Memorandum

Date: 18 February 2010

To: Arsenio Reyes, PREPA

Copy: BONUS File

From: Chad Webb, BONUS RADCON Manager

Subject: **2009 Annual Survey**

MMG conducted the comprehensive annual survey at the Dr. Modesto Iriarte Technological Museum (former BONUS Facility) during the dates of 31 August – 3 September 2009 with support from PREPA personnel. Due to inclement weather, completion of the survey was delayed until PREPA personnel could return to the facility and perform masslin smears on 8 December 2009. 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: 31 August – 3 September 2009 and 8 December 2009
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 (uR/hour)	Total Contamination (dpm/100 cm^2)	Removable Contamination (dpm/100 cm^2)	Comments
Routine Sampling					
Pipe Chase Face	1	4	<MDA	<MDA	Monolith Top
Pipe Chase Face	2	5	<MDA	<MDA	Monolith Top
Pipe Chase Face	3	4	<MDA	<MDA	Monolith Top
Pipe Chase Face	4	4	<MDA	<MDA	Monolith Top
Top Plug Face #1	5	3	<MDA	<MDA	Monolith Top
Top Plug Face #1	6	3	<MDA	<MDA	Monolith Top
Top Plug Face #1	7	3	<MDA	<MDA	Monolith Top
Top Plug Face #2	8	6	<MDA	<MDA	Monolith Top
Top Plug Face #2	9	3	1,084	<MDA	Monolith Top
Top Plug Face #2	10	5	<MDA	<MDA	Monolith Top
Top Plug Face #3	11	4 Dup=4	<MDA	<MDA	Monolith Top
Top Plug Face #3	12	4	<MDA	<MDA	Monolith Top
Top Plug Face #3	13	4	<MDA	<MDA	Monolith Top
Top Plug Face #4	14	4	<MDA	<MDA	Monolith Top
Top Plug Face #4	15	4	<MDA	<MDA	Monolith Top
Top Plug Face #4	16	5	<MDA	<MDA	Monolith Top
Top Plug Top Surface	17	3	<MDA	<MDA	Monolith Top
Top Plug Top Surface	18	3	<MDA	<MDA	Monolith Top
Top Plug Top Surface	19	4	<MDA Dup=<MDA	<MDA	Monolith Top
Main Floor Water Column	20	4	<MDA	<MDA	Main Level-Controlled Area
Main Floor Water Column	21	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #1	22	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #2	23	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #3	24	5	<MDA	<MDA	Main Level-Controlled Area
Pipe Chase Ext Hatch	25	4	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #4	26	5	<MDA	<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27	15	5,961	<MDA Dup=<MDA	Main Level-Controlled Area
Fuel Pool Purif. Floor, area	27A	4	917	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif Floor, area	27B	4	<MDA	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purif. Floor (CM005)	28	15	76,955 Dup=83,417	<MDA	Main Level-Controlled Area

Table 1 (Continued)

Sampling Location	Sample Number	Dose Rate (uR/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	18	1,495	<MDA	Basement Level, Att. A – Fig.s 4 and 6
Side of Liq. Waste Ret. Tank #2	31	17	1,834	<MDA	Basement Level, Att. A – Fig.s 4, 5, and 6
F.W. Heater Room (Wall)	40A	56[a] Dup=52[a]	8,129 Dup=7,337	<MDA	Basement Level, Att. A – Fig. 9
F.W. Heater Room (Wall)	40B	12	<MDA	<MDA	Basement Level, Att. A – Fig. 9
Vapor Sphere Room	42	6	<MDA	<MDA Dup=<MDA	Basement Level
Vapor Sphere Room	43	4	<MDA	<MDA	Basement Level
Condenser Room Entry Wall (Block)	50A	5	<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	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 2	66	4	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	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 5	69	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 6	72	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 7	73	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 8	74	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 9	75	4 Dup=4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 10	76	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 11	77	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear

[a]This measurement was likely taken less than 30 cm from the source. The reading will be confirmed during next survey.

Table 1 (Continued)

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm^2)	Removable Contamination (dpm/100 cm^2)	Comments
Additional Sampling Locations (Continued)					
Main Floor-Zone 12	78	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 14	79	4	NA	<1000dpm/100cm^2	Main Level-Public Access. Masslin Smear
Main Floor-Zone 13	80	4	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	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 3	81	9	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 4	89	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 5	90	5 Dup=5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 6	91	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 7	92	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 8	93	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	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 12	97	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 13	98	5	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 14	99	6	NA	<1000dpm/100cm^2	Basement Level Masslin Smear
Basement Floor-Zone 15	100	5	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

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. The motor of the entrance gate was not operational at the time of the survey, but was manually operated by the attending guard. The security guard controlled access into the gated facility and kept log of visitors. The security fence 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 (same as in previous surveys - refer to Attachment 1 Photos, 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. 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 (refer to Attachment 1 Photos, 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 appears to be functioning properly. No immediate action is necessary.

Dome-Main Level: The Main Level (Controlled Area) is that portion of the Mail 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, which is also effective in reducing elevated dose rule 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, Figure 3). 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 did not reveal any significant discrepancies, although to paint on the Dome shell has faded. The building appears well maintained. No immediate action is 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 park appeared temporarily closed due to the demolition of buildings infested with termites. However, the lighthouse grounds are expected to reopen and continue as a tourist destination. No immediate action is necessary.

General Site Upkeep: The buildings and grounds appear well maintained. No immediate action is necessary.

Site Security: A security guard was present at all times during the survey. No immediate action is necessary.

Erosion: Inspection of the surrounding property and slopes to the beach revealed no significant changes or signs of excessive erosion. Dense vegetation on the slopes from the facility to the beach appears to be effectively controlling erosion. No immediate action is necessary.

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 (uR/hour)			Expected Exposure Rate[a]		Annual Dose Limits (rem/year)	
	Min. (uR/hour)	Ave. (uR/hour)	Max. (uR/hour)	Max. Exposure (hour/year)	Rate (rem/year)	Rad Worker	Visitor
Monolith Top	3	3.9	6	416	0.002	2	NA
Main Level (Controlled Area)	4	6.2	15	416	0.006	2	NA
Main Level (Public Access)	4	4	4	2,080 (employee)	0.008	2	NA
				832 (visitor)	0.003	NA	0.1
Basement Level	4	8.5	56[b]	416	0.023[b]	2	NA

[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 uR/hour × (1 rem/1,000,000 uR) × (8 hours/1 week) × (52 weeks/1 year) = 0.002 rem/year.

[b]This measurement was likely taken less than 30 cm from the source. The reading will be confirmed during next survey.

The results summarized in the Table 2 indicate that there are no Radiation Areas as defined in 40 CFR 835 (0.005 rem/hour at 30 cm or 5,000 uR/hour at 30 cm for the dose rate measurements conducted at BONUS) in the BONUS Facility. 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 limits.

