-Inches of Water on Floor)**



**Figure 25. Basement Level – Beneath North Entrance Air Lock (No Signs of Recent Water Infiltration – Older Stains Persist) – 1- to 2-Inches of Water on Floor Due to Accidental Flooding**



**Figure 26. Basement Level – Concrete Filled Sink**



**Figure 27. Basement Level – Lowest Point in Basement with No Standing Water in Sump (1- to 2-Inches of Water on Floor Due to Accidental Flooding)**



**Figure 28. 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” (Water on Floor)**



**Figure 29. Basement Level – Painted Flange (Engineering Controls) at Former Decontamination Sink Location**



**Figure 30. Basement Level – Sample Locations #30 and #31 on Liquid Water Retention Tanks with Engineering Control (Yellow Paint) – Showing Signs of Wear**



**Figure 31. Basement Level – Condensate Pumps #1 and #2 with Loose/Removable Contaminated debris (1- to 2-Inches of Water on Floor)**





**Figure 32. Dome Structure – Exterior with Protective Coating and Paint**



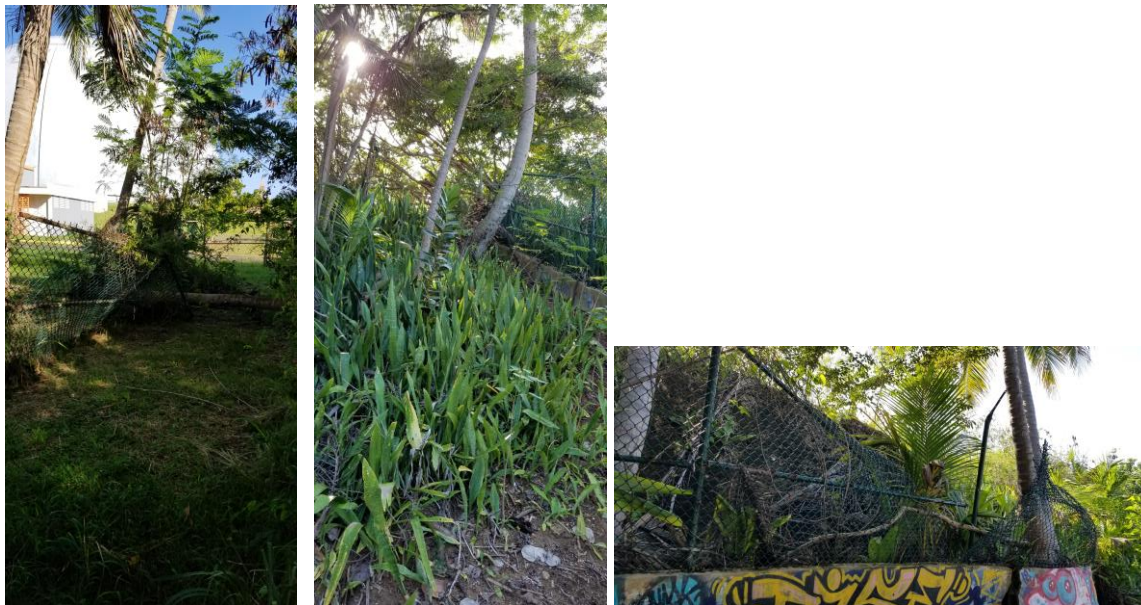
**Figure 33. Dome Structure – Interior with Fire Suppression Piping**



**Figure 34. Dome Structure – Drainage Outfall Points and Ditches (Southern Outfall)**



**Figure 35. Dome Structure – Drainage Outfall Points and Ditches (Under Main Access Road)**



**Figure 36. Fence –Fencing and Perimeter – 2017 Hurricane Season Damaged Several Sections of Fencing (Approximately 100-ft Total Length)**



**Figure 37. Dome Structure – Flexible Gasket/Seal – Dome Perimeter**



**Figure 38. Dome Structure – Rain Trough Below Flexible Gasket/Seal (Drain is Free of Debris)**



**Figure 39. Security – Main Gate in Good Working Condition (Manual Open/Close)**



**Figure 40. Ancillary Buildings and Structures – Bathroom and Museum Area at South Entrance**

**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 11/20/19 - 1130hrs Task Number NA

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 2019 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	7/18/2020	44-9	154511	7/18/2020	18%	10 12	48	666
Ludlum 2221	149991	7 118 120	44-9	154511	7 118 120	18%	10 12	55	713

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	North Side	NA	40	NA	<MDA
2	North Side	NA	46	NA	<MDA
3	North Side	NA	45	NA	<MDA
4	North Side	NA	40	NA	<MDA
24	North Side**	NA	22	NA	<MDA
26	North Side**	NA	25	NA	<MDA
NA	NA	NA	NA	NA	NA

Survey Technician: C. Webb and J. Lopez

Reviewed By: C. Webb

\*\* Different background used for #24 and #26.

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

Background in CPM = 66

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building Time: 1130 Hrs Date: Yr 19 Mo 11 Dy 20

