DR. MODESTO IRIARTE TECHNOLOGICAL MUSEUM (FORMER BONUS FACILITY)

2016 ANNUAL RADIOLOGICAL SURVEY REPORT

RINCON
PUERTO RICO

October 2016

FOR THE PUERTO RICO ELECTRIC POWER AUTHORITY

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2016 ANNUAL RADIOLOGICAL SURVEY REPORT

RINCON, PUERTO RICO

October 2016

Prepared for:

Puerto Rico Electric Power Authority

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^2	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 12 – 15 September 2016 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^2)	Removable Contamination (dpm/100 cm^2)	Comments
Routine Sampling					
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 Dup=<MDA	<MDA	Monolith Top
Top Plug Face #1	5	7	<MDA	<MDA	Monolith Top
Top Plug Face #1	6	6	<MDA	<MDA	Monolith Top
Top Plug Face #1	7	3	702	<MDA	Monolith Top
Top Plug Face #2	8	5	<MDA	<MDA	Monolith Top
Top Plug Face #2	9	8	1,018 Dup=1,018	<MDA	Monolith Top
Top Plug Face #2	10	5	667	<MDA Dup=<MDA	Monolith Top
Top Plug Face #3	11	5	702	<MDA	Monolith Top
Top Plug Face #3	12	6	<MDA	<MDA	Monolith Top
Top Plug Face #3	13	5	<MDA	<MDA	Monolith Top
Top Plug Face #4	14	8	<MDA	<MDA	Monolith Top
Top Plug Face #4	15	4	1,018	<MDA	Monolith Top
Top Plug Face #4	16	5	<MDA	<MDA	Monolith Top
Top Plug Top Surface	17	3	667	<MDA	Monolith Top
Top Plug Top Surface	18	4	<MDA	<MDA	Monolith Top
Top Plug Top Surface	19	3 Dup=3	<MDA	<MDA	Monolith Top
Main Floor Water Column	20	5	<MDA	<MDA	Main Level-Controlled Area
Main Floor Water Column	21	4	632	<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	4 Dup=4	<MDA	<MDA	Main Level-Controlled Area
Pipe Chase Ext Hatch	25	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #4	26	4	<MDA	<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27	16 Dup=16	13,516	<MDA Dup=<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27A	4	772	<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^2)	Removable Contamination (dpm/100 cm^2)	Comments
Routine Sampling (Continued)					
Fuel Pool Purif Floor, area	27B	5	<MDA	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif. Floor (CM005)	28	13	56,414 Dup=55,782	<MDA Dup=<MDA	Main Level-Controlled Area
Side of Liq. Waste Ret. Tank #1	30	20	1,439	<MDA Dup=<MDA	Basement Level
Bottom of Tank #1	30A-1	14	16,886	<MDA Dup=<MDA	Basement Level
Side of Liq. Waste Ret. Tank #2	31	15	1,158	<MDA	Basement Level
F.W. Heater Room (Wall)	40A	19 Dup=19	4,739 Dup=5,231	<MDA	Basement Level
F.W. Heater Room (Wall)	40B	9	<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
Additional Sampling Locations					
Main Floor-Zone 1	65	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 2	66	6	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 3	67	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 4	68	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 5	69	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 6	72	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 7	73	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 8	74	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 9	75	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 10	76	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 11	77	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear

Table 1 (Continued)

Sampling Location	Sample Number	Dose Rate (µR/hour)	Total Contamination (dpm/100 cm^2)	Removable Contamination (dpm/100 cm^2)	Comments
Additional Sampling Locations (Continued)					
Main Floor-Zone 12	78	6	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 14	79	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 13	80	6	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Basement Floor-Zone 1	70	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 2	71	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 3	81	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 4	89	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 5	90	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 6	91	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 7	92	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 8	93	4	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 9	94	3	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 10	95	4	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 11	96	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 12	97	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 13	98	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 14	99	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 15	100	4	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 16	101	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 17	102	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 18	103	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
F.W. Heater Room (Wall), 5-ft from Floor	X1	9	61,555	<MDA Dup=<MDA	Basement Level – Additional Location

dpm/100 cm^2 = 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 it is manually operated by the attending guard (Appendix A, Figure 39). The security guard controlled access into the gated facility and kept a sign-in log of visitors. The fence surrounding the property is mostly functional at controlling access. However, it has been patched in many places as a temporary fix; there are also areas with gaps under the fence; and vegetation is crowding the fence in some areas (Appendix A, Figure 36). Recommend instructing the maintenance contractor to cut vegetation away from fencing to maintain a clear path around the perimeter of the property. One section of fence near the front gate is in need of repair (Appendix A, Figure 36). 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). 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. Absorbent clothes have continued to be 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, after the crane is moved.
- **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) and south side of the property (outside of perimeter fence) were inspected (Appendix A, Figure 34). One of the drainage pipes on the west side, where it passes under the main access road, is partially obstructed with silt and debris (Appendix A, Figure 35). It is recommended that the accumulated silt and debris be removed.
- **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 similar to past inspections, 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, 2014, and 2015). This appears to be centered on the grounding wire in this location which is attached to a structural steel column and passes through the concrete flooring (Appendix A, Figure 31). The spalling area does not appear any larger than

noted in 2015; however, loose/flaked concrete material is beginning to accumulate in the area. It is recommended that an electrician be contacted to inspect the grounding of structural steel in the basement. Also near Sample Locations 50A and 50B, oil/lubricant stains (similar to the previous 2015 inspection) were noted (Appendix A, Figure 24). It is recommended that absorbent clothes continue to be placed at these locations during quarterly surveys.

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 starting to show signs of thinning and wear, 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 year (Appendix A, Figure 30). 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:** 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 27). 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, 2014, and 2015), 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, remains intact and effective (Appendix A, Figure 25). The gasket is showing signs of weathering and surficial cracks 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 and 14), except for one area near the railing between the Controlled Area and Museum Area where the tiles feel loose or “floating” but no discernable cracks/failures are noticeable. The safety guard along the railing (Appendix A, Figure 17), 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 (termite frass) was observed (repeat from 2015) on the east side of Main Level (Museum Area) where plywood walls were constructed in recent years (Appendix A, Figure 22). It is recommended that this area be inspected by a termite professional and treated, as 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.

- **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. 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 is mostly in good condition. However, there is staining on the southwest side (Appendix A, Figure 32) below an iron channel, which is attached to the Dome exterior. The interior surface of the channel may not have been painted/coated and the corroded interior surface may be leaching/staining the Dome exterior. No immediate action is necessary. Both entrance portals are in good condition, except water is pooling on the roof above the southern portal and leaking onto the floor in front of the entrance to the portal (Appendix A, Figure 42) – refer to General Site Upkeep below.
- **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 Theatre Building and administrative building at the southern portal/entrance to the Dome were entered and inspected since they are utilized during museum tours. The roof of the administrative building at the south entrance of the Dome is holding water and leaks below onto the flooring in front of the southern portal (Appendix A, Figure 42). The roofing on other sections of the administrative building at the southern entrance is also in need of repair and leaking water into the rooms below (Appendix A, Figure 42). Evidence of termites ("mud tubes") was also noted in the administrative building at the southern portal/entrance to the Dome. Evidence of termites and rodents (Appendix A, Figure 41) were noted on the interior of the Theatre Building (repeat from 2015). It is recommended that pest control inspection and treatment be administered at the Theatre Building and administrative building at the southern portal/entrance to the Dome. It is recommended that roofing repairs be made on the administrative building at the south entrance to the Dome to prevent rain water retention and/or intrusion.

The roofing on the guard shack is also in need of repair. Water intrusion and staining is visible around the light fixtures (Appendix A, Figure 40). It is recommended that inspection and repair of the guard shack roofing be completed.

The remaining 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.

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 (µR/hour)			Expected Exposure Rate[a]		Annual Dose Limits (rem/year)	
	Min. (µR/hour)	Ave. (µR/hour)	Max. (µR/hour)	Max. Exposure (hour/year)	Rate (rem/year)	Rad Worker	Visitor
Monolith Top	3	4.9	8	416	0.003	2	NA
Main Level (Controlled Area)	4	6.1	16	416	0.007	2	NA
Main Level (Public Access)	4	4.9	6	2,080 (employee)	0.012	2	NA
				832 (visitor)	0.005	NA	0.1
Basement Level[b]	4	10.6	20	416	0.008	2	NA

rem = roentgen equivalent in man

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

[b]Does not include the additional survey location, X1, at a historical hot spot. Dose rate at X1 was 9 µR/hour.

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 µR/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		
24	4	4	0	Very good
19	3	3	0	Very good
27	16	16	0	Very good
40A	19	19	0	Very good

RPD = Relative Percent Difference = [(Sample – Duplicate)/((Sample + Duplicate)/2)] × 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. Six survey locations, 7, 9, 10, 11, 15, and 17 exhibited total surface contamination levels above MDA, but well below the 5,000 dpm/100 cm^2 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, four planned survey locations (21, 27, 27A, and 28) had total surface beta/gamma contamination levels above MDA, two of which were above the 5,000 dpm/100 cm^2 total surface action level (632; 13,516; 772; and 56,414 dpm/100 cm^2, 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^2. 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 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^2. 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 (planned survey locations 30, 31, 40A, 40B, 50A, and 50B, as well as an additional location for 2016, 30A-1 from the bottom of Liquid Waste Retention Tank #1). None of the smear samples from these locations exhibited removable contamination above MDA. However, two of these survey locations, 30A-1 and the duplicate for 40A, had total surface beta/gamma contamination levels above the 5,000 dpm/100 cm^2 action level (16,886 and 5,231 dpm/100 cm^2, respectively). Additionally, two survey locations, 30 and 31, exhibited a total surface contamination level above MDA, but well below the 5,000 dpm/100 cm^2 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. Re-application of the yellow paint on the liquid retention tanks (Appendix A, Figure 30) is recommended since the paint is showing signs of wear, historical smear samples (prior to painting) resulted in removable contamination above MDA, and elevated total surface level remain (e.g., sample locations 30, 31, and 30A-1).