Table 3

Location	Result (uR/hour)		RPD (%)	Comments
	Initial	Duplicate		
11	4	4	0	Very good
40A	56	52	7	Good
75	4	4	0	Very good
90	5	5	0	Very good
103	5	5	0	Very good

RPD = [(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 minimum detectable activity (MDA). One survey location exhibited total surface contamination levels above the MDA. Survey location 9 had total surface beta/gamma contamination level of 1,084 disintegrations per minute (dpm)/100 cm^2. This value is 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 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 (5,961 and 76,955 dpm/100 cm^2, respectively). Two additional survey locations, 27A and 27B (917 dpm/100 cm^2 and less than MDA, 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 1,000dpm/100cm^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. 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 1,000dpm/100cm^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 6, 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 (refer to Attachment 1), had total surface beta/gamma contamination levels

above the 5,000 dpm/100 cm^2 action level (8,129 dpm/100 cm^2). Two additional survey locations, 30 and 31, exhibited a total surface contamination level above MDA, but well below the 5,000 dpm/100 cm^2 action level. Based on these results, there are no radioactive Contamination Areas associated with the Basement Level.

Two additional survey locations (42 and 43) were evaluated in the Vapor Sphere Room where a tank (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 (repeated from last year's annual survey) 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 be 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 and 5), it is recommended that the proposed non-public access areas in the Basement Level be 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.
- There is no need for special marking/posting of the Vapor Sphere Room or the tank in this room that was historically used for storage of radiological waste/material. Survey locations 42 and 43 may be removed from subsequent surveys. However, the Vapor Sphere Room will continue to be assessed through the masslin floor surveys performed annually on the Basement Level.

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		
19 (Total Surface)	<MDA	<MDA	NA	Good
27 (Removable)	<MDA	<MDA	NA	Good
28 (Total Surface)	76,955	83,417	8%	Good
40A (Total Surface)	8,129	7,337	10%	Good
42 (Removable)	<MDA	<MDA	NA	Good

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

All QA/QC checks performed within limits.

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, but was manually operated by the attending guard. Repair or replacement of the gate motor is recommended, but not critical in maintaining site security.
- Concrete Monolith: It is recommended that the Concrete Monolith Top be 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. Before the Fuel Storage Room is put to public use, it is recommended that the equipment be relocated elsewhere in the facility and a comprehensive survey performed on the floor, walls, and other accessible surfaces.

- 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 be 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 be 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) 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.
- There is no need for special marking/posting of the Vapor Sphere Room or the tank in this room that was historically used for storage of radiological waste/material. The current condition (i.e., potential for contamination of internal system/surfaces) of this tank is no different from other tanks, piping, and ancillary equipment in the Basement Level. Survey locations 42 and 43, which have been covered by the newer concrete flooring, may be removed from subsequent surveys. However, the Vapor Sphere Room will continue to be assessed through the masslin floor surveys performed annually on the Basement Level.
- 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)

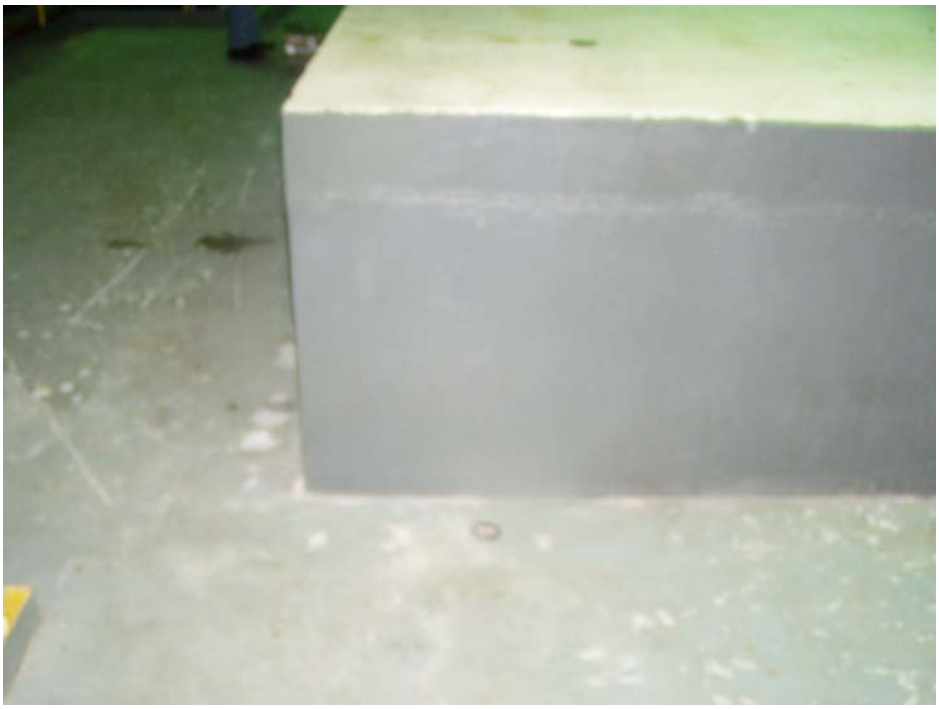


Figure 2. Entombment Top (Top Plug)

