



# Memorandum

Date: 22 February 2005

To: Carlo Velez, BONUS Facility Manager

Copy: Fred Haywood, URS HP, BONUS File

From: Chad Webb, BONUS RADCON Manager

Subject: **2004 Annual Survey and Verification Survey for Basement Floor**

The results of the annual survey and verification survey are presented below, as well as recommendations for future radiological control measures.

## **1. 2004 ANNUAL SURVEY**

URS Corporation (URS) conducted the fourth comprehensive annual survey at the BONUS Reactor from June 29 through July 1, 2004 with support from Puerto Rico Electrical Power Authority (PREPA) personnel. This survey was conducted in accordance with the Sampling and Analysis Plan (SAP) for the BONUS Reactor prepared by the U.S. Department of Energy (DOE) (or DOE contractor) as amended by a January 16, 2001 Memorandum from Webb to Alvarado. This report is organized in accordance with Section 6.2 of the SAP. The sampling and inspection results are discussed below.

### **1.1 Purpose**

**Date:** June 29 through July 1, 2004

**Purpose:** Conduct 2004 annual 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.

### **1.2 Location**

This sampling and inspection effort focused on the BONUS Reactor Building. Surveys and inspections were performed on the (1) exterior of the entombment, (2) Main Level, and (3) Basement Level. A list of specific survey locations is provided in Table 1.

### **1.3 Physical Condition**

**Primary Reactor Building Structure (Dome):** Inspection of the primary reactor building structure did not reveal any significant discrepancies, although in the basement minor corrosion was noted around the entire base of the dome. Ongoing and routine assessment of the dome is recommended. No immediate action is necessary.

**Entombment:** Inspection of the entombment area revealed superficial cracks throughout the surface of the structure (same as in previous surveys). All dose rate measurements taken around the structure were not significantly different from background measurements taken. Ongoing and routine assessment of the entombment is recommended. No immediate action is necessary.

**Table 1**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Routine Sampling</b>					
Pipe Chase Face	1	5	<MDA	<MDA	Entombment Top
Pipe Chase Face	2	4	<MDA	<MDA	Entombment Top
Pipe Chase Face	3	4	<MDA	<MDA	Entombment Top
Pipe Chase Face	4	4	<MDA	<MDA	Entombment Top
Top Plug Face #1	5	4	<MDA	<MDA	Entombment Top
Top Plug Face #1	6	4	<MDA	<MDA	Entombment Top
Top Plug Face #1	7	4	<MDA	<MDA	Entombment Top
Top Plug Face #2	8	4	<MDA	<MDA	Entombment Top
Top Plug Face #2	9	5	1,191	<MDA	Entombment Top
Top Plug Face #2	10	5	1,668	<MDA	Entombment Top
Top Plug Face #3	11	4	1,286	<MDA	Entombment Top
Top Plug Face #3	12	5	1,334	<MDA	Entombment Top
Top Plug Face #3	13	4	<MDA	<MDA	Entombment Top
Top Plug Face #4	14	4	<MDA	<MDA	Entombment Top
Top Plug Face #4	15	4	<MDA	<MDA	Entombment Top
Top Plug Face #4	16	4	<MDA	<MDA	Entombment Top
Top Plug Top Surface	17	3	905	<MDA	Entombment Top
Top Plug Top Surface	18	3	<MDA	<MDA	Entombment Top
Top Plug Top Surface	19	4	<MDA	<MDA	Entombment Top
Top Plug Top Surface	19 Dup	4	<MDA	<MDA	Entombment Top
Main Floor Water Column	20	6	1,143	<MDA	Main Level-Controlled Area
Main Floor Water Column	21	5	1,906	<MDA	Main Level-Controlled Area
Instrument Thimble #1	22	5	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #1	22 Dup	NA	NA	<MDA	Duplicate smear count
Instrument Thimble #2	23	5	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #3	24	5	<MDA	<MDA	Main Level-Controlled Area
Pipe Chase Exterior Hatch	25	5	<MDA	<MDA	Main Level-Controlled Area
Instrument Thimble #4	26	5	<MDA	<MDA	Main Level-Controlled Area
Fuel Pool Purification Floor, area	27	17	8,814	<MDA	Main Level-Controlled Area
Fuel Pool Purification Floor, area	27A	5	1,668	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purification Floor, area	27B	5	1,096	<MDA	Main Level-Controlled Area. Taken to define elevated area associated with 27 and 28.
Fuel Pool Purification Floor (CM005)	28	16	105,291	<MDA	Main Level-Controlled Area

