Memorandum

Date: 13 April 2011

To: Madeline Ramos, Puerto Rico Electric Power Authority (PREPA)

Copy: Boiling Nuclear Superheat (BONUS) File and Gunseli Shareef, URS (Program Manager)

From: Chad Webb, BONUS RADCON Manager (RCM)

Subject: **2010 Annual Survey**

MMG conducted the comprehensive annual survey at the Dr. Modesto Iriarte Technological Museum (former BONUS Facility) during the dates of 27 September – 1 October 2010 with support from PREPA personnel. Due to PREPA's Ludlum Micro-R Meter, Model 19 being damaged and not responding within calibration parameters, direct radiation monitoring with this instrument was delayed and performed on 20 through 21 December 2010. 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.

PURPOSE

Date: 27 September – 1 October 2010 and 20 – 21 December 2010
Purpose: Conduct 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.

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. A list of specific survey locations is provided in Table 1.

Table 1

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	5 Dup=4	<MDA	<MDA	Monolith Top
Pipe Chase Face	2	5	<MDA	<MDA	Monolith Top
Pipe Chase Face	3	4	<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	706	<MDA Dup=<MDA	Monolith Top
Top Plug Face #1	7	6	<MDA	<MDA	Monolith Top
Top Plug Face #2	8	6 Dup=5	706	<MDA	Monolith Top
Top Plug Face #2	9	5	1,256 Dup=863	<MDA	Monolith Top
Top Plug Face #2	10	6	785	<MDA	Monolith Top
Top Plug Face #3	11	6	1,099	<MDA	Monolith Top
Top Plug Face #3	12	4	706	<MDA	Monolith Top
Top Plug Face #3	13	5	745	<MDA	Monolith Top
Top Plug Face #4	14	4 Dup=5	745	<MDA	Monolith Top
Top Plug Face #4	15	5	<MDA	<MDA	Monolith Top
Top Plug Face #4	16	4	863	<MDA	Monolith Top
Top Plug Top Surface	17	4 Dup=4	<MDA	<MDA	Monolith Top
Top Plug Top Surface	18	4	<MDA	<MDA	Monolith Top
Top Plug Top Surface	19	5	<MDA	<MDA	Monolith Top
Main Floor Water Column	20	6 Dup=6	<MDA	<MDA	Main Level-Controlled Area
Main Floor Water Column	21	3 Dup=3	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #1	22	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #2	23	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #3	24	5	<MDA	<MDA	Main Level-Controlled Area
Pipe Chase Ext Hatch	25	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #4	26	6	<MDA	<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27	18	18,754	<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27A	5	785	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif Floor, area	27B	4	1,099	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif. Floor (CM005)	28	15	76,470 Dup=79,059	<MDA Dup=<MDA	Main Level-Controlled Area

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)					
Side of Liq. Waste Ret. Tank #1	30	20	1,067	<MDA	Basement Level, Att. A – Fig.s 4 and 6
Side of Liq. Waste Ret. Tank #2	31	17	1,844	<MDA	Basement Level, Att. A – Fig.s 4, 5, and 6
F.W. Heater Room (Wall)	40A	15	5,571 Dup=5,846	<MDA Dup=<MDA	Basement Level, Att. A – Fig. 9
F.W. Heater Room (Wall)	40B	15	1,138	<MDA	Basement Level, Att. A – Fig. 9
Vapor Sphere Room	42	4	<MDA	<MDA	Basement Level
Vapor Sphere Room	43	4	<MDA	<MDA	Basement Level
Condenser Room Entry Wall (Block)	50A	6	<MDA	<MDA	Basement Level, Att. A – Fig. 11
Condenser Room Entry Wall (Concrete)	50B	5	<MDA	<MDA	Basement Level, Att. A – Fig. 11
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	5	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	6	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 9	75	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 10	76	5	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 11	77	6	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	6	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	7	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 3	81	7	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 4	89	7	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 5	90	3	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 6	91	5	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	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 9	94	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 10	95	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 11	96	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 12	97	7	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 13	98	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 14	99	4	NA	<1000dpm/100cm^2 Dup<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 Dup<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 17	102	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 18	103	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear

dpm/100 cm^2 = disintegrations per minute per 100 centimeters squared
Dup = Duplicate
MDA = Minimum Detectable Activity
µR/hour = micro-Roentgen per hour

PHYSICAL CONDITION

Attachment 3 provides a copy of the facility inspection checklist used during the annual survey. Findings and observations are provided below.

Site Surveillance Features: Asphalt of the access road and parking area is in fair and usable condition (Attachment 1, Figures 19, 21, and 22). The motor of the entrance gate was not operational at the time of the survey, but was manually operated by the attending guard (Attachment 1, Figures 19 and 20). The security guard controlled access into the gated facility and kept log of visitors. The security fence (Attachment 1, Figure 24) and Dome monolith plaques were in fair condition. Repair or replacement of the gate motor is recommended, but not critical in maintaining site security.

Dome-Entombed Concrete Monolith and Monolith Penetrations: Inspection of the Concrete Monolith area revealed superficial cracks throughout the surface of the structure (Attachment 1, Figure 1). Superficial cracks are also present along the base of the "top plug" of the concrete monolith top (Attachment 1, Figure 2). All dose rate measurements taken around the structure were not significantly different from background measurements taken. No immediate action is necessary.

Dome-External Piping Systems: Inspection of accessible external piping systems revealed no significant indications of deterioration. Some areas of flaking paint were noted. No immediate action is necessary.

Dome-Basement Level: Corrosion is 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 where surface contamination was present, which is preventing contact with previously accessible contaminated and corroding surfaces. Only surface fissures/cracks were noted in the concrete floor covering (Attachment 1, Figure 8). Control measures (fixed with paint and thin concrete layer in some places), which were previously implemented, were inspected and do not require maintenance at this time. Ongoing and routine assessment of accessible surfaces in the basement is recommended to evaluate the continued effectiveness of the new flooring and control measures (e.g., paint) emplaced on previous contamination areas. Access to areas with historical removable contamination is being effectively controlled. No immediate 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 the sump is filling with silt/mud (Attachment 1, Figure 25). Sampling and removal of silt/mud should be planned within the next two to three years.

Rainwater infiltration into the Basement Level is occurring due to two sources:

- The rubber gasket around the exterior base of the Dome is deteriorated (Attachment 1, Figures 28 and 30). The infiltration into the Basement Level due to the deteriorated gasket is most evident by staining on the interior Basement Level walls (Attachment 1, Figures 26 and 27) near and within the Vapor Sphere Room, which is beneath the northern entrance.
- The metal frame of the Basement Level loading door is corroded and allowing rainfall to infiltrate. The paved and concrete entrance pathway outside the loading door diverts rainwater toward the door, which infiltrates the basement through the deteriorated metal frame under the door (Attachment 1, Figure 31).

It is recommended that the exterior rubber gasket surrounding the Dome structure be replaced. Also, it is recommended that the concrete berm be expanded into a concrete ramp covering the corroded frame at the Basement Level loading entrance door after a civil survey has determined that the height of the ramp will effectively divert rainfall away from the door.

Dome-Main Level: The Main Level (Controlled Area) is that portion of the Main Level that is not accessible to the public (Attachment 1, Figure 3). 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 (Attachment 1, Figure 18), which is effective in reducing elevated dose rate levels in this area. Ongoing and routine assessment of the floor tile and lead bricks in this area is recommended. There is also no discernable evidence of work and/or damage affecting the control measures (floor tiles) on the Main Level, Museum Area (Attachment 1, Figures 3, 12, and 14 through 17). No immediate action is necessary on the Main Level.

Dome-Mezzanine Level: Access to ladders and stairways leading to the mezzanine level are being effectively maintained. The structure appears sound and in good condition. No immediate action is necessary.

Dome-Exterior: Inspection of the Dome structure (Attachment 1, Figure 21) did not reveal any significant structural discrepancies, although the paint on the Dome shell has faded and is flaking in spots. Also, refer to the Basement Level flooding issues mentioned above. The metallic pass-through portal at the northern entrance also shows signs of significant corrosion (Attachment 1, Figure 29) and flaking paint. It is recommended that corrosion control coating and new paint be applied to the north entrance pass-through portal to prevent any structural or mechanical damage to the entrance door mechanism.

There is also a small water storage tank adjacent to an ancillary support building on the east side of the Dome (Attachment 1, Figure 32) that is malfunctioning. The float switch, which cuts off the flow of water into the tank, appears to be in need of repair/replacement and allowing the tank to overflow. Water is ponding on the ground surrounding the tank and may eventually flood the ancillary support building. It is recommended that the mechanical operation of the tank be evaluated and repair/replacement of malfunctioning parts/systems performed, as necessary.

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 has reopened. No immediate action is necessary.

General Site Upkeep: The buildings and grounds appear well maintained (Attachment 1, Figures 22 and 24). 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 (Attachment 1, Figure 23). No immediate action is necessary.

DIRECT RADIATION MONITORING

Table 1 presents direct radiation monitoring results for this survey. Attachment 2 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

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	4	4.9	6	416	0.002	2	NA
Main Level (Controlled Area)	3	6.7	18	416	0.007	2	NA
Main Level (Public Access)	4	5.4	6	2,080 (employee)	0.012	2	NA
				832 (visitor)	0.003	NA	0.1
Basement Level	3	7.1	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 6 µR/hour × (1 rem/1,000,000 µR) × (8 hours/1 week) × (52 weeks/1 year) = 0.002 rem/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 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. Attachment 4 provides a copy of instrument calibration sheets. Duplicate field measurements were also made at a rate of 5% of the routine measurements and are summarized in Table 3. All quality assurance (QA)/quality control (QC) checks performed within acceptable limits.

Table 3

Location	Result (µR/hour)		RPD (%)	Comments
	Initial	Duplicate		
1	5	4	22	Acceptable
8	6	5	18	Acceptable
14	4	5	22	Acceptable
17	4	4	0	Very good
20	6	6	0	Very good
21	3	3	0	Very good

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

CONTAMINATION LEVEL MONITORING

Table 1 presents contamination level monitoring results for this survey. Attachment 2 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. Nine survey locations exhibited total surface contamination levels above the MDA ranging from 706 to 1,256 dpm/100 cm^2. These values are well below the survey action level for total surface beta/gamma contamination (5,000 dpm/100 cm^2). It is recommended that the Concrete Monolith Top be designated as a Controlled Area due to the presence of slightly elevated fixed surface beta/gamma contamination levels. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the Concrete Monolith surface) work is performed on this level without review and approval by the RCM. Job-specific Radiological Work Permits (RWPs) may be required for any future intrusive work on the Concrete Monolith Top.

Main Level (Controlled Area)

There are no radioactive Contamination Areas associated with the controlled area (inside the railing and Plexiglas) of the Main Level. Smear samples were collected from the floor surface of the Main Level (controlled area) to assess transferable or removable surface beta/gamma contamination. None of the smear samples exhibited removable contamination above MDA. However, two planned survey locations, 27 and 28, had total surface beta/gamma contamination levels above the 5,000 dpm/100 cm^2 action level (18,754 and 76,470 dpm/100 cm^2, respectively). Two additional survey locations, 27A and 27B (785 and 1,099 dpm/100 cm^2, respectively), were added to the sampling locations in 2001 and assessed to determine the extent of the surface contamination (refer to survey sketch in Attachment 2). 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 (Attachment 1, Figure 3). 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 (survey locations 30, 31,40A, 40B, 50A, and 50B). Attachment 1, Figures 4 through 7, 9 and 11 depict these six Basement Level survey locations. None of the smear samples from these locations exhibited removable contamination above MDA. However, one of these survey locations, 40A (Attachment 1, Figure 9), had total surface beta/gamma contamination levels above the 5,000 dpm/100 cm^2 action level (5,571 dpm/100 cm^2). Three additional survey locations, 30, 31 and 40B, 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 (Attachment 1, Figure 10) 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 (examples found in Attachment 1, Figures 4 through 7 and 9), it is recommended that the proposed non-public access areas in the Basement Level remain designated as a controlled area and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4 (modify posting to avoid alarming visitors). The non-public access areas are those portions of the Liquid Waste Pump Room/F.W. Heater Room and Retention Tank Room that will be partitioned off as "no public access". Those portions of these rooms that will allow public access will be controlled as stated in the previous bullet. Administrative procedures should be in place to ensure that no intrusive (disturbing the floor or wall surfaces) work is performed on this level without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work in this area.