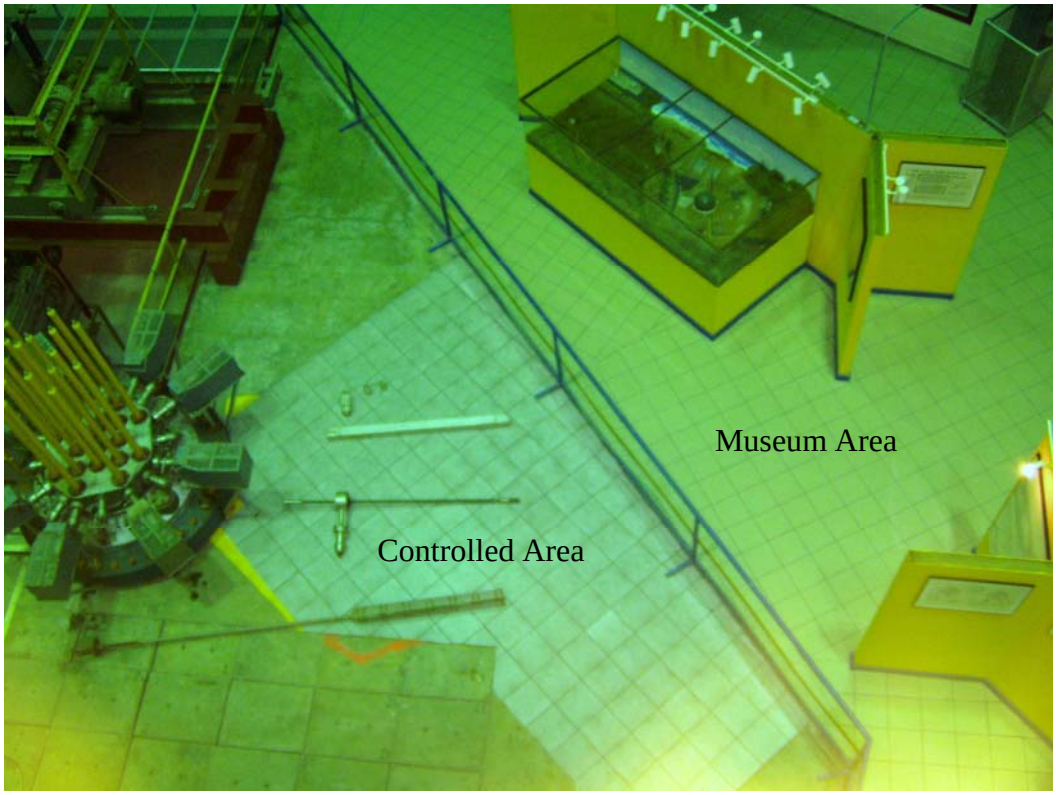


Figure 3. Main Level View from Entombment Top

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

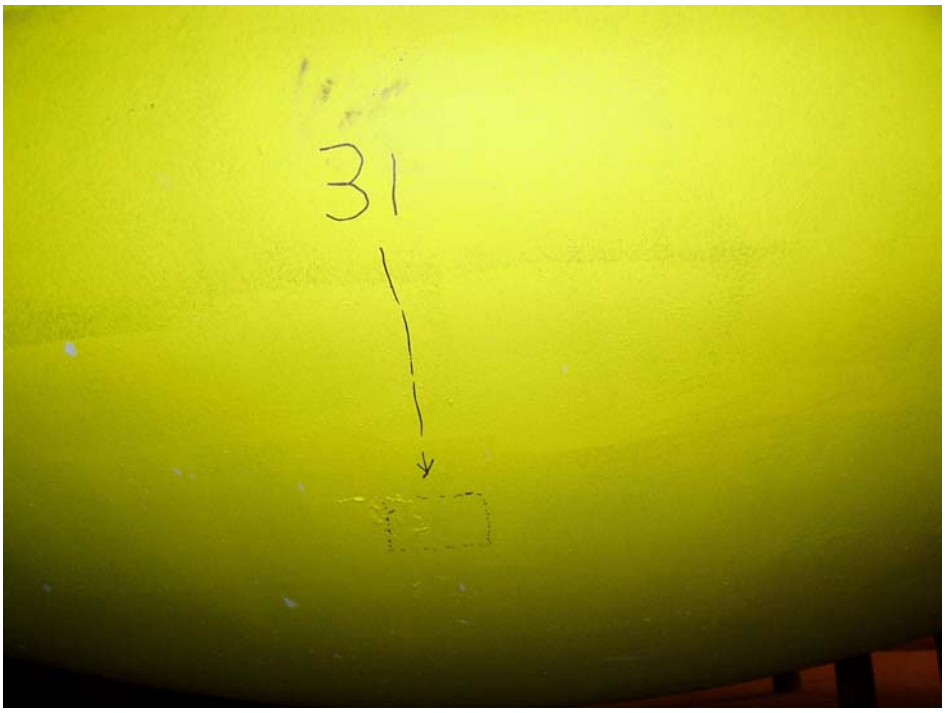


Figure 7. Basement Level – Survey Location 31 on Retention Tank 2

Figure 8. 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

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 Sept 2, 2009 9:40 am Task Number —

CF=6.67

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 2009 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	Feb 19 2010	44-9	154535	Feb 19, 200	16 %	10 / 2	49	757
"	"	/ " /	"	"	/ " /	16 %	10 / 1	38	901 ✓

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 - Entombment Top		49		< MDA
2	North Side "	See smear Data	45	See smear Data	< MDA
3	North Side "		41		< MDA
4	North Side "		49		< MDA
24	North Side - Floor Level		39		< MDA
26	North Side - Floor Level		42		< MDA

Survey Technician: Brenda Aponte

Reviewed By: C. Zeabb

*MDA is total in dpm/100 cm²

MDA ≈ 162 cpm CW

MDA ≈ 59 cpm

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

RADIOLOGICAL SURVEY REPORT (MAP)

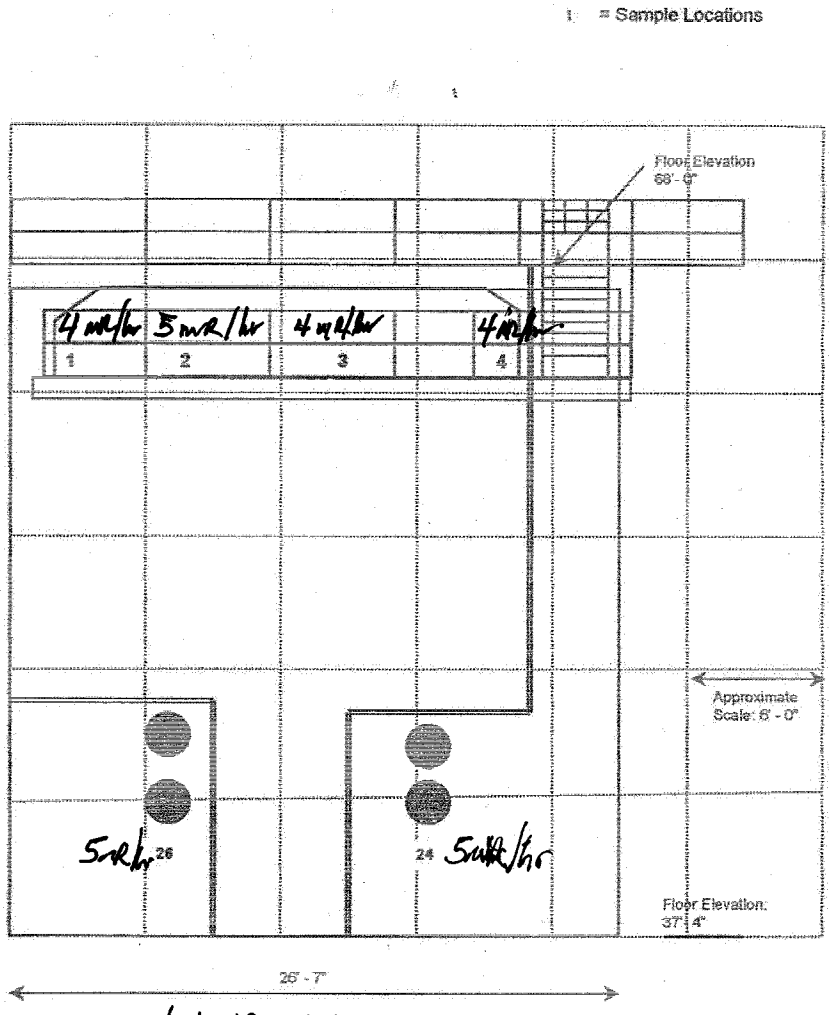
SITE: Entombed Reactor Building	Time: 9:55 am	Date: Yr 2009 Mo Sept Dy 2
Task: Comprehensive Survey	RWP: N/A	

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:



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

Survey Technician(s): Jose Medina Ilka

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 2-Sep-2009 1015 hrs Task Number —

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

Purpose of Survey: Year 2009 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	19-FEB-2010	44-9	154535	19-FEB-2010	16 %	10 / 2	49	757
		/ /			/ /	%	/		

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	see Smear Data	53 50 CW 9/2/09	see Smear Data	<MDA
6	Top Plug Face		62		<MDA
7	Top Plug Face		49		<MDA
8	Top Plug Face		47		<MDA
9	Top Plug Face		75	CW 9/4/09 1,084	~~<MDA~~
10	Top Plug Face		53		<MDA
11	Top Plug Face		64		<MDA
12	Top Plug Face		65		<MDA
13	Top Plug Face		56		<MDA
14	Top Plug Face		53		<MDA
15	Top Plug Face		54		<MDA
16	Top Plug Face		54		<MDA
17	Top Plug – Top Surface		50		<MDA
18	Top Plug – Top Surface		50		<MDA
19	Top Plug – Top Surface		55		<MDA
19 Dup	Duplicate		54		<MDA