**Table 1 (Continued)**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Routine Sampling (continued)</b>					
Pre heater Room Moat Surface	29	6	<MDA	<MDA	Basement Level
Liquid Waste Ret. Tank Floor	30	18	<MDA	<MDA	Basement Level
Liquid Waste Ret. Tank Floor (Near Wall)	30A	15	7,337	<MDA	Basement Level
Liquid Waste Ret. Tank Floor	31	16	<MDA	<MDA	Basement Level
Corridor Moat Surface	32	9	10,148	<MDA	Basement Level
Corridor Moat Surface	33	9	8,623	<MDA	Basement Level
Corridor Moat Surface	34	11	2,144	<MDA	Basement Level
Corridor Moat Surface	35	11	51,788	<MDA	Basement Level
Corridor Moat Surface	36	6	<MDA	<MDA	Basement Level
Corridor Moat Surface	37	5	<MDA	<MDA	Basement Level
Corridor Moat Surface	37 Dup	5	<MDA	<MDA	Basement Level
Liquid Waste Pump Room (B003)	38	8	NA	NA	Historical removable area to be covered w/new concrete
F.W. Heater Room Floor	39	15	3,144	<MDA	Basement Level
F.W. Heater Room Floor (B017)	40	9	<MDA	<MDA	Basement Level
F.W. Heater Room (Wall)	40A	Not Taken	Not Taken	<MDA	After first coat of paint
F.W. Heater Room (Floor)	40B	Not Taken	Not Taken	<MDA	After first coat of paint
F.W. Heater Room Floor	41	8	<MDA	<MDA	Basement Level
Vapor Sphere Room	42	5	<MDA	<MDA	Basement Level
Vapor Sphere Room	43	6	<MDA	<MDA	Basement Level
Air Ejector Room Floor	44	9	<MDA	<MDA	Basement Level
Air Ejector Room Floor	45	8	<MDA	<MDA	Basement Level
Condensate Pump Room Floor	46	13	<MDA	<MDA	Basement Level
Hogging Pump Room Floor	47	15	1,286	<MDA	Basement Level
Hogging Pump Room Floor	48	9	619	<MDA	Basement Level
Condenser Room Floor	49	8	810	<MDA	Basement Level
Condenser Room Floor	50	8	<MDA	<MDA	Basement Level
Condenser Room Floor	50 Dup	8	<MDA	<MDA	Basement Level
Condenser Room Entry Wall (Block)	50A	6	39,210	<MDA	Basement Level
Condenser Room Entry Wall (Concrete)	50B	5	30,015	<MDA	Basement Level
Condenser Purification Floor Area	51	6	<MDA	<MDA	Basement Level
Condenser Purification Floor Area	52	6	<MDA	<MDA	Basement Level
Condenser Resin Regeneration (B023)	53	10	22,726	<MDA	Basement Level
Condenser Resin Regeneration	54	9	1,286	<MDA	Basement Level
Reactor Water Purification	55	7	<MDA	<MDA	Basement Level
Reactor Water Purification	56	7	<MDA	<MDA	Basement Level