Task: Comprehensive Survey RWP: NA

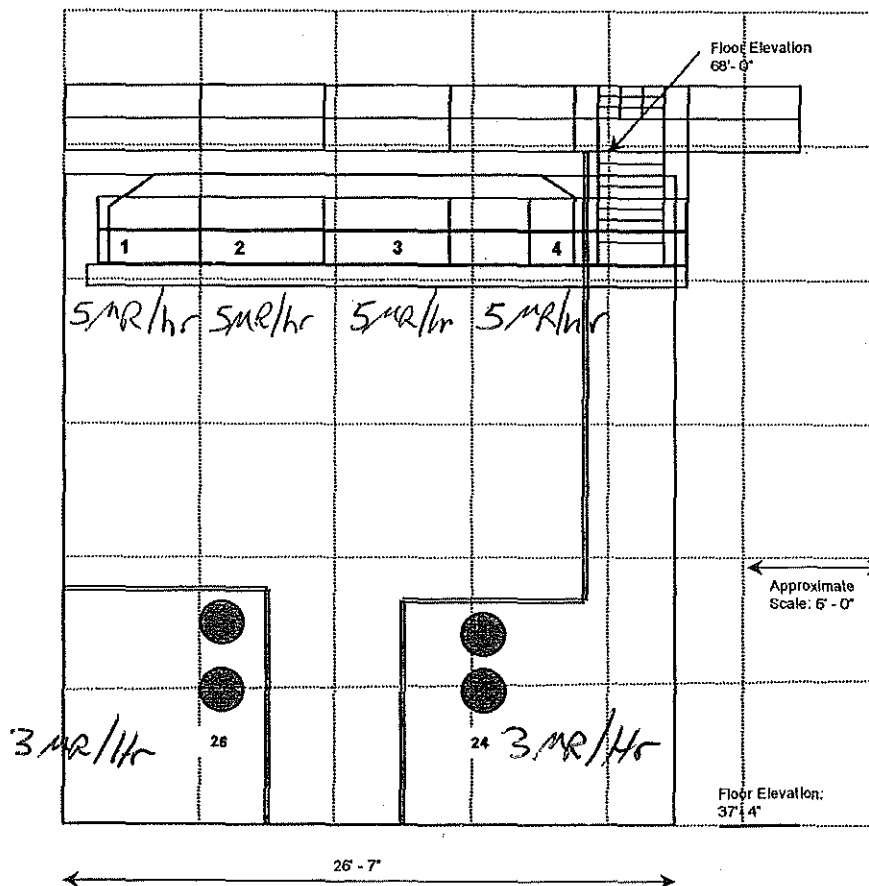
Map key: ° = Sample Location □ = Air Sampler Location \_ = Core Sample

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

Building: Entombed Reactor Building Location: North Side

Sketch: **Entombment System - North View**

1 = Sample Locations



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

Survey Technician(s): J. Lopez

Reviews:  
C. Webb  
ca Webb

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

**Rincón, Puerto Rico**

**CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 11/20/19 -- 1205 Hrs Task Number NA

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 2019 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	7/18/2020	44-9	154511	7/18/2020	18%	10 12	48	666
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	47		<MDA
6	Top Plug Face	NA	56		<MDA
7	Top Plug Face	NA	54		<MDA
8	Top Plug Face	NA	52		<MDA
9	Top Plug Face	NA	57		<MDA
10	Top Plug Face	NA	65		<MDA
11	Top Plug Face	NA	71		852
12	Top Plug Face	NA	59		<MDA
13	Top Plug Face	NA	57		<MDA
14	Top Plug Face	NA	60		<MDA
15	Top Plug Face	NA	57		<MDA
16	Top Plug Face	NA	51		<MDA
17	Top Plug - Top Surface	NA	51		<MDA
18	Top Plug - Top Surface	NA	42		<MDA
19	Top Plug - Top Surface	NA	49		<MDA
19 Dup	Duplicate	NA	53		<MDA

Survey Technician: J. Lopez

Reviewed By: C. Webb

\*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: 1205 Hrs Date: Yr 19 Mo 11 Dy 20

Task: Comprehensive Survey RWP: NA

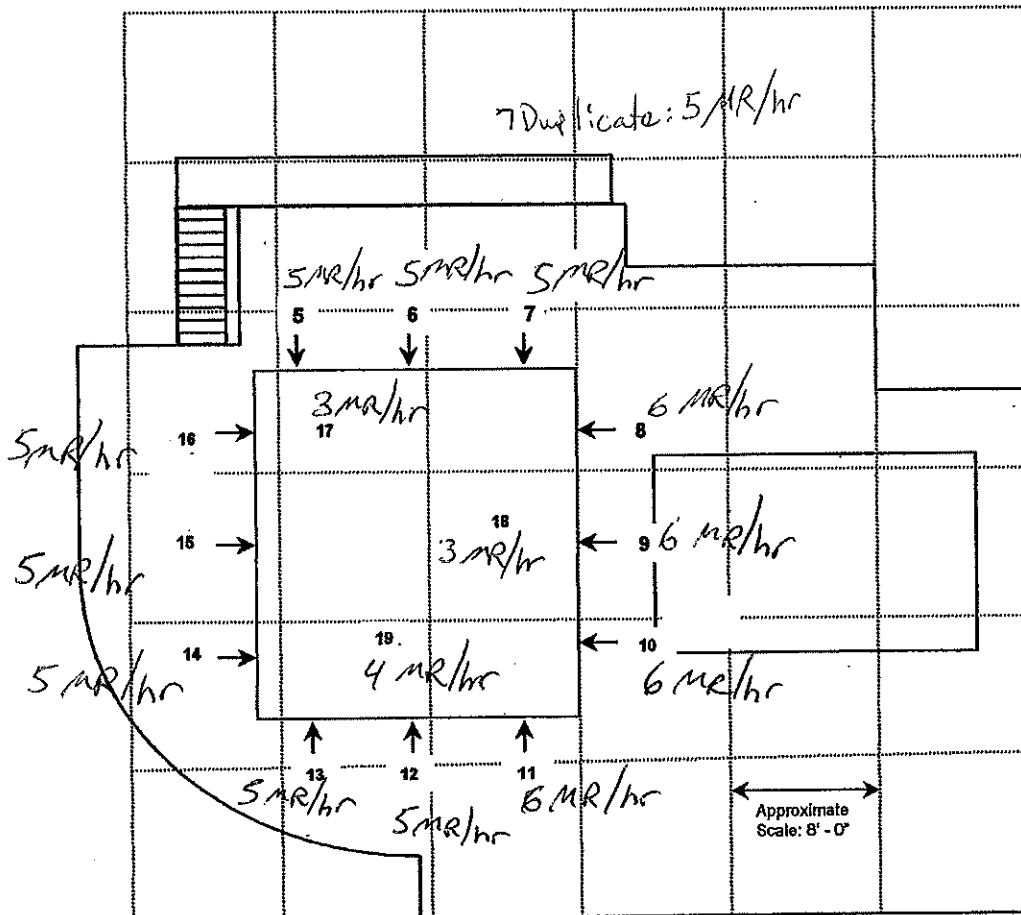
Map key: ° = Sample Location □ = Air Sampler Location \_\_\_ = Core Sample

