

Memorandum

Date: 21 September 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: 2011 Annual Survey

MMG conducted the comprehensive annual survey at the Dr. Modesto Iriarte Technological Museum (former BONUS Facility) during the dates of 4 – 5 August 2011 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.

PURPOSE

Date: 4 – 5 August 2011

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. Table 1 provides a list of specific survey locations.



Table 1

Sampling Location	Sample Number	Dose Rate	Total Contamination (dpm/100 cm ²)	Removable Contamination (dpm/100 cm ²)	Comments
	1 (unito et	R	outine Sampling	(upin 100 cm)	
Pipe Chase Face	1	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Pipe Chase Face	2	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Pipe Chase Face	3	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Pipe Chase Face	4	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #1	5	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
		Dup=4	Dup= <mda< td=""><td></td><td></td></mda<>		
Top Plug Face #1	6	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #1	7	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #2	8	5	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #2	9	6	1,584	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #2	10	6	1,084	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #3	11	6	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #3	12	5	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #3	13	5	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #4	14	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #4	15	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Face #4	16	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
				Dup= <mda< td=""><td></td></mda<>	
Top Plug Top Surface	17	3	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Top Surface	18	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Top Plug Top Surface	19	4	<mda< td=""><td><mda< td=""><td>Monolith Top</td></mda<></td></mda<>	<mda< td=""><td>Monolith Top</td></mda<>	Monolith Top
Main Floor Water Column	20	9	<mda< td=""><td><mda< td=""><td>Main Level-Controlled Area</td></mda<></td></mda<>	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
Main Floor Water Column	21	10	1,417	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
Instrument Thimble #1	22	9	<mda< td=""><td><mda< td=""><td>Main Level-Controlled Area</td></mda<></td></mda<>	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
Instrument Thimble #2	23	7	<mda< td=""><td><mda< td=""><td>Main Level-Controlled Area</td></mda<></td></mda<>	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
T			Dup= <mda< td=""><td></td><td></td></mda<>		
Instrument Thimble #3	24	5	<mda< td=""><td><mda< td=""><td>Main Level-Controlled Area</td></mda<></td></mda<>	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
Pipe Chase Ext Hatch	25	6	<mda< td=""><td><mda< td=""><td>Main Level-Controlled Area</td></mda<></td></mda<>	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
Instrument Thimble #4	26	5	<mda< td=""><td><mda< td=""><td>Main Level-Controlled Area</td></mda<></td></mda<>	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27	32	18,759	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	2/A	10	1,617	<mda< td=""><td>Taken to define elevated area</td></mda<>	Taken to define elevated area
					associated with 27 and 28.
Fuel Pool Purif Floor, area	27B	10	1,099	<mda< td=""><td>Main Level-Controlled Area.</td></mda<>	Main Level-Controlled Area.
					Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif. Floor	28	30	88,503	<mda< td=""><td>Main Level-Controlled Area</td></mda<>	Main Level-Controlled Area
(CM005)		Dup=30	Dup=83,583	Dup= <mda< td=""><td></td></mda<>	



Table 1 (Continued)

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm ²)	Removable Contamination (dpm/100 cm ²)	Comments
	1 (4110) 01	Routine	Sampling (continue	ed)	
Side of Liq. Waste Ret. Tank #1	30	18	1,292	<mda< td=""><td>Basement Level, Att. A – Fig.s 4 and 6</td></mda<>	Basement Level, Att. A – Fig.s 4 and 6
Side of Liq. Waste Ret. Tank #2	31	16	1,501	<mda< td=""><td>Basement Level, Att. A – Fig.s 4, 5, and 6</td></mda<>	Basement Level, Att. A – Fig.s 4, 5, and 6
F.W. Heater Room (Wall)	40A	30 Dup=30	6,295 Dup=5,628	<mda Dup=<mda< td=""><td>Basement Level, Att. A – Fig. 9</td></mda<></mda 	Basement Level, Att. A – Fig. 9
F.W. Heater Room (Wall)	40B	22	<mda< td=""><td><mda< td=""><td>Basement Level, Att. A – Fig. 9</td></mda<></td></mda<>	<mda< td=""><td>Basement Level, Att. A – Fig. 9</td></mda<>	Basement Level, Att. A – Fig. 9
Vapor Sphere Room	42	4	<mda< td=""><td><mda< td=""><td>Basement Level</td></mda<></td></mda<>	<mda< td=""><td>Basement Level</td></mda<>	Basement Level
Vapor Sphere Room	43	5	<mda< td=""><td><mda< td=""><td>Basement Level</td></mda<></td></mda<>	<mda< td=""><td>Basement Level</td></mda<>	Basement Level
Condenser Room Entry Wall (Block)	50A	10	<mda< td=""><td><mda< td=""><td>Basement Level, Att. A – Fig. 11</td></mda<></td></mda<>	<mda< td=""><td>Basement Level, Att. A – Fig. 11</td></mda<>	Basement Level, Att. A – Fig. 11
Condenser Room Entry Wall (Concrete)	50B	10	<mda< td=""><td><mda< td=""><td>Basement Level, Att. A – Fig. 11</td></mda<></td></mda<>	<mda< td=""><td>Basement Level, Att. A – Fig. 11</td></mda<>	Basement Level, Att. A – Fig. 11
		Addition	al Sampling Locati	ons	1
Main Floor-Zone 1	65	3	NA	<1000dpm/100cm ²	Main Level-Public Access. Masslin Smear
Main Floor-Zone 2	66	5	NA	<1000dpm/100cm ²	Main Level-Public Access. Masslin Smear
Main Floor-Zone 3	67	5	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	5	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	5	NA	<1000dpm/100cm ²	Main Level-Public Access. Masslin Smear



	Total Remova		Removable		
	Sample	Dose Rate	Contamination	Contamination	
Sampling Location	Number	(µR/hour)	(dpm/100 cm ²)	(dpm/100 cm ²)	Comments
	Α	dditional San	npling Locations (C	continued)	
Main Floor-Zone 12	78	4	NA	<1000dpm/100cm ²	Main Level-Public Access. Masslin Smear
Main Floor-Zone 14	79	5 Dup=5	NA	<1000dpm/100cm ²	Main Level-Public Access. Masslin Smear
Main Floor-Zone 13	80	5	NA	<1000dpm/100cm ²	Main Level-Public Access. Masslin Smear
Basement Floor-Zone 1	70	4	NA	<1000dpm/100cm ²	Basement Level Masslin Smear
Basement Floor-Zone 2	71	5	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	5	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	6	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	4	NA	<1000dpm/100cm ²	Basement Level Masslin Smear
Basement Floor-Zone 12	97	4	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 Dup=5	NA	<1000dpm/100cm ²	Basement Level Masslin Smear

 $\begin{array}{l} dpm/100\ cm^2 = \ disintegrations \ per \ minute \ per \ 100 \ centimeters \ squared \\ Dup = \ Duplicate \\ MDA = \ Minimum \ Detectable \ Activity \\ \mu R/hour = \ micro-Roentgen \ per \ hour \end{array}$



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 through 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 Dome monolith plaques were in fair condition. At one location on the beach-side of the property, the fence needs to be prepared to control access. Repair or replacement of the gate motor is recommended, but not critical in maintaining site security (repeat from 2010).