**Table 1 (Continued)**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Additional Sampling Locations</b>					
Reactor Top (MEZI) Fuel Transfer Assembly Track	57	NA	NA	NA	Item removed prior to this survey
Monitoring Well 1	58	NA	NA	NA	No longer included in survey
Monitoring Well 2	59	NA	NA	NA	No longer included in survey
Monitoring Well 3	60	NA	NA	NA	No longer included in survey
Soil Sample 1-North entrance	61	NA	NA	NA	No longer included in survey
Soil Sample 2-South entrance	62	NA	NA	NA	No longer included in survey
Soil Sample 3-Surface composite adjacent to facility	63	NA	NA	NA	No longer included in survey
Composite Dust Sample	64	NA	NA	NA	No longer included in survey
<b>Random Sampling (Specify Location)</b>					
Main Floor-Zones 1-4	65-68	5-6	NA	>MDA, but <1,000 dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zones 5-8	69-74	5	NA	>MDA, but <1,000 dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zones 9-10	75-76	4-5	NA	>MDA, but <1,000 dpm/100cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
Main Floor-Zones 11-14	77-80	5	NA	>MDA, but <1000dpm/100 cm <sup>2</sup>	Main Level-Public Access. Masslin Smear
<b>Other Special Readings (as required) Specify Location</b>					
Decontamination Room, Decontamination Sink Pipe	84	6	9,338	<MDA	Basement Level
Decontamination Room, Decontamination Sink Pipe	84 Dup	NA	9,671	<MDA	Duplicate
Sump Pump 1	86	NA	29,634	<MDA	Basement Level
Shield Pump 2	91	NA	1,953	<MDA	Basement Level
<b>Readings Before Paint</b>					
Neutr. Tank West Side	NT-W	Not Taken	NA	<MDA	Basement Level
Neutr. Tank East Side	NT-E	Not Taken	NA	<MDA	Basement Level
Neutr. Tank South Side	NT-S	Not Taken	NA	<MDA	Basement Level
Neutr. Tank North Side	NT-N	Not Taken	NA	<MDA	Basement Level
Neutr. Tank Top West End	NT-TopW	Not Taken	NA	<MDA	Basement Level
Neutr. Tank Top East End	NT-TopE	Not Taken	NA	<MDA	Basement Level
Neutr. Tank Bottom	NT-B	Not Taken	NA	<MDA	Basement Level
Neutr. Tank Bottom	NT-B Dup	Not Taken	NA	<MDA	Duplicate Count
Ret. Tank 1 North Side	RT1-N	Not Taken	NA	<MDA	Basement Level
Ret. Tank 1 East Side	RT1-E	Not Taken	NA	<MDA	Basement Level