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:

• = Sample Locations



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

Survey Technician(s): J. Lopez

QC: C. Webb

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 11/21/19 - 1105 Hrs Task Number NA

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 2019 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	7/18/2020	44-9	154511	7/18/2020	18%	1012	55	713
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	31	NA	<MDA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: J. Lopez  
 Reviewed By: C. Webb

\*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 19 Mo 11 Dy 21

Task: Comprehensive Survey RWP: NA

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

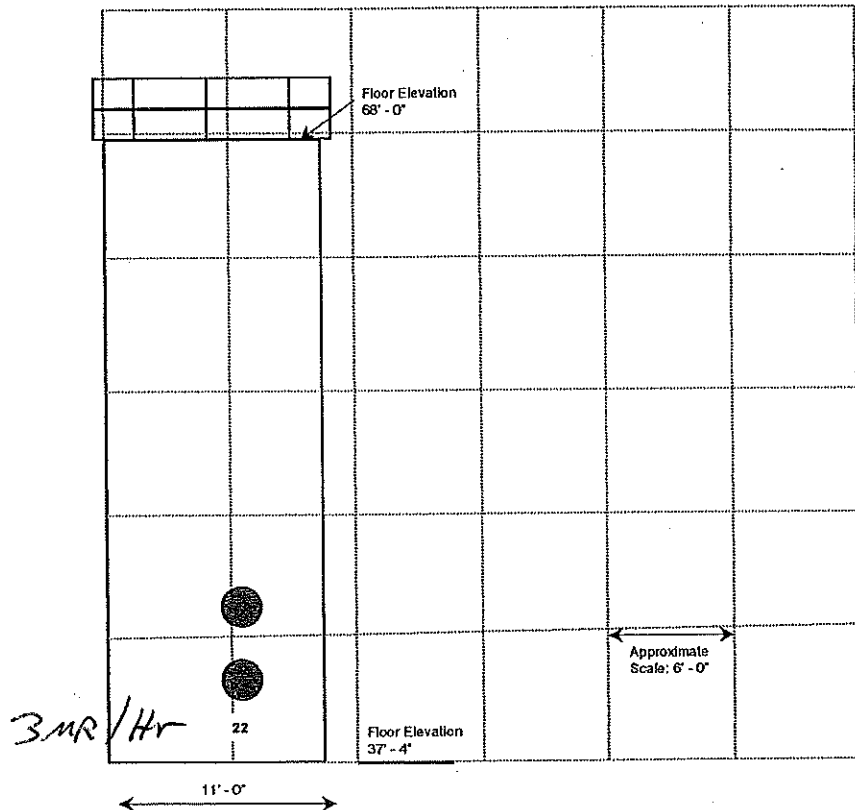
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: South Side

Sketch:

Entombment System - South View

1 = Sample Locations



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

Survey Technician(s): H. Santiago

Review:  
C. Webb  
C. Webb

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 11/21/19 - 1110 Hrs Task Number NA

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 2019 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	7/18/2020	44-9	154511	7/18/2020	18%	1012	55	713
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	28	NA	<MDA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: J. Lopez  
 Reviewed By: C. Webb

\*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: 1110 Hrs Date: Yr 19 Mo 11 Dy 21

Task: Comprehensive Survey RWP: NA

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

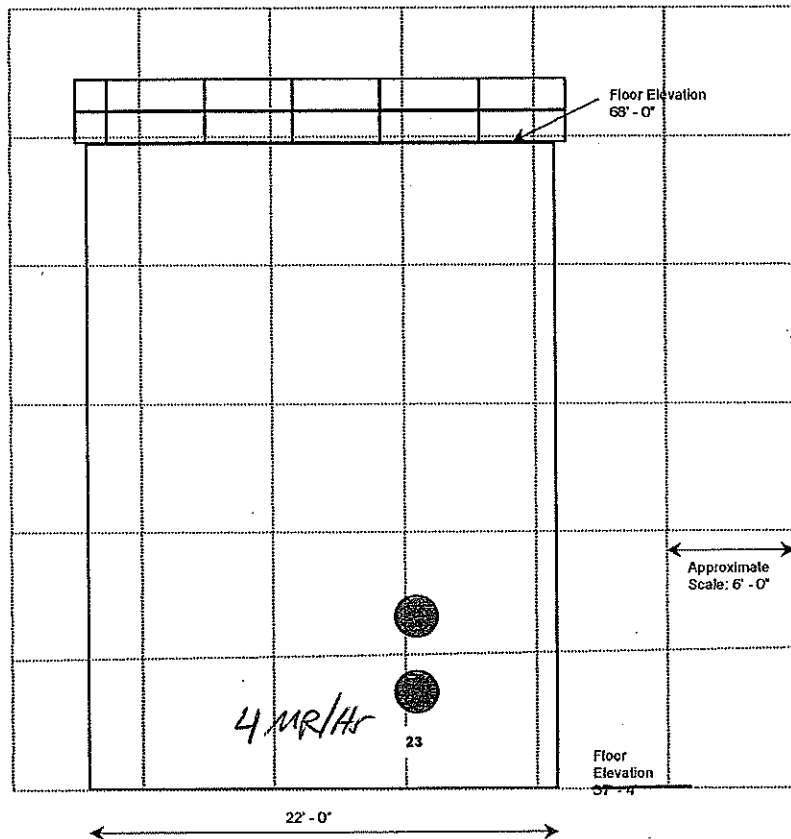
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: SouthWest Side