Survey Technician: Arsenio Reyes

Reviewed By: C. Webb

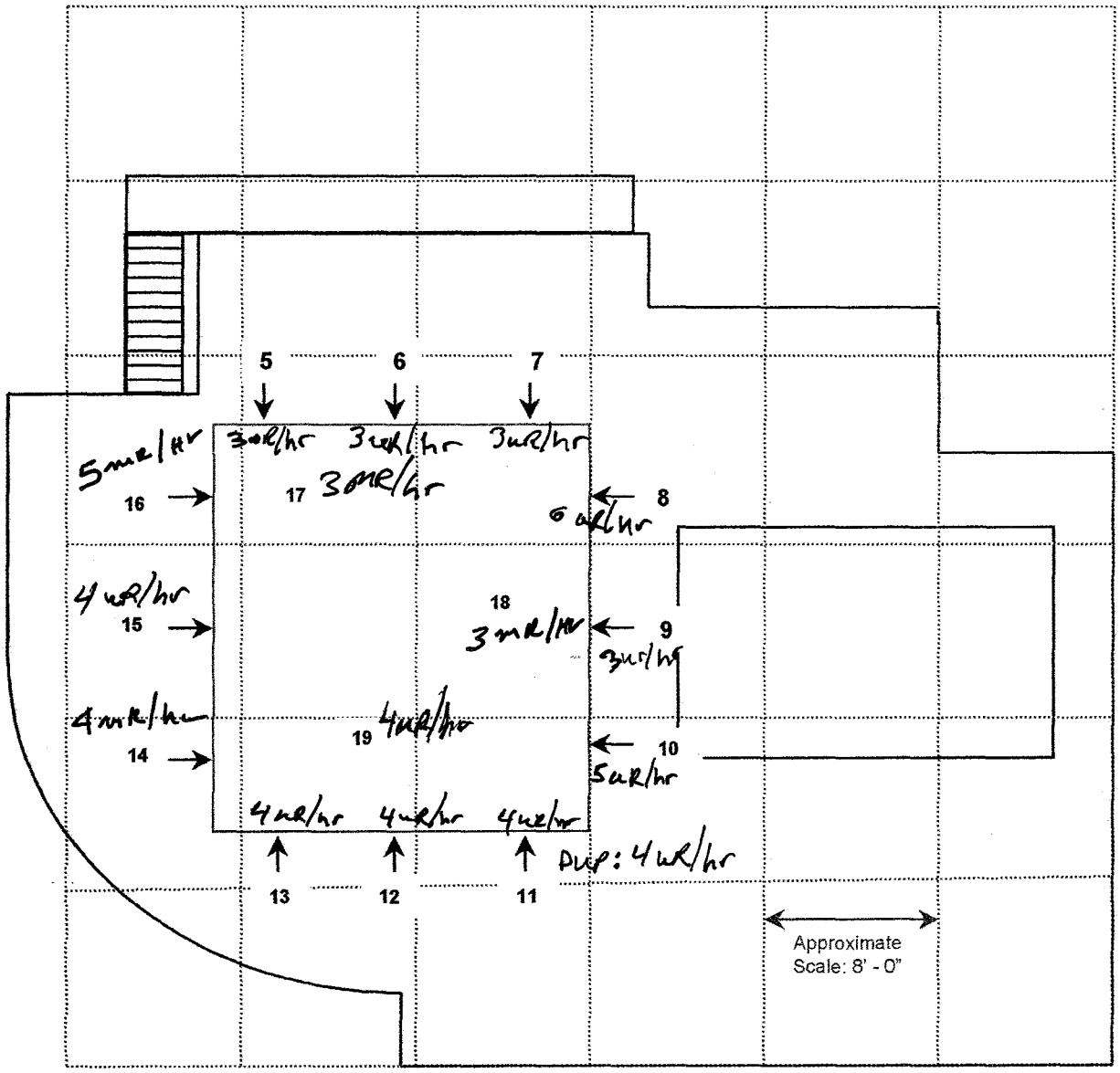
*MDA is total in dpm/100 cm²

MDA ≥ 67 cpm

Figure 1 - Entombment System - Plan at Elevation 68' - 0"

2 Sep 2009
1015hrs

1 = Sample Locations



9/2/09
A. Reyes
C. Webb

Model 19
#148190

2 of 2

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 1325 9/2/09 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 2009 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	2/19/10	44-9	154535	2/19/10	16 %	10 / 1	38	901
		/ /			/ /	%	/		

SURVEY DATA Survey Map Attached ☑ Yes ☐ No See page 2 of 2 on Plastic Survey

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	47	see Smear Data	<MDA	
21	Main Floor		59		<MDA	
27	Main Floor		181		5,961	✓
28	Main Floor		1,884		76,955	✓
27A	Main Floor		60		917	✓
27B	Main Floor		48		<MDA	
29	Duct		2,039		83,417	✓

Survey Technician: C. Webb
Reviewed By: D. Jenkins

*MDA is total in dpm/100 cm²

$$CF = \frac{100\,cm}{15\,cm} = 6.67$$

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 1335 9/2/09 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 2009 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	2/19/10	44-9	154535	2/19/10	16 %	10/1	38	901
		/ /			/ /	%	/		

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	40	See Smear Data	<MDA

Survey Technician: C. Webb
Reviewed By: D. Jenkins

*MDA is total in dpm/100 cm²

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

RADIOLOGICAL SURVEY REPORT (MAP)

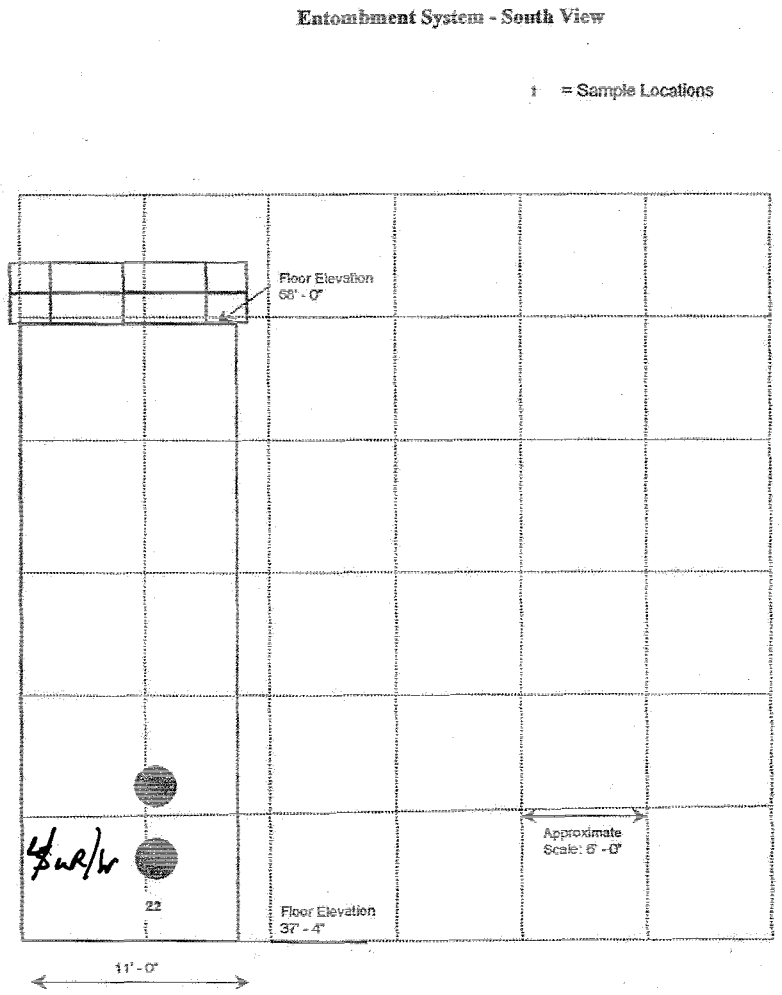
SITE: Entombed Reactor Building	Time: 1335	Date: Yr 08 Mo 9 Dy 2
Task: Comprehensive Survey	RWP: N/A	