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^2)		RPD (%)	Comments
	Initial	Duplicate		
4 (Total Surface)	<MDA	<MDA	NA	Good
9 (Total Surface)	1,018	1,018	0%	Very Good
10 (Removable)	<MDA	<MDA	NA	Good
27 (Removable)	<MDA	<MDA	NA	Good
28 (Removable)	<MDA	<MDA	NA	Good
30 (Removable)	<MDA	<MDA	NA	Good
30A-1(Removable)	<MDA	<MDA	NA	Good
40A (Total Surface)	4,739	5,231	9.9%	Good

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

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 2016 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:
    - The fence surrounding the property is functional at controlling access; however, vegetation is crowding the fence in some areas (Appendix A, Figure 36). Recommend instructing the maintenance contractor to cut vegetation away from fencing to maintain a clear path around the perimeter of the property. One section of fence near the front gate is also in need of repair (Appendix A, Figure 36). Recommend a more permanent repair to the fence in this location.
    - It is recommended that absorbent clothes continue to be placed at those locations where oil/grease is accumulating on the Concrete Monolith and, especially, after the crane is moved.
    - One of the drainage pipes on the west side (beach) of the property, where it passes under the main access road, is partially obstructed with silt and debris (Appendix A, Figure 35). It is recommended that the accumulated silt and debris be removed.
    - On the concrete flooring and structural steel near Sample Locations 50A and 50B, significant corrosion and concrete spalling is occurring (repeat from 2013, 2014, and 2015). The spalling area does not appear any larger than noted in 2015; however, debris is accumulating due to the spalling. This appears to have been 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 31). It is recommended that an electrician be contacted to inspect the grounding of structural steel in the basement.
    - Near Sample Locations 50A and 50B, oil/lubricant stains were noted (Appendix A, Figure 24). It is recommended that absorbent clothes continue to be placed at these locations during quarterly surveys.
    - Control measures (fixed with paint and concrete layer in some places), which were previously implemented, were inspected. 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 year (Appendix A, Figure 30).
    - Storm water drains appear to be functioning properly in the Basement Level, but the sump has filled with silt/mud (Appendix A, Figure 27) from past events. Sampling and removal of silt/mud should be planned within

the next two years (repeat from 2013, 2014, and 2015), 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, remains intact and effective (Appendix A, Figure 25). However, the gasket is showing signs of weathering and surficial cracks in the low areas of the gasket where it holds rain water and dries in the sun (Appendix A, Figure 37). 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.
- Evidence of termites (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). It is recommended that this area be inspected by a termite professional and treated, as 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.
- The roof of the administrative building at the south entrance of the Dome is holding water and leaks below onto the flooring in front of the southern portal (Appendix A, Figure 42). The roofing on other sections of the administrative building at the southern entrance is also in need of repair and leaking water into the rooms below (Appendix A, Figure 42). Evidence of termites ("mud tubes") was also noted in the administrative building at the southern portal/entrance to the Dome. Evidence of termites and rodents (Appendix A, Figure 41) were noted on the interior of the Theatre Building (repeat from 2015). It is recommended that pest control inspection and treatment be administered at the Theatre Building and administrative building at the southern portal/entrance to the Dome. It is recommended that roofing repairs be made on the administrative building at the south entrance to the Dome to prevent rain water retention and/or intrusion.
- The roofing on the guard shack is also in need of repair. Water intrusion and staining is visible around the light fixtures (Appendix A, Figure 40). It is recommended that inspection and repair of the guard shack roofing be completed.

- 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, walls, 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).

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APPENDIX A
PHOTOS

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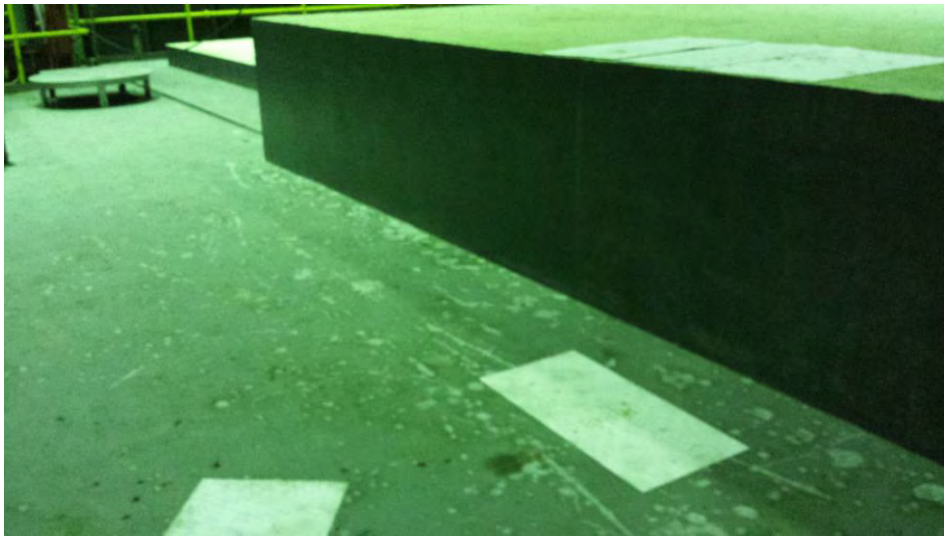

Figure 1. Entombment Top (Top Plug, Northwest Side) – Sampling Point 17 with Oil Pads Due to Overhead Crane (Left) and Oil Pad near Sampling Points 1 – 4.

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)