Contamination Survey QA/QC

Instrument calibration records and daily response check records are maintained at the BONUS facility. Attachment 4 provides a copy of instrument calibration records. Duplicate field measurements were also made at a rate of 5% and are summarized in Table 4.

Table 4

Location	Result (dpm/100 cm^2)		RPD (%)	Comments
	Initial	Duplicate		
6 (Removable)	<MDA	<MDA	NA	Good
9 (Total Surface)	1,256	863	37%	Measurement very near MDA, background fluctuation expected
28 (Total Surface & Removable)	76,470 <MDA	79,059 <MDA	3% NA	Good Good
40A (Total Surface & Removable)	5,571 <MDA	5,846 <MDA	5% NA	Good Good
99 (Removable)	<MDA	<MDA	NA	Good
101 (Removable)	<MDA	<MDA	NA	Good

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

Contamination survey QA/QC checks are acceptable.

LABORATORY DATA

None.

SUMMARY OF RECOMMENDATIONS

Based on previous surveys and the 2009 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 motor of the entrance gate was not operational at the time of the survey (same as last year), but was manually operated by the attending guard. Repair or replacement of the gate motor is recommended, but not critical in maintaining site security.
  - Storm water drains appear to be functioning properly in the Basement Level, but the sump is filling with silt/mud (Attachment 1, Figure 25). Sampling and removal of silt/mud should be planned within the next two to three years.
  - The rubber gasket around exterior base of the Dome is deteriorated (Attachment 1, Figures 28 and 30). It is recommended that the exterior rubber gasket surrounding the Dome structure be replaced.
  - The metal frame of the Basement Level loading door is corroded and allowing rainfall, which is diverted toward a concrete berm at the door entrance, to infiltrate (Attachment 1, Figure 31). It is recommended that the concrete berm be expanded into a concrete ramp covering the corroded frame at the Basement Level loading entrance door after a civil survey has determined that the height of the ramp will effectively divert rainfall away from the door.
  - The metallic pass-through portal at the northern entrance shows signs of significant corrosion (Attachment 1, Figure 29) and flaking paint. It is recommended that corrosion control coating and new paint be applied to the north entrance pass-through portal to prevent any structural or mechanical damage to the entrance door mechanism.
  - There is a small water storage tank adjacent to an ancillary support building on the east side of the Dome (Attachment 1, Figure 32) that is malfunctioning. It is recommended that the mechanical operation of the tank be evaluated and repair/replacement of malfunctioning parts/systems performed, as necessary.
- Concrete Monolith: It is recommended that the Concrete Monolith Top remain designated as a controlled area due to the presence of elevated fixed surface beta/gamma contamination levels. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the 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 exposure rates and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4 (modify posting to avoid alarming visitors – current posting is acceptable). Administrative procedures should be in place to ensure that no intrusive (disturbing the floor surface) work is performed on this level without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work in this area.

- Main Level (public access area): Despite the fact that fixed contamination has been shielded with floor tiles, it is recommended that the Main Level (public access area) remain a controlled area. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the floor surface) work is performed on this level without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work in this area.
- Proposed public access area in Basement Level: Despite the fact that fixed contamination has been shielded with the added concrete flooring in the basement, it is recommended that the proposed public access area in the Basement Level remain designated as a controlled area. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the floor surface) work is performed on this level without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work in this area.
- Proposed non-public access area in the Basement Level – Despite the fact that elevated removable surface contamination levels have been fixed through control measures, it is recommended that the non-public access areas in the Basement Level remain designated as a controlled area and be marked/posted in accordance with Section 6.7 of SOP PBR-11.1.4 (modify posting to avoid alarming visitors). The non-public access areas are those portions of the Liquid Waste Pump Room/F.W. Heater Room and Retention Tank Room that will be partitioned off as "no public access". Those portions of these rooms that will allow public access will be controlled as stated in the previous bullet. Administrative procedures should be in place to ensure that no intrusive (disturbing the floor surface or control measures) work is performed on this level without review and approval by the RCM. Job-specific RWPs may be required for any future intrusive work in this area.
- Per SOP PBR-11.1.4, routine surveys are required to ensure removable contamination remains below action levels. For this purpose, it is recommended that the annual comprehensive survey and quarterly surveys continue to be repeated. Quarterly surveys should focus on public access areas in close proximity to historical removable contamination areas (F.W. Heater Room/Liquid Waste Pump Room and Retention Tank Room).

Attachment 1
Photos

Figure 1. Entombment Top (North Side) – Surface Cracks (Typical)

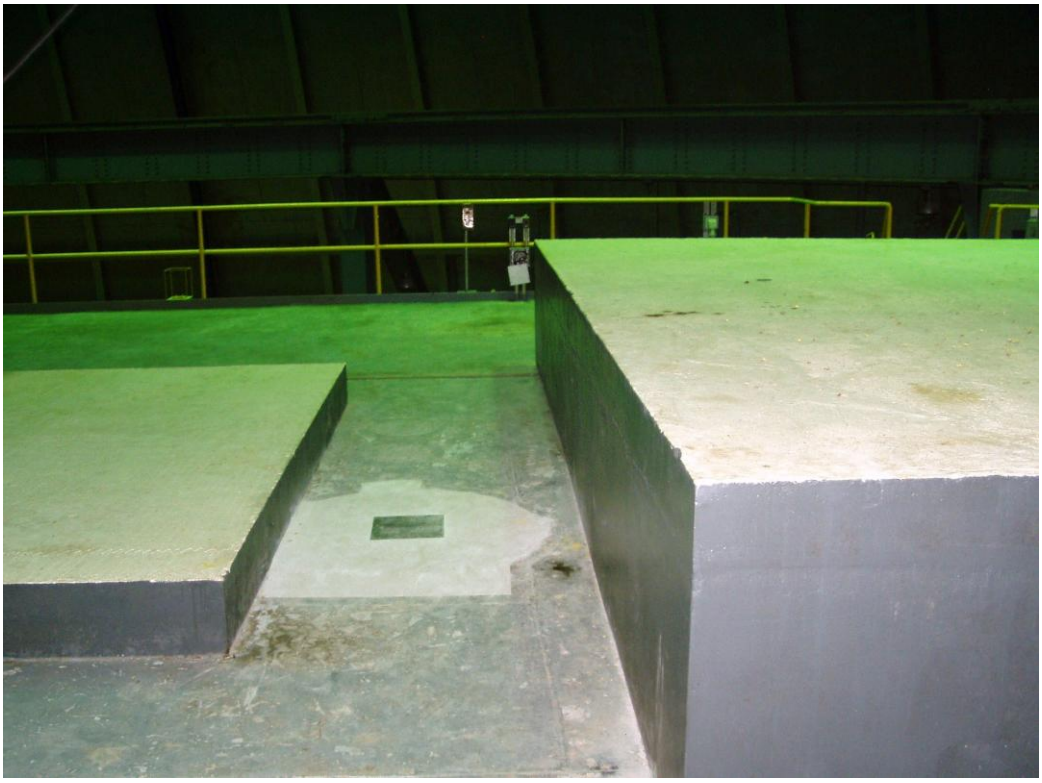


Figure 2. Entombment Top (Top Plug)