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, Figures 2 and 3). 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 concrete layer in some places), which were previously implemented, were inspected and do not require maintenance at this time (Attachment 1, Figures 9, 11, and 24). 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 (repeat from 2010).

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, Figures 31 and 32).

It is recommended that the exterior rubber gasket surrounding the Dome structure be replaced or repaired (repeat from 2010). 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 (repeat from 2010).

Minimal evidence of termites (vertical "tracks" on interior wall) was also noted in the Basement Level (Attachment 1, Figure 33). Since there are little to no wood building materials associated with the facility, no action is required at this time.

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 4). 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 4, 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 (repeat from 2010).

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, Figure 22). However, it appears that the grass is not being routinely mowed. 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.

						Annua	l Dose	
	Dose Rate	e at 30 cm fro	om Source			Limits		
		(µR/hour)		Expected Exp	posure Rate ^a	(rem/year)		
				Max.				
	Min.	Ave.	Max.	Exposure	Rate	Rad		
Location	(µR/hour)	(µR/hour)	(µR/hour)	(hour/year)	(rem/year)	Worker	Visitor	
Monolith Top	3	4.4	6	416	0.002	2	NA	
Main Level	5	12.1	32	416	0.013	2	NA	
(Controlled Area)								
Main Level	3	4.8	5	2,080	0.010	2	NA	
(Public Access)				(employee)				
				832 (visitor)	0.004	NA	0.1	
Basement Level	3	7.7	30	416	0.003	2	NA	

Table 2	2
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rem = roentgen equivalent in man

^aBased conservatively on the maximum-recorded dose rate at a conservative exposure scenario. For example, exposure level for the Monolith top would be 6 μ R/hour × (1 rem/1,000,000 μ R) × (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 μ R/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.



	Result (µR/	/hour)		
Location	Initial	Duplicate	RPD (%)	Comments
5	4	4	0	Very good
28	30	30	0	Very good
40A	30	30	0	Very good
79	5	5	0	Very good
103	5	5	0	Very good

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

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. Two survey locations exhibited total surface contamination levels above the MDA ranging from 1,084 to 1,584 dpm/100 cm². These values are well below the survey action level for total surface beta/gamma contamination (5,000 dpm/100 cm²). 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 cm² action level (18,759 and 88,503 dpm/100 cm², respectively). Three additional survey locations, 21, 27A and 27B (1,417, 1,617 and 1,099 dpm/100 cm², respectively), exhibited total surface beta/gamma contamination levels above MDA, but below the 5,000 dpm/100 cm² action level (27A and 27B were added to the sampling locations in 2001 and assessed to determine the extent of the surface contamination – refer to survey sketch in Attachment 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 cm². 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 4). 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 $dpm/100 \text{ cm}^2$. 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 5 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 cm² action level (6,295 dpm/100 cm²). Two additional survey locations, 30 and 31, exhibited a total surface contamination level above MDA, but well below the 5,000 dpm/100 cm² 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 5 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. Jobspecific 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.

	Result (d	pm/100 cm ²)	RPD	
Location	Initial	Duplicate	(%)	Comments
5 (Total Surface)	<mda< td=""><td><mda< td=""><td>NA</td><td>Good</td></mda<></td></mda<>	<mda< td=""><td>NA</td><td>Good</td></mda<>	NA	Good
16 (Removable)	<mda< td=""><td><mda< td=""><td>NA</td><td>Good</td></mda<></td></mda<>	<mda< td=""><td>NA</td><td>Good</td></mda<>	NA	Good
23 (Total Surface)	<mda< td=""><td><mda< td=""><td>NA</td><td>Good</td></mda<></td></mda<>	<mda< td=""><td>NA</td><td>Good</td></mda<>	NA	Good
28 (Total Surface &	88,503	83,583	6%	Good
Removable)	<mda< td=""><td><mda< td=""><td>NA</td><td>Good</td></mda<></td></mda<>	<mda< td=""><td>NA</td><td>Good</td></mda<>	NA	Good
40A (Total Surface	6,295	5,628	11%	Good
& Removable)	<mda< td=""><td><mda< td=""><td>NA</td><td>Good</td></mda<></td></mda<>	<mda< td=""><td>NA</td><td>Good</td></mda<>	NA	Good

Table 4

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

Contamination survey QA/QC checks are acceptable.

LABORATORY DATA

None.



SUMMARY OF RECOMMENDATIONS

Based on previous surveys and the 2011 Annual Survey results presented above, the following recommendations are provided:

- <u>No "general" RWPs</u> 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:
 - Fence repair is needed at one location on the beach-side of the property.
 - 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 (repeat from 2010).
 - 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 or repaired (repeat from 2010).
 - 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 (repeat from 2010).
 - 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 (repeat from 2010).
- 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. Entombment Top (Top Plug) – Surface Cracks (Typical)



Figure 4. Main Level View from Entombment Top



Figure 5. Basement Level – Retention Tanks 1 and 2



Figure 6. Basement Level – Retention Tanks 2 and 3



Figure 7a and 7b. Basement Level – Survey Locations 30 and 31 on Retention Tanks 1 and 2, Respectively



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. Basement Level – Concrete Filled Sink to Fix Removable Contamination (Good Condition)



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 32. Basement Level – East Side Loading Access (Interior) with Water Stain Visible on Floor (Inflow through Corrosion of Metal Frame – Figure 31.



Figure 33. Basement Level – East Side Near Loading Access (Interior) with "Termite Tracks" Visible on Wall.