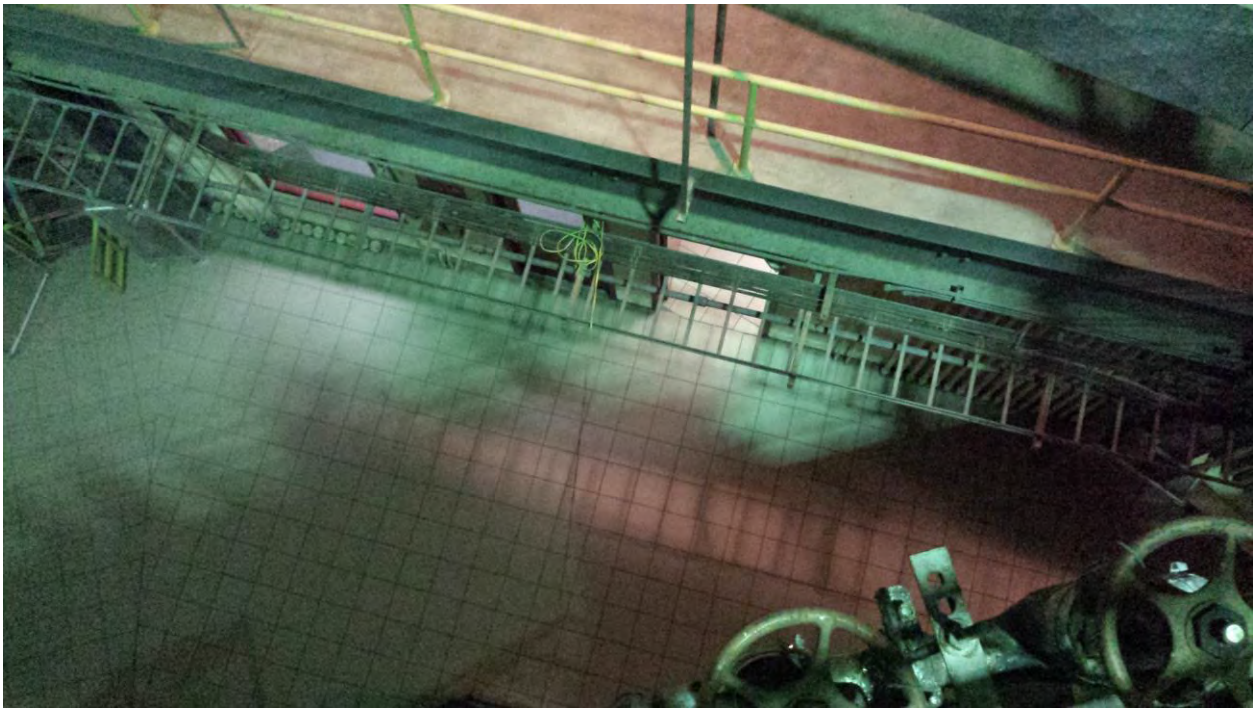

Figure 4. Main Level (Southwest Side) – Overhead View

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

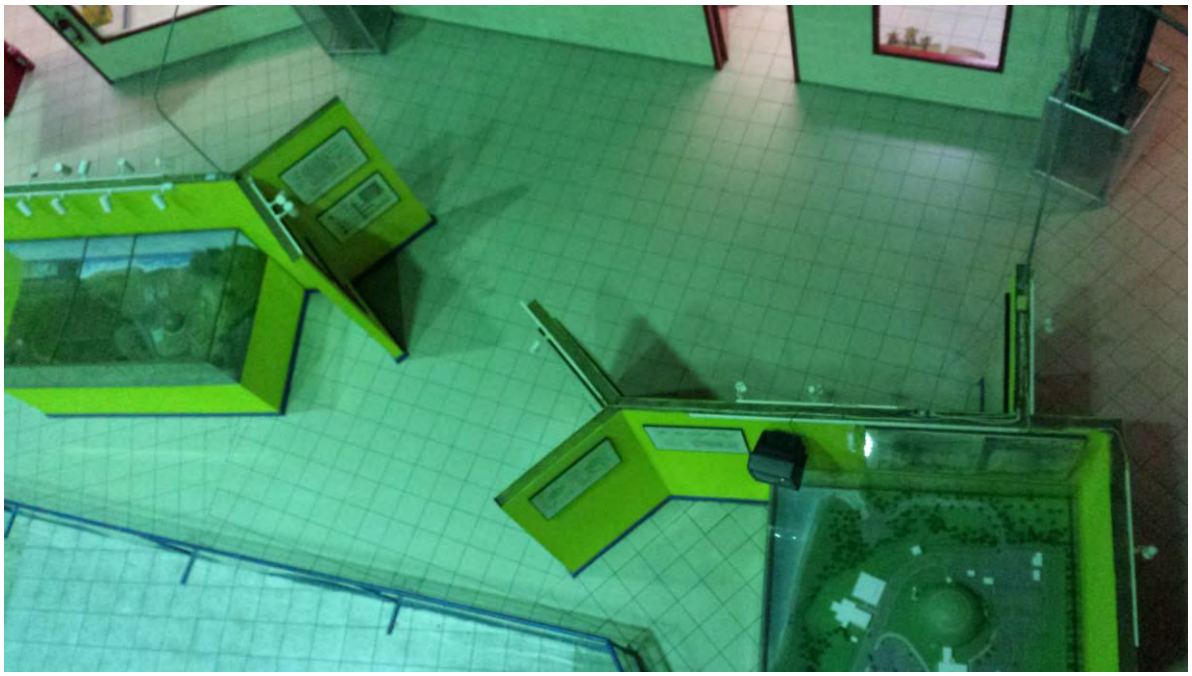

Figure 6. Main Level (Southeast Side) – Overhead View

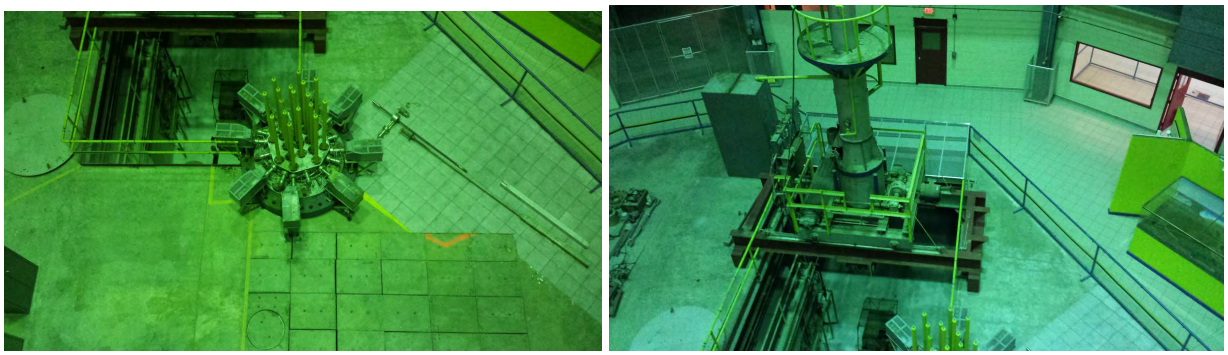

Figure 7. Main Level (East Side) – Overhead View

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

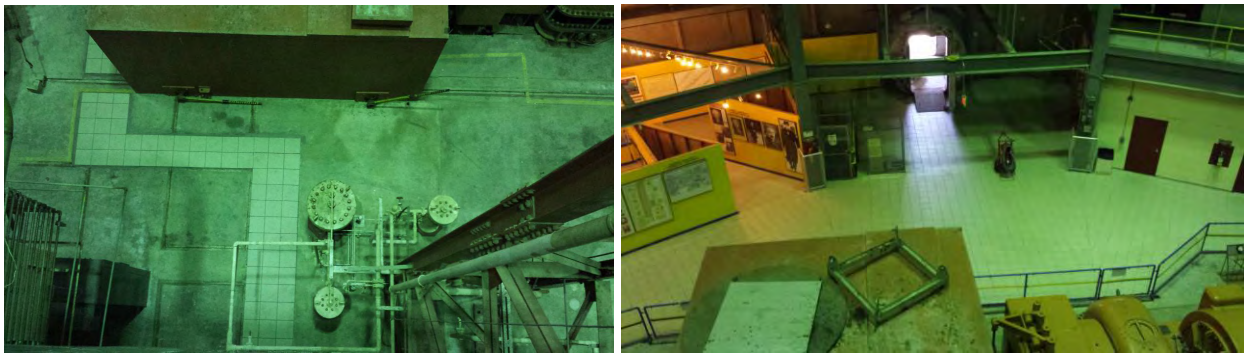

Figure 9. Main Level (North Side) – Overhead View

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

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

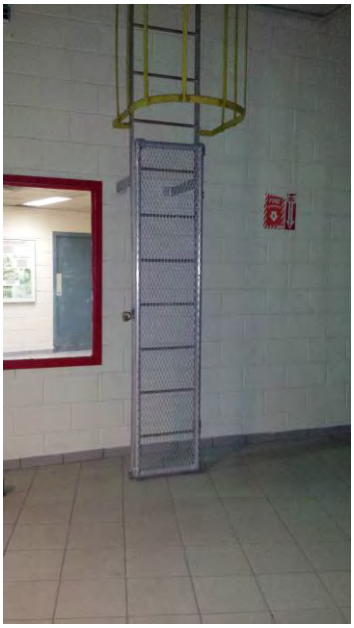

Figure 12. Main Level – Locked and Controlled Access to South Mezzanine

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) File Storage

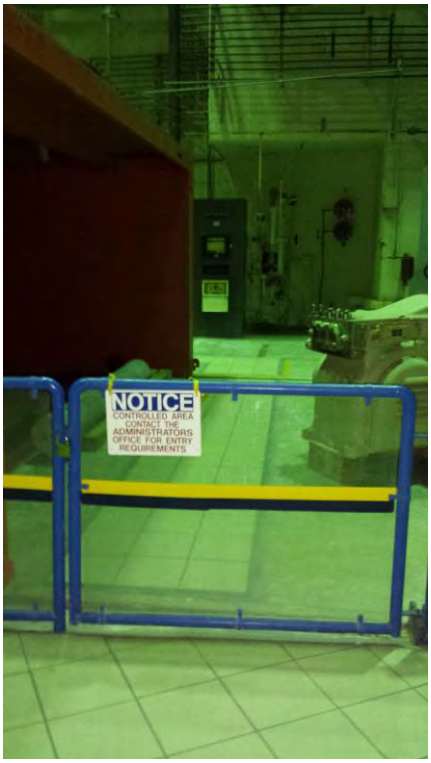

Figure 15. Main Level (Controlled Area) – Locked Access from Museum Area to Controlled Area

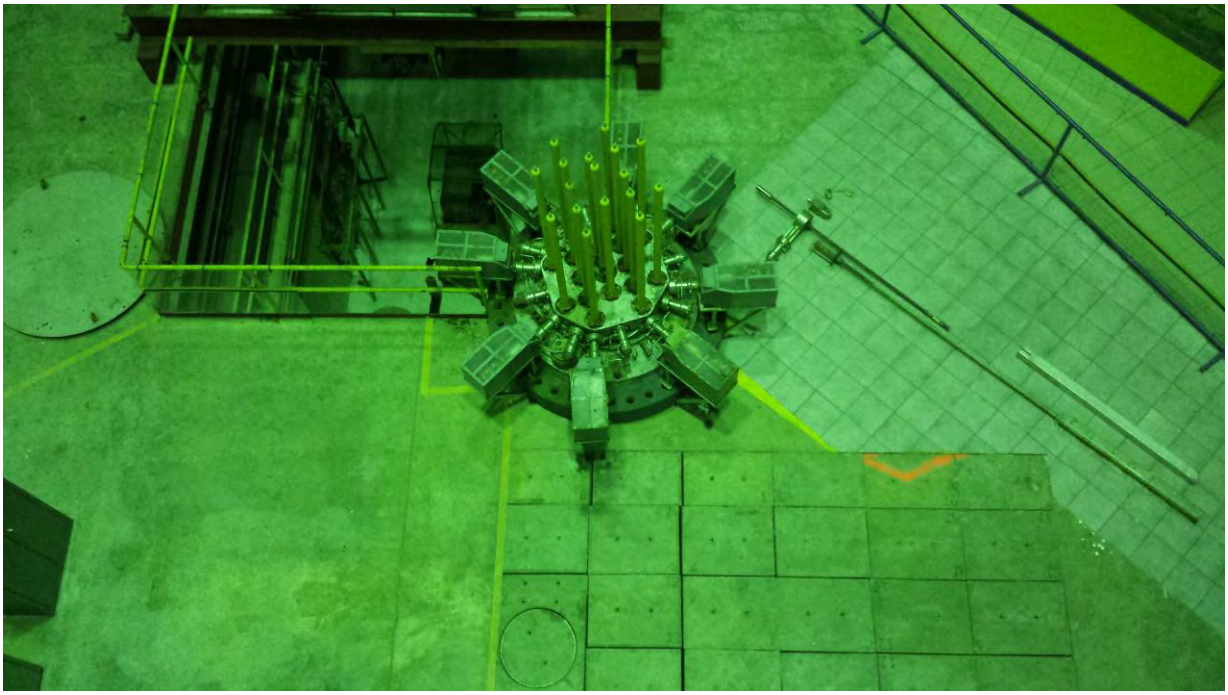

Figure 16. Main Level (Controlled Area) – Overhead View (Southeast Side)

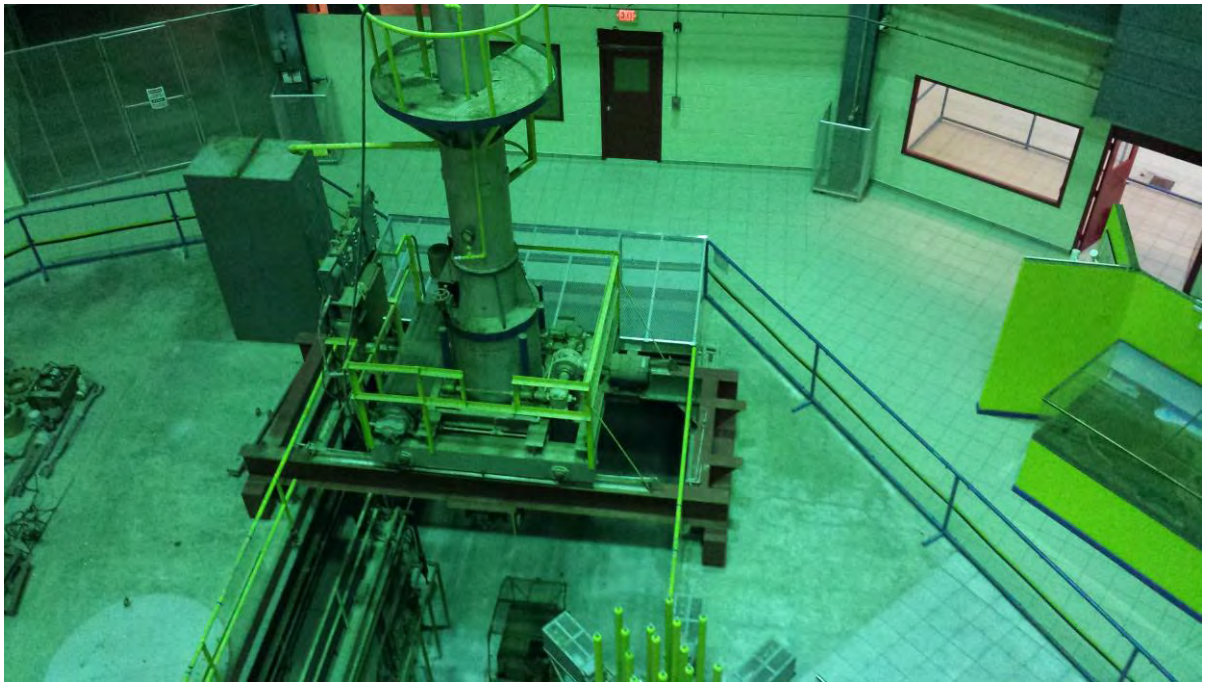

Figure 17. Main Level (Controlled Area) – Overhead View (East Side)

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

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

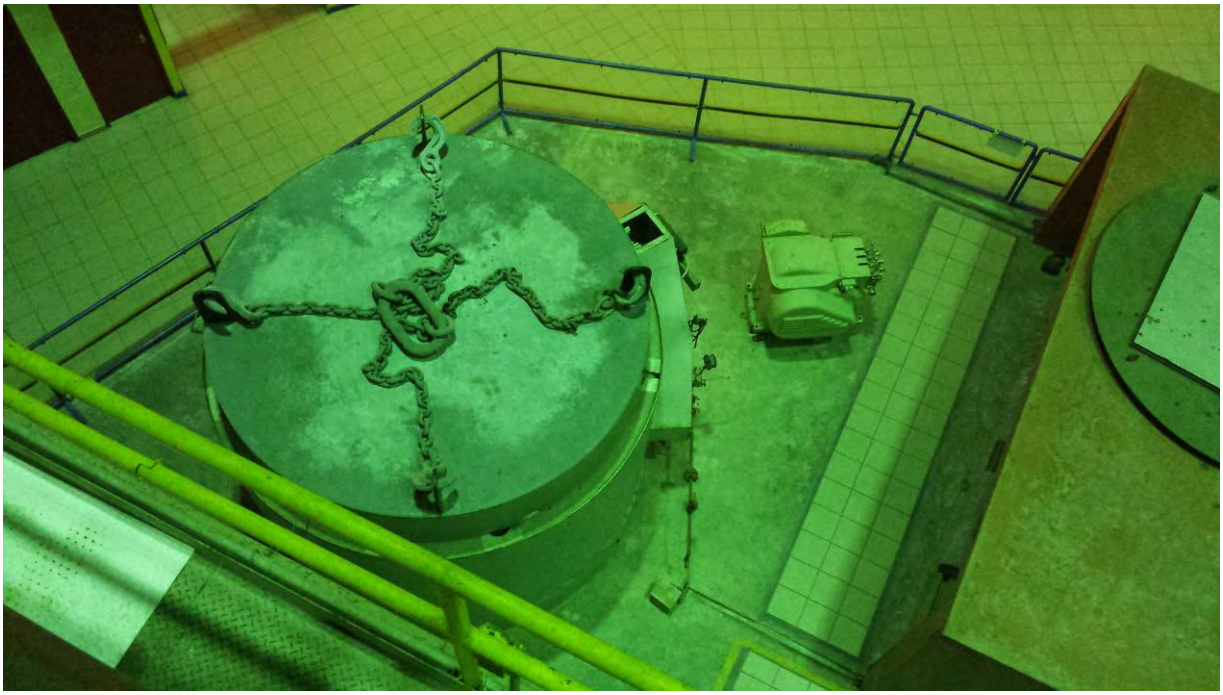

Figure 20. Main Level (Controlled Area) – Overhead View (Northwest Side)