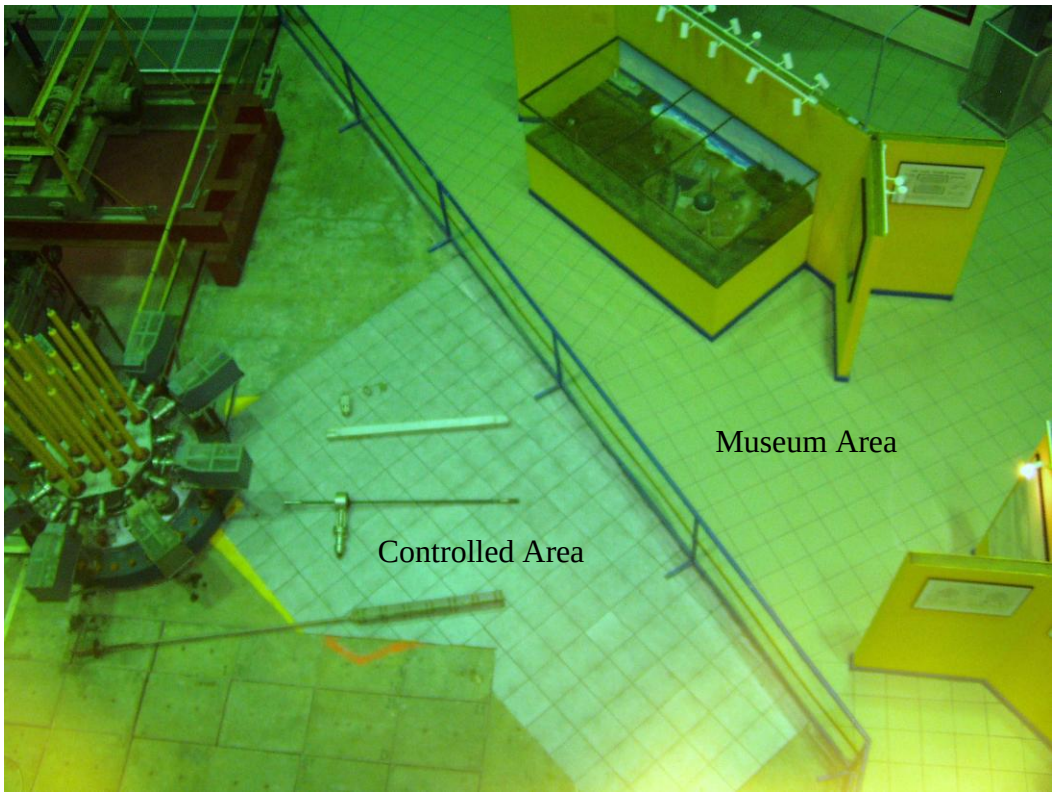


Figure 3. Main Level View from Entombment Top

Figure 4. Basement Level – Retention Tanks 1 and 2

Figure 5. Basement Level – Retention Tanks 2 and 3

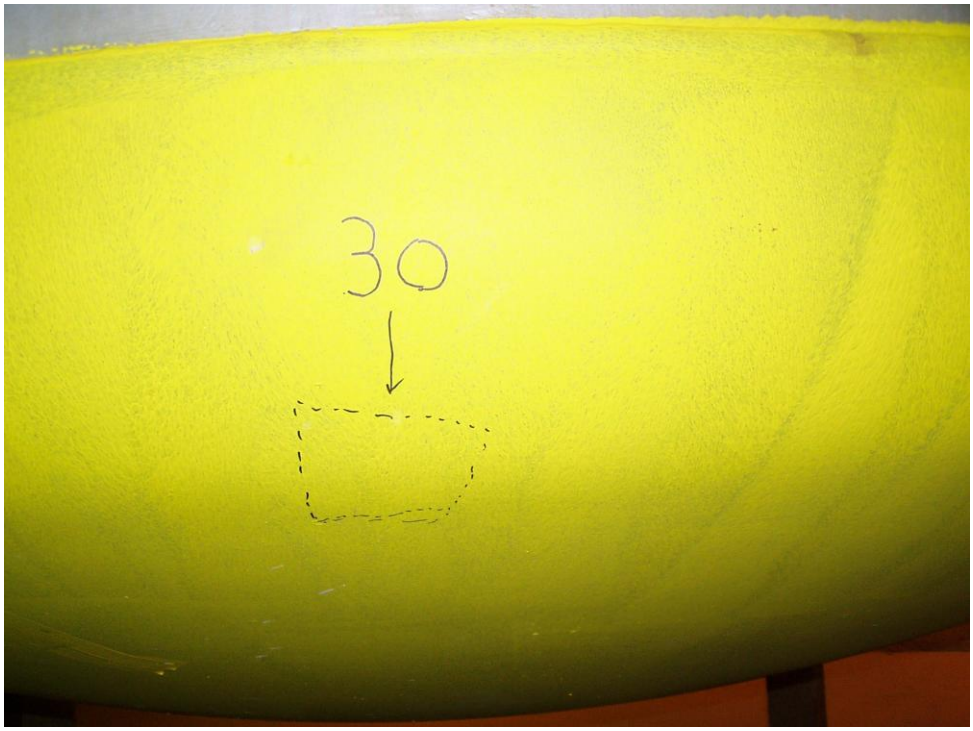


Figure 6. Basement Level – Survey Location 30 on Retention Tank 1

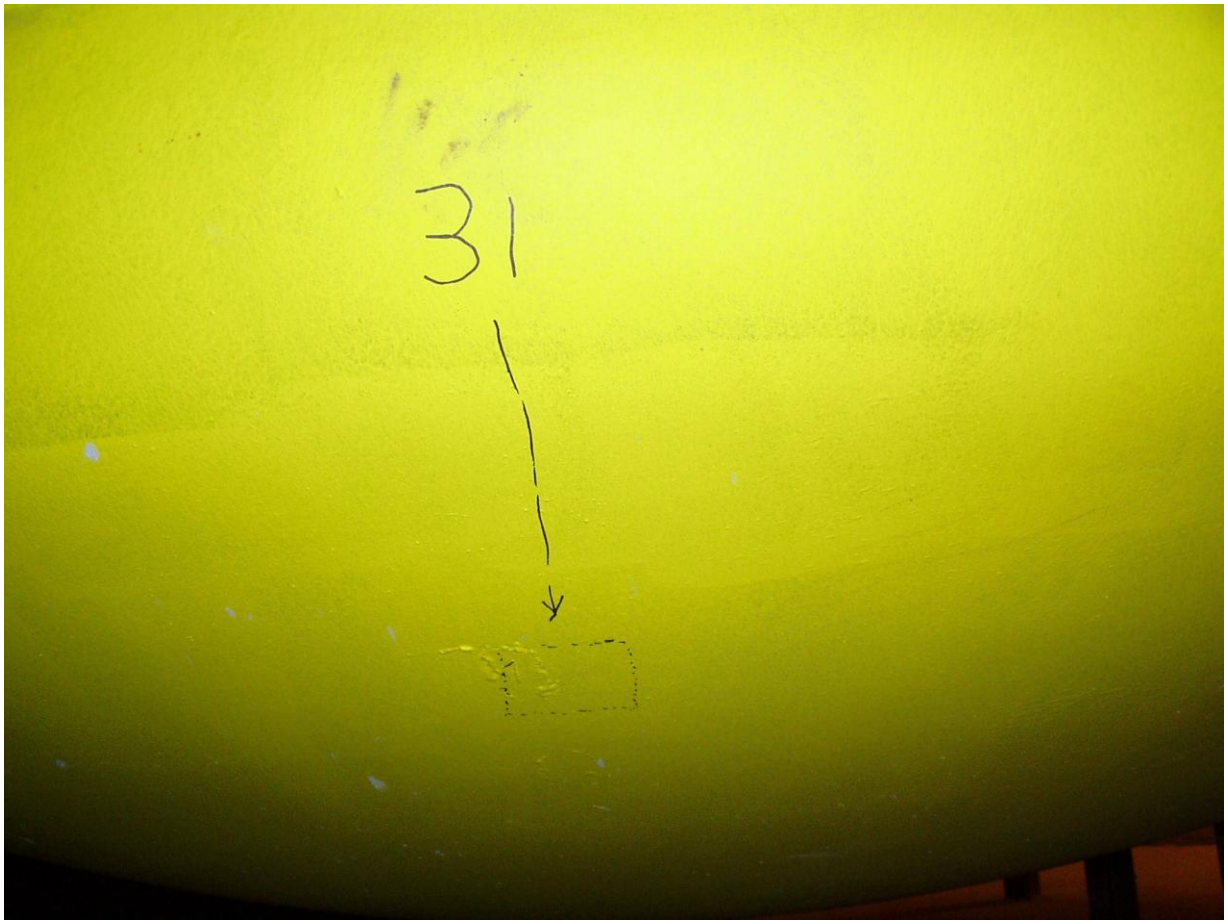


Figure 7. Basement Level – Survey Location 31 on Retention Tank 2

Figure 8a and 8b. Basement Level – Surface Cracks in Concrete Cover (Typical)

Figure 9. Basement Level – Survey Locations 40A and 40B

Figure 10. Basement Level – Tank Formerly Labeled as Radioactive Material/Waste Storage Tank