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:



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

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 1336 9/2/69 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 2009 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
Ludlum 2221	149991	2/19/10	44-9	154535	2/19/10	16 %	10/1	38	901
		/ /			/ /	%	/		

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 cm^2 βγ Removable	Contamination in dpm/100 cm^2 βγ Total
23	SouthWest Side	See Smear Data	30	See Smear Data	<MDA

Survey Technician: C. Webb
Reviewed By: D. Jenkins

*MDA is total in dpm/100 cm^2

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

RADIOLOGICAL SURVEY REPORT (MAP)

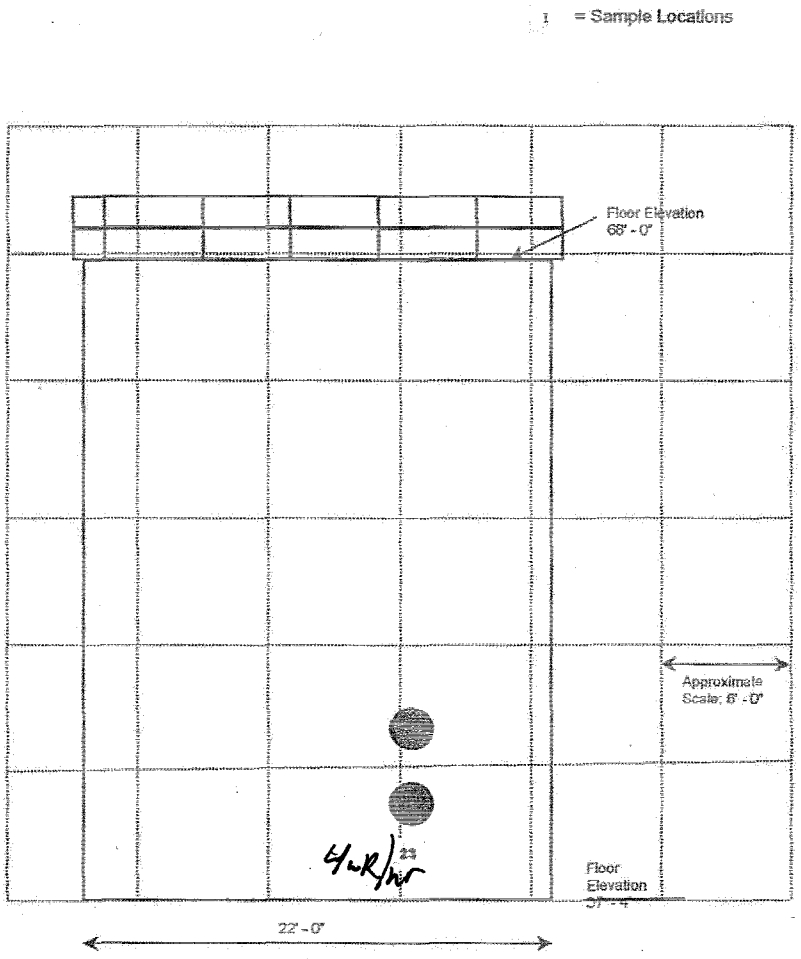
SITE: Entombed Reactor Building	Time: 1330	Date: Yr 09 Mo 9 Dy 2
Task: Comprehensive Survey	RWP: N/A	

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:



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

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 1315 9/2/09 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 2009 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
Ludlum 2221	149991	2/19/10	44-9	154535	2/19/10	16 %	10/1	38	901
		/ /			/ /	%	/		

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 cm^2 βγ Removable	Contamination in dpm/100 cm^2 βγ Total
25	NorthWest Side	See Smear Data	43	See Smear Data	<MDA

Survey Technician: C. Webb
Reviewed By: D. Jenkins

*MDA is total in dpm/100 cm^2

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

RADIOLOGICAL SURVEY REPORT (MAP)

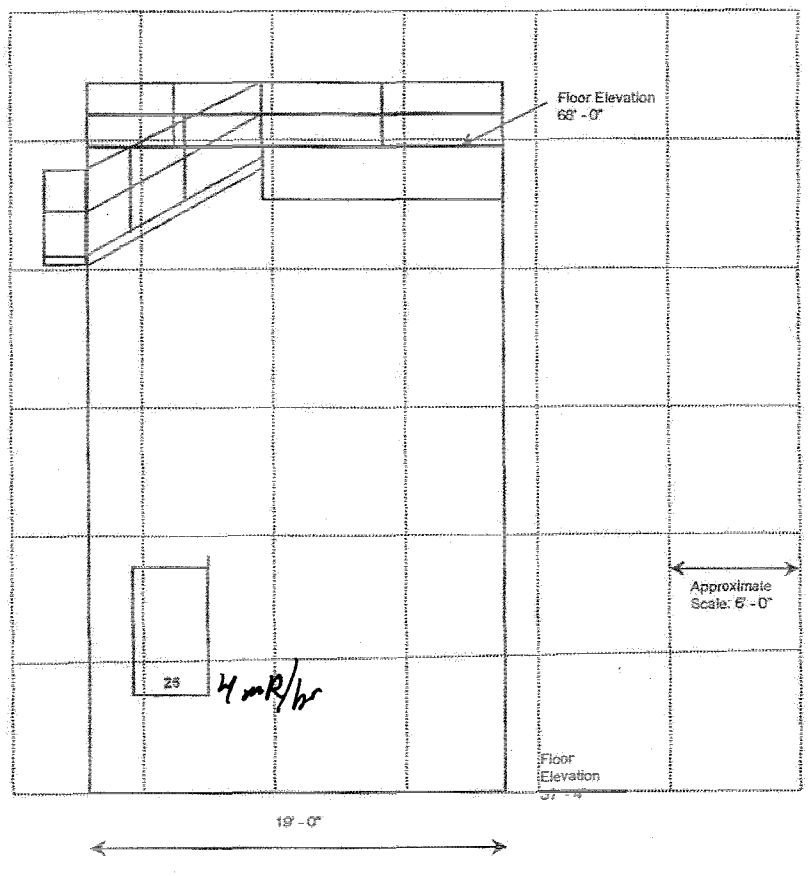
SITE: Entombed Reactor Building	Time: 1315	Date: Yr 09 Mo 9 Dy 2
Task: Comprehensive Survey	RWP: NA	