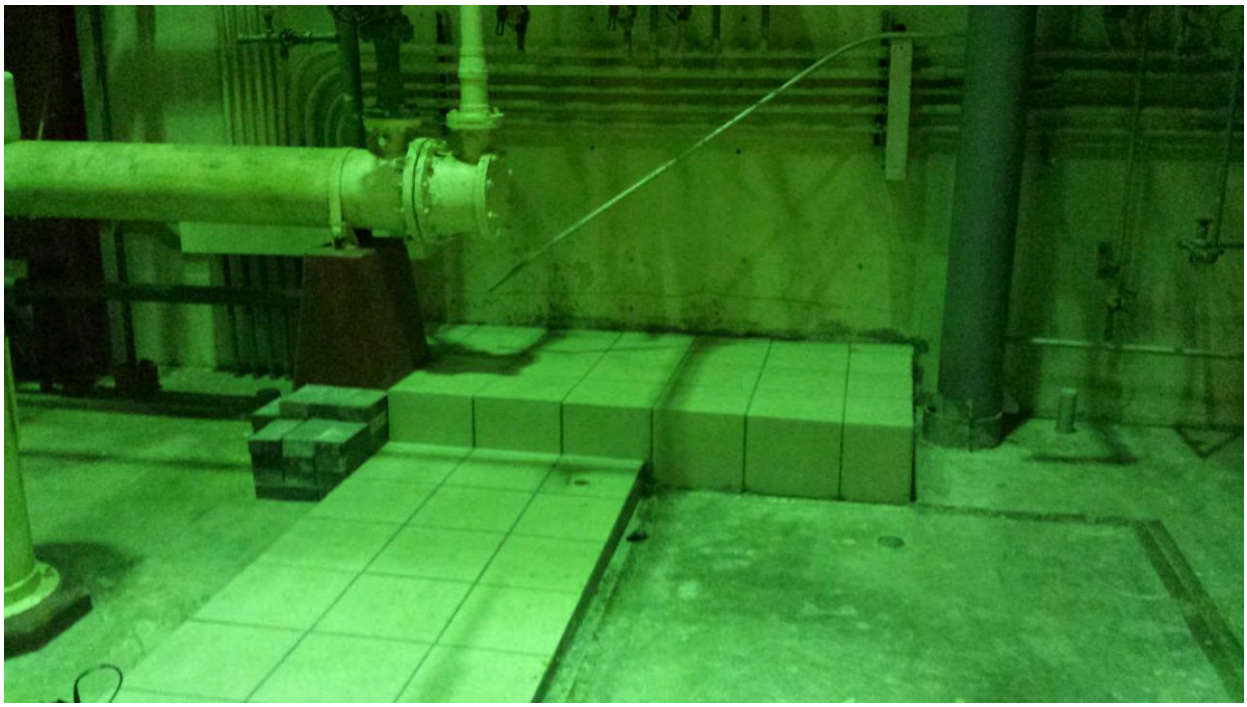

Figure 21. Main Level (Controlled Area) – Engineering Controls (Concrete, Tiles, and Lead Bricks) in Good Condition

Figure 22. Main Level (Museum Area) – Wood Paneling with 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

Figure 25. Basement Level – Beneath North Entrance Air Lock (No Signs of Recent Water Infiltration – Older Stains Persist)

Figure 26. Basement Level – Concrete Filled Sink

Figure 27. Basement Level – Lowest Point in Basement with No Standing Water

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"

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

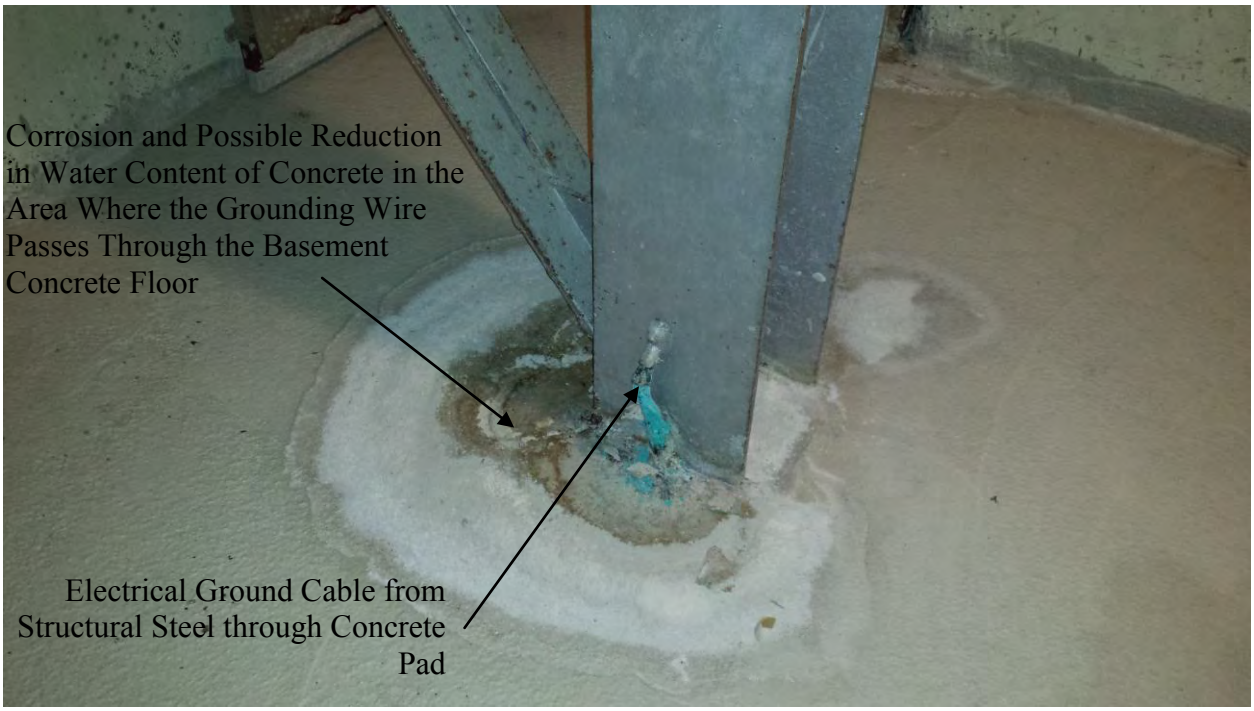

Figure 31. Basement Level – Corrosion Issues on Concrete Floor near Sample Locations 50A and 50B – No Change from Previous Year

Figure 32. Dome Structure – Exterior With Protective Coating and Paint (Staining Present Beneath Raised Channel)

Figure 33. Dome Structure – Interior with Fire Suppression Piping

Figure 34. Dome Structure – Drainage Outfall Points and Ditches (Western Outfall on Left and Southern Outfall on Right)

Figure 35. Dome Structure – Drainage Outfall Points and Ditches (Under Main Access Road – Once Pipe is Partially Filled with Debris)

Figure 36. Fence –Fencing and Perimeter – Some Areas with Vegetation Crowding Exterior of the Fence, Patched Areas, and a Temporary Repair Where the Fence had Fallen

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)

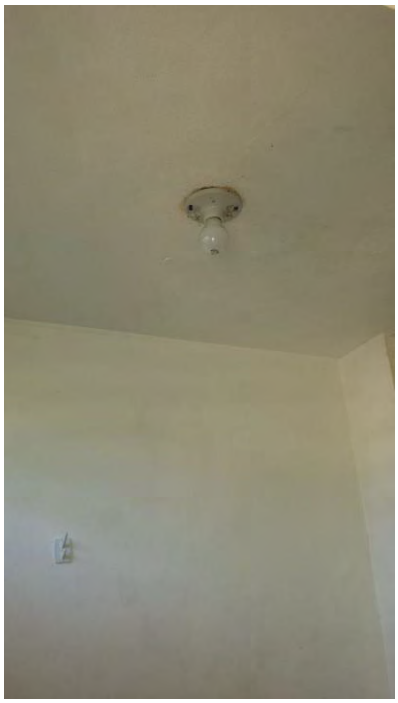

Figure 40. Ancillary Buildings and Structures – Guard Shack with Water Stains around Light Fixtures

Figure 41. Ancillary Buildings and Structures – Theatre Building with Evidence of Rodents and Termites, and the Air Conditioning Units are Not Working Properly

Figure 42. Ancillary Buildings and Structures – Entrance/Administrative Building at Southern Entrance to Dome – with Roofing in Need of Repair (Top) and Retaining Water/Leaking into Building (Below)

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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 9/12/16 - 1300hrs 9/13/16 - 0915 hrs Task Number —

Specific Area of Survey: Entombed Building-North Side MDA=((2.71/Tbkg + 3.3sqrt(Bkg/Tbkg+Bkg/Ts))/E x CF

Purpose of Survey: Year 2016 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/100cm²
9/12/16 24-26	Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19%	10|2	47	625
1-4 9/13/26	Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19%	10|2	44	605

SURVEY DATA **Survey Map Attached ☒ Yes ☐ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
1	North Side	NA	43~~36~~ cw 9/13/16	NA	<MDA
2	North Side	NA	49	NA	<MDA
3	North Side	NA	42	NA	<MDA
4	North Side	NA	53	NA	<MDA
24	North Side	NA	36	NA	<MDA
26	North Side	NA	32	NA	<MDA
4Dup	Duplicate	NA	51	NA	<MDA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Lee Krahenbuhl

*MDA is total in dpm/100 cm²

$MDA_{cpm} \geq 65$

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building	Time: 1300 hrs 0915 hrs	Date: Yr 16 Mo 9 Dy 12 13
Task: Comprehensive Survey	RWP: NA	