Figures 11a and 11b. Basement Level – Survey Locations 50A and 50B

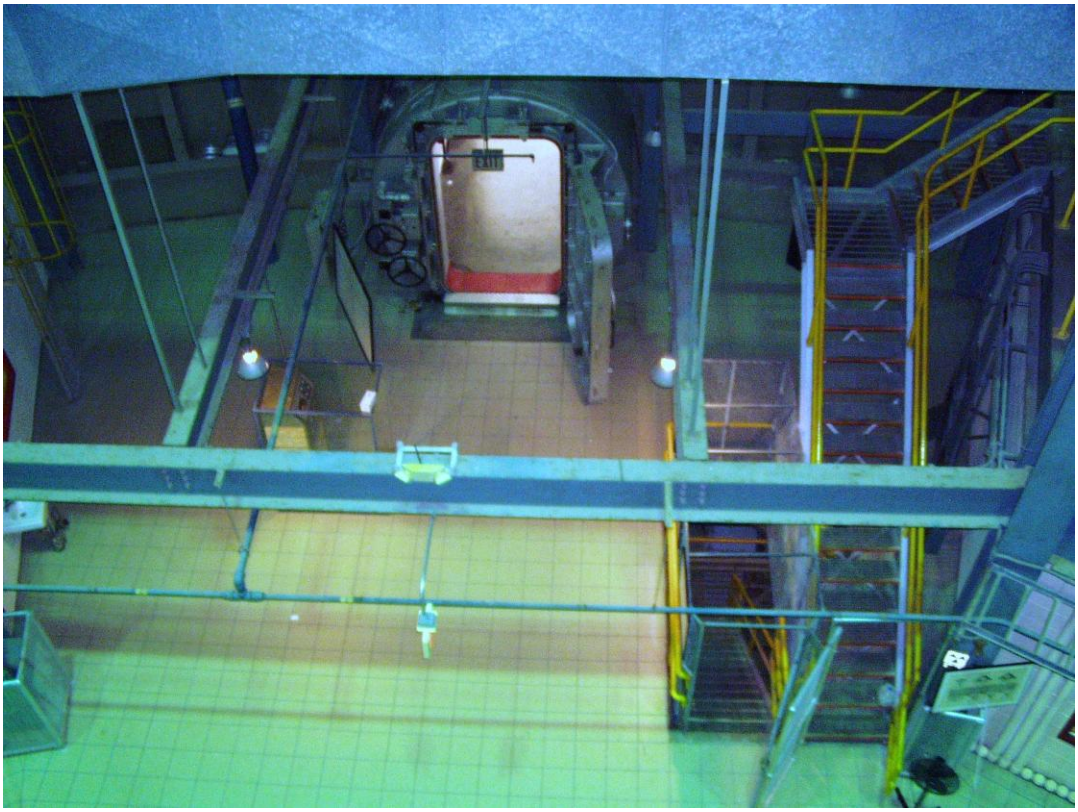


Figure 12. View from Crane Catwalk – South Side/Entrance, Main Level

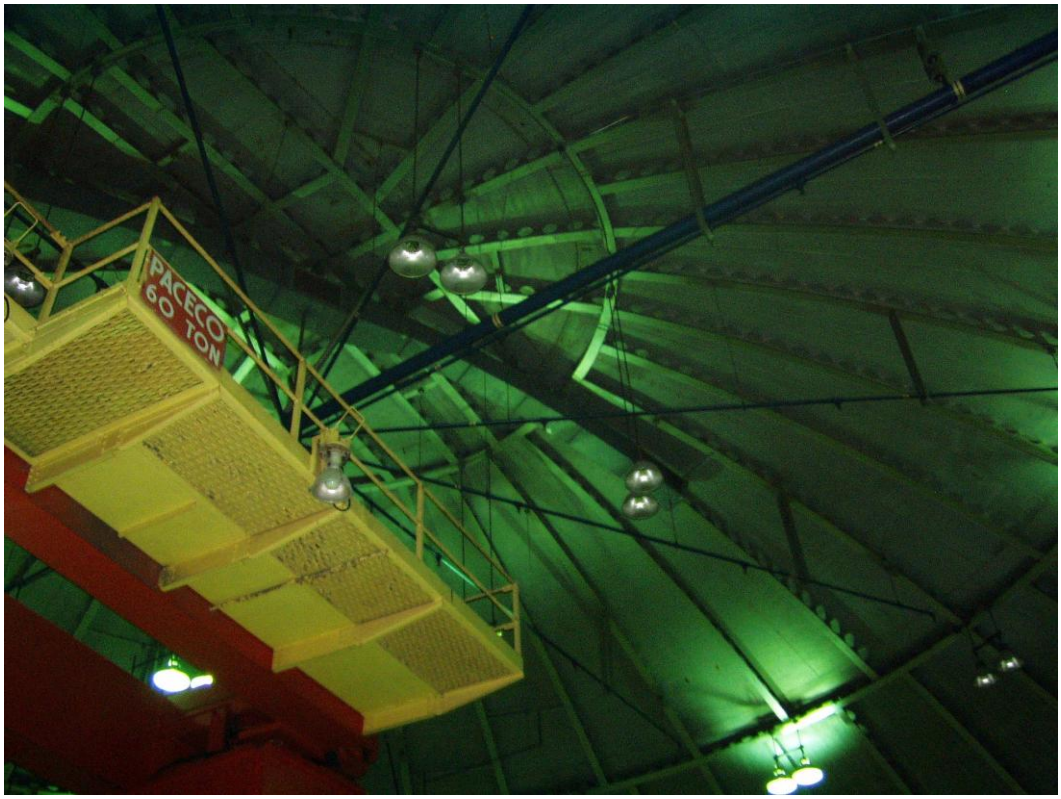


Figure 13. Interior View of Dome "Shell" and Crane Catwalk

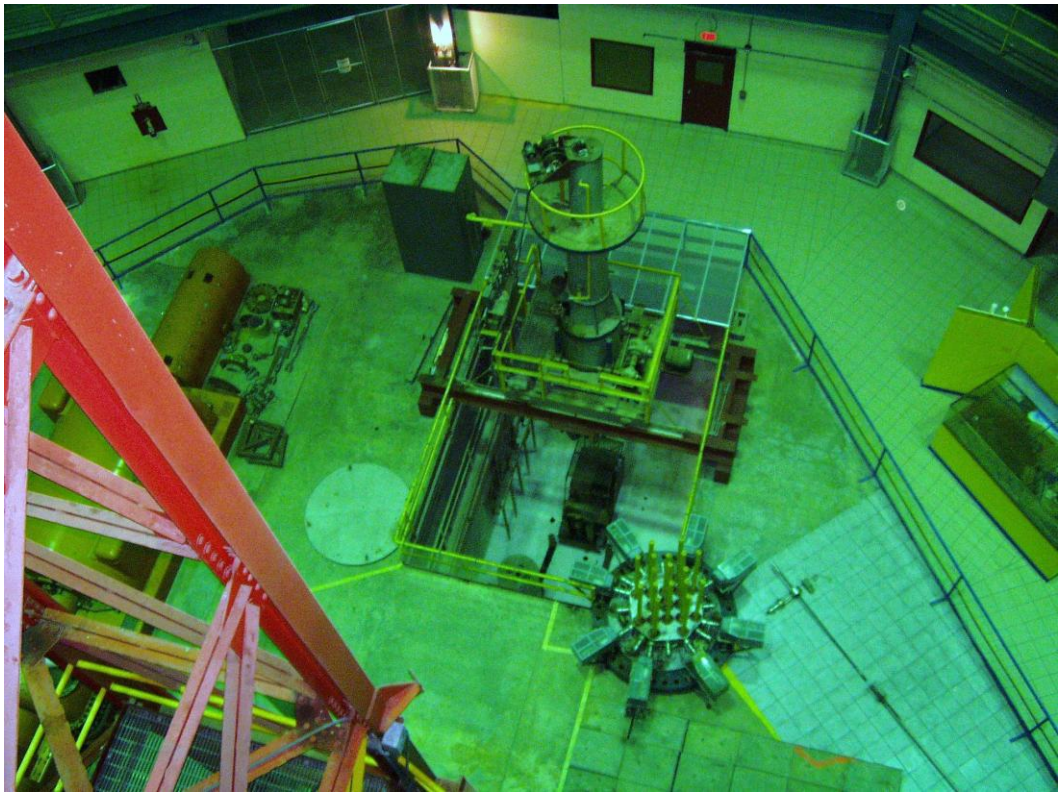


Figure 14. View from Crane Catwalk – East Side, Main Level

Figure 15. View from Crane Catwalk – North Side/Entrance, Main Level

Figure 16. View from Crane Catwalk – North/Northwest Side, Main Level

Figure 17. View from Catwalk – West/Northwest Side, Main Level (Survey Technician on Entombment Top Below)

Figures 18a and 18b. Main Level – Tile, Concrete, and Lead Bricks Covering "Hot Spot" on North Side (Adjacent to Sample Locations 27 and 28)

Figure 19. Site Security – Main Gate (Motor is Not Operational)

Figure 20. Site Security – Gate Security Building and Main Gate (Motor is Not Operational)

Figure 21. Dome Exterior

Figure 22. Support Facilities (Theatre Building on Left)

Figure 23. General Site – View from Back Deck of Theatre Building (Vegetation on Slope)

Figure 24. General Site – Grounds Maintained Along Southern Fence Line

Figure 25. Basement Level – Lowest Point in Basement Shows No Recent Signs of Flooding (Dry, Cracked Silt/Mud is Visible)

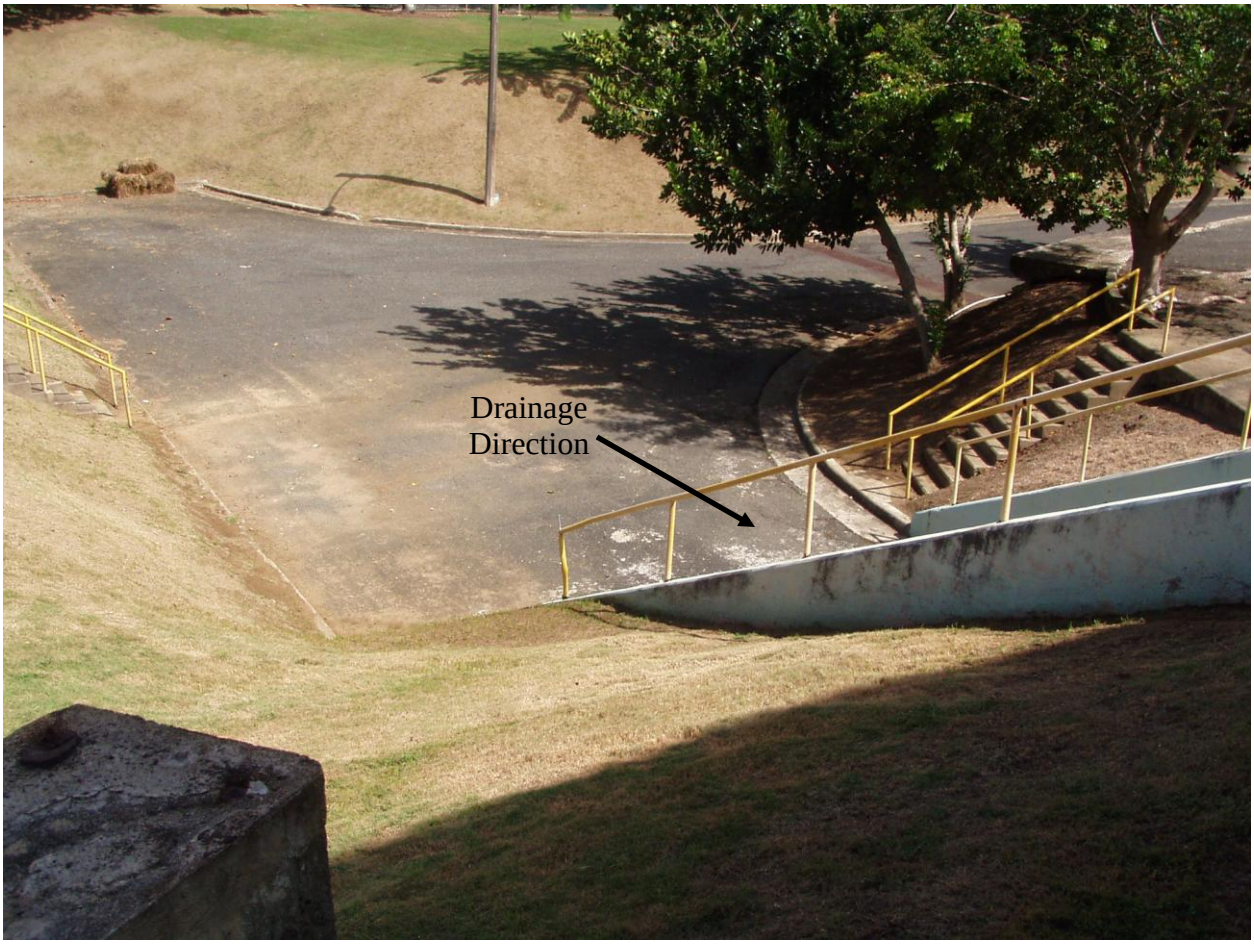
Figure 26a and 26b. Basement Level – Staining Due to Water Infiltration beneath Northern Entrance

Figure 27. Basement Level – Additional View of Staining Due to Water Infiltration beneath the Northern Entrance

Figure 28. Gasket Seal at Northern Entrance Exterior Deteriorated

Figure 29. North Entrance – Pass-Through Chamber (Significant Corrosion)

Figure 30a and 30b. Gasket Seal around Domed Metal Structure and Dome Base is Damaged and Diverts Rainwater into the Basement Level



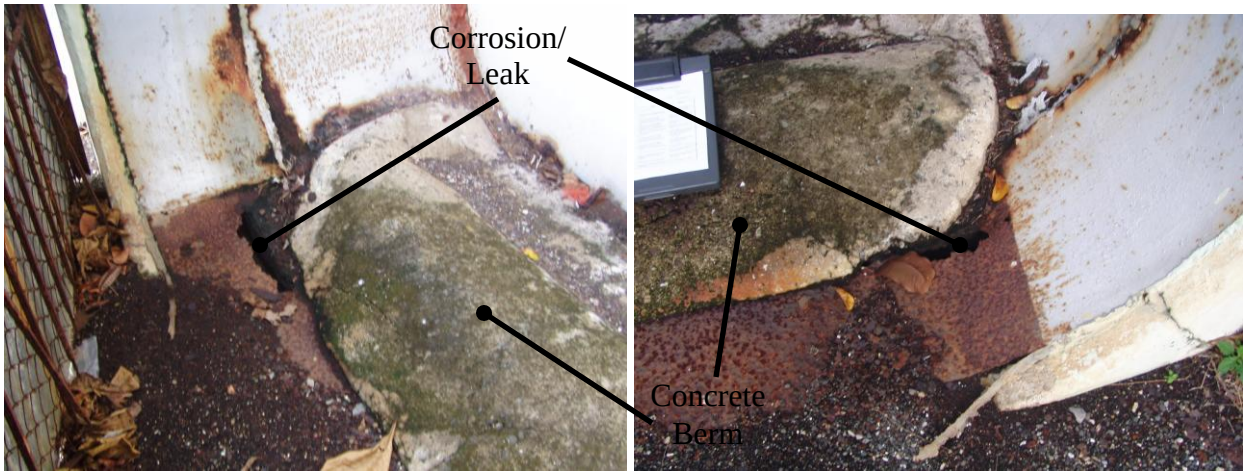


Figure 31a, 31b, and 31c. Basement Level – East Side Basement Loading Access. 31a (Top) Shows the Pave Access Pad Drains Rainwater Toward the Loading Door. 31b and 31c (Left and Right) Show a Concrete Berm Across the Loading Door to Prevent Rainwater from being Diverted into the Basement Level. However, Corrosion of the Metal Frame in Front of the Berm Allows Rainwater to Leak into the Basement.

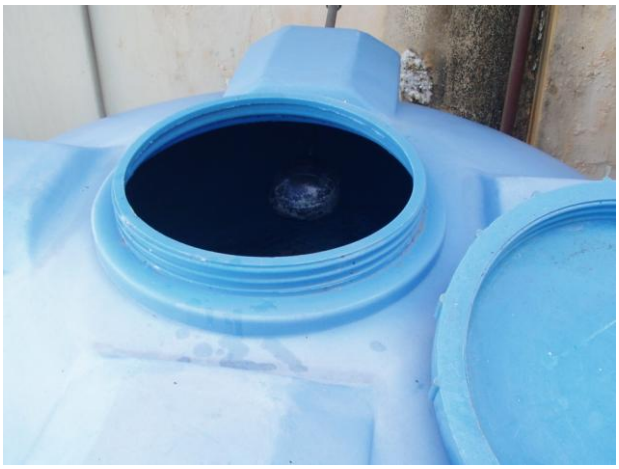



Figure 32a and 32b. Water Storage Tank with Malfunctioning Float Switch (32b) – Resulting in Overflow and Pooling Water on Ground (32a)

Attachment 2
Annual Survey Contamination Survey Forms and Sketches

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/29/10 -0820 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 2010 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	3/11/11	44-9	154535	3/11/11	17 %	5 / 2	40	706
		/ /			/ /	%	/		

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	Same data	38		<MDA
2	North Side		49		<MDA
3	North Side		45		<MDA
4	North Side		46		<MDA
24	North Side		37		<MDA
26	North Side		32		<MDA

Survey Technician: X [illegible]
Reviewed By: [illegible]

*MDA is total in dpm/100 cm²

$$MDA = \frac{\frac{2.71}{5} + 3.3\sqrt{\frac{40}{5} + \frac{40}{2}}}{.17} \times 6.67$$

$= 706$ dpm/100cm²

$= 58$ cpm

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building	Time: 0820	Date: Yr 10 Mo 9 Dy 29
Task: Comprehensive Survey	RWP: NA	