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

4			4	-Aug-1	1		A		
Project: BONUS - N	MMG		Date/Time _/	000	Task I	Number		-	Con
Specific Area of Surv Purpose of Survey:)	ey: <u>Entombed</u> Year 2011 Com	Building-North S	ide ey	MD	DA=((2.71/Tbkg +	· 3.3sqrt(Bkg/ x CF	Fbkg+Bkg/Ts)))/E x CF	5
Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading (cpm)	MDA [*] dpm/100cm ²
Ludlum 2221	149991		44-9	154535		16 %	512	61	921

11

11

74+26

SURVEY	Y DATA	Survey Map Attached 🗹 Yes 🗆 No								
		Gross Cou	nts in CPM	Contamination in dpm/100						
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total					
1	North Side	{	78	(EMDA					
2	North Side	See	65		CM.DA					
3	North Side	Smear	72		LMDA					
4	North Side	Data	73		LMDA					
24	North Side	ς	40		LMDA					
26	North Side	5	42	}	ZMDA					
Survey 1	Technician: A. Luca									

Reviewed By: _____C. cerebb

^{*}MDA is total in dpm/100 cm²

100 Cm2 + IScurz

62 CPM (5-43) × 6.67 777 Rev 2 (2007) 0.16

- 61.6

43

77

16 % 512

 $\frac{2.71}{5} + 3.3\sqrt{\frac{61}{5} + \frac{61}{2}} + 6.67 \qquad CF = 6.67$ $= 921 \frac{d_{PM}}{100 \text{ Cm}^2} \qquad (2.71 + 3.3\sqrt{\frac{43}{5} + \frac{43}{2}}) 6.67$ MDA = 777 dpm/looca2

 $921 = (S-61) \times 6.67$.16 S = 83 cpm (mDA)Page | of 2

SITE: Entombed Reactor Building Time Fask: Comprehensive Survey Map key: ° = Sample Location = Air Sampler Location Dose Rate Abbreviations: CT/WB/GA, where CT = Contractor Building: Entombed Reactor Building Sketch: Image: Comprehensive Survey	::	Date: Yr <u>I</u> Mo <u>8</u> Dy <u>4</u> <u>VA</u> GA = General Area th Side stem - North View 1 = Sample Locations Floor Elevation 68-6
Fask: Comprehensive Survey Map key: ° = Sample Location Dose Rate Abbreviations: CT/WB/GA, where CT = Contraction Building: Entombed Reactor Building Sketch:	RWP:	GA = General Area th Side stem - North View 1 = Sample Locations Floor Elevation 687-67
Map key: ° = Sample Location	n _= Core Sample .t, WB = Whole Body, C Location: Nort Entombment Sys	GA = General Area th Side stem - North View 1 = Sample Locations Floor Elevation 687-67
Dose Rate Abbreviations: CT/WB/GA, where CT = Contrac Building: Entombed Reactor Building Sketch:	t, WB = Whole Body, (Location: Nort Entombment Sys	GA = General Area th Side stem - North View 1 = Sample Locations Floor Elevation 687-67
Building: Entombed Reactor Building Sketch:	Location: Nort Entombment Sys	th Side stem - North View 1 = Sample Locations Floor Elevation 687-0*
Sketch:	Entombment Sy:	stem - North View 1 = Sample Locations Floot Elevation 68*-0*
		1 = Sample Locations
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	-	
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	510	Floor Elevation: 37' 4'
	25 7	

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

 Project:
 BONUS - MMG
 Date/Time
 U-Aug
 If
 Task Number
 MA

 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 2011 Comprehensive Survey
 A=(Sample-Bkg)/E x CF

 Inst. type
 Serial #
 Cal. due date
 Probe type
 Serial #
 Cal. due date
 Efficiency
 Ct. Time
 Bkgd

										(minutes)	(cpm)	apm/100cm*
Ludlum 2221	149991	20/April	12	44-9	154535	20/A1	or/12	16	%	512	61	921
		1	1			1	1	4	%	1		

SURVEY	DATA	Survey M	Nap Attached 🗹 Yes 🗆 No	0	
		Gross Co	ounts in CPM	Contamination	n in dpm/100 cm ²
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total
5	Top Plug Face	(76	1	< MDA
6	Top Plug Face	See	73		EMDA.
7	Top Plug Face	Somen	64		GMDA
8	Top Plug Face	Data	73		EMDA
9	Top Plug Face	1	99		1.584
10	Top Plug Face		87		1,084
11	Top Plug Face		75		< MDA
12	Top Plug Face		63		CMDA
13	Top Plug Face		74		2MDA
14	Top Plug Face		75		GARNA
15	Top Plug Face		2.70		ZNDA
16	Top Plug Face		242-74		ZMDA
17	Top Plug – Top Surface		66		EMDA
18	Top Plug – Top Surface		76		LMDA
19	Top Plug – Top Surface		65		CMDA
5 Dup	Duplicate	1	78	}	CMDA
Survey To Reviewed	echnician: <u>A. Luca</u> 1 By: <u>C. Webb</u>				

*MDA is total in dpm/100 cm²

Page 1 of 2

MDA'

E:	D. I.L.		1015	Data Va // Ma 8 Da	4
Entombed React	or Building	Time: _	RWP.	Date: IF <u>Mo</u> Dy	
lding: Entombed Reac	tor Building		Location: En	tombment System – Top (Plan V	View)
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	5 6 4uR/	K 7 77			
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Page 2 of 2

Rev 2 (2/07)

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

			4	4-An	-1/				
Project: BONUS - N	MMG		Date/Time	1330	Description Task N	Number	vA	_	
Specific Area of Surve Purpose of Survey: <u>)</u>	ey: <u>Entombec</u> /ear 2011 Cor	l Building-Main Flo	oor ey	MI	DA=((2.71/Tbkg + =(Sample-Bkg)/E	· 3.3sqrt(Bkg/ x CF	Tbkg+Bkg/Tsj))/E x CF	
Inst. Type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading (cpm)	MDA [*] dpm/100cm ²
Ludlum 2221	149991	20/405/12	44-9	154535	20/Apr/12	16 %	512	43	777
		1 1			1 1	%	1		

SURVEY	DATA	Survey I	Map Attached 🗹 Yes 🗆 N	lo	
		Gross C	ounts in CPM	Contamination i	in dpm/100 cm ²
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total
20	Main Floor		59	1	EMDA
21	Main Floor	See	77		1.417
27	Main Floor	iners	493		18,759
28	Main Floor	(2166	600	88,503
27A	Main Floor		W 75 71	\$1,167	1,376
27B	Main Floor		77		1,417
28 Dup	Main Floor		2048	1	83,583
Survey Te Reviewed	echnician: <u>A. Inco</u>				