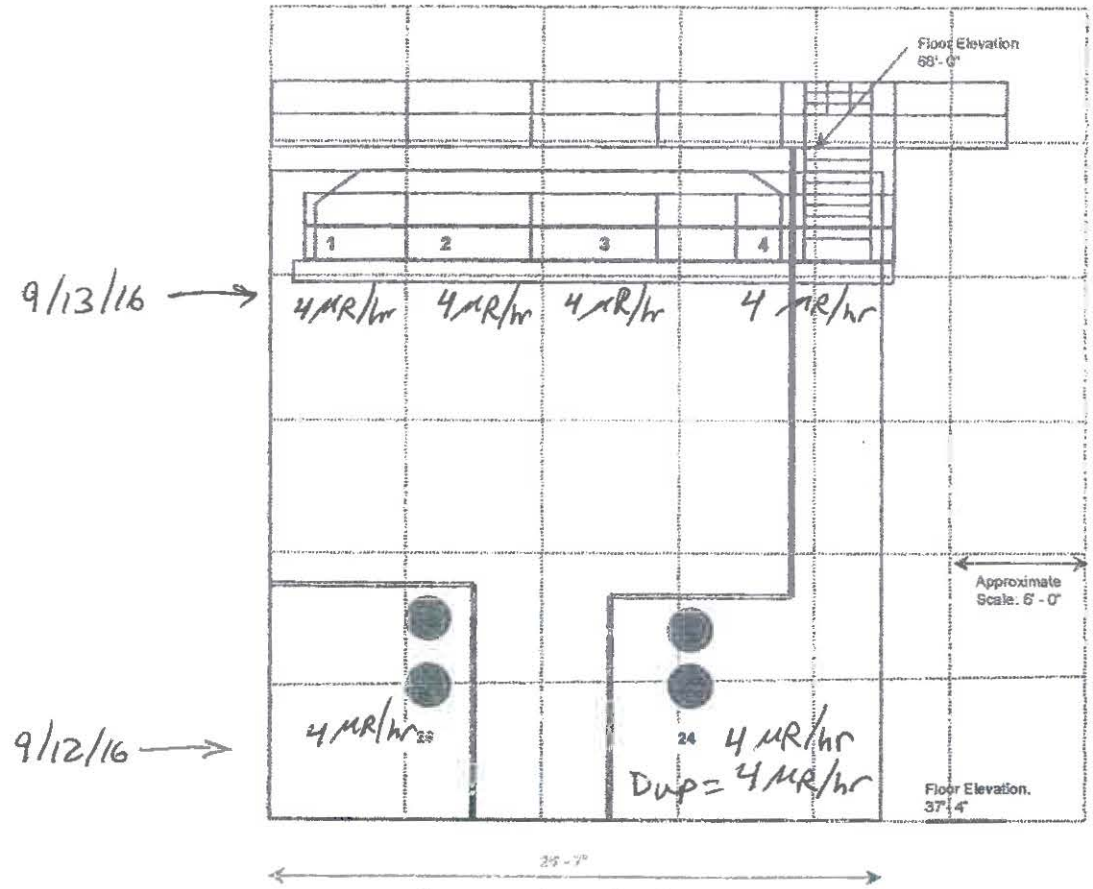
Map key: ° = Sample Location ☐ = Air Sampler Location _ = Core Sample

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**

= Sample Locations



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

Survey Technician(s): C. Webb, A. Vega, J. Lopez

checked by! Stephen Cox/Holcomb

Rev 3 (10/12)

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/13/16 - 0840hrs Task Number —

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

Purpose of Survey: Year 2016 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/100cm²
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	10 | 2	44	605
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA **Survey Map Attached ☒ Yes ☐ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
5	Top Plug Face	NA	55	NA	<MDA
6	Top Plug Face	NA	60	NA	<MDA
7	Top Plug Face	NA	64	NA	702
8	Top Plug Face	NA	54	NA	<MDA
9	Top Plug Face	NA	73	NA	1,018
10	Top Plug Face	NA	63	NA	667
11	Top Plug Face	NA	64	NA	702
12	Top Plug Face	NA	56	NA	<MDA
13	Top Plug Face	NA	61	NA	<MDA
14	Top Plug Face	NA	58	NA	<MDA
15	Top Plug Face	NA	73	NA	1,018
16	Top Plug Face	NA	55	NA	<MDA
17	Top Plug – Top Surface	NA	63	NA	667
18	Top Plug – Top Surface	NA	55	NA	<MDA
19	Top Plug – Top Surface	NA	61	NA	<MDA
9 Dup	Duplicate	NA	73	NA	1,018

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Cox Holcomb

*MDA is total in dpm/100 cm²

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building	Time: 0840hrs	Date: Yr 16 Mo 9 Dy 13
Task: Comprehensive Survey	RWP: NA	

Map key: ° = Sample Location ☐ = Air Sampler Location _ = Core Sample

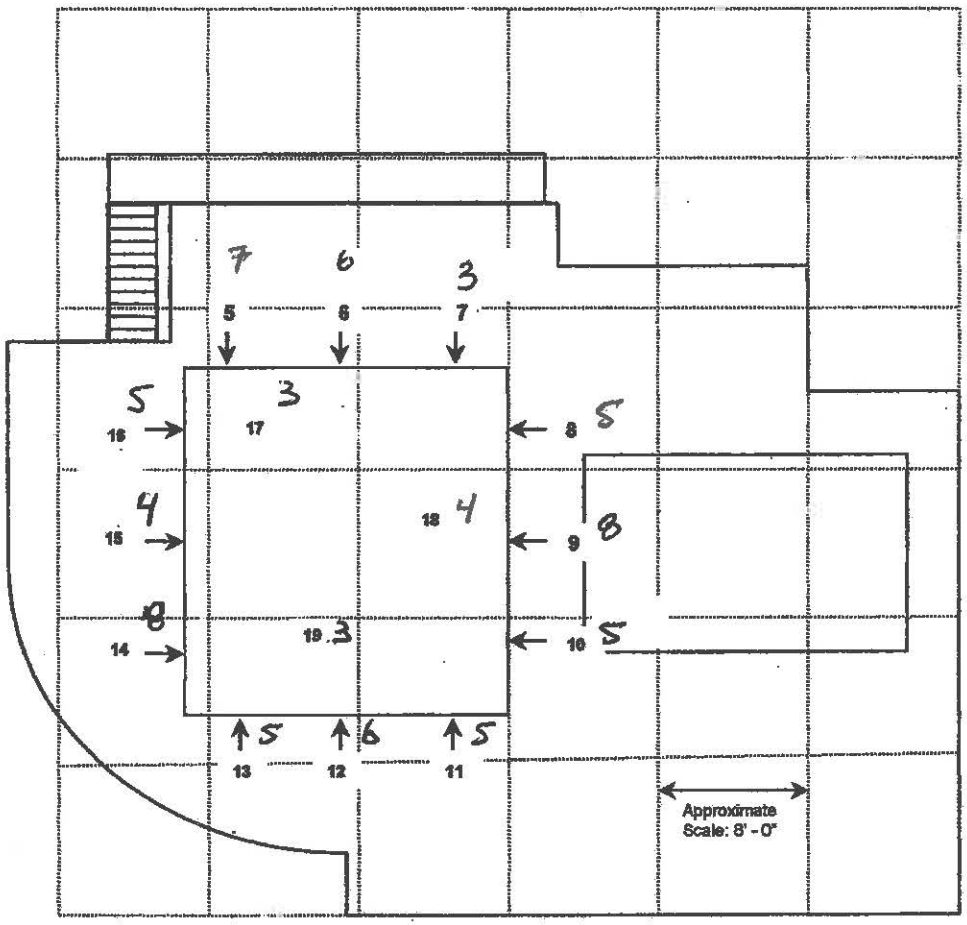
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

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

Sketch:

1 = Sample Locations

19 Dup = 3 MR/hr



Instruments (Model and Serial Numbers): Micro R Meter (Model 1A) #148190

Survey Technician(s): A. Vega, C. Webb, J. Lopez

Reviewed By: Stephen Cox

Rev 3 (10/12)

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/12/16 - 1400 hrs Task Number —

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

Purpose of Survey: Year 2016 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/100cm²
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	10|2	47	625
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA **Survey Map Attached ☒ Yes ☐ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
22	South Side	NA	32	NA	<MDA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Cox Holcombe

*MDA is total in dpm/100 cm²

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building	Time: 1400hrs	Date: Yr 16 Mo 9 Dy 12
Task: Comprehensive Survey	RWP: NA	

Map key: ° = Sample Location ☐ = Air Sampler Location _ = Core Sample

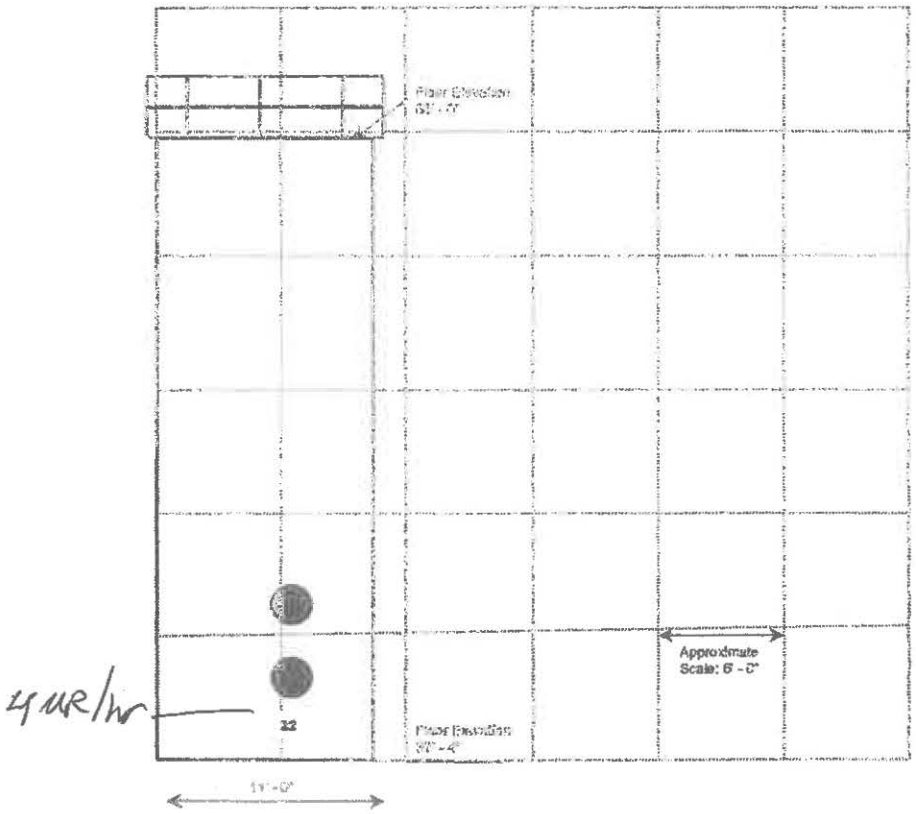
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: South Side

Sketch:

Entombment System - South View

= Sample Locations



4 MR/hr

Instruments (Model and Serial Numbers): Ludlum Mode 19 #148190

Survey Technician(s): C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Cattaldo

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/12/16 - 1405 hrs Task Number —

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

Purpose of Survey: Year 2016 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/100cm²
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	10/2	47	625
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA **Survey Map Attached ☑ Yes ☐ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
23	SouthWest Side	NA	29	NA	<MDA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Co-Holcomb

*MDA is total in dpm/100 cm²

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building	Time: 1405	Date: Yr 16 Mo 9 Dy 12
Task: Comprehensive Survey	RWP: NA	