**Table 1 (Continued)**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Readings Before Paint</b>					
Ret. Tank 1 South Side	RT1-S	Not Taken	NA	<MDA	Basement Level
Ret. Tank 1 West Side	RT1-W	Not Taken	NA	<MDA	Basement Level
Ret. Tank 1 Bottom	RT1-B	Not Taken	NA	821	Basement Level
Ret. Tank 2 North Side	RT2-N	Not Taken	NA	<MDA	Basement Level
Ret. Tank 2 East Side	RT2-E	Not Taken	NA	<MDA	Basement Level
Ret. Tank 2 South Side	RT2-S	Not Taken	NA	<MDA	Basement Level
Ret. Tank 2 West Side	RT2-W	Not Taken	NA	<MDA	Basement Level
Ret. Tank 2 Bottom	RT2-B	Not Taken	NA	1,850	Basement Level
Ret. Tank 2 Bottom	RT2-B Dup	Not Taken	NA	1,986	Basement Level
Ret. Tank 3 North Side	RT3-N	Not Taken	NA	<MDA	Basement Level
Ret. Tank 3 East Side	RT3-E	Not Taken	NA	157	Basement Level
Ret. Tank 3 South Side	RT3-S	Not Taken	NA	<MDA	Basement Level
Ret. Tank 3 West Side	RT3-W	Not Taken	NA	257	Basement Level
Ret. Tank 3 Bottom	RT3-B	Not Taken	NA	336	Basement Level
Ret. Tank 1 Floor Under Pipe (side)	RT1-F	Not Taken	NA	<MDA	Basement Level
Ret. Tank 1 Bottom 6 in. from Pipe (side)	RT1-BA	Not Taken	NA	<MDA	Basement Level
Ret. Tank 1 Pipe (side)	RT1-P	Not Taken	NA	<MDA	Basement Level
Ret. Tank 1 Center Pipe	RT1-PC	Not Taken	NA	<MDA	Basement Level
Ret. Tank 1 Bottom 6 in. from Pipe Center	RT1-BB	Not Taken	NA	3,093	Basement Level
Ret. Tank 1 Floor Under Center Pipe	RT1-FC	Not Taken	NA	<MDA	Basement Level
<b>Readings Post Paint</b>					
Ret. Tank 1 Top	RT1-T	Not Taken	NA	<MDA	Basement Level
Ret. Tank 1 Bottom	RT1-B	Not Taken	NA	<MDA	Basement Level
Ret. Tank 2 Top	RT2-T	Not Taken	NA	<MDA	Basement Level
Ret. Tank 2 Bottom	RT2-B	Not Taken	NA	400	Basement Level
Ret. Tank 2 Bottom	RT2-B	Not Taken	NA	<MDA	Taken after second coat of paint
Ret. Tank 3 Top	RT3-T	Not Taken	NA	<MDA	Basement Level
Ret. Tank 3 Bottom	RT3-B	Not Taken	NA	<MDA	Basement Level
Ret. Tank 3 West Side	RT3-W	Not Taken	NA	<MDA	Basement Level

MDA = Minimum Detectable Activity

NA = Not applicable

**Main Level (Controlled Area):** The two historical contamination sites remain covered with floor tiles; the tile work is in excellent condition and is effective in reducing the dose levels. One area adjacent to the north side of the entombment is also covered with lead bricks, which is also effective in reducing elevated dose rule levels in this area (not accessible to the public). Ongoing and routine assessment of the floor tile and lead bricks in this area is recommended. No immediate action is necessary.

**Basement Level:** Corrosion is evident on all surfaces within approximately 6 in. of the floor, including contaminated surfaces. However, a new 4-in. concrete floor has been placed over the Basement Level. The new concrete floor covers all floor areas where surface contamination was present and areas where corrosion was occurring (the verification survey performed on the new floor is discussed below). Control measures (fixed with paint) have been implemented on surfaces where removable contamination has been detected. Ongoing and routine assessment of accessible surfaces in the basement is recommended to evaluate the continued effectiveness of the new flooring and control measures emplaced on previous contamination areas.

**1.4 Direct Radiation Monitoring**

Table 1 presents direct radiation monitoring results for this survey. Attachment 1 provides survey records and sketches depicting survey locations for the direct radiation monitoring conducted during this annual comprehensive survey. 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 <sup>a</sup>		Annual Dose Limits (rem/year)	
	Min. (uR/hour)	Average (uR/hour)	Max. (uR/hour)	Max. Exposure (hour/year)	Rate (rem/year)	Rad Worker	Visitor
Entombment Top	3	4.3	5	416	0.002	2	NA
Main Level (Controlled Area)	5	7.2	17	416	0.007	2	NA
Main Level (Public Access)	4	4.1	6	2,080 (employee)	0.01	2	NA
				832 (visitor)			
Basement Level	4	8.8	18	416	0.007	2	NA

<sup>a</sup>Based conservatively on the maximum recorded dose rate at a conservative exposure scenario. For example, exposure level for the entombment top would be 5 uR/hour × (1 rem/1,000,000 uR) × (8 hours/1 week) × (52 weeks/1 year) = 0.002 rem/year.