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

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

Building: Entombed Reactor Building Location: NorthWest Side

Sketch:



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

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 8-DEC-09 Task Number NA

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 2009 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	19-Feb-2010	44-9	154535	19-Feb-2010	16%	10/1	39	NA
		/ /			/ /	%	/		

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

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
65	Main Floor-Maslim (Zone 1)	41	NA	<MDA	NA
66	Main Floor-Maslim (Zone 2)	43	NA	<MDA	NA
67	Main Floor-Maslim (Zone 3)	38	NA	<MDA	NA
68	Main Floor-Maslim (Zone 4)	38	NA	<MDA	NA
69	Main Floor-Maslim (Zone 5)	50	NA	<MDA	NA
72	Main Floor-Maslim (Zone 6)	46	NA	<MDA	NA
73	Main Floor-Maslim (Zone 7)	52	NA	<MDA	NA
74	Main Floor-Maslim (Zone 8)	52	NA	<MDA	NA
75	Main Floor-Maslim Zone 9)	46	NA	<MDA	NA
76	Main Floor-Maslim (Zone 10)	44	NA	<MDA	NA
77	Main Floor-Maslim (Zone 11)	42	NA	<MDA	NA
78	Main Floor-Maslim (Zone 12)	42	NA	<MDA	NA
79	Main Floor-Maslim (Zone 14)	39	NA	<MDA	NA
80	Main Floor-Maslim (Zone 13)	41	NA	<MDA	NA

Survey Technician: A. Lucca

Reviewed By: AO C. Webb 1/11/2010

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

Approx. MDA ≃ 71 cpm

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

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: Entombed Reactor Building | Time: 1400 hrs | Date: Yr 09 Mo 9 Dy 2

Task: Comprehensive Survey | RWP: NA

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

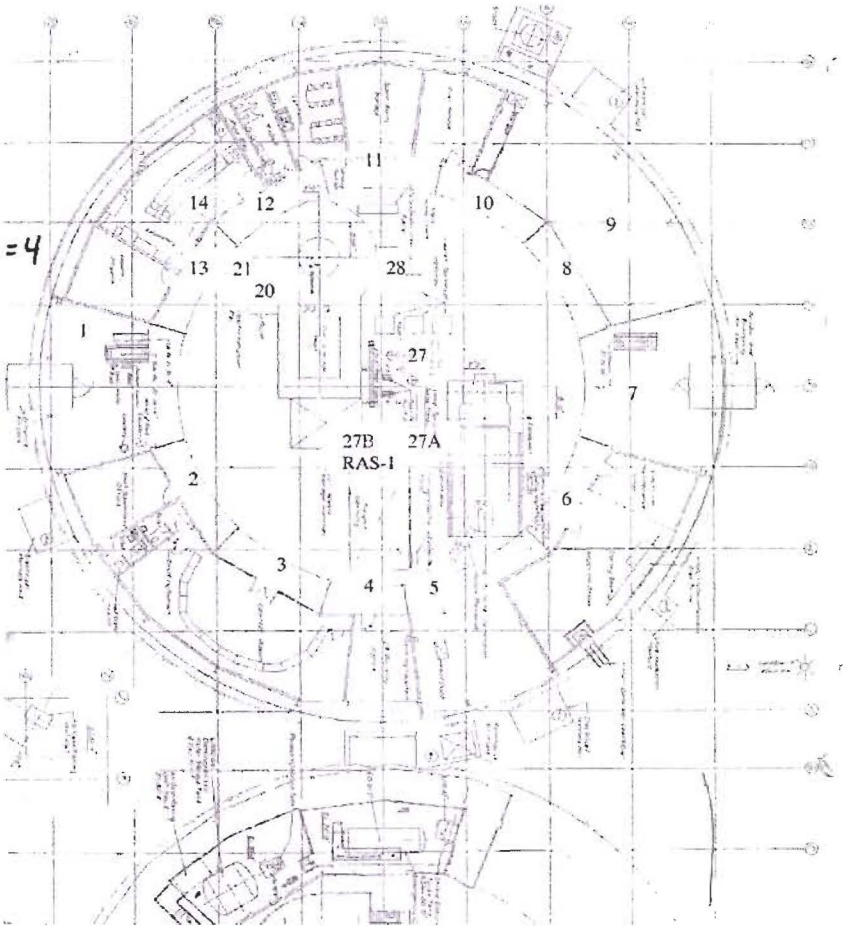
Dose Rate Abbreviations: CT/WB/GA, where CT = Contract, WB = Whole Body, GA = General Area

Building: Entombed Reactor Building | Location: Main Floor

Sketch:

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

NS=not swiped



RAS-Air Sample

#20	4 µR/hr
#21	4
#27	15
#27A	4
#27B	4
#28	15

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

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 1350 9/2/09 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 2009 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	2/19/10	44-9	154535	2/19/10	16 %	10/1	38	901
		/ /			/ /	%	/		

SURVEY DATA Survey Map Attached ☑ Yes ☐ No See 3 of 3 for Mass Survey

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	See Smear Data	73	See Smear Data	1,459 √
31	Basement Floor-Side of Tank #2		82		1,834 √
40A	Basement Floor-Wall (4" from floor)		233		8,129 √
40B	Basement Floor-Wall (4" from floor)		47		<MDA
42	Basement Floor		46		<MDA
43	Basement Floor		30		<MDA
50A	Basement Floor-Wall (block)		46		<MDA
50B	Basement Floor-Wall (concrete)		51		<MDA
40A	Duplicate		214		7,337 √

Survey Technician: Allen

Reviewed By: C. Webb

*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 8-DEC-09 Task Number NA

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 2009 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	19-Feb-2010	44-9	154535	19-Feb-2010	16%	10/1	41	NA
		/ /			/ /	%	/		

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

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
70	Maslim - Zone 1	36	NA	<MDA	NA
71	Maslim - Zone 2	43	NA	<MDA	NA
81	Maslim - Zone 3	39	NA	<MDA	NA
89	Maslim - Zone 4	44	NA	<MDA	NA
90	Maslim – Zone 5	41	NA	<MDA	NA
91	Maslim – Zone 6	43	NA	<MDA	NA
92	Maslim – Zone 7	41	NA	<MDA	NA
93	Maslim – Zone 8	44	NA	<MDA	NA
94	Maslim – Zone 9	41	NA	<MDA	NA
95	Maslim – Zone 10	41	NA	<MDA	NA
96	Maslim – Zone 11	35	NA	<MDA	NA
97	Maslim – Zone 12	38	NA	<MDA	NA
98	Maslim – Zone 13	44	NA	<MDA	NA

Survey Technician: A. Lucca

Reviewed By: C. Webb 1/11/2010

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

approx. MDA ≃ 73 cpm

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 8-Dec-09 Task Number NA

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 2009 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	19-Feb-2010	44-9	154535	19-Feb-2010	16%	10/1	41	NA
		/ /			/ /	%	/		