Map key: ° = Sample Location ☐ = Air Sampler Location _ = Core Sample

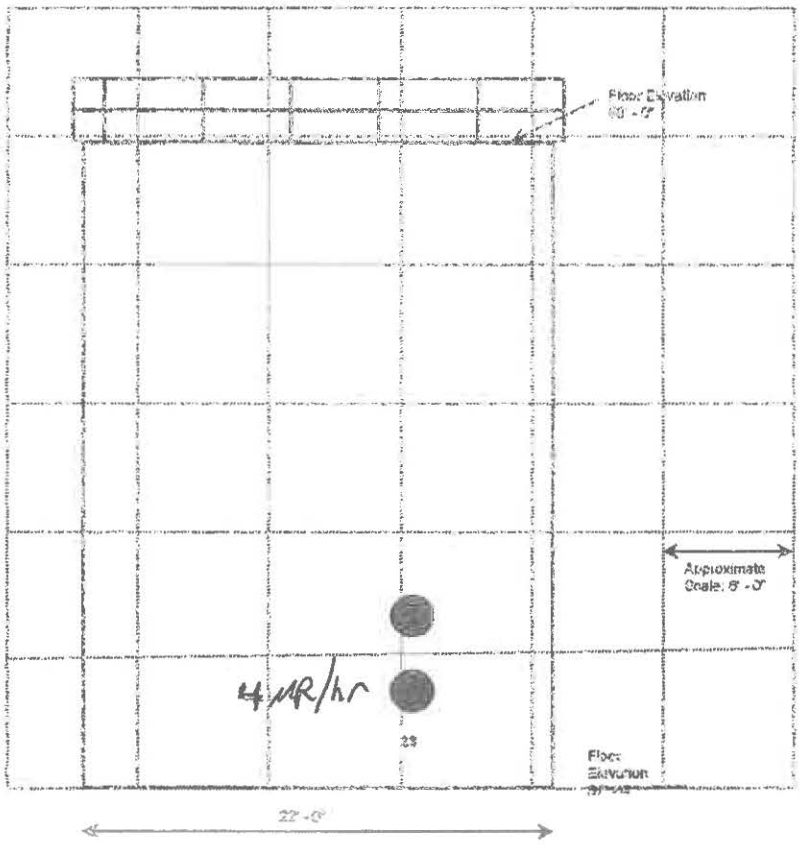
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: SouthWest Side

Sketch:

Entombment System - Southwest View

= Sample Locations



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

Survey Technician(s): C. Webb, A. Vega, J. Lopez

Reviewed By:

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/12/16 - 1330 hrs Task Number —

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

Purpose of Survey: Year 2016 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/100cm²
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	10 | 2	47	625
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA **Survey Map Attached ☑ Yes ☐ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
25	NorthWest Side	NA	35	NA	<MDA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen C. Hobbs

*MDA is total in dpm/100 cm²

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

RADIOLOGICAL SURVEY REPORT (MAP)

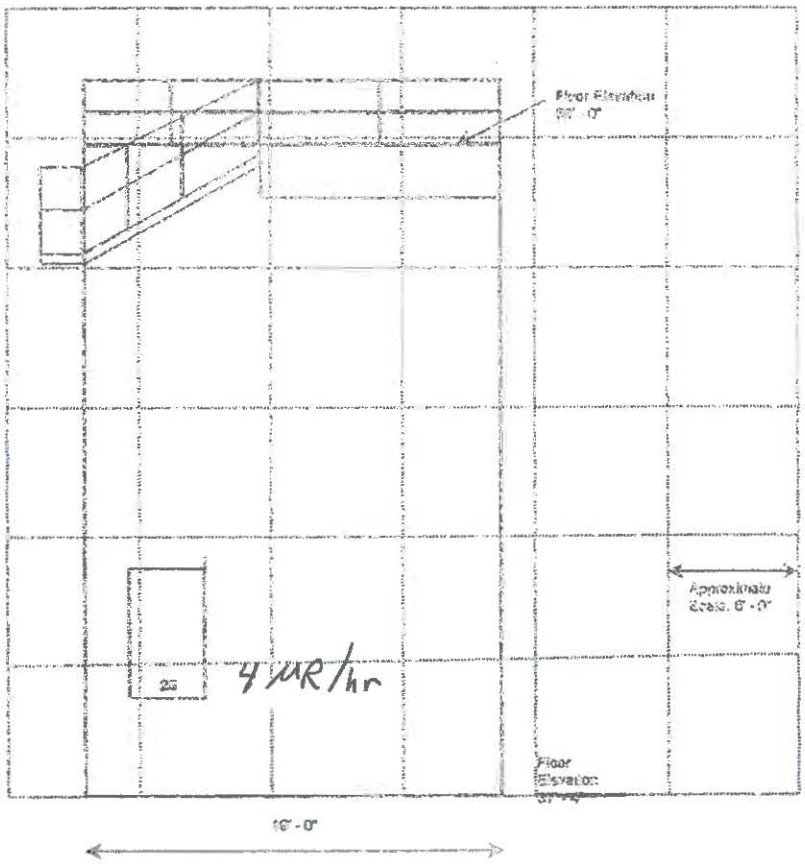
SITE: Entombed Reactor Building	Time: 1330 hrs	Date: Yr 16 Mo 9 Dy 12
Task: Comprehensive Survey	RWP: NA	

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:



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

Survey Technician(s): C. Webb, A. Vega, J. Lopez Reviewed By: Stephen Cee Kalemba

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/12/16 – 1335 hrs Task Number —

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

Purpose of Survey: Year 2016 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/100cm²
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	10 | 2	47	625
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA **Survey Map Attached ☑ Yes ☐ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
20	Main Floor	NA	47	NA	<MDA
21	Main Floor	NA	65	NA	632
27	Main Floor	NA	432	NA	13,516
28	Main Floor	NA	1,654	NA	56,414
27A	Main Floor	NA	69	NA	772
27B	Main Floor	NA	62	NA	<MDA
28 Dup	Main Floor	NA	1,636	NA	55,782
NA	NA	NA	NA	NA	NA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Co Hibernet

*MDA is total in dpm/100 cm²

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/14/16 – 1400hrs Task Number —

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

Purpose of Survey: Year 2016 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*
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	10 / 1	46	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 βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
65	Main Floor-Masslin (Zone 1)	46	NA	<MDA	NA
66	Main Floor-Masslin (Zone 2)	48	NA	<MDA	NA
67	Main Floor-Masslin (Zone 3)	44	NA	<MDA	NA
68	Main Floor-Masslin (Zone 4)	46	NA	<MDA	NA
69	Main Floor-Masslin (Zone 5)	42	NA	<MDA	NA
72	Main Floor-Masslin (Zone 6)	41	NA	<MDA	NA
73	Main Floor-Masslin (Zone 7)	41	NA	<MDA	NA
74	Main Floor-Masslin (Zone 8)	37	NA	<MDA	NA
75	Main Floor-Masslin Zone 9)	51	NA	<MDA	NA
76	Main Floor-Masslin (Zone 10)	36	NA	<MDA	NA
77	Main Floor-Masslin (Zone 11)	50	NA	<MDA	NA
78	Main Floor-Masslin (Zone 12)	56	N/A	<MDA	NA
79	Main Floor-Masslin (Zone 14)	49	NA	<MDA	NA
80	Main Floor-Masslin (Zone 13)	39	NA	<MDA	NA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen A. Haldeman

*MDA < 200 dpm/100cm² (cannot be quantified due to large are survey).

200 dpm/100 cm² ≃ 84 cpm

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building | Time: 0830 | Date: Yr 16 Mo 9 Dy 14

Task: Comprehensive Survey | RWP: NA

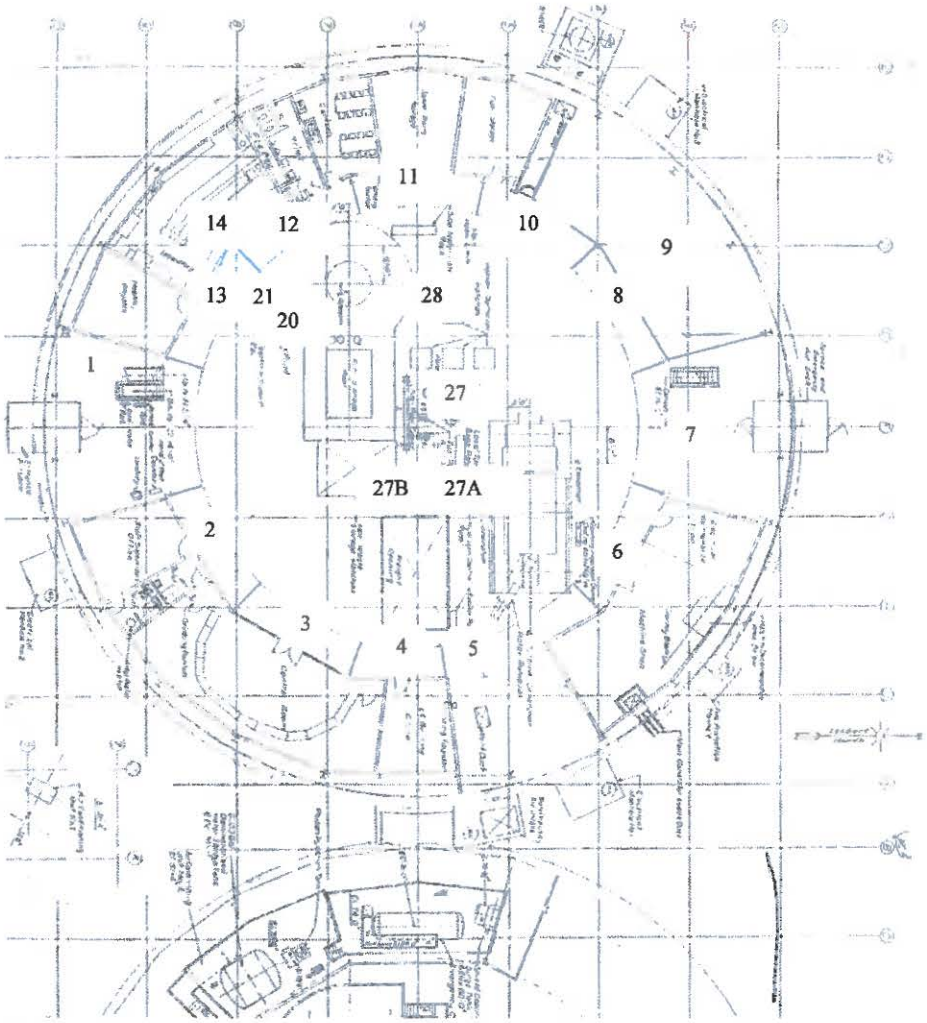
Map key: ° = Sample Location ☐ = Air Sampler Location _ = Core Sample

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

Building: Entombed Reactor Building Location: Main Floor

Sketch:

	No.	µR/hr
Zone 1=	65	5
Zone 2=	66	6
Zone 3=	67	4
Zone 4=	68	5
Zone 5=	69	4
Zone 6=	72	5
Zone 7=	73	5
Zone 8=	74	5
Zone 9=	75	4
Zone 10=	76	4
Zone 11=	77	5
Zone 12=	78	6
Zone 13=	80	6
Zone 14=	79	5
Zone NA=		NA
Zone NA=		NA
	20	5
	21	4
	27	16
	28	13
	27A	4
	27B	5
27 Dup		16



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

Survey Technician(s): C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Lee Holcomb

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/14/16 - 0900hrs Task Number —

Specific Area of Survey: Entombed Building-Basement Floor MDA=((2.71/Tbkg + 3.3sqrt(Bkg/Tbkg+Bkg/Ts))/E x CF

Purpose of Survey: Year 2016 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/100cm²
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	5/1	43	851
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA **Survey Map Attached ☑ Yes ☐ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
30	Basement Floor-Side of Tank #1	NA	84	NA	1,439
31	Basement Floor-Side of Tank #2	NA	76	NA	1,158
40A	Basement Floor-Wall (4" from floor)	NA	178	NA	4,739
40B	Basement Floor-Wall (4" from floor)	NA	42	NA	<MDA
42	Basement Floor	NA	44	NA	<MDA
43	Basement Floor	NA	42	NA	<MDA
50A	Basement Floor-Wall (block)	NA	47	NA	<MDA
50B	Basement Floor-Wall (concrete)	NA	40	NA	<MDA
40A Dup	Basement Floor-Wall (4" from floor)	NA	192	NA	5,231
30A-1	Bottom of Tank #1	NA	524	NA	16,886
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA
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: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen C. Holcomb

*MDA is total in dpm/100 cm²

$MDA_{cpm} \approx 67$ cpm

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/15/16 - 1000 hrs Task Number —

Specific Area of Survey: Entombed Building-Basement Floor MDA=((2.71/Tbkg + 3.3sqrt(Bkg/Tbkg+Bkg/Ts))/E x CF

Purpose of Survey: Year 2016 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*
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	10 / 1	46	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 βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
70	Masslin - Zone 1	38	NA	<MDA	NA
71	Masslin - Zone 2	40	NA	<MDA	NA
81	Masslin - Zone 3	46	NA	<MDA	NA
89	Masslin - Zone 4	45	NA	<MDA	NA
90	Masslin – Zone 5	36	NA	<MDA	NA
91	Masslin – Zone 6	46	NA	<MDA	NA
92	Masslin – Zone 7	46	NA	<MDA	NA
93	Masslin – Zone 8	35	NA	<MDA	NA
94	Masslin – Zone 9	44	NA	<MDA	NA
95	Masslin – Zone 10	37	NA	<MDA	NA
96	Masslin – Zone 11	33	NA	<MDA	NA
97	Masslin – Zone 12	35	NA	<MDA	NA
98	Masslin – Zone 13	42	NA	<MDA	NA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Cox Hollenbeck

*MDA < 200 dpm/100 cm² (cannot be quantified due to large area survey).

200 dpm/100cm² ≈ 84cpm

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/15/16 – 1030 hrs Task Number —

Specific Area of Survey: Entombed Building-Basement Floor MDA=((2.71/Tbkg + 3.3sqrt(Bkg/Tbkg+Bkg/Ts))/E x CF

Purpose of Survey: Year 2016 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*
Ludlum 2221	149991	4/13/17	44-9	154535	4/13/17	19 %	10|1	46	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 βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
99	Masslin – Zone 14	40	NA	<MDA	NA
100	Masslin – Zone 15	49	NA	<MDA	NA
101	Masslin – Zone 16	39	NA	<MDA	NA
102	Masslin – Zone 17	29	NA	<MDA	NA
103	Masslin – Zone 18	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

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: [signature]

*MDA < 200 dpm/100 cm² (cannot be quantified due to large area survey).

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

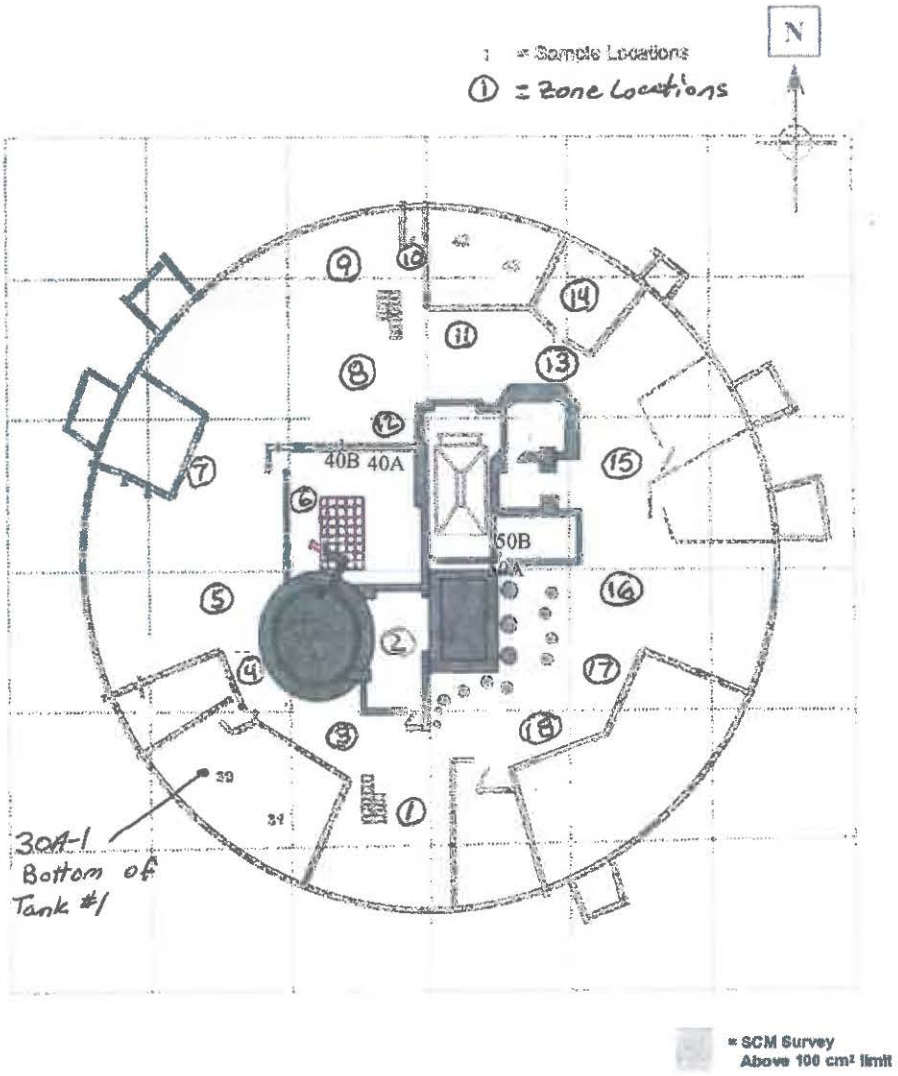
RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building	Time: 0900hrs	Date: Yr 16 Mo 9 Dy 14
Task: Comprehensive Survey	RWP: NA	

Building: Entombed Reactor Building **Location:** Basement Floor

Sketch:

	No.	µR/hr
Zone 1=	71	6
Zone 2=	80	6
Zone 3=	81	6
Zone 4 =	89	5
Zone 5 =	90	5
Zone 6 =	91	6
Zone 7 =	92	5
Zone 8 =	93	4
Zone 9 =	94	3
Zone10 =	95	4
Zone11 =	96	5
Zone12 =	97	5
Zone13 =	98	5
Zone14 =	99	5
Zone15 =	100	4
Zone16 =	101	5
Zone17 =	102	5
Zone18 =	103	5
	30	20
	31	15
	40A	19
	40A Dup	19
	40B	9
	42	4
	43	4
	50A	5
	50B	5
	30A-1	14
NA		NA



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

Survey Technician(s): C. Webb, A. Vega, J. Lopez

Reviewed By:

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/13/16 - 1335hrs Task Number —

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

Purpose of Survey: Year 2016 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	4/13/17	44-9	154535	4/13/17	19 %	10/1	48	128
NA	NA	NA	NA	NA	NA	NA%	NA	NA	NA

SURVEY DATA **Survey Map Attached ☐ Yes ☒ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
1	Smear	38	NA	<MDA	NA
2	Smear	41	NA	<MDA	NA
3	Smear	39	NA	<MDA	NA
4	Smear	47	NA	<MDA	NA
5	Smear	44	NA	<MDA	NA
6	Smear	41	NA	<MDA	NA
7	Smear	46	NA	<MDA	NA
8	Smear	47	NA	<MDA	NA
9	Smear	48	NA	<MDA	NA
10	Smear	36	NA	<MDA	NA
10 Dup	Smear	39	NA	<MDA	NA
11	Smear	35	NA	<MDA	NA
12	Smear	60	NA	<MDA	NA
13	Smear	42	NA	<MDA	NA
14	Smear	43	NA	<MDA	NA
15	Smear	38	NA	<MDA	NA
16	Smear	34	NA	<MDA	NA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: [signature]

*MDA is removable in dpm/100 cm²

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/13/16 — 1400hrs Task Number —

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

Purpose of Survey: Year 2016 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	4/13/17	44-9	154535	4/13/17	19 %	10, 1	48	128
NA	NA	NA	NA	NA	NA	NA %	NA	NA	NA

SURVEY DATA **Survey Map Attached ☐ Yes ☒ No**

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
17	Smear	46	NA	<MDA	NA
18	Smear	36	NA	<MDA	NA
19	Smear	34	NA	<MDA	NA
20	Smear	33	NA	<MDA	NA
21	Smear	53	NA	<MDA	NA
22	Smear	53	NA	<MDA	NA
23	Smear	41	NA	<MDA	NA
24	Smear	47	NA	<MDA	NA
25	Smear	47	NA	<MDA	NA
26	Smear	39	NA	<MDA	NA
27A	Smear	48	NA	<MDA	NA
27B	Smear	34	NA	<MDA	NA
28	Smear	42	NA	<MDA	NA
28Dup	Duplicate	40	NA	<MDA	NA
27	Smear	38	NA	<MDA	NA
27Dup	Duplicate	39	NA	<MDA	NA
NA	NA	NA	NA	NA	NA

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Co McDermott

*MDA is removable in dpm/100 cm²

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 4/14/16 – 1300 hrs Task Number —

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

Purpose of Survey: Year 2016 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	4/13/17	44-9	154535	4/13/17	19 %	10 | 1	46	125
NA	NA	NA	NA	NA	NA	NA%	NA	NA	NA

SURVEY DATA Survey Map Attached ☐ Yes ☑ No

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
30	Smear	48	NA	<MDA	NA
31	Smear	37	NA	<MDA	NA
40A	Smear	43	NA	<MDA	NA
40B	Smear	47	NA	<MDA	NA
42	Smear	44	NA	<MDA	NA
43	Smear	47	NA	<MDA	NA
50A	Smear	34	NA	<MDA	NA
50B	Smear	54	NA	<MDA	NA
30 Dup	Duplicate Count	46	NA	<MDA	NA
30A-1	Smear	38	NA	<MDA	NA
30A-1 Dup	Duplicate Count	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

Survey Technician: C. Webb, A. Vega, J. Lopez

Reviewed By: Stephen Co Adams

*MDA is removable in dpm/100 cm²

APPENDIX C
PHYSICAL CONDITION – INSPECTION CHECKLIST

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Inspection Checklist
BONUS Decommissioned Facility, Rincón, Puerto Rico

Date of This Inspection/Revision: 13-15 September 2016
Last Inspection: 20-21 August 2015
Inspectors: [signature] and [signature]
Next Inspection (Planned): Summer 2017

No.	Item	Issue	Action
1	Specific site surveillance features	See attached table.	Inspect. See page 3 of 3.
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: No significant change. Minor surficial cracks.
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: No noticable change in piping. Outfall at beach will need to be cleaned out (see pic). Others are okay.
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: Access control is maintained. Oil drips. Additional concrete spalling, chips/debris, and cracks were noted.
5	Dome—Basement Level flooding	Water accumulating in Basement Level may mobilize and redistribute surface contamination.	Inspect for gasket and storm water drains. Notes: Gasket is working effectively but is blistered/peeling in some areas due to low areas retaining water.
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 are in good condition and maintained. No significant changes in tiles. Evidence of termites noted (see pics). Recommend termite inspection/treatment.