'MDA is total in dpm/100 cm²

Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS - N	IMG	*	Date/Time	4/Hu 14:	s/11 35 Task N	lumber	H	_	
Specific Area of Surve Purpose of Survey: Y	ey: <u>Entombec</u> ′ear 2011 Cor	I Building-Main Flo nprehensive Surve	or y	MI A=	DA=((2.71/Tbkg + =(Sample-Bkg)/E :	3.3sqrt(Bkg/	Tbkg+Bkg/Ts) してスーラ メニコして	DAL Pro	
Inst. Type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading (cpm)	MDA' dem/108cm
Ludlum 2221	149991	20/Apr/2	44-9	154535	20/Apr/12	16 %	DII	51	136
		1 1			1 1	%	1		

SURVE	Y DATA	Survey Map	Attached M Yes	□ No	
		Gross Coun	ts in CPM	Contamination	in dpm/100 cm ²
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total
65	Main Floor-Maslim (Zone 1)	49	/	LMDA	/
66	Main Floor-Maslim (Zone 2)	37		<mda< td=""><td></td></mda<>	
67	Main Floor-Maslim (Zone 3)	44		LMDA	
68	Main Floor-Maslim (Zone 4)	56		ZMDA	
69	Main Floor-Maslim (Zone 5)	52	(2MDA	
72	Main Floor-Maslim (Zone 6)	40		CMDA	(
73	Main Floor-Maslim (Zone 7)	55		KMDA	
74	Main Floor-Maslim (Zone 8)	44		ZMDA	
75	Main Floor-Maslim Zone 9)	42	(KMDA	
76	Main Floor-Maslim (Zone 10)	38		LMDA	
77	Main Floor-Maslim (Zone 11)	53		EMDA	
78	Main Floor-Maslim (Zone 12)	39		LMDA	
79	Main Floor-Maslim (Zone 14)	58	1	EMDA	
90	Main Floor-Maslim (Zone 13)	42	1	Impa	(

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

 $MDA = \frac{2.71}{10} + 3.3 \sqrt{\frac{31}{10}} + \frac{51}{1} = 156 \frac{cpm}{100 cm^2}$

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Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

			L	1-Ang-	11		11		
Project: BONUS - N	IMG		Date/Time	1313	Task I	Number	vor	-	
Specific Area of Surv Purpose of Survey: <u>)</u>	ey: <u>Entombeo</u> ⁄ear 2011 Con	I Building-South S	ide 9y	MC A=	DA=((2.71/Tbkg + (Sample-Bkg)/E	- 3.3sqrt(Bkg/ x CF	Tbkg+Bkg/Ts))/E x CF	
Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading (cpm)	MDA [*] dpm/100cm ²
Ludlum 2221	149991	20/Apr/12	44-9	154535	20/Apr/12	16 %	512	43	777
		1 1			1 1	%	1		

SURVE	Y DATA	Survey Map	Attached D Yes	No	
		Gross Count	s in CPM	Contamination	in dpm/100 cm ²
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total
22	South Side		41	~	4mDA
Survey	Technician: A. Luca				
Reviewe	ed By: <u>C: Webh</u>				

*MDA is total in dpm/100 cm²

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

ask: Comprehensive Survey			R	WP	:A	IA		
Map key: $^{\circ}$ = Sample Location \Box = Air Sa	ampler Lo	cation	= Co	re S	Sample			
Dose Rate Abbreviations: CT/WB/GA, where	e CT = C	ontract, W	- 'B = W	Vhc	ole Body, C	A = General	Area	
Building: Entombed Reactor Building			Lo	ocat	tion: South	Side		100
Sketch:								
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Page Z of Z

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

CONTAMINATION SURVEY FORM

Project: <u>BONUS - N</u>	IMG		Date/Time	4-Ang 1400	- // Task N	Number	vA		
Specific Area of Surv Purpose of Survey: <u>)</u>	ey: <u>Entombeo</u> Year 2011 Con	I Building-SouthW	est Side	MI A=	DA=((2.71/Tbkg + (Sample-Bkg)/E	· 3.3sqrt(Bkg/ x CF	Tbkg+Bkg/Ts))/E x CF	
Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading (cpm)	MDA [*] dpm/100cm ²
Ludlum 2221	149991	20/Apr/12	44-9	154535	20/AA/12	16 %	512	43	777
		1 1			1 1	%	1		

SURVEY	DATA	Survey Ma	o Attached 🗹 Yes 🗆	No	
		Gross Cour	nts in CPM	Contamination	in dpm/100 cm ²
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total
23	SouthWest Side	see or	41	5	EMDA
3 Dup	V	Data	36	1	CMDA
Survey Te Reviewed	echnician: <u>A- Luca</u> I By: <u>C Webb</u>				

'MDA is total in dpm/100 cm²

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Rev 2 (2/07)

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Dose Rate Abbreviations: CT/WB/	GA, where (CT =	Con	tract, W	VB =	Whole	Bod	y, GA	= Ge	eneral	Area	
Building: Entombed Reactor Buildi	ng				_ 1	Locatio	n: <u>S</u>	outhW	est S	ide		
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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	4-Ang 132	-11 5 Task M	Number	NA	_	
Specific Area of Surve Purpose of Survey: Y	ey: <u>Entombed</u> ear 2011 Con	Building-NoruthV	Vest Side	MI A=	DA=((2.71/Tbkg + (Sample-Bkg)/E :	- 3.3sqrt(Bkg/ x CF	Tbkg+Bkg/Ts))/E x CF	
Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts	Bkgd Reading	MDA [*] dpm/100cm ²
Ludium 2221	149991	20/Apr/12	44-9	154535	20/Apr/12	16 %	(minutes)	(cpm) 43	777

1

1

%

1

1

1

SURVE	(DATA	Survey Map Attached 🗹 Yes 🗆 No						
		Gross Cou	nts in CPM	Contamination	in dpm/100 cm ²			
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total			
25	NorthWest Side		34		LMDA			
Survey T Reviewe	rechnician: <u>A-luca</u> d By: <u>Lucebb</u>							