Sketch:

**Entombment System - Southwest View**

1 = Sample Locations



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

Survey Technician(s): H. Santiago *[Signature]*

Review: C. Webb  
*[Signature]*

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 11/21/19 - 1115 Hrs Task Number NA

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 2019 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	7/18/2020	44-9	154511	7/18/2020	18%	1012	55	713
NA	NA	NA	NA	NA	NA	NA%	NIA	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>	
		βy Removable	βy Total	βy Removable	βy Total
25	NorthWest Side	NA	32	NA	MDA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: J. Lopez  
 Reviewed By: C. Webb

\*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: 1115 Hrs Date: Yr 19 Mo 11 Dy 21

Task: Comprehensive Survey RWP: NA

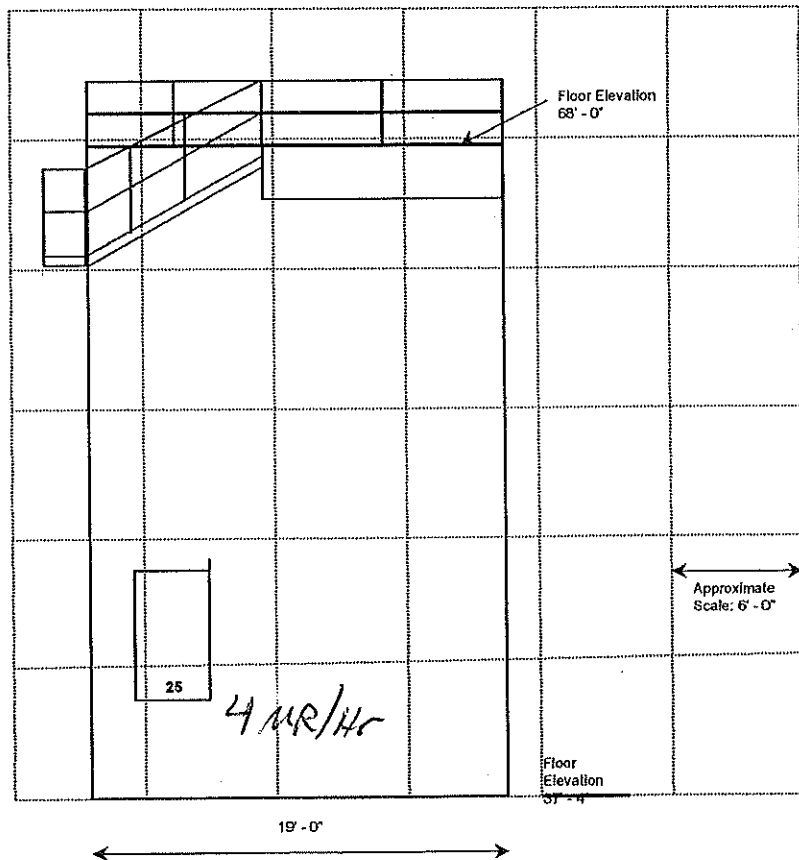
Map key: ° = Sample Location □ = Air Sampler Location \_ = Core Sample

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): Model 19, 148190

Survey Technician(s): H. Santiago *[Signature]*

Review: *C. Webb*  
*[Signature]*

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 11/21/19 - 1130 Hrs Task Number NA

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 2019 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	7/18/2020	44-9	154511	7/18/2020	18%	10, 2	55	713
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
20	Main Floor	NA	49	NA	<MDA
21	Main Floor	NA	52	NA	<MDA
27	Main Floor	NA	370	NA	11,673
28	Main Floor	NA	1,917	NA	68,997
27A	Main Floor	NA	68	NA	<MDA
27B	Main Floor	NA	66	NA	<MDA
28 Dup	Main Floor	NA	1,944	NA	69,998
NA	NA	NA	NA	NA	NA

Survey Technician: J. Lopez

Reviewed By: C. Webb

\*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 11/21/19 - 1410 Hrs Task Number NA  
 Specific Area of Survey: Entombed Building-Main Floor MDA= $(2.71/Tbkg + 3.3\sqrt{Bkg/Tbkg+Bkg/Ts})/E \times CF$  <sup>cw</sup> 11/21/19  
 Purpose of Survey: Year 2019 Comprehensive Survey A= $(Sample-Bkg)/E \times CF$  <sup>cw</sup> 11/21/19

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	7/18/2020	44-9	154511	7/18/2020	18%	1011	45	NA
<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u> %	<u>NA</u>	<u>NA</u>	<u>NA</u>

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
65	Main Floor-Masslin (Zone 1)	40	N/A	<MDA	N/A
66	Main Floor-Masslin (Zone 2)	43	N/A	<MDA	N/A
67	Main Floor-Masslin (Zone 3)	32	N/A	<MDA	N/A
68	Main Floor-Masslin (Zone 4)	45	N/A	<MDA	N/A
69	Main Floor-Masslin (Zone 5)	35	N/A	<MDA	N/A
72	Main Floor-Masslin (Zone 6)	55	N/A	<MDA	N/A
73	Main Floor-Masslin (Zone 7)	40	N/A	<MDA	N/A
74	Main Floor-Masslin (Zone 8)	42	N/A	<MDA	N/A
75	Main Floor-Masslin (Zone 9)	39	N/A	<MDA	N/A
76	Main Floor-Masslin (Zone 10)	45	N/A	<MDA	N/A
77	Main Floor-Masslin (Zone 11)	39	N/A	<MDA	N/A
78	Main Floor-Masslin (Zone 12)	37	N/A	<MDA	N/A
79	Main Floor-Masslin (Zone 14)	<sup>cw</sup> 11/21/19 <del>33</del> 43	N/A	<MDA	N/A
80	Main Floor-Masslin (Zone 13)	37	N/A	<MDA	N/A