Reviewed by: [signature]

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 mezzazine; note general housekeeping. Notes: All access gates/ controls were locked and maintained.
8	Dome—exterior	Building should appear well maintained	Visually inspect. Notes: Dome exterior coating is mostly in good condition. There is staining on the SW side (see pic).
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 changes noted.
10	General site upkeep	Building should appear well maintained.	Observe and evaluate changes in site conditions. Notes: The roof of admin building at south entrance of dome is holding water + leaks into rooms below. (see pics). Theatre Room has termites, water damage, + rodents.
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 significant erosion on beach slopes - west side of property.

Reviewed by:
Stephen Coe Nelson

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

Feature	Comment
Access road and parking area	Asphalt - No significant changes - same broken asphalt, but functional.
Entrance gate	Motor-operated Motor is not operational, but guard was present and maintained lock/key for gate. The guard opened + closed gate.
Access through security gate	Note security of site; sign-in required on log sheet Guard required sign-in on log sheet. Pertinent information was recorded.
Security fence	Chain-link, topped with three strands of barbed wire Fence is mostly functional. Fence has been patched in many places. There are areas where there are gaps under the fence (see pics). Vegetation needs to be cut from fence. One section near the front gate needs repair.
Dome—monolith plaques	Visually inspect No change - plaques are in good condition.

Reviewed by:
Stephen Goldsmith

APPENDIX D
CALIBRATION SHEETS AND DAILY RESPONSE CHECKS

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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 POWER AUTHORITY ORDER NO. 20287467/434116

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

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

Cal. Date 13-Apr-16 Cal Due Date 13-Apr-17 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 41 % Alt 707.0 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. (Min. Volt) 4.4 VDC
☑ 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 / 500 V Ref./Inst. 2000 / 1996 V

COMMENTS:

Firmware: 261010
Window set to 2X threshold.
Calibrated with WIN in OUT position.
SrY90 check source SN 3432 reads ≈ 21425 cpm with source placed against screen of 44-9.

Source	SN	Size	Background	Reading(1/4")	Efficiency(1/4")	Reading(Surf)	Efficiency(Surf)
SrY90	5281	89927 dpm	≈ 48 cpm	≈ 23966 cpm	≈ 26.60 %	≈ 37857 cpm	≈ 42.04 %
Cs137(gamma)	0754	156684 dpm	≈ 48 cpm	≈ 2279 cpm	≈ 1.42 %	≈ 2604 cpm	≈ 1.63 %
Cs137(beta)	1075	17004 dpm	≈ 48 cpm	≈ 3946 cpm	≈ 22.92 %	≈ 5446 cpm	≈ 31.75 %
Co60	0886	4625 dpm	≈ 48 cpm	≈ 640 cpm	≈ 12.80 %	≈ 964 cpm	≈ 19.81 %
Ni63	0909	236997 dpm	≈ 48 cpm	≈ 286 cpm	≈ 0.10 %	≈ 1352 cpm	≈ 0.55 %

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*
Digital Readout	400 kcpm	39998 (0)	39998(0)
	40 kcpm	4001	4001
	4 kcpm	400	400
	400 cpm	40	40
	40 cpm	4	4

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale	500 kcpm	500K	500K
	50 kcpm	50K	50K
	5 kcpm	5K	5K
	500 cpm	500	500
	50 cpm	50	50

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 S/N: ☐ 059 ☐ 2171CP ☐ 2261CP ☐ 720 ☐ 734 ☑ 781 ☑ 1131 ☐ 1616 ☐ 1696 ☐ 1909 ☐ 1916CP ☐ 5105 ☐ 5717CO
☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ 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 McBeth Date 13APR16

Reviewed By: Date 13Apr16

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

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

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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.

CONVERSION CHART

Customer PUERTO RICO ELECTRIC POWER AUTHORITY Date 13-Apr-16 Order #. 20287467/434116

Model 2221 Serial No. 149991 Detector Model 44-9 Serial No. PR154535

Source Cs137 54 mCi 4 mCi High Voltage 900 V

Input Sensitivity 50 mV

Reference Point	"As Found" Readings (CPM): Analog	Range/Scale	After Adjustment Readings (CPM): Analog	Range/Scale
150 mR/hr	330	~~x10~~ x1K	330	x1K
50	140		140	
15	50		50	
5	170	x100	170	x100
1.5	50		50	
1	320	x10	320	x10

Reference Point	"As Found" Readings: Digital	Count Time	After Adjustment Readings: Digital	Count Time
150 mR/hr	33468	6 Seconds	33468	6 Seconds
50	14190		14190	
15	5034		5034	
5	1693		1693	
1.5	495		495	
1	322		322	

Signature: James McBee Date 13APR16

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 POWER AUTHORITY ORDER NO. 20287467/434116

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

Mfg. _____ Model _____ Serial No. _____

Cal. Date 13-Apr-16 Cal Due Date 13-Apr-17 Cal. Interval 1 Year Meterface 202-016

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 41 % Alt 707.0 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. (Min. Volt) 2.2 VDC
☐ Calibrated in accordance with LMI SOP 14.8 ☑ Calibrated in accordance with LMI SOP 14.9

Instrument Volt Set 550 V Input Sens. 34 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 ≈ 270 µR/hr (27 at 500) with source placed against dimple on front of 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 = 70000 cpm	380	400
500	100 µR/hr	95	100
250	200 µR/hr = 34400 cpm	200	200
250	100 µR/hr	100	100
50	7000 cpm	38	40
50	1750 cpm	9.5	10
25	3440 cpm	20	20
25	860 cpm	5	5

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

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. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 S/N: ☐ 059 ☐ 2171CP ☐ 2261CP ☐ 720 ☐ 734 ☑ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 1909 ☐ 1916CP ☐ 5105 ☐ 5717CO ☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ 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 McBeth Date 13APR16

Reviewed By: _____ Date 13Apr16

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

PREPA BONUS Reactor Facility
Rincón, Puerto Rico

RADIATION DETECTOR OPERATIONAL CHECK FORM

Detector Type: 44-9
Instrument Type: 221
Source Type: Sr/Y 90
Posted Source Activity: _____
Posted Efficiency: _____
Low Reading[1] cpm 17,140
[1]Source dpm × Posted Efficiency × 0.8.

Serial #: PR154535
Serial #: 149991
Serial #: 3432-09
Source Half-life: _____
High Voltage: volts
Effective Reading[2]: 21425 cpm
[2]Source dpm × Posted Efficiency

Cal Due Date: 13-Apr-17
Cal Due Date: 13-Apr-17
Cal Due Date: 13-Apr-17
Current Source dpm: _____
Threshold: _____ mV
High Reading[3]: _____ cpm 25,710
[3]Source dpm × Posted Efficiency × 1.2.

Name	Date	Time	Location	Detector Reading (cpm) Background	Gross	Net	Notes
J. López	7/11/16	1:13PM	Comp Room	48	21,015	20967	Ok pass.
J. López	7/11/16	3:30pm	Comp. Room	46	21,093	21,047	Ok pass.
J. López	7/12/16	8:20 Am	Comp Room	43	21,138	21,095	Ok pass.
I. Figueroa	7/12/16	1510	Comp. Room	47	21,011	20,964	Ok pass
J. López	7/13/16	8:05 Am	Comp. Room	49	21,020	20,971	Ok pass.
J. López	7/13/16	11:20 Am	Comp. Room	45	21,035	20,990	Ok pass
C. Webb	9/12/16	10:35 AM	Comp. Room	36	20,669	20,633	Ok pass
J. López	9/12/16	3:15 pm	Comp Room	37	20993	20956	Ok pass.
C. Webb	9/13/16	0815	Comp Room	49	20,829	20,780	ok
C. Webb	9/13/16	1500	Comp Room	49	21,012	20,963	ok
C. Webb	9/14/16	0822	Comp Room	56	21,125	21,069	ok
C. Webb	9/14/16	1525	Comp. Room	56	21,242	21,186	ok
C. Webb	9/15/16	0945	Comp. Room	40	21,372	21,332	ok
C. Webb	9/15/16	1400	Comp. Room	40	20,987	20,947	ok

ATTACHMENT II
EXPOSURE RATE INSTRUMENT OPERATIONAL CHECK FORM

PREPA BONUS Reactor Facility
Rincón, Puerto Rico

EXPOSURE RATE INSTRUMENT OPERATIONAL CHECK FORM

☐ Ionization Chamber
Meter Type: MICTOR
Source Type: Cs-137
Low Reading[1]: 216 μR or mR
[1]Expected Reading x 0.8

☐ Micro-R Meter
Serial #: 148190
Serial #: 2008
Expected Reading: 270 μR or mR

☐ Other
Cal Date Date: 13-Apr-2016
Cal Due Date: 13-Apr-2017
High Reading[2]: 324 μR or mR
[2]Expected Reading x 1.2

Name	Date	Time	Location	Detector Reading (μR or mR)			Notes
				Gross	Background	Net	
J. Lopez	7/11/16	12:50	Comp. Room	300	6	294	ok pass.
J. López	7/11/16	3:25	Comp. Room	300	5	295	ok pass
J. Lopez	7/12/16	8:15	Comp. Room	300	6	294	ok pass.
I. Figueroa	7/12/16	15:00	Comp. Room	300	5	295	ok pass
J. López	7/13/16	8:00	Comp. Room	300	5	295	ok pass.
J. Lopez	7/13/16	11:15	Comp. Room	300	5	295	ok pass
J. Lopez	9/12/16	11:00	Comp. Room	280	5	275	ok pass.
A. Vega	9/12/16	1500	Comp. Room	230	5	225	ok
C. Webb	9/13/16	0815	Comp. Room	240	5	235	ok
C. Webb	9/13/16	1500	Comp. Room	250	5	245	ok
C. Webb	9/14/16	0820	Comp. Room	250	5	245	ok
C. Webb	9/14/16	1520	Comp. Room	250	5	245	ok