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

No.	Description/Location	Gross Counts in CPM βγ Removable	Gross Counts in CPM βγ Total	Contamination in dpm/100 cm² βγ Removable	Contamination in dpm/100 cm² βγ Total
99	Maslim – Zone 14	45	NA	<MDA	NA
100	Maslim – Zone 15	41	NA	<MDA	NA
101	Maslim – Zone 16	46	NA	<MDA	NA
102	Maslim – Zone 17	34	NA	<MDA	NA
103	Maslim – Zone 18	43	NA	<MDA	NA
			NA		NA
			NA		NA
			NA		NA
			NA		NA
			NA		NA
			NA		NA
			NA		NA
			NA		NA
			NA		NA

Survey Technician: A. Lucca

Reviewed By: C. Webb 1/11/2010

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

Approx. MDA ≈ 73 cpm

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

RADIOLOGICAL SURVEY REPORT (MAP)

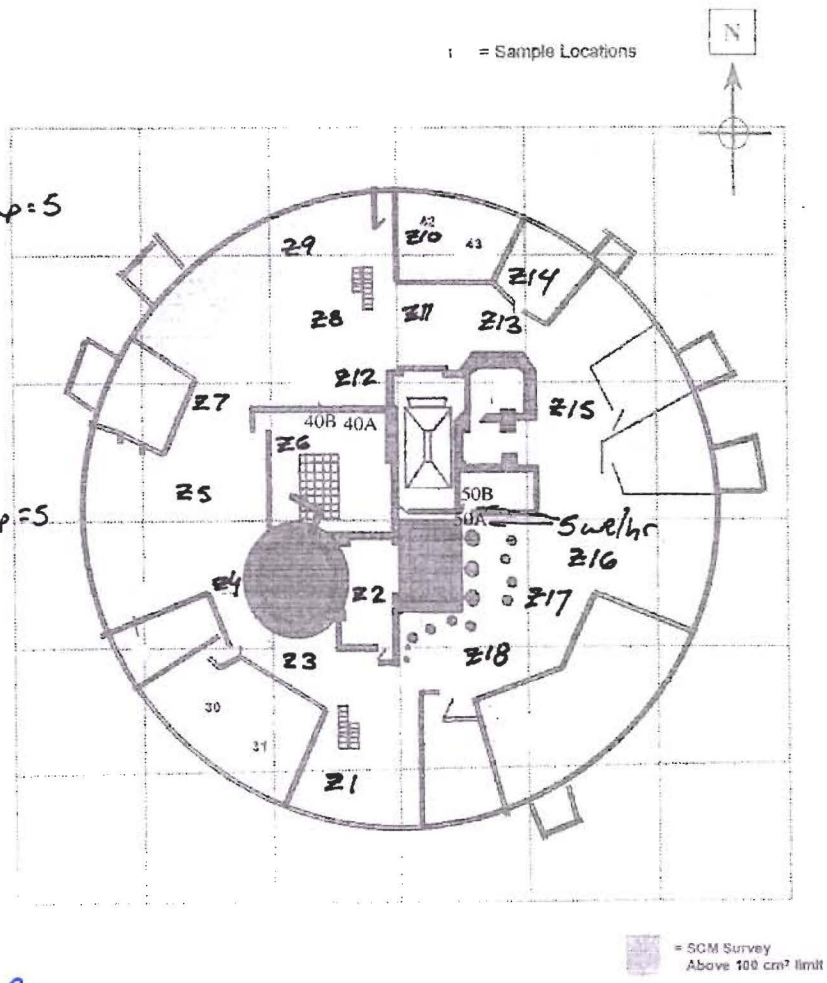
SITE: Entombed Reactor Building | Time: 1430 | Date: Yr 09 Mo 9 Dy 2

Task: Comprehensive Survey | RWP: NA

Building: Entombed Reactor Building | Location: Basement Floor

Sketch:

	No.	µR/hr
Zone 1=	71	5
Zone 2=	80	5
Zone 3=	81	9
Zone 4 =	89	6
Zone 5 =	90	5 Dup=5
Zone 6 =	91	6
Zone 7 =	92	5
Zone 8 =	93	5
Zone 9 =	94	5
Zone10 =	95	5
Zone11 =	96	5
Zone12 =	97	5
Zone13 =	98	5
Zone14 =	99	6
Zone15 =	100	5
Zone16 =	101	5
Zone17 =	102	5
Zone18 =	103	5 Dup=5
30		18
31		17
40A		56
40A Dup		52
40B		12
42		6
43		4
50A		5
50B		5
30A		8 flow.



8-DIC-2009

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 1500 9/2/09 Task Number —

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

Purpose of Survey: Year 2009 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	MDA*
Ludlum 2221	149991	2/9/10	44-9	154535	2/9/10	16 %	10 / 1	28	116
		/ /			/ /	%	/		

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
16	smear	39		<MDA	
15	smear	29		<MDA	
14	"	30		<MDA	
13	"	32		<MDA	
12	"	34		<MDA	
11	"	39		<MDA	
10	"	39		<MDA	
9	"	35		<MDA	
8	"	42		<MDA	
7	"	35		<MDA	
6	"	39		<MDA	
5	"	37		<MDA	
4	"	38		<MDA	
3	"	35		<MDA	
2	"	31		<MDA	
1	"	30		<MDA	
1/2	"				

Survey Technician: C. Webb
Reviewed By: D. Jenkins

*MDA is removable ~~total~~ 2 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 1435 9/2/09 Task Number —

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

Purpose of Survey: Year 2009 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	MDA* dpm/100cm2
Ludlum 2221	149991	2/9/10	44-9	154535	2/9/10	16 %	10/1	28	116
		/ /			/ /	%	/		

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
31	Smear	40		<MDA	
30	Smear	42		<MDA	
23	Smear	37		<MDA	
20	Smear	44		<MDA	
21	"	34		<MDA	
22	"	42		<MDA	
27B	"	34		<MDA	
27A	"	35		<MDA	
28	"	30		<MDA	
27	"	39		<MDA	
27	Duplicate count	37		<MDA	
26	Smear	42		<MDA	
24		39		<MDA	
25		36		<MDA	
19		33		<MDA	
18		30		<MDA	
17		42		<MDA	

Survey Technician: A. Reyes

Reviewed By: C. Webb

*MDA is removable ~~total~~ in dpm/100 cm² MDA ≥ 46 cpm

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

Rincón, Puerto Rico **CONTAMINATION SURVEY FORM**

Project: BONUS - MMG Date/Time 1520 9/2/09 Task Number —

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

Purpose of Survey: Year 2009 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	MDA*
Ludlum 2221	149991	2/19/10	44-9	154535	2/19/10	16 %	10 / 1	28	116
		/ /			/ /	%	/		

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
42	Smear	51		~~444~~ removed as anomaly	
42	Duplicate	29		<MDA	
42	Add. Duplicate	39		<MDA	
43	Smear	35		<MDA	
50A	"	28		<MDA	
50B	"	31		<MDA	
40A	"	29		<MDA	
40B	"	33		<MDA	

Survey Technician: C. Cribb

Reviewed By: D. Jenkins

*MDA is removable/~~total~~ in dpm/100 cm²

Attachment 3
Physical Condition - Inspection Checklist

Inspection Checklist
BONUS Decommissioned Facility, Rincón, Puerto Rico

Date of This Revision: 8-Dic-09

Last Inspection: 8-Dic-09

Inspectors: Jimmy Reyes and Agustín García

Next Inspection (Planned): _____

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.
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.
5	Dome—Basement Level flooding	Water accumulating in Basement Level may mobilize and redistribute surface contamination.	Inspect for gasket and storm water drains.
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.
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.
8	Dome— exterior	Building should appear well maintained	Visually inspect.
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.
10	General site upkeep	Building should appear well maintained.	Observe and evaluate changes in site conditions.
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.