*MDA is total in dpm/100 cm²

Page 1 of Z

SITE: Entombed Reactor Building	Time:	1325	Date: Yr 1/ Mo 8 Dy	4
Task: Comprehensive Survey		RWP:	NA	
Map key: $^{\circ}$ = Sample Location \Box = Air Sam	pler Location	_= Core Sample		
Dose Rate Abbreviations: CT/WB/GA, where	CT = Contract, V	– /B = Whole Boo	ly, GA = General Area	
Building: Entombed Reactor Building		Location: N	NorthWest Side	
Sketch:		Entombm	ent System - Northwest View	
			1 = Sample Lo	cations
		1	Floor Elevation 68' - 0'	
	H			
	-			~
		lar		Approximate Scale: 6" - 0"
		2 MMS 100		
	25			
			Floor	
	<u> </u>	19' - 0"	1 <u>1</u> 37-4	
	<		>	

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Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Date/Time 0835 Task Number MA Project: BONUS - MMG

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 2011 Comprehensive Survey

A=(Sample-Bkg)/E x CF

Inst. Type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading (cpm)	MDA [*] dpm/100cm ²
Ludium 2221	149991	20/Apr/12	44-9	154535	20/Apr/12	16 %	512	44	786
		1 1			1 1	%	1		

SURVEY	DATA	Survey Map Attached Dres D No							
		Gross Cou	nts in CPM	Contamination	n in dpm/100 cm ²				
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total				
30	Basement Floor-Side of Tank #1	{	75	1	1,292				
31	Basement Floor-Side of Tank #2	see	80		1,501				
40A	Basement Floor-Wall (4" from floor)	Smeet	195		6,295				
40B	Basement Floor-Wall (4" from floor)	deta	54		ZMDA				
42	Basement Floor	1	41		LMDA.				
43	Basement Floor		43		CMDA				
50A	Basement Floor-Wall (block)		48		CMDA.				
50B	Basement Floor-Wall (concrete))	49		LMDA				
40ADup	Basement Floor-Wall (4" from floor))	179	(5,628				
			l	1					
Survey Te Reviewed	By: Cr. Wibb								

*MDA is total in dpm/100 cm²

Page _ of \$4

w

 $\frac{2.71}{5} + 3.3 \sqrt{\frac{44}{5} + \frac{44}{2}}_{.16} \times 6.67 = 786 \frac{dpm}{100cm^2}_{.16}$ Rev 2 (2/07)
63 Cpm

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

5-Aug-11 Date/Time 1015 Task Number NA Project: BONUS - MMG 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 2011 Comprehensive Survey A=(Sample-Bkg)/E x CF MDA^{*} Inst. Type Serial # Cal. due date Probe type Serial # Cal. due date Efficiency Ct. Time Bkgd Reading Tbkg/Ts (minutes) (cpm) 50 ZolArliz 16% 1011 155 154535 20/Apr Ludlum 2221 149991 44-9 In %

1

1

SURVEY	/ DATA	Survey Map Attached 🗹 Yes 🗆 No							
		Gross Count	s in CPM	Contan	nination i	in dpm/100 cm	2		
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total	α Removable	α Total		
70	Maslim - Zone 1	52		LMDA					
71	Maslim - Zone 2 Smear	35		= MDA					
81	Maslim - Zone 3	41		LMDA					
89	Mastim - Zone 4 Smeas	55		2MDA					
90	Maslim – Zone 5	50		ZMDA					
91	Mastim - Zone 6 Smear	32		LADA					
92	Maslim – Zone 7	45		Enoq					
93	Mastim - Zone 8 Smcas	44		EMDA					
94	Mastim - Zone 9 Smcor	42		emDA					
95	Mastim - Zone 10	43		ZMDA					
96	Maslim - Zone 11	38		2MDA					
97	Mastim - Zone 12 Smear	52		=MDA					
98	Mastim - Zone 13 Snear	50		CMDA					

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

Page 2 of \$ 4 LW

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or smears

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

			5-	-Aug-11					
Project: <u>BONUS - M</u>	IMG	[Date/Time	1015	Task N	lumber	VA	_	
Specific Area of Surv Purpose of Survey:	ey: <u>Entombed</u> Year 2011 Con	Building-Baseme	nt Floor	ME A=	DA=((2.71/Tbkg + (Sample-Bkg)/E	· 3.3sqrt(Bkg/ x CF	Tbkg+Bkg/Ts))/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	20/12-12	44-9	154535	20/Apr/12	16 %	1011	50	155,
		1 1			1 1	%	1		formears

SURVEY	/ DATA	Survey Map	Attached Yes	∃ No	
		Gross Count	ts in CPM	Contamination	in dpm/100 cm ²
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total
99	Maslim-Zone 14 Smear	43		LMDA	
100	Maslim – Zone 15	41		LMDA	
101	Mastim - Zone 16 Smear	50		LMDA	
102	Mastim - Zone 17 Smear	46		EMDA	
103	Mastim - Zone 18 Smear	38		< MDA	
		¥			
Survey T Reviewe	echnician: <u>4 luca</u> d By: <u>C lucebb</u>		*		

 $^{\circ}$ MDA < 200 dpm/100 cm² (cannot be quantified due to large area survey).

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RADIO	LOGICAL SU	RVEY REP	ORT (MAP)
SITE: Entombed Reactor Building	Time:	915	Date: Yr <u>1/ Mo </u> <u>&</u> <u>5</u>
Task: Comprehensive Survey		RWP:	NA
Building: Entombed Reactor Building Sketch: No. μ R/hr Zone $(1) = 2^{+}7^{+}7^{+}$ Zone $(2) = 80^{-}7^{+}7^{+}$ Zone $(2) = 80^{-}7^{+}7^{+}7^{+}7^{+}7^{+}7^{+}7^{+}7^{+$		Location: I	Assement Floor
Instruments (Model and Serial Numbers): Me	odel 19- 1	148 190	*
Survey Technician(a): Dr Luca			

Page <u>4</u> of <u>4</u>

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

Project: <u>BONUS - N</u>	MMG		9 Date/Time	1- Aug 1435	- // Task I	Number	VA		
Specific Area of Surv Purpose of Survey:	ey: <u>Smears</u> /ear 2011 Con	nprehensive Surve	ey	MI	DA=((2.71/Tbkg + =(Sample-Bkg)/E	3.3sqrt(Bkg/	Tbkg+Bkg/Ts 156 = ($4 \times =$	1/E X-51)/ 76 cpm	.16
Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA" dpm/100cm2
Ludlum 2221	149991	20-Apr-12	44-9	154535	20-Apr-12	16%	1011	51	156