Survey Technician: I. Rosado + J. Lopez + Orlando Alcazar  
 Reviewed By: C. Webb *[Signature]*

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

$200 \text{ dpm}/100 \text{ cm}^2 \approx 8 \text{ cpm}$  use as MDA

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE:

Entombed Reactor Building

Time: 1415

Date: Yr 19 Mo 11 Dy 20

Task: Comprehensive Survey

RWP: NA

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

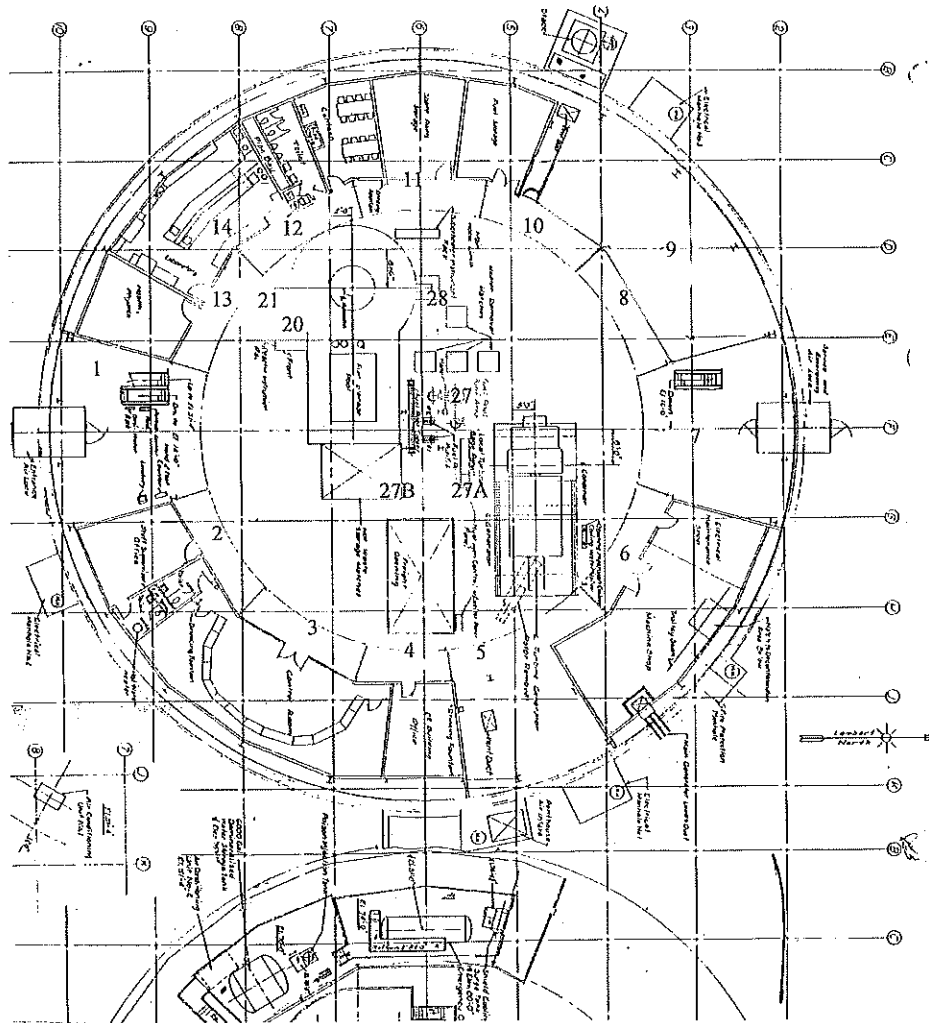
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

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 NA	NA
Zone NA	NA
20	5
21	4
27	16
28	15
27A	4
27B	4
28 Dup	15



CW  
11/20/19

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

Review:  
C. Webb  
CW Webb

Survey Technician(s): J. Lopez

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 11/21/19 0830 Hrs 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 2019 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	7/18/2020	44-9	154511	7/18/2020	18%	1012	35	570
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	67	NA	1,186
31	Basement Floor-Side of Tank #2	NA	71	NA	1,334
40A	Basement Floor-Wall (4" from floor)	NA	178	NA	5,299
40B	Basement Floor-Wall (4" from floor)	NA	42	NA	<MDA
42	Basement Floor (Not Accessible)**	NA	NA	NA	NA
43	Basement Floor (Not Accessible)**	NA	NA	NA	NA
50A	Basement Floor-Wall (block)	NA	50	NA	<MDA
50B	Basement Floor-Wall (concrete)	NA	31	NA	<MDA
40A Dup	Basement Floor-Wall (4" from floor)	NA	183	NA	5,484
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	NA	NA	NA	NA	NA

Survey Technician: Ivan Rosado  
 Reviewed By: C. Webb

\*\* Floor points not accessible due to flooding of Basement.