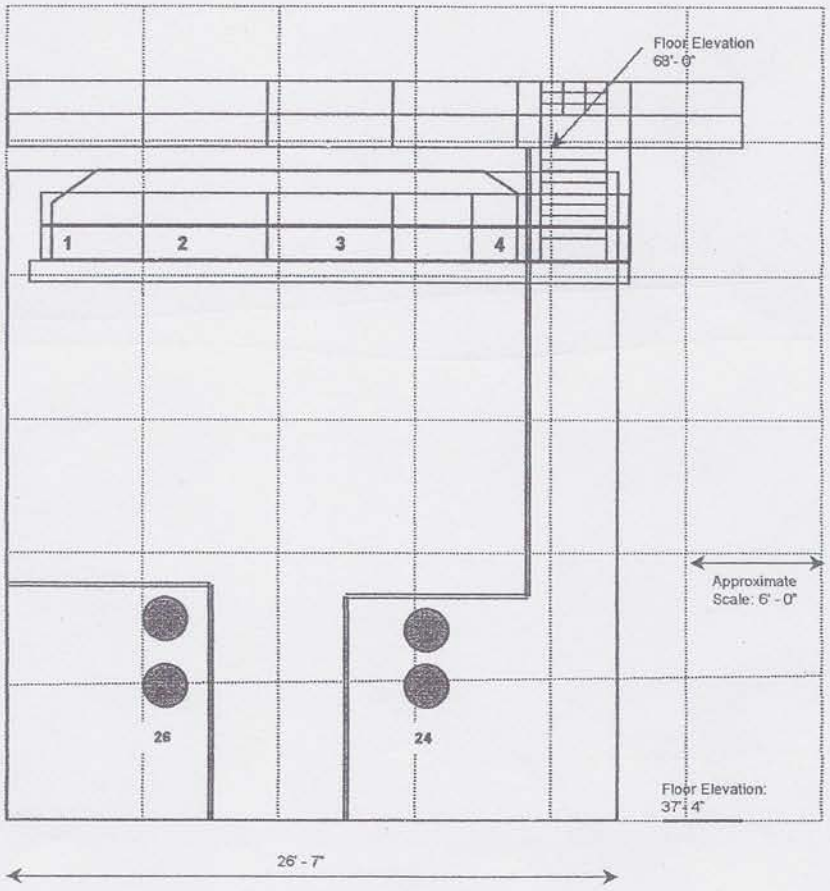
Map key: ° = Sample Location ☐ = Air Sampler Location _ = Core Sample

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): NA

Survey Technician(s): C. Webb

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/29/10 0840 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 2010 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	3/4/11	44-9	154535	3/11/11	17 %	5 | 2	40	706
		/ /			/ /	%	/		

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		42		<MDA
6	Top Plug Face		58		706
7	Top Plug Face	See	53		<MDA
8	Top Plug Face	Smear	58		706
9	Top Plug Face	Data	72		1,256
10	Top Plug Face		60		785
11	Top Plug Face		68		1,099
12	Top Plug Face		58		706
13	Top Plug Face		59		745
14	Top Plug Face		59		745
15	Top Plug Face		49		<MDA
16	Top Plug Face		62		863
17	Top Plug – Top Surface		50		<MDA
18	Top Plug – Top Surface		50		<MDA
19	Top Plug – Top Surface		50		<MDA
9Dup	Duplicated		62		863

Survey Technician: [signature]

Reviewed By: [signature]

*MDA is total in dpm/100 cm²

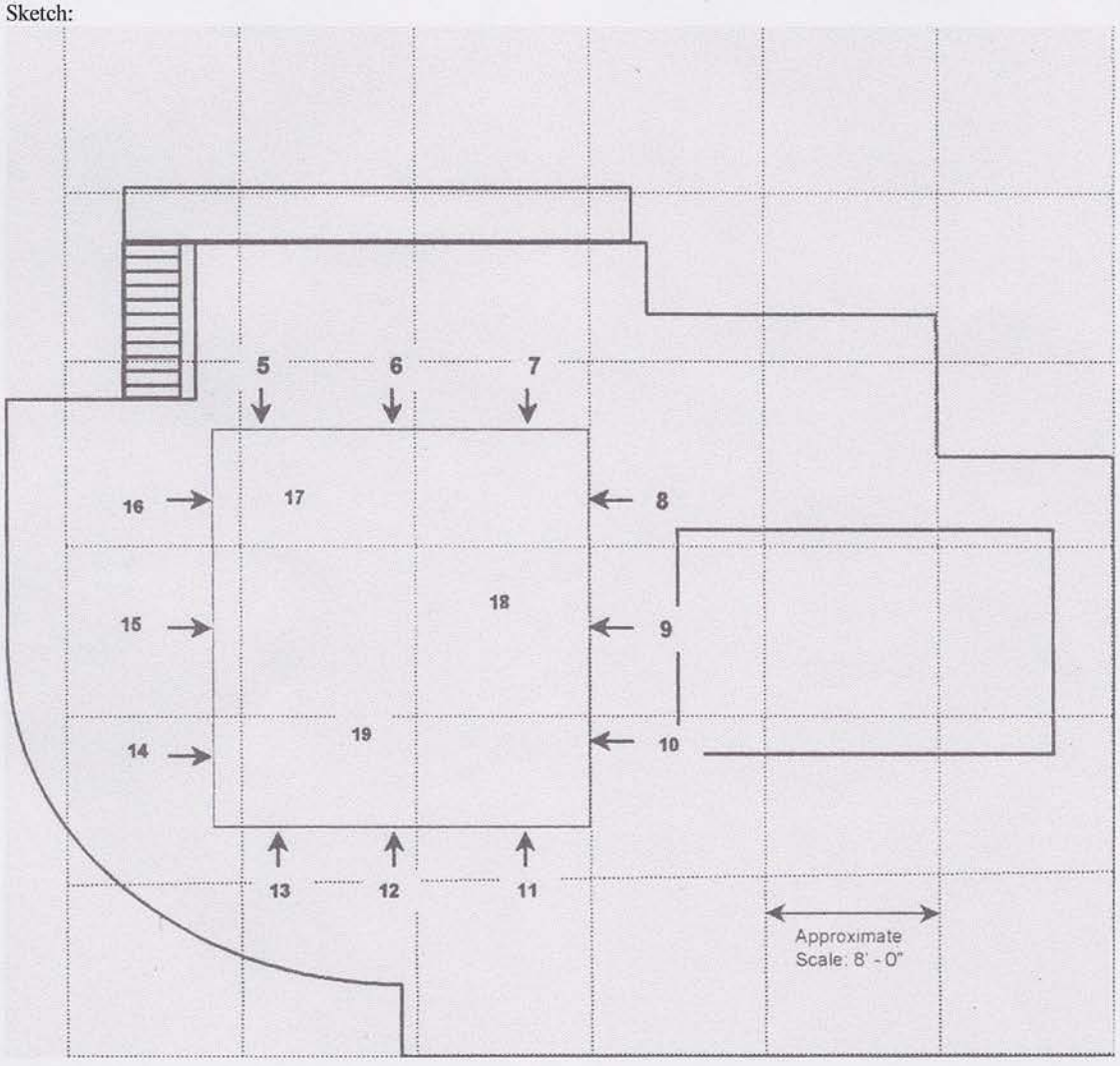
TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY)
Rincón, Puerto Rico

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building	Time: 0840	Date: Yr 10 Mo 9 Dy 29
Task: Comprehensive Survey	RWP: NA	

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

Sketch:



Instruments (Model and Serial Numbers): NA

Survey Technician(s): C. Webb

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/29/10 - 1015 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 2010 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	3/11/11	44-9	154535	3/11/11	17 %	5 | 2	40	706
		/ /			/ /	%	/		

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	see Smear Data	36	}	< MDA

Survey Technician: X

Reviewed By:

*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: 1015	Date: Yr 10 Mo 9 Dy 29
Task: Comprehensive Survey	RWP: NA	

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

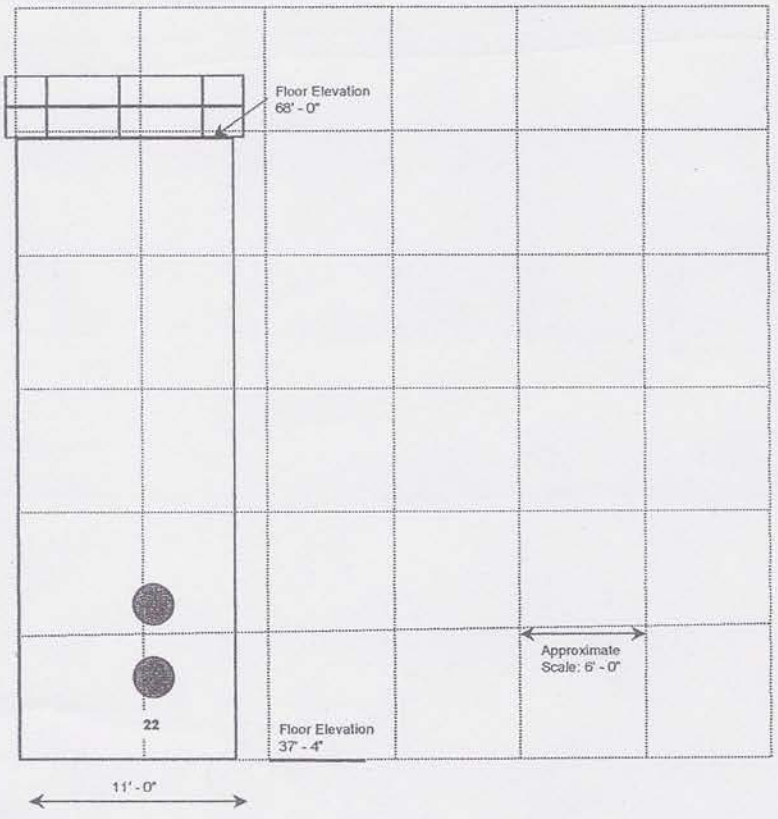
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: South Side

Sketch:

Entombment System - South View

1 = Sample Locations



Instruments (Model and Serial Numbers): NA

Survey Technician(s): C Webb

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/29/10-1020 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 2010 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	3/11/11	44-9	154535	3/11/11	17 %	5 | 2	40	706
		/ /			/ /	%	/		

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	See Smear Data	36	{	< MDA

Survey Technician: x Ath. Vaz Phy

Reviewed By: ~~~

*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: 1020	Date: Yr 10 Mo 9 Dy 29
Task: Comprehensive Survey	RWP: NA	

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

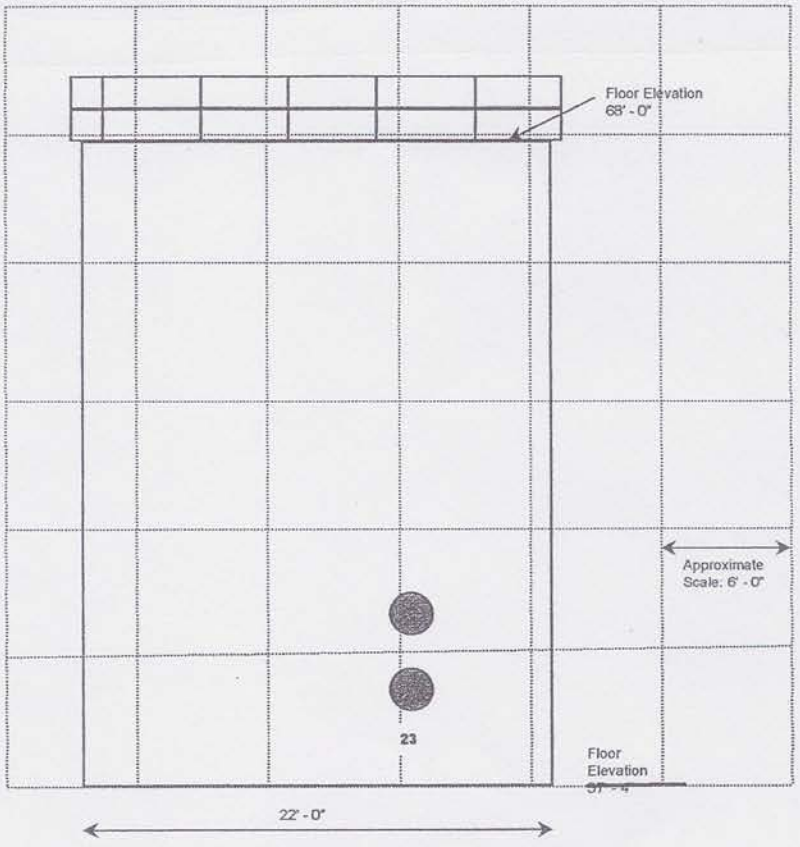
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: SouthWest Side