SURVEY DA	ТА	Survey Map	Attached Yes	A No	
		Gross Count	ts in CPM	Contamination in	dpm/100 cm
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total
1	Smears	46	1	LNIDA	(
2	1	46		ZMDA	
3		44		CMDA	
4		51		CMDA	(
5		45		CMDA	
G		40		KMDA	
		57	5	< MOA	
8		39		KMOA	
9		43		KMDA	í
10		53		KMOA	
11		40)	< MOA	
12		37		KIMDA	
15		(i)		KMDA)
H		44		AMDA	
15		54		LMDA	
16		48		KMON	
UFT!		49	1	LMDA	(

*MDA is removable in dpm/100 cm²

Page 1 of 3 $MDA = \frac{2.71}{10} + 3.3 \sqrt{\frac{51}{10} + \frac{51}{1}} = 156 \frac{0.000}{100} cm^2 \text{ Rev 2 (2/07)}$

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

			4	1/Auc	/n				
Project: BONUS - N	MMG		Date/Time	14	5 Task N	Number)/A	-	
Specific Area of Surve Purpose of Survey: <u>)</u>	ey: <u>Smears</u> /ear 2011 Cor	nprehensive Surve	ey	MI	DA=((2.71/Tbkg + (Sample-Bkg)/E	3.3sqrt(Bkg/ 1らし = ス。	Tbkg+Bkg/Ts) (ス-51) / = 76 のか)/E	
Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. Time Tbkg/Ts (minutes)	Bkgd Reading	MDA' dem/100cm2
Ludlum 2221	149991	20 Apr /2	44-9	154535	20/Apr/12	16 % %	10/1	51	156

SURVEY D	ATA	Survey Map Attached 🗆 Yes 🕅 No						
		Gross Cou	nts in CPM	Contamination in	dpm/100 cm ²			
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total			
17	Smears	29		LMDA	^			
18	(47		LMDA				
19		47		ZMDA				
DC		20		LMDA	/			
21		39		LMDA				
99		43		LMDA				
23		45		LMDA				
24		34		LMDA	(
25		52		LMDA				
24		40		LMDA				
27		50		LMDA				
JA		39		LMDA				
278)	47		LMDA				
28		39		LMOA				
28	1	44		LMDA				
)			
					}			
Survey Tech Reviewed B	y: Cr Webb		,					

*MDA is removable in dpm/100 cm²

Page 2 of 3 $MOA = \frac{2.71 + 3.3 \sqrt{\frac{51}{10} + \frac{51}{1}}}{.10} = 156120 \text{ cm}^{2}$

 $\frac{100 \text{ Cm}^2}{15 \text{ cm}^2} = 6.67 \\ \frac{2.71}{10} + 3.3 \sqrt{\frac{50}{10}} + \frac{50}{1} \times 1 = 155 \text{ Cpm}}{100 \text{ cm}^2} \\ \text{MDA} = \frac{16}{100} \times 16$ 16 TECHNOLOGICAL MUSEUM DR. MODESTO IRIARTE BEAUCHAMP (former BONUS REACTOR FACILITY) **CONTAMINATION SURVEY FORM** Rincón, Puerto Rico 5/Aug/11 N/A Date/Time ______AM___ Task Number Project: BONUS - MMG Specific Area of Survey: Smears MDA=((2.71/Tbkg + 3.3sqrt(Bkg/Tbkg+Bkg/Ts))/E 156 = (x--> x = 75 cpm (MDA) Purpose of Survey: Year 2011 Comprehensive Survey A=(Sample-Bkg)/E 155=(X-30)/.16 Efficiency MDA' Serial # Cal. due date Probe type Serial # Cal. due date Ct. Time Bkgd Inst. type Tbkg/Ts (minutes) Reading licocm 201 Ap1/12 16 50 55 154535 1011 Ludlum 2221 149991 20 44-9 % 1 1 1 % 1 1

SURVEY DATA		Survey Map Attached DYes No						
	P	Gross Coun	ts in CPM	Contamination in dpm/100 cm ²				
No.	Description/Location	βγ Removable	βγ Total	βγ Removable	βγ Total			
30	smears	29	1	< MD A				
31	(52		EMDA				
10A		55	1	LMDA				
HOB		40		LMDA				
42		58		CMDA				
43		57		LMDA				
SOA		46)	CMDA				
SDB	l	43	1	CMDA				
HOAdup		47		CMDA				
-		~						

^{*}MDA is removable in dpm/100 cm²

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Attachment 3 Physical Condition - Inspection Checklist

Inspection Checklist BONUS Decommissioned Facility, Rincón, Puerto Rico

Date of This Inspection/Revision: Last Inspection: 814 2011 Inspectors: Next Inspection (Planned):

<u>if August 2011</u> <u>30 September 2010</u> and

Summer 2012

No.	ltem	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.	
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.	
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. Access control is 30	od.
5	Dome—Basement Level flooding	Water accumulating in Basement Level may mobilize and redistribute surface contamination.	Inspect for gasket and storm water drains. Goshef-poor condition Leak of Gosting door - see that of Gosting door - see	pho toj
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. Novereeping of Actes of the posted	
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, Perling point wat an Stain	son
8	Dome— exterior	Building should appear well maintained	Visually inspect some flaking p corresion on back entrance. "Skirt" deteriorated + allowing	aint, water
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. Mare.	basement.
10	General site upkeep	Building should appear well maintained.	Observe and evaluate changes in site conditions. Fair Condition some worker damage. Vesetation - not maintained.	
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.	

overherd cauve dipping oil

ser lost a

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

Feature	Comment
Access road and parking area	Asphalt 0K
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 - repair neto
Dome-monolith plaques	Visually inspect , on beach-sid