\*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: 0840

Date: Yr 19 Mo 11 Dy 21

Task: Comprehensive Survey

RWP: NA

Building: Entombed Reactor Building

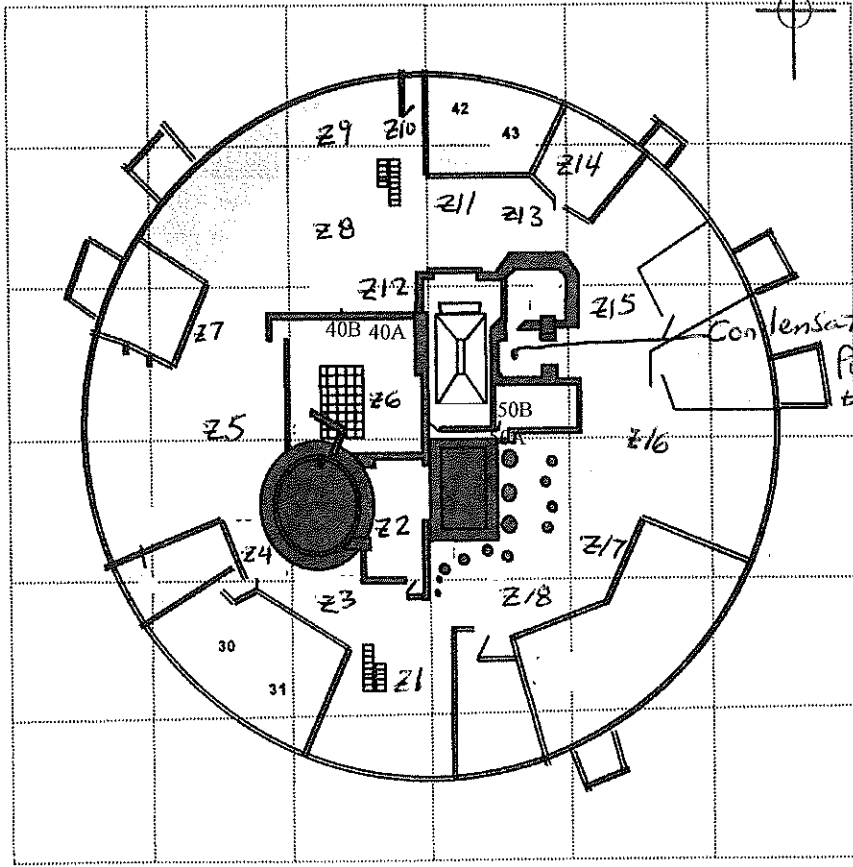
Location: Basement Floor

Sketch:

11/21/19  
cw  
11/21/19  
cw

No.	μR/hr
Zone 1 = 71	4
Zone 2 = 80	4
Zone 3 = 81	6
Zone 4 = 89	5
Zone 5 = 90	4
Zone 6 = 91	5
Zone 7 = 92	4
Zone 8 = 93	4
Zone 9 = 94	4
Zone 10 = 95	4
Zone 11 = 96	4
Zone 12 = 97	4
Zone 13 = 98	5
Zone 14 = 99	5
Zone 15 = 100	4
Zone 16 = 101	4
Zone 17 = 102	4
Zone 18 = 103	4
30	15
31	14
40A	13
40A Dup	13
40B	8
42	4
43	4
50A	5
50B	5
31 Dup	14
71 Dup	4

1 = Sample Locations



■ = SCM Survey Above 100 cm² limit

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

Survey Technician(s): I. Rosado

Reviews:  
C. Webb  
[Signature]



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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 11/20/19 - 1415 Hrs Task Number NA

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

Purpose of Survey: Year 2019 Comprehensive Survey A= $(Sample-Bkg)/E$

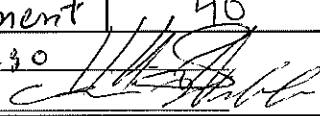
Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading CPM	MDA* dpm/100cm <sup>2</sup>
Ludlum 2221	149991	7/18/2020	44-9	154511	7/18/2020	18%	1011	45	130
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

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	Smear	32	NA	<MDA	NA
2	Smear	42	NA	<MDA	NA
3	Smear	40	NA	<MDA	NA
4	Smear	34	NA	<MDA	NA
5	Smear	37	NA	<MDA	NA
6	Smear	38	NA	<MDA	NA
7	Smear	39	NA	<MDA	NA
8	Smear	39	NA	<MDA	NA
9	Smear	37	NA	<MDA	NA
10	Smear	33	NA	<MDA	NA
11	Smear	42	NA	<MDA	NA
12	Smear	34	NA	<MDA	NA
13	Smear	41	NA	<MDA	NA
14	Smear	41	NA	<MDA	NA
15	Smear	44	NA	<MDA	NA
16	Smear	50	NA	<MDA	NA
16 Dup	Duplicate Measurement	40	NA	<MDA	NA

Survey Technician: Hector Santiago

Reviewed By: Chad Webb 

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

$$MDA_{cpm} = 68 \text{ cpm}$$

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - MMG Date/Time 11/20/19 - 1520 Hrs Task Number NA

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

Purpose of Survey: Year 2019 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 CPM	MDA*
Ludlum 2221	149991	7/18/2020	44-9	154511	7/18/2020	18%	1011	45	130
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
17	Smear	35	NA	<MDA	NA
18	Smear	40	NA	<MDA	NA
19	Smear	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
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	NA	NA	NA	NA	NA

Survey Technician: H. Santiago  
 Reviewed By: C. Webb

\*MDA is removable 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 11/21/19 - 1010 Hrs Task Number NA

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

Purpose of Survey: Year 2019 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	7/18/2020	44-9	154511	7/18/2020	18%	10 1 1	45	130
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	Smear	43	NA	<MDA	NA
31	Smear	46	NA	<MDA	NA
40A	Smear	46	NA	<MDA	NA
40ADup	Duplicate	35	NA	<MDA	NA
40B	Smear	59	NA	<MDA	NA
50A	Smear	31	NA	<MDA	NA
50B	Smear	42	NA	<MDA	NA
20	Smear	33	NA	<MDA	NA
21	Smear	42	NA	<MDA	NA
22	Smear	40	NA	<MDA	NA
23	Smear	30	NA	<MDA	NA
24	Smear	34	NA	<MDA	NA
25	Smear	29	NA	<MDA	NA
26	Smear	33	NA	<MDA	NA
27	Smear	37	NA	<MDA	NA
27A	Smear	29	NA	<MDA	NA
27B	Smear	39	NA	<MDA	NA