Sketch:

Entombment System - Southwest View

1 = Sample Locations



Instruments (Model and Serial Numbers): NA

Survey Technician(s): C. Webb

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/29/10 - 1025 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 2010 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	3/11/11	44-9	154535	3/11/11	17 %	5 | 2	40	706
		/ /			/ /	%	/		

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	See Smear Data	45	5	<MDA

Survey Technician: X

Reviewed By:

*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: 1025	Date: Yr 10 Mo 9 Dy 29
Task: Comprehensive Survey	RWP: NA	

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

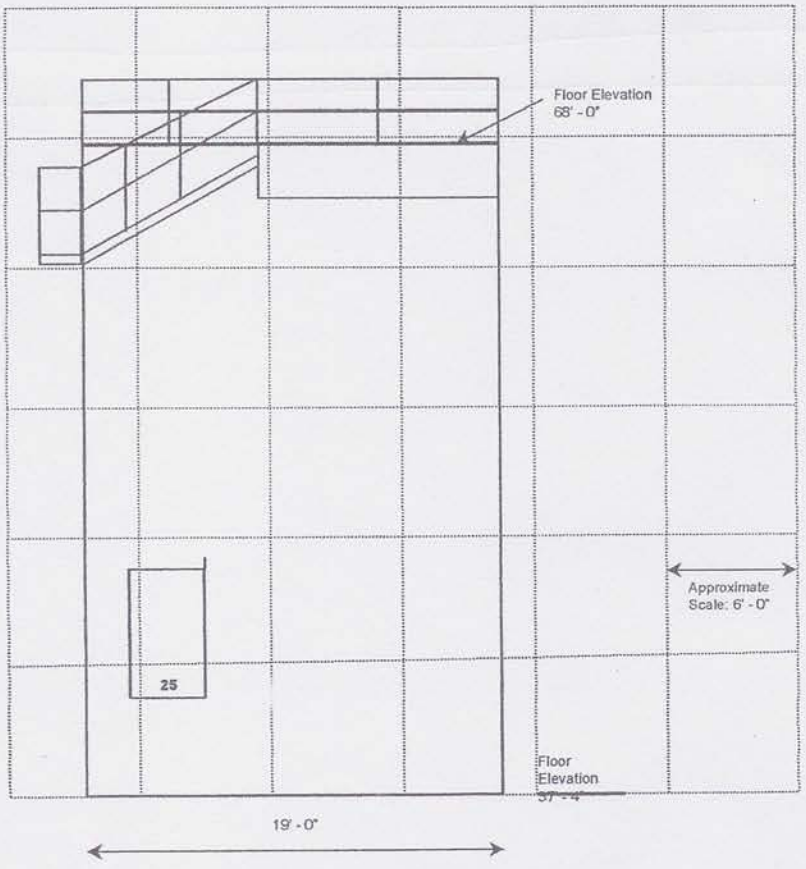
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building Location: NorthWest Side

Sketch:

Entombment System - Northwest View

1 = Sample Locations



Instruments (Model and Serial Numbers): NA

Survey Technician(s): C. Webb

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/29/10 0945 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 2010 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	3/11/11	44-9	154535	3/11/11	17 %	5|2	40	706
		/ /			/ /	%	/		

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	See Smear Data	55		<MDA
21	Main Floor		57		<MDA
27	Main Floor		518		18,754
28	Main Floor		1,989		76,470
27A	Main Floor		60		785
27B	Main Floor		68		1,099
28 Dup	Main Floor		2,055		79,059

Survey Technician: HH VG PM

Reviewed By: CA MM

*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 9/30/10 - 0915 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 2010 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	3/11/11	44-9	154535	3/11/11	17 %	10 / 1	45	~140-160
		/ /			/ /	%	/		

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-Maslim (Zone 1)	46		<MDA	
66	Main Floor-Maslim (Zone 2)	42		<MDA	
67	Main Floor-Maslim (Zone 3)	48		<MDA	
68	Main Floor-Maslim (Zone 4)	51		<MDA	
69	Main Floor-Maslim (Zone 5)	41		<MDA	
72	Main Floor-Maslim (Zone 6)	54		<MDA	
73	Main Floor-Maslim (Zone 7)	54		<MDA	
74	Main Floor-Maslim (Zone 8)	47		<MDA	
75	Main Floor-Maslim Zone 9)	59		<MDA	
76	Main Floor-Maslim (Zone 10)	38		<MDA	
77	Main Floor-Maslim (Zone 11)	59		<MDA	
78	Main Floor-Maslim (Zone 12)	51		<MDA	
79	Main Floor-Maslim (Zone 14)	40		<MDA	
80	Main Floor-Maslim (Zone 13)	45		<MDA	

Survey Technician: [signature]
Reviewed By: X [signature]

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

Conservative ~MDA ≃ 70 cpm

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building	Time: 9/29/10-0945 9/30/10-0915	Date: Yr 10 Mo 9 Dy 29 10 9 30
Task: Comprehensive Survey	RWP: NA	

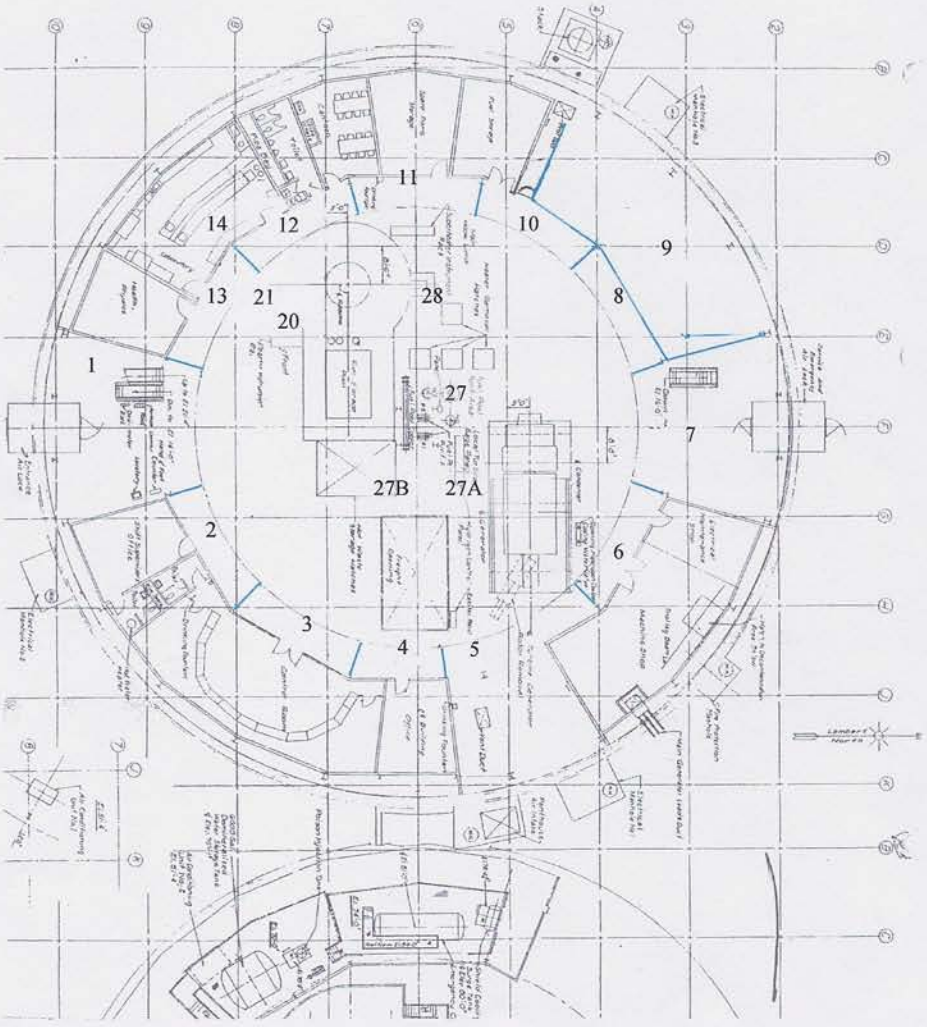
Map key: ° = Sample Location ☐ = Air Sampler Location _ = Core Sample

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 __=		
Zone __=		
	20	
	21	
	27	
	28	
	27A	
	27B	



Instruments (Model and Serial Numbers): NA

Survey Technician(s): C. Webb

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/28/10 - 1315 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 2010 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	3/11/11	44-9	154535	3/11/11	17 %	5 / 2	36	671
		/ /			/ /	%	/		

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		77		1,607
31	Basement Floor-Side of Tank #2		83		1,844
40A	Basement Floor-Wall (4" from floor)	Smear	178		5,571
40B	Basement Floor-Wall (4" from floor)	Smear	65		1,138
42	Basement Floor	data	42		<MDA
43	Basement Floor		44		<MDA
50A	Basement Floor-Wall (block)		47		<MDA
50B	Basement Floor-Wall (concrete)		40		<MDA
40ADup	Basement Floor-Wall (4" from floor)		185		5,846

Survey Technician: HV, PF

Reviewed By: CR 2nd

*MDA is total in dpm/100 cm²

$$MDA = \frac{\frac{2.71}{5} + 3.3\sqrt{\frac{36}{5} + \frac{36}{2}}}{.17} \times 6.67 = 671$$

53 cpm

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/30/10 - 1035 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 2010 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	3/11/11	44-9	154535	3/11/11	17 %	10 1	45	~140-160
		/ /			/ /	%	/		

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	Contamination in dpm/100 cm² α Removable	Contamination in dpm/100 cm² α Total
70	Maslim - Zone 1	37		LMDA			
71	Maslim - Zone 2	41		LMDA			
81	Maslim - Zone 3	38		LMDA			
89	Maslim - Zone 4	36		LMDA			
90	Maslim – Zone 5	49		LMDA			
91	Maslim – Zone 6	47		LMDA			
92	Maslim – Zone 7	48		LMDA			
93	Maslim – Zone 8	48		LMDA			
94	Maslim – Zone 9	43		LMDA			
95	Maslim – Zone 10	44		LMDA			
96	Maslim – Zone 11	50		LMDA			
97	Maslim – Zone 12	55		LMDA			
98	Maslim – Zone 13	40		LMDA			

Survey Technician: _____

Reviewed By: _____

*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 **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/30/10 - 1130 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 2010 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	3/11/11	44-9	154535	3/11/11	17%	10 / 1	45	~140-160
		/ /			/ /	%	/		

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	Maslim – Zone 14	36		LMDA	
100	Maslim – Zone 15	40		LMDA	
101	Maslim – Zone 16	41		LMDA	
102	Maslim – Zone 17	46		LMDA	
103	Maslim – Zone 18	46		LMDA	
101 Dup	Maslim - Zone 16 Duplicate	48		LMDA	
99 Dup	Maslim - Zone 14 Duplicate	42		LMDA	

Survey Technician: _____

Reviewed By: _____

*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)