Attachment 4 Calibration Sheets

CUST	Scientific ar Instrum	Manufacturer of 1d Industrial nents		OF CALIBRATION	SVEETWATE	MEASUREMENT CE BOX 810 PH. 325 REET FAX NG ER, TEXAS 79556, U.S.	S, INC. 5-235-5494 D. 325-235-4672 A.
Mfg	Ludium Mer	suramonts inc	Nedel		OR	DER NO. 2016	2613/355573
Mafe	Cocioni Mec	isorements, inc.		19	Serial No		0
Mig.			Model	-	Serial No)	
Cal. D		-Oct-10	Cal Due Date	9-Oct-11	Cal. Interval1	Year Meterface	202-016
Checkr	nark 🕑 applies to a	applicable instr. a	nd/or detector IAW m	ifg. spec. T. 74	_ °F RH	35_ % Alt	708.8 mm Hg
Me Me Me Me Au Cal Instrume	echanical ck. 5 Resp. ck idio ck. ibrated in accordar nt Volt Set <u>525</u> HV Readout (2 poir	Moment Received Mete Reset Alarm nce with LMI SOP V Input Ser nts) Ref./Inst	r Zeroed r ck. 1 Setting ck. 14.8 rev 12/05/89. ns. 32 mV De 500 /_	0% 10-20% Out of Background Subt Window Operation Batt. ck. (Min. Vol Calibrated in acco t. Oper V	of Tol. LRequiring F tract on It) <u>2.2</u> VDC ordance with LMI SC at mV ef./Inst1000	Repair Other-See Input Sens. Line Geotropism OP 14.9 rev 02/07/97. Threshold Dial Ratio	comments prity = mV
Gamma Calibr	ration: GM detectors positione	ed perpendicular to source	except for M 44-9 in which the from	it of probe faces source.			
	RANGE/MULTI 5000 500 500 50 50 50 50 50 50 50	PLIER 40 40 40 10 40 10 10 10 10 10 10 10 10 10 1	REFERENCE CAL. POINT 00 uR/hr 00 uR/hr 0 uR/hr = 7/20000 uR/hr 0 uR/hr = 360000000 uR/hr 0 uR/hr = 3600000000000000000000000000000000000	INSTRUMEN "AS FOUND 2020		INSTRUMENT METER READING 4000 400 400 700 200 200 200 5	
	25		50 cpm		50 25 Pa	ingo(s) Calibrated El	
	25 *Uncertainty within ± 1	0% C.F. within ± 20	%	DESEDENC	50, 25 Ro	inge(s) Calibrated El	ectronically
)igital eadout	25 *Uncertainty within ± 1 REFERENCE CAL. POINT	INSTRUMENT RECEIVED		ING* REFERENC CAL. POIN Log Scale	50, 25 Ra CE INSTRUM NT RECEIV	Inge(s) Calibrated Eli MENT INSTR ED METE	ectronically UMENT R READING*
)igital eadout idum Measu her Internation e colibration		10% C.F. within ± 20 INSTRUMENT RECEIVED	% INSTRUMENT METER READI has been colibrated by stand been derived from accepted CSL Z540-1-1994 and ANSt N32	ING* REFERENC Log Scale ards traceable to the National Ins volues of natural physical constar 3-1978	50, 25 Ra 2E INSTRUM NT RECEIV 11 11 11 11 11 11 11 11 11 1	chnology, or to the calibration the ratio type of calibration the ratio type of calibration	ectronically UMENT R READING READING on facilities of on facilities of on facilities of on facilities of on facilities of on
)igital eadout her internation colibration Referenc	 *Uncertainty within ± 1 REFERENCE CAL. POINT rements. Inc. certifies that onal Standards Organizati system conforms to the re- system conforms to the re- system conforms to the re- te Instruments and	C.F. within ± 20 INSTRUMENT RECEIVED the above instrument ion members, or have b equirements of ANSI/N0 d/or Sources: [NSTRUMENT METER READ	REFERENC CAL. POIN Log Scale ards traceable to the Notional Ins volues of natural physical constar 3-1978 31 2781 059 1	50, 25 Ra E INSTRUM NT RECEIV initiate of Standards and Tec state of 280 60646 7	Inge(s) Calibrated Ele MENT INSTR ED METER Chrology, or to the calibratic y the rolio type of calibratic rexas Calibration Licens 70897	ectronically UMENT R READING Confacilities of on facilities of
igital eadout her internation ceferenc 2s-137 Gan	 *Uncertainty within ± 1 REFERENCE CAL. POINT uncertainty of the tertainty rements. Inc. certifies that and Standards Organization to the tertainty to the tertainty	C.F. within ± 20 INSTRUMENT RECEIVED Instrument ion members, or have b equirements of ANSI/N0 d/or Sources:] G112 M565 [has been colibrated by stand been derived from accepted csL 2540-1-1994 and ANSI N32 73410 111 5105 11008 18: Beta S/N	ING* REFERENC CAL. POIN Scale ards traceable to the National Ins volues of natural physical constar 3-1978 31 [781] 059] 79 [] E552] E551]	50, 25 Ra	Ange(s) Calibrated El MENT INSTR ED METE Chrology, or to the calibratic y the rolio type of colibratic Texas Calibration Licens 70897	ectronically UMENT R READING*
)igital eadout her internation colibration Referenc Cs-137 Gan	 *Uncertainty within ± 1 REFERENCE CAL. POINT werents. Inc. certifies that onol Standards Organization system conforms to the re- re Instruments and nma S/N1162 that S/N123	C.F. within ± 20 INSTRUMENT RECEIVED Interpretation Interpretatio Interpretation Interpretation	has been calibrated by stand peen derived from accepted CSL Z540-1-1994 and ANSI N32 73410 111 5105 11008 18/ Beta S/N	REFERENC Log Scale ards traceable to the National Instruction physical constar 31 778 1 79 E552 E551	50, 25 Ra E INSTRUM IT RECEIV IT RECEIV It Instrum It Instrum	Ange(s) Calibrated El MENT INSTR ED METE Chrology, or to the calibratic y the rolio type of calibratic texas Calibration Licens 70897 Neutron Am-2 S/N68260.	ectronically UMENT R READING READING on facilities of on facilities of on
Digital eadout her internation colibration Colibrate Calibrate	 *Uncertainty within ± 1 REFERENCE CAL. POINT werents. Inc. certifies that and Standards Organization system conforms to the re- re Instruments and nma S/N1162 and S/N123 and S/N123 and By:	C.F. within ± 20 INSTRUMENT RECEIVED Interpretation Interpretatio Interpretation Interpretation	has been calibrated by stand been derived from accepted CSL Z540-1-1994 and ANSI N32 73410 111 5105 11008 18/ Beta S/N 0 Scilloscope S/N	ING* REFERENC CAL. POIN Scale ards Iraceable to the National Ins volues of natural physical constar 3-1978 31 [781] 059] 79 [] ESS2] ESS1] 4 Smadle Do	50, 25 Ra E INSTRUM IT RECEIV IT RECEIV It INSTRUM I	Inge(s) Calibrated El MENT INSTR ED METE Choology, or to the calibratic y the rolio type of calibratic rexas Calibration Licens 70897 Neutron Am-2 S/N	ectronically UMENT R READING READING on facilities of on facilities of on facilities of on facilities of on facilities of on facilities of on facilities of on facilities of on facilities of on facilities of on