Survey Technician: H. Santiago

Reviewed By: C. Webb

\*MDA is removable 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 11/21/19 - 1400 Hrs Task Number NA

Specific Area of Survey: Smears MDA= $((2.71/\text{Tbkg} + 3.3\text{sqrt}(\text{Bkg}/\text{Tbkg} + \text{Bkg}/\text{Ts}))/E) \times \text{CF}$  <sup>cw</sup> 11/21/19

Purpose of Survey: Year 2019 Comprehensive Survey A= $(\text{Sample}-\text{Bkg})/E \times \text{CF}$  <sup>cw</sup> 11/21/19

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA*
Ludlum 2221	149991	7/18/2020	44-9	154511	7/18/2020	18%	1011	45	130
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
28	Smear	47	NA	<MDA	NA
28 Dup	Duplicate	42	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
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	NA	NA	NA	NA	NA

Survey Technician: H. Santiago  
 Reviewed By: C. Webb

\*MDA is removable/total 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:

*Care with  
M. Webb*

22 November 2019

Last Inspection:

30 November 2018

Inspectors:

C. Webb

and I. Rosado

Next Inspection (Planned):

Summer-Fall 2020

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>Moisture/standing water was observed on 11/20/19, but was dry by 11/22/19 - Monolith top. No structural damage/issues.</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>Could not access south outfall (Under road) pipes on west side are relatively free of sand and debris - good condition.</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 maintained. Basement Level was flooded with 1 to 2 inches of water due to renovation of the southern entry bathrooms (non-functioning valve).</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>See above. There is a concern that the loose contamination discovered in 2018 at Pumps (Condensate) #1 and #2 has spread due to flooding. PREPA is coordinating with DOE on management of the water.</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: Controls remain in good condition and are maintained. No active termite tracks/tunnels, but more granular material has accumulated (possible frass).
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: All access gates/controls locked. Fan/blower is not functional to exhaust and circulate air in the facility (and remove moisture).
8	Dome—exterior	Building should appear well maintained	Visually inspect. Notes: Dome exterior coating remains damaged on South side from 2017 hurricane.
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: No significant changes in surrounding land use.
10	General site upkeep	Building should appear well maintained.	Observe and evaluate changes in site conditions. Notes: Improvements of the Theatre Building have continued. Condition of ancillary buildings are in fair condition. Improvements to the South Dome entrance bld. continue.
11	Site security	Security guard should be stationed at site at all times.	Ensure security guard is present. Notes: Guard was present at all times.
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: No erosion impacting the beach slopes. However, the fence on beach-side was severely damaged in 2017 hurricane.



**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 always present and attentive - maintained lock/key for gate and controlled access. Guard kept entry/exit logbook.
Access through security gate	Note security of site; sign-in required on log sheet See above.
Security fence	Chain-link, topped with three strands of barbed wire Repeat - There is significant damage to the fence from 2017 hurricanes. There are several locations requiring repair. (approximately 100-ft or more).
Dome—monolith plaques	Visually inspect Plaques remain in good shape.

**APPENDIX D**  
**CALIBRATION SHEETS AND DAILY RESPONSE CHECKS**

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Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

www.ludlums.com

# CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**

501 Oak Street  
325-235-5494

Sweetwater, TX 79556, U.S.A.



**CERT # 4084.01**

Customer PUERTO RICO ELECTRIC POWER AUTHORITY ORDER NO. 20359613/481197  
 Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 148190  
 Mfg. \_\_\_\_\_ Model \_\_\_\_\_ Serial No. \_\_\_\_\_  
 Cal. Date 18-Jul-19 Cal Due Date 18-Jul-20 Cal. Interval 1 Year Meterface 202-016

Check mark  applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 49 % Alt 704.0 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.  
 Calibrated in accordance with LMI SOP 14.8  Calibrated in accordance with LMI SOP 14.9

Instrument Volt Set 550 V Input Sens. 31 mV Det. Oper. \_\_\_\_\_ V at \_\_\_\_\_ mV Threshold Dial Ratio \_\_\_\_\_ = \_\_\_\_\_ mV  
 HV Readout (2 points) Ref./Inst. \_\_\_\_\_ / \_\_\_\_\_ V Ref./Inst. \_\_\_\_\_ / \_\_\_\_\_ V

**COMMENTS:**

Cs-137 ≈ 1 µCi check source SN 2009 reads ≈ 270uR/hr@(500) with the source against the front of the can, lable down.

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

Multimeter uncertainty within 1.3% of reading, Gamma uncertainty within 5.0% of reading, Neutron uncertainty within 7.0% of reading, Count rate uncertainty within 5.4% of reading

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING
5000	4000 µR/hr	4000	4000
5000	1000 µR/hr	1000	1000
500	400 µR/hr = 71100 cpm	400	400
500	100 µR/hr	100	100
250	200 µR/hr = 36700 cpm	200	200
250	100 µR/hr	100	100
50	7110 cpm	40	40
50	1775 cpm	10	10
25	3670 cpm	20	20
25	910 cpm	5	5

50, 25 Range(s) Calibrated Electronically

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

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. All pass/fail determinations are based on the manufacturer's specifications without considering uncertainty factors. Measurement results represent expanded uncertainties expressed at approximately the 95% level of confidence, using a coverage factor of k=2. ISO/IEC 17025:2017(E) State of Texas Calibration License No. LO-1963 The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323A8-2013

Reference Instruments and/or Sources: Cs-137 S/N:  059  2171CP  2261CP  720  734  781  1131  1616  1696  1909  1916CP  2324/2521  5717CO  5719CO  60646  70897  73410  E552  G112  2168CP  S-394  S-1054  T10081  T10082 Neutron Am-241 Be  T-304 Ra-226  Y982  E551  5105  CSV280

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

m 500 S/N 238275  Oscilloscope S/N \_\_\_\_\_  Multimeter S/N 70602489

Calibrator Duaine Jackson Title Calibrator Date 18 Jul 19

QC'd By [Signature] Title Final QC Date 19 Jul 19

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.