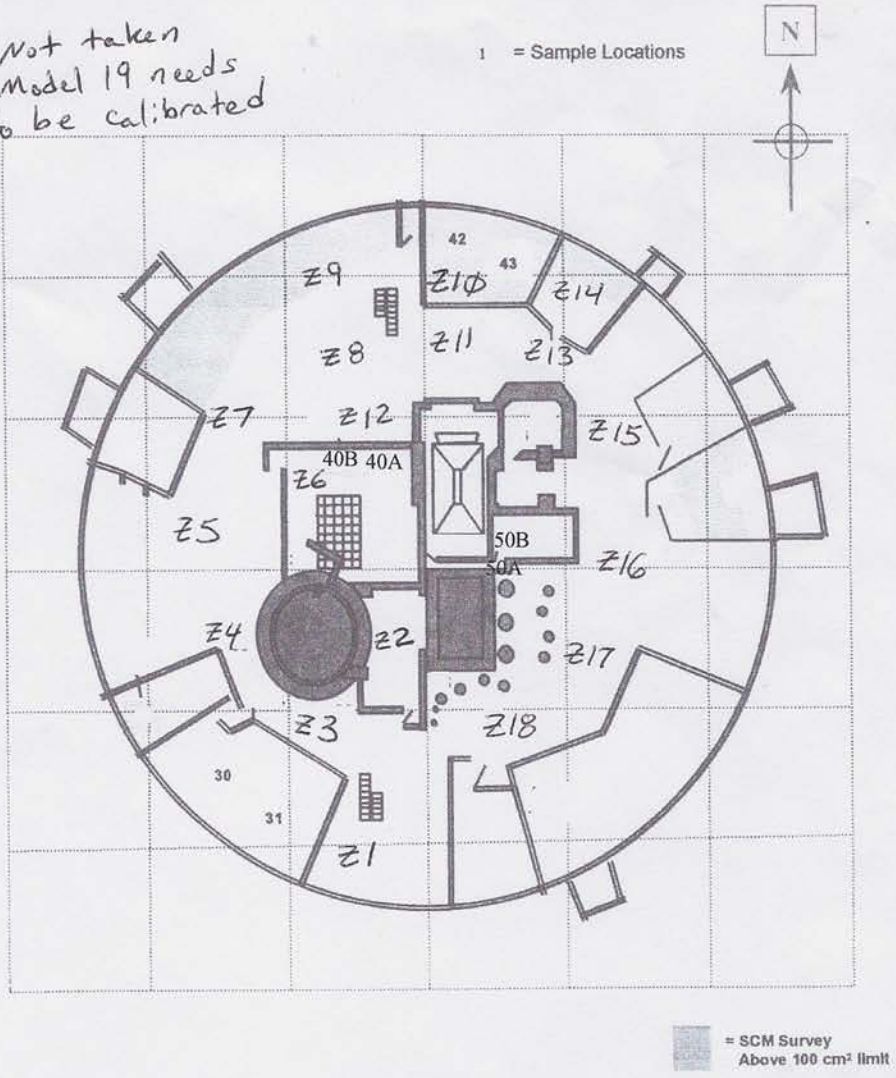
SITE: Entombed Reactor Building	Time: 9/28 – 1315 / 9/30 – 1035	Date: Yr 10 Mo 9 Dy 28 / 30
Task: Comprehensive Survey	RWP: NA	

Building: Entombed Reactor Building Location: Basement Floor

Sketch:

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

Not taken – Model 19 needs to be calibrated



Instruments (Model and Serial Numbers): NA

Survey Technician(s): C. Webb

Rev 2 (2/07)

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/28/10-1415 Task Number —

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

Purpose of Survey: Year 2010 Comprehensive Survey A=(Sample-Bkg)/E

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA*
Ludlum 2221	149991	3/11/11	44-9	154535	3/11/11	17 %	10 5 / 1	56	154
		/ /			/ /	%	/		

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	40		<MDA	
31	"	41		<MDA	
40A	"	44		<MDA	
40A Dup	Duplicate	55		<MDA	
40B	Smear	46		<MDA	
42	"	45		<MDA	
43	"	48		<MDA	
50A	"	45		<MDA	
50B	"	41		<MDA	

Survey Technician: [signature]

Reviewed By: [signature]

*MDA is removable in dpm/100 cm²

MDA = 82 cpm

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 9/29/10 - 1100 Task Number ———

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

Purpose of Survey: Year 2010 Comprehensive Survey A=(Sample-Bkg)/E

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA*
Ludlum 2221	149991	3/11/11	44-9	154535	3/11/11	17 %	10 / 1	56	154
		/ /			/ /	%	/		

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
27A	Smear	43		<MDA	
27B		51		<MDA	
26		62		<MDA	
20		58		<MDA	
21		57		<MDA	
23		49		<MDA	
8		53		<MDA	
10		33		<MDA	
14		43		<MDA	
22		51		<MDA	
2		61		<MDA	
1		46		<MDA	
4		38		<MDA	
3		48		<MDA	
5		49		<MDA	
6		55		<MDA	
6 Dup	Duplicate Count	31 ~~44~~ cw		<MDA	

Survey Technician: AHV PH

Reviewed By: CE-2nd

*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 9/29/10 - 1315 Task Number ——

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

Purpose of Survey: Year 2010 Comprehensive Survey A=(Sample-Bkg)/E

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA*
Ludlum 2221	149991	3/11/11	44-9	154535	3/11/11	17 %	10/1	56	154
		/ /			/ /	%	/		

SURVEY DATA		Survey Map Attached ☐ Yes ☑ No			
		Gross Counts in CPM		Contamination in dpm/100 cm²	
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total
7	Smear	34		<MDA	
11		48		<MDA	
9		49		<MDA	
12		51		<MDA	
13		42		<MDA	
15		40		<MDA	
16		36		<MDA	
17		53		<MDA	
18		56		<MDA	
19		61		<MDA	
24		50		<MDA	
25		36		<MDA	
27		45		<MDA	
28		44		<MDA	
28Dup	Duplicate	57		<MDA	

Survey Technician: [illegible signature]
Reviewed By: [illegible signature]

*MDA is removable in dpm/100 cm²

Rev 2 (2/07)

Micro-R Meter Dose Rate Measurements Taken By PREPA
20 – 21 December 2010

Collected By: Jimmy Reyes, Anthony Vega, and Alan Lucca

Reviewed By: Chad Webb, MMG

CONTAMINATION SURVEY FORM

Project: Museum Survey Date/Time 20-DIC-2010 Task Number _____

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

Purpose of Survey: Year 2010 Quarterly Survey A=(Sample-Bkg)/E x CF

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA
Ludlum 2221	149991		44-9	154535		%	10/2		
Ludlum 19	148190				/ /	%	/		

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

No.	Description/Location	µR/hr	Gross Counts in CPM				Contamination in dpm/100 cm²			
			βγ Removable (smears)	βγ Total (counts)	α Removable	α Total	βγ Removable (smears)	βγ Total (counts)	α Removable	α Total
BKG	Main Floor-Hallway in front Machine Shop near 480 VAC Spandle Metal	7			NA*	NA			NA	NA
65	Main Floor- Corner hallway Exhibition and Fuel Storage Room	5								
66	Main Floor- Entrance inside Spare Parts Storage Room	6								
67	Main Floor-At Cafeteria near sink	5								
68	Main Floor-Inside Lab Room near exit close to Cafeteria	5								
69	Main Floor-Hallway in front Control Room near 480 VAC Spandle Metal	5								
28		15								
27		18								
27A		5								
27B		4								
27C		14								

Survey Technician: _____ : _____

Reviewed By: Ing. Agustin Garcia

27D - - - - - - 13

Note:

27.E - - - - - - 20

26 - - - - - - 6

29 - - - - - - 5

24 - - - - - - 5

30 - - - - - - 20 } BASEMENT

31 - - - - - - 17

21-DIC.2010 = 8:20 AM.

1=5,4,5,5,4,6=

2=5

3=4

4=5

5=5

6=5

7=6

8=6,5,5,6,5,5=

9=5

10=6

11=6

12=4

13=5

14=4,5,4,6,5,5=

15=5

16=4

17=4,5,4,4,5,5=

18=4

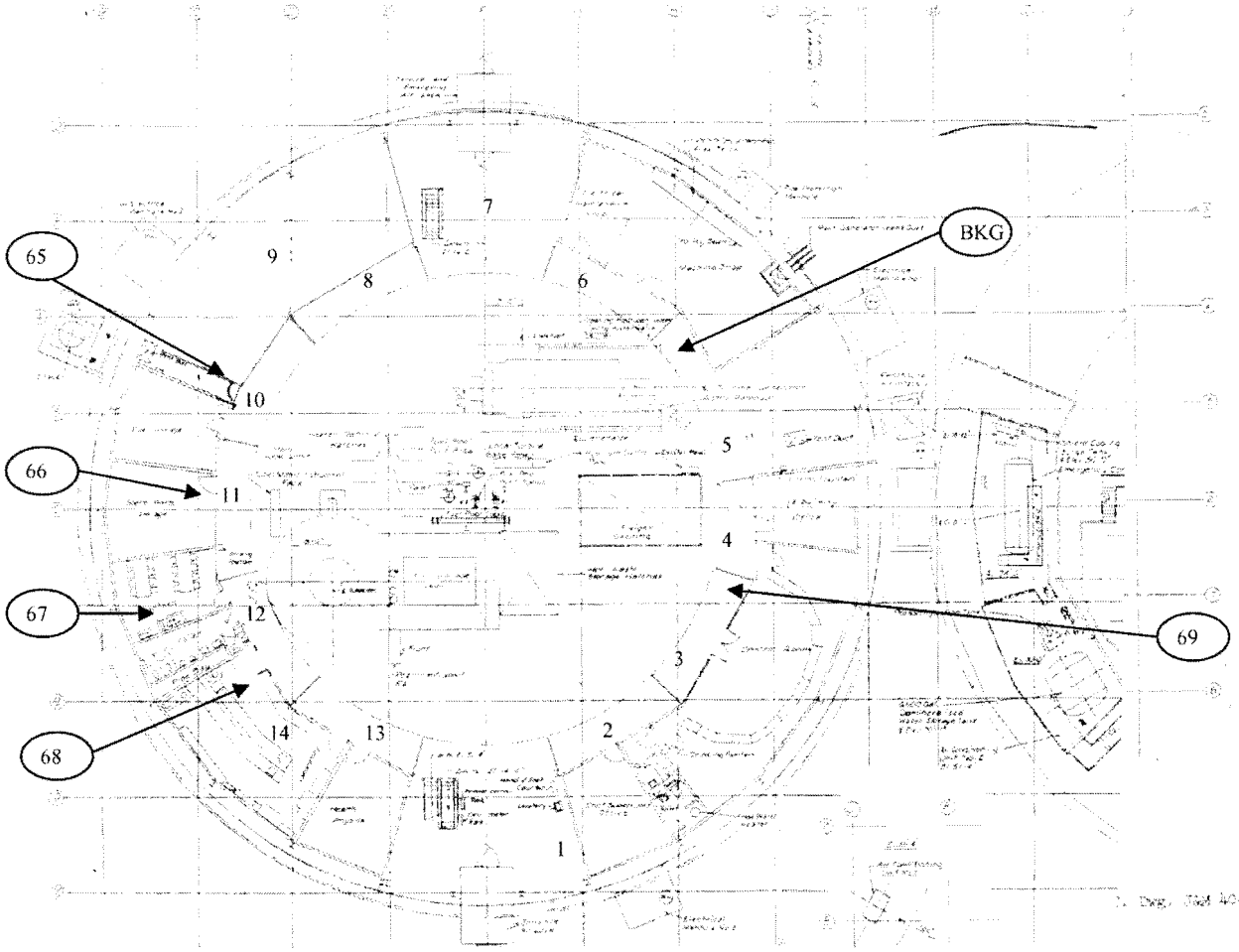
19=5

20=6,6,5,6,5,5=

21=3,3,3,4,3,3=

22=4,

23=4



Zone	µR/hr
1	5
2	6
3	4
4	5
5	5
6	5
7	5
8	6
9	5
10	5
11	6
12	6
13	6
14	6

Survey Technician : _____

Review by : _____

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

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Museum Survey Date/Time 20-DIC-2010 Task Number _____