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

Feature	Comment
Access road and parking area	Asphalt
Entrance gate	Motor-operated
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 POWER AUTHORITY ORDER NO. 20129026/331706

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

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

Cal. Date 19-Feb-09 Cal Due Date 19-Feb-10 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 24 % Alt 698.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

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

☑ HV Readout (2 points) Ref./Inst. 500 / 505 V Ref./Inst. 2000 / 2006 V

COMMENTS:

Sr90y90 s/n 5281 act.107,385dpm 27% 4Pi
ct.29,047cpm -Bg40 ct.29,007cpm
Co60 s/n 0886 act.12,089dpm 13.3% 4Pi
ct.1,658cpm -Bg40 ct.1,618cpm
Ni-63 s/n 0909 act.285,704dpm 0.13% 4Pi
ct.400cpm -Bg40 ct.360cpm
Cs-137 s/n 0754 act.185,339dpm 1.5% 4Pi
ct.2,810cpm -Bg40 ct.2,770cpm (gamma)
Cs-137 s/n 1588-112 act.6,632dpm 21% 4Pi
ct.1,361cpm -Bg40 ct.1,321cpm (beta)

All efficiencies taken at 1/4 in.
from the surface of the detector

Cs-137 s/n 2008 reads~32,283cpm 1/4
inches from surface
Sr90y90 s/n 3432-09 reads~17,314cpm 1/4
inches from surface

Firmware:26-10-10

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	400	400
x1K	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

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

ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	40059	40059
	40kcpm	4002	4002
	4kcpm	401	401
	400cpm	40	40
	40cpm	4	4

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale	500kcpm	500K	500K
	50kcpm	50	50
	5kcpm	5	5
	500cpm	500	500
	50cpm	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 Cs-137 #1696 42.4mCi

☑ m 500 S/N 54683 ☐ Oscilloscope S/N ☑ Multimeter S/N 70602489

Calibrated By: Deanna Jackson Date 19-Feb-09

Reviewed By: Rhonda Hamm Date 20 Feb 09

FORM C22A 10/15/2008

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

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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.

CONVERSION CHART

Customer PUERTO RICO ELECTRIC POWER AUTHORITY Date 19-Feb-09 Order #. 20129026/331706

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

Source Cs-137 #1696 42.4mCi High Voltage 900 V

Input Sensitivity 50 mV

Reference Point	"As Found" Readings (CPM): Analog	Range/Scale	After Adjustment Readings (CPM): Analog	Range/Scale
150 mR/hr	340	x 1K	340	x 1K
50 mR/hr	150	x 1K	150	x 1K
15 mR/hr	50	x 1K	50	x 1K
5 mR/hr	185	x 100	185	x 100
1.5 mR/hr	55	x 100	55	x 100
1.0 mR/hr	320	x 10	320	x 10

Reference Point	"As Found" Readings: Digital	Count Time	After Adjustment Readings: Digital	Count Time
150 mR/hr	34040	6sec.	34040	6sec.
50 mR/hr	14632		14632	
15 mR/hr	5120		5120	
5 mR/hr	1844		1844	
1.5 mR/hr	572		572	
1.0 mR/hr	320		320	

Signature: Duane Jackson Date 19-Feb-09

Designer and Manufacturer of Scientific and Industrial Instruments

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.

CERTIFICATE OF CALIBRATION

CUSTOMER PUERTO RICO ELECTRIC POWER AUTHORITY ORDER NO. 20134990/338724

Ludlum Measurements, Inc. Model 19 Serial No. 148190

Mfg. Model Serial No.

Cal. Date 10-Jun-09 Cal Due Date 10-Jun-10 Cal. Interval 1 Year Meterface 202-016

Check mark (✓) applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 55 % Alt 698.8 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 850 V Input Sens. 33 mV Det. Oper. V at mV Threshold Dial Ratio = mV

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

COMMENTS:
Cs-137 ≈ 1 µCi check source SN 2008 reads ≈ 25uR/hr@(500) with the source against the front of the can, label down.

=250 µR

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
5000	4000 µR/hr	4000	4000
5000	1000 µR/hr	1005	1005
500	400 µR/hr = 71000cpm	400	400
500	100 µR/hr	100	100
250	200 µR/hr = 35400cpm	200	200
250	100 µR/hr	100	100
50	7100 cpm	39	40
50	1770 cpm	10	10
25	3540 cpm	19.5	20
25	880 cpm	5	5

*Uncertainty within ± 10% C.F. within ± 20% 50, 25 Range(s) Calibrated Electronically

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

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. 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: Date 10-Jun-09

Reviewed By: Date 10 Jun 09

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

Assessment of the 2009 Dr. Modesto Iriarte Technological Museum Annual Radiological Survey

Purpose:

A review and assessment was performed on the 2009 Annual Radiological Survey to ensure that exposure levels to employees; the public and the environment to ionizing radiation are as low as reasonably achievable (ALARA). Also to ensure the survey was conducted in accordance with the Long Term Surveillance and Maintenance Plan for the BONUS Reactor Facility prepared by the U.S. Department of Energy, Office of Legacy Management.

Results:

The survey results indicate that the exposure levels of ionizing radiation to employees, the public and environment are as low as reasonably achievable (ALARA). Due to the presence of elevated fixed contamination, several locations are designated as controlled areas. In lieu of posting these areas, administrative procedures should be in place to ensure no intrusive work be performed without a review and approval of the Radiological Control Manager (RCM).

Several of the hand written dose rates are not written clearly enough to determine if the symbol is actually millirem or microrem. This is the most significant issue of the items that should be addressed.

I have noticed inconsistencies with hand written error corrections throughout the survey. Examples are: a one line correction exists without initials and date and another example there are initials, but no date. I have also noticed numbers “written over” or scratched out and another number rewritten in its place. The proper and acceptable method for a correction is to one line out (only one), initials, and date of correction next to the correction.

I also believe the word “maslim” or large area smear is misspelled in the survey forms, and should be spelled “masslin” which would be consistent with its spelling in the Memorandum and in Table 1.

Conclusion:

I conclude that the Annual Survey exposure levels to ionizing radiation results are ALARA; administrative controls are in place to include any intrusive work requiring approval of the RCM, and the levels of radioactivity at the facility remains within the criteria that support the basis for continued use as a museum. However, the same errors and inconsistencies occur ever year these surveys are performed and reviewed. These are legal documents in which care, clear denotation, acceptable correction methods and quality control are essential.

Larry Oeffner Jr. 04/14/2010
Radiological Health and Safety Department
S.M. Stoller Corporation