**CERT # 4084.01**

Customer PUERTO RICO ELECTRIC POWER AUTHORITY ORDER NO. 20359613/481197  
 Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 149991  
 Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR154511  
 Cal. Date 18-Jul-19 Cal Due Date 18-Jul-20 Cal. Interval 1 Year Meterface 202-159

Check mark  applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 49 % Alt 704.0 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.  
 Calibrated in accordance with LMI SOP 14.8  Calibrated in accordance with LMI SOP 14.9  
 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 / 497 V Ref./Inst. 2000 / 1997 V

**COMMENTS:**

Cs-137 #2009 reading ~ 2,772cpm against the screen. Both 1/4 from surface.  
 Sr90Y90: 3432-09 14,775cpm with the source placed against protective screen of 44-9 detector.  
 Sr90Y90:sn 5281-04,act. 85,011dpm background 55cpm, source count. 23,153cpm, Eff 27% 41% 34,761 cpm  
 Co60:sn 0886,act. 3,012dpm background 55cpm, source count. 413cpm, Eff 13% 21% 645 cpm  
 Ni63:sn 99Ni220,act. 266,291dpm background 55cpm, source count. 340cpm, Eff 0.12% 0.70% 1,586 cpm  
 Cs-137(gamma):sn 0754,act. 145,370dpm background 55cpm, source count. 275cpm, Eff 0.18 0.26% 388 cpm  
 Cs-137(beta):sn 1075 ,act. 15,776dpm background 55cpm, source count. 3,854cpm, Eff 24% 32% 5,074 cpm  
 All Efficiencies are in 4pi. All efficiency taken 1/4" and from surface.  
 Firmware:26-10-10  
 Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.  
 Multimeter uncertainty within 1.3% of reading, Gamma uncertainty within 5.0% of reading, Neutron uncertainty within 7.0% of reading, Count rate uncertainty within 5.4% of reading

1/4" surface readings

Eff 27%	41%	34,761 cpm
Eff 13%	21%	645 cpm
Eff 0.12%	0.70%	1,586 cpm
Eff 0.18	0.26%	388 cpm
Eff 24%	32%	5,074 cpm

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING
X 1000	400 Kcpm	400	400
X 1000	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

ALL Range(s) Calibrated Electronically

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING
	400 K cpm	400/1000	400/1000		500 K cpm	495K	495K
	40 K cpm	400	400		50 K cpm	50	50
	4 K cpm	40	40		5 K cpm	5	5
	400 cpm	40	40		500 cpm	500cpm	500cpm
	40 cpm	4	4		50 cpm	50	50

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 All pass/fail determinations are based on the manufacturer's specifications without considering uncertainty factors.  
 Measurement results represent expanded uncertainties expressed at approximately the 95% level of confidence, using a coverage factor of k=2.  
 The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323AB-2013  
 ISO/IEC 17025:2017(E)  
 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 S/N:  059  2171CP  2261CP  720  734  781  1131  1616  1696  1909  1916CP  2324/2521  
 5717CO  5719CO  60646  70897  73410  E552  G112  2168CP  S-394  S-1054  T10081  T10082 Neutron Am-241 Be  T-304 Ra-226  Y982  
 E551  5105  CSV280  
 Alpha S/N \_\_\_\_\_  Beta S/N \_\_\_\_\_  Other \_\_\_\_\_  
 m 500 S/N 238275  Oscilloscope S/N \_\_\_\_\_  Multimeter S/N 70602489  
 Calibrator Duaine Jackson Title Calibrator Date 18 Jul 19  
 QC'd By [Signature] Title Final QC Date 19 Jul 19

AC Inst. Only	<input type="checkbox"/>	Passed Dielectric (Hi-Pot) and Continuity Test
	<input type="checkbox"/>	Failed: _____



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CONVERSION CHART  
FOR REFERENCE ONLY

Customer PUERTO RICO ELECTRIC POWER AUTHORITY ORDER NO. 20359613/481197

Date 18-Jul-19

Model 2221 Serial No. 149991 Detector Model 44-9 Serial No. PR154511

Source Cs-137 194.6 mCi  $\rightarrow$  3mCi High Voltage 900 V

Input Sensitivity 50 mV

"As Found" Readings (CPM):

After Adjustment Readings (CPM):

Reference Point	"As Found" Readings (CPM):		After Adjustment Readings (CPM):	
	Analog	Range/Scale	Analog	Range/Scale
150 mR/hr	330	x1k	330	x1k
50 mR/hr	150	x1k	150	x1k
15 mR/hr	55	x1k	55	x1k
5 mR/hr	185	x100	185	x100
1.5 mR/hr	55	x100	55	x100
1.0 mR/hr	3300 <sup>ST</sup>	x10	330	x10

"As Found" Readings:

After Adjustment Readings:

Reference Point	"As Found" Readings:		After Adjustment Readings:	
	Digital	Count Time	Digital	Count Time
150 mR/hr	33095	6sec.	33095	6sec.
50 mR/hr	14612	}	14612	}
15 mR/hr	5290		5290	
5 mR/hr	1885		1885	
1.5 mR/hr	533		533	
1.0 mR/hr	338		338	

Signature: Duaine Jackson *Duaine Jackson* Date 18 Jul 19