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

Purpose of Survey: Year 2010 Quarterly Survey A=(Sample-Bkg)/E x CF

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA
Ludlum 2221	149991		44-9	154535		%	5/1		
Ludlum 19	148190				/ /	%	/		

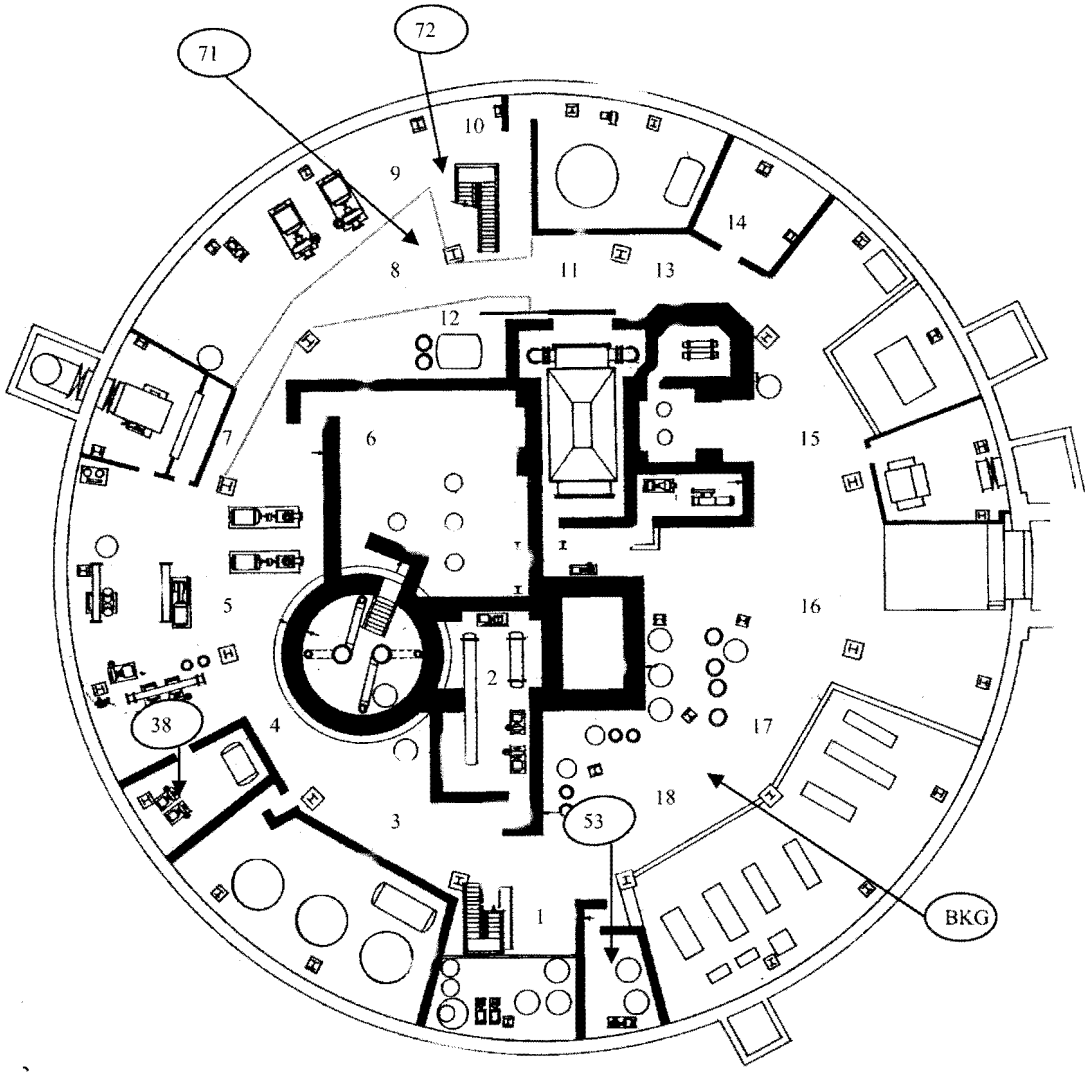
SURVEY DATA **Survey Map Attached ☐ Yes ☐ No**

No.	Description/Location	µR/hr	Gross Counts in CPM				Contamination in dpm/100 cm^2			
			βγ Removable (smears)	βγ Total (counts)	α Removable	α Total	βγ Removable (smears)	βγ Total (counts)	α Removable	α Total
BKG	Basement Floor- Hallway in front Switchgear	5			NA	NA			NA	NA
38	Basement Floor-Inside Liquid Waste Pump Room	7								
53	Basement Floor-Inside Resin regeneration Room	8								
71	Basement Floor-Hallway near stairs Sphere Room	5								
72	Basement Floor-Hallway near stairs Sphere Room	3								
40A		15								
50A		6								
50B		5								
40B		15								
42		4								
43		4								
30		20								

Survey Technician: _____ : _____

Reviewed By: Ing. Agustin Garcia

31 - - - - - - 17



KEY

1. Liquid Waste Storage
2. Liquid Waste Processing
3. Shield Cooling Water System
4. Instrument & Service Air Supply
5. Building Ventilation Exhaust Fan
6. Auxiliary Cooling Water Pumps
7. Radiolytic Gas Holdup System
8. Equipment Decontamination Room
9. 440 V Switchgear
10. Building Ventilation Intake Fan
11. Truck Loading Ramp
12. 440 V Motor Load Centers
13. AC & DC Valve Motor Load Centers
14. AC/DC Switchgear
15. Battery Rack & MG Set
16. Make-up Water Purifiers
17. Condensate Resin Regeneration System
18. Reactor Feedwater Pumps
19. Turbine Lube Oil Filter
20. Feedwater Heater/Main Steam Compartment
21. Condenser
22. Steam Jet Air Ejectors
23. Condensate Pumps
24. Gland Exhauster/Evactor Room
25. Solid Radioactive Waste Storage
26. Condensate Filters & IX Columns
27. Reactor Water Filters & IX Columns
28. Startup Heater
29. Reactor Water Purification Pumps & Coolers
30. Reactor Circ. Water Pump Room
31. Floor & Equipment Drain Sumps
32. Waste Paper Baler

Containment building basement (el. 16', 0") plan.

Zone	µR/hr
1	5
2	7
3	7
4	7
5	3
6	5
7	5
8	5
9	5
10	5
11	6
12	7
13	6
14	4
15	4
16	5
17	6
18	6

Survey Technician : _____

Review by : _____

Attachment 3
Physical Condition - Inspection Checklist

Inspection Checklist
BONUS Decommissioned Facility, Rincón, Puerto Rico

Date of This Inspection/Revision: 9/30/2010

Last Inspection: 8 December 2009

Inspectors: C. Webb and A. Reyes

Next Inspection (Planned): Summer 2011

No.	Item	Issue	Action
1	Specific site surveillance features	See attached table.	Inspect. ✓
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. ✓ Some cracks on surface
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. some flaking of paint
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. ✓ Basement steps locked. Ropes + Signs used.
5	Dome—Basement Level flooding	Water accumulating in Basement Level may mobilize and redistribute surface contamination.	Inspect for gasket and storm water drains. ✓ Current water stains in Vapor Sphere Room. Gasket around dome is deteriorated.
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. ✓ Good.
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. steps access-locked. Good.
8	Dome— exterior	Building should appear well maintained	Visually inspect. ✓ some flaking paint - minor. Also some erosion Good. on back entrance.
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. ✓ None. Lighthouse Park open.
10	General site upkeep	Building should appear well maintained.	Observe and evaluate changes in site conditions. ✓ Good.
11	Site security	Security guard should be stationed at site at all times.	Ensure security guard is present. ✓

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. ✓ Good Condition.

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

Feature	Comment
Access road and parking area	Asphalt
Entrance gate	Motor-operated Not operable. Manually open/close.
Access through security gate	Note security of site; sign-in required on log sheet ✓
Security fence	Chain-link, topped with three strands of barbed wire ✓
Dome—monolith plaques	Visually inspect ✓

Attachment 4
Calibration Sheets

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER PUERTO RICO ELECTRIC PWR AUTHORITY ORDER NO. 20162613/355573

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

Mfg. _____ Model _____ Serial No. _____

Cal. Date 9-Oct-10 Cal Due Date 9-Oct-11 Cal. Interval 1 Year Meterface 202-016

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 35 % Alt 708.8 mm Hg

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

☑ Mechanical ck.	☑ Meter Zeroed	☐ Background Subtract	☐ Input Sens. Linearity
☑ F/S Resp. ck	☑ Reset ck.	☐ Window Operation	☑ Geotropism
☑ Audio ck.	☐ Alarm Setting ck.	☑ Batt. ck. (Min. Volt) 2.2 VDC	

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

Instrument Volt Set 525 V Input Sens. 33 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

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

COMMENTS:
Cs-137 ≈ 1 µCi check source SN 2008 reads ≈ 270 uR/hr when placed flat against dimple on front of can with description facing out. (on 500 Range)

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
5000	4000 uR/hr	N/A	4000
5000	1000 uR/hr		1000
500	400 uR/hr = 71200cpm		400
500	100 uR/hr		100
250	200 uR/hr = 36000cpm		200
250	100 uR/hr		100
50	7120 cpm		40
50	1780 cpm		10
25	3600 cpm		20
25	900 cpm		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: ☐ 73410 ☐ 1131 ☑ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897

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

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

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

Calibrated By: _____ Date 9oct10

Reviewed By: _____ Date 10 Oct 10

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

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER PUERTO RICO ELECTRIC POWER AUTHORITY ORDER NO. 20149583/347599

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

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

Cal. Date 11-Mar-10 Cal Due Date 11-Mar-11 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 29 % Alt 690.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 5.0 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 900 V Input Sens. 50 mV Det. Oper. 900 V at 50 mV Threshold Dial Ratio 100 = 10 mV

☑ HV Readout (2 points) Ref./Inst. 500 / 502 V Ref./Inst. 2000 / 2008 V

COMMENTS:

Sr90Y90: sn 3432-09 reads as follows: Cs-137:#2008 reads~32,825cpm 1min (61,100dpm ct.15,459cpm -Bg40cpm =25%) with the source placed against protective screen of 44-9 detector.
Sr90Y90:sn 4016 act-53,963dpm,background=40cpm, source count= 10760cpm Eff= 20%
Co60:sn 0886 act=10,313dpm,background=40cpm,source count= 1360cpm,Eff= 13%
Ni63:sn 4017 act=283,324dpm,background=40cpm,source count= 390cpm,Eff= 0.14%
Cs-137(gamma):sn 0754 act=180,254dpm,background=40cpm,source count= 409cpm,Eff= 0.22%
Cs-137(beta): 158-112 act=6,451dpm,background=40cpm, source count= 1425cpm Eff= 22%
All Efficiencies are in 4pi. and 1/4 inch from surface using inhouse 180-2 Firmware 2640-10

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

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

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

ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400 K cpm	400000	400000
	40 K cpm	40001	40001
	4 K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale	500 K cpm	500K	500K
	50 K cpm	50K	50K
	5 K cpm	5K	5K
	500 cpm	500cpm	500cpm
	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: ☐ S-394/1122 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646
Cs-137 Gamma S/N ☐ 1162 ☑ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☑ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 189506 ☐ Oscilloscope S/N ☑ Multimeter S/N 93870637

Calibrated By: Dwight Jackson Date 11-MAR-10

Reviewed By: Rhonda Haines Date 11 March 10

FORM C22A 10/15/2008

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