CONVERSION CHART

Customer	PUERTC	RICO ELECTR	RIC POWER AUTH	ORITY Date		Order #.	20173630	0/361966
Model	2221	Serial No.	149991	Detector Model	44-9	Serial No.	PR 159	1535
Source	Cs-13	37 194.6 mCi	Cs-137 2	20 mCi		High Voltage		900 V
					Inj	out Sensitivity	50	mV

	"As Found" Readings (CPM):			
Reference Point	Analog	Range/Scale		
150 mR/hr	340	x 1K		
50 mR/hr	150	KIK		
15 mR/hr	50	xlk		
5 mR/hr	185	*100		
1.5 mR/hr	55	4/00		
1.0 mR/hr	330	* 10		

After Adjustment Readings (CPM):					
Analog	Range/Scale				
340	¥ IK				
150	×1K				
50	×lk				
185	*100				
55	x 100				
330	\$ 10				

		"As Found" I	Readings:
	Reference Point	Digital	Count Time
	150 mR/hr	34225	losec.
	50 mR/hr	14833	5
,	15 mR/hr	5221	
	5 mR/hr	1960	
	1.5 mR/hr	548	
	1.0 mR/hr	332	2
Signature:	Dus	inerackom	Date
*		1	

After Adjustment Readings:

Digital Count Time leser. 34225 14833 5221 1960 548 332

20 Apr-11

Description Searching and quality CERTIFICATE OF CALIBRATION POST OFFICE BOX 80 CP 1132335-544 CUSTOMER PUERTO RICO ELCTRIC POWER AUTHORITY ODDET OFFICE BOX 80 CP 1132355-544 OWDER Luthum Massurements, Inc. Model 2221 Strain No. JUG 20138050966 Mg Luthum Massurements, Inc. Model 2221 Strain No. JUG 20138050966 Gal Date 20-Apr.12 Cal Interval 1 Year Mainface 202138050946 Guid massurements, Inc. Model 2221 Strain No. JUG 2014805016 Total Strain No. JUG 2014805016 Concentration Mainface 202189 Cal Date 20-Apr.12 Cal Interval Year Mainface 202199 Cal Date Cal Apr.12 Cal Interval Year Mainface 202199 Cal Date Cal Date Cal Apr.13 Cal Interval Year Mainface 202199 Cal Date Cal Apr.14 Cal Date Cal Date Cal Date Cal Date Cal Date Vinterancin Main Strain Strain<		Designer and Manufact	turer			LUD	DLUM MEASU	REMENTS, INC.
CUSTOMER PUERTO RICO ELECTRIC POWER AUTHORITY ORDER NO. 20173530351955 Mg. Ludium Measurements, Inc. Model 2221 Serial No. 1/// 9991 Gal Date 20.40pc11 Cal Duo Date 20.40pc12 Cal Inhara 1// 9991 Cal Date 20.40pc11 Cal Duo Date 20.40pc12 Cal Inhara 1// 9991 Cal Date 20.40pc11 Cal Duo Date 20.40pc12 Cal Inhara 1// 9991 Cold Date 20.40pc11 Cal Duo Date 20.40pc13 Cal Date 20.40pc1 Cal Date 20.40pc1 Cal Inhara 1// 9991 State Cal Inhara 1// 9991 Cal Date Cal Inhara Cal Inhara 1// 9991 Cal Date Cal		or Scientific and Industr Instruments	rial CER	TIFICATE OF C	ALIBRATION	J POS ⁻ 501 C SWE	T OFFICE BOX 810 DAK STREET ETWATER, TEXAS	PH. 325-235-5494 FAX NO. 325-235-4672 79556, U.S.A,
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Calibrated in accordance with UM SOP 148 rev 1205/89. Calibrated in accordance with UM SOP 148 rev 1205/89. Calibrated in accordance with UM SOP 148 rev 1205/89. The accordance with UM SOP 148 rev 1205/87. instrument Vol Set 900 V Input Sens. 50 mV Det Oper. 900 V set finat. 2000 I Oper. 10 mV M M Readoul (2 points) Ref.Inst. 500 I 492 V Ref.Inst. 2000 I Oper. 10 V S1907901:sn3432-091 Ca-137 #2008 reads as follows:32,250cpm, Eff-26.48 Cocologn, Eff-26.48 Cocologn, Eff-26.48 Cologna, 50750, act. 8, 910dpm, background=40cpm, source count=360cpm, Eff-0.138 Ca-137 (gamma Eff-0.208 Ca-137 (gamma Eff-0.208 Gamma Calibration is source accold to 44.40 cpm, source count=1, 320cpm, Eff-21.8 All Efficiencies are in 4pi. and 1/4 inch from the surface of inhouse 180-2 Firmware:26-10-10 Gamma Calibration OM detectors positioned pependicular to source eccold to 44.9 in which he front oprobe faces source. Yop Yop X100 40 kcpm Yop Yop Yop Yop X100 Yop Yop Yop Yop Yop X100 Yop Yop	Mechar F/S Res Audio c	nical ck. sp. ck k.	Meter Zeroed Reset ck. Alarm Setting of	ck.	Background Sub Window Operation Batt. ck. (Min. Vo	tract on olt)5.0	✓ Input S ✓ Geotro VDC	ens. Linearity pism
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COMMENTS: STOYUG: Ca-137 #2008 reads as follows:32,250cpm IN ININ. (61,100dpm) 15,131cpm -Bett 2008 with the source placed against protective screen of 44-9 detector. STOYUG: StoyUge, Dackground-40cpm, source counc-9,620cpm,Efr-26.48 Co60:sn0886,act = 8,910dpm, background-40cpm, source counc-9,620cpm,Efr-20 Ca-137 (beta):sn158-112,act = 6,288(bpm, background-40cpm, source counc-300cpm,Efr-21 All Efficiencies are in 4pi. and 1/4 inch from the surface of inhouse 180-2 Firmware:26-10-10 Germa Catibration GM detectors positioned perpendicular to source ecounce 1,320cpm, Efr-21 All Efficiencies are in 4pi. and 1/4 inch from the surface of inhouse 180-2 Firmware:26-10-10 Germa Catibration GM detectors positioned perpendicular to source ecounce 1,320cpm, Efr-21 All Efficiencies are in 4pi. and 1/4 inch from the surface of inhouse 180-2 Firmware:26-10-10 Germa Catibration GM detectors positioned perpendicular to source ecounce 1,300 model and	V HV	Readout (2 points)	Ref./Inst. 5	1 49	1 v	Ref./Inst.	2000 /	2010 V
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