The results summarized in 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 Reactor facility. The highest dose rate recorded at 30 cm in the BONUS facility (18 uR/hour) is less than 1% of 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 Table 2.

Instrument calibrations and daily response check records are maintained at the BONUS facility. Duplicate field measurements were also made at a rate of 5% of the routine measurements and are summarized in Table 3.

**Table 3**

Location	Result (uR/hour)		RPD (%)	Comments
	Initial	Duplicate		
19	4	4	0	Very good
37	5	5	0	Very good
50	8	8	0	Very good
84	6	6	0	Very Good

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

All quality assurance (QA)/quality control (QC) checks performed within limits.

**1.5 Contamination Level Monitoring**

Table 1 presents contamination level monitoring results for this survey. Attachment 1 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.

**1.5.1 Entombment**

There are no radioactive contamination areas (as defined in 10 CFR 835) associated with the exterior of the entombment structure. Smear samples were collected from the surface of the entombment to assess transferable or removable surface beta/gamma contamination. None of the smear samples exhibited removable contamination above the minimum detectable activity (MDA). Five survey locations exhibited total surface contamination levels above the MDA. Survey locations 9, 10, 11, 12, and 17 had total surface beta/gamma contamination levels ranging from 905 to 1,668 disintegrations per minute (dpm)/100 cm<sup>2</sup>. These values are less than twice background values, but are well below the survey action level for total surface beta/gamma contamination (5,000 dpm/100 cm<sup>2</sup>). It is recommended that the entombment 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 entombment surface) work is performed on this level without review and approval by the RCM.

**1.5.2 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<sup>2</sup> action level (8,814 and 105,291 dpm/100 cm<sup>2</sup>, respectively). Two additional survey locations, 27A and 27B, were added to the sampling locations in 2001 and assessed to determine the extent of surface contamination (refer to survey sketch in Attachment 1). Two other planned survey locations, 20 and 21, exhibited total surface contamination levels above MDA, but below the 5,000 dpm/100 cm<sup>2</sup> action level. 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). Minimum entry/exit requirements for this area should include signing a log-in/log-out sheet and frisking feet, as well as other areas/equipment that contacted area surfaces, upon exit from the area.

### 1.5.3 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 65-68, 69-74, 75-76, and 77-80) 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 removable contamination above MDA; however, when considering the wide area of coverage of the masslin smears (400–800 ft<sup>2</sup>), levels were well below 1,000 dpm/100 cm<sup>2</sup>. Historically, fixed surface contamination does exist on the concrete floor of the Main Level (public access area), but has been shielded by the placement of tiles in this area. Due to the presence of fixed contamination beneath the 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.

### 1.5.4 Basement Level

Table 1 indicates several total and removable surface contamination areas above action levels in the Basement Level. Historically, removable surface contamination in the Basement Level has been detected on floors and process equipment. The following areas have been noted as exhibiting removable surface contamination:

- Liquid Waste Pump Room (B003-floor) – historical sample location 38
- F.W. Heater Room (wall) – sample location 40A
- Basement sink (heavy corrosion on fixed contamination area) – historical sample location 85
- Retention Tank Room (Retention Tanks 1, 2, and 3) – special samples taken

During this comprehensive survey, the following control measures were implemented to address the removable contamination in the basement:

- Liquid Waste Pump Room – removable contamination areas on the floor were fixed with paint (the floor was later covered with approximately 4 in. of concrete – no confirmatory smear samples necessary)
- F.W. Heater Room – removable contamination areas were fixed with paint (surfaces were later covered with plywood and a thin coating of concrete – confirmatory smear samples in Table 1 indicate that the removable contamination has been fixed)
- Basement Sink – removable contamination areas were fixed with paint (the sink was later completely filled with concrete – no confirmatory smear samples necessary)
- Retention Tank Room – surfaces of Tanks 1, 2, and 3 were coated with paint until no removable contamination was detected (Table 1 – Readings Post Paint)

Total beta/gamma surface contamination levels throughout the Basement Level were also elevated. Following this comprehensive survey, however, those areas with elevated total surface contamination readings were covered with approximately 4 in. of concrete (discussed in Section 2). The comprehensive annual survey results of the total surface contamination survey for the basement are summarized in Table 4.

**Table 4**

Total Surface Contamination (dpm/100 cm <sup>2</sup> )	Survey Locations	Low (dpm/100 cm <sup>2</sup> )	Average (dpm/100 cm <sup>2</sup> )	High (dpm/100 cm <sup>2</sup> )
< MDA	29, 30, 31, 36, 37, 37Dup, 40, 41, 42, 43, 44, 45, 46 50, 50Dup, 51, 52, 55, and 56	< MDA	< MDA	< MDA
MDA – 5,000	34, 39, 47, 48, 49, 54, and 91	619 (Loc. 48)	1,606	3,144 (Loc. 39)
5,001 – 50,000	30A, 32, 33, 50A, 50B, 53, 84, 84Dup, and 86	7,337 (Loc. 30A)	18,522	39,210 (Loc. 50A)
>50,000	35	51,788 (Loc. 35)	51,788	51,788 (Loc. 35)

Note that the measurements in Table 4 above were taken prior to the installation of 4 in. of concrete on the basement flooring. A discussion of the verification survey performed subsequent to the installation of new concrete flooring is discussed below. Recommendations for access control and posting of this area are discussed at the conclusion of this memorandum.

**1.5.5 Contamination Survey QA/QC**

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

**Table 5**

Location	Result (dpm/100 cm <sup>2</sup> )		RPD (%)	Comments
	Initial	Duplicate		
19	<MDA	<MDA	NA	Good
37	<MDA	<MDA	NA	Good
50	<MDA	<MDA	NA	Good
84	9,338	9,671	3.5	Good

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

All QA/QC checks performed within limits.

**1.6 Laboratory Data**

None.

**2. VERIFICATION SURVEY FOR BASEMENT FLOOR**

**2.1 Purpose**

**Date:** January 12–13, 2005

**Purpose:** Conduct verification survey on newly poured concrete floor at BONUS facility, basement floor level, 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. The newly poured concrete flooring was specifically evaluated for acceptable public access from museum visitors.

## 2.2 Location

The verification survey consisted of both biased and randomly selected locations. The biased locations routinely performed on the basement floor during the annual comprehensive survey were repeated for this verification survey. Specifically, sample locations 29–56 of the SAP were performed. 29 locations were also randomly selected on the newly poured concrete floor of the basement.

## 2.3 Physical Condition

The new concrete floor consists of 3- to 4-in. of concrete poured directly on the pre-existing basement floor. Photographs and documentation from the activity demonstrate that the new floor was also reinforced with rebar. The new flooring appears adequate to prevent disturbance of the fixed contamination levels present on the pre-existing floor surfaces and appears to be structurally sound. Only surface fissures/cracks were noted.

Two underground storage tanks (Radioactive Waste Storage Tanks – North and South) and three monitoring wells (MW-1, MW-2, and MW-3) were also inspected. The tanks and wells have been filled with concrete and no internal surfaces are accessible. The abandonment method for the well and tanks appears to be structurally sound and effective.

## 2.4 Contamination Level Monitoring

Table 6 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 SOPs PBR-11.3.1 and 11.4.1.

The routine annual survey locations associated with the basement floor (29-56 and 84-86) were repeated during this verification survey. None of these locations exhibited removable surface contamination levels above MDA. Only the following locations exhibited total surface contamination levels above MDA:

- F.W. Heater Room – Locations 40A and 40B resulted in 1,411 and 3,549 dpm/100cm<sup>2</sup> total surface contamination, respectively. However, the elevated readings are not attributed to surface contamination as the surfaces have been painted and covered with plywood and concrete.
- Decon Room – Location 84 exhibited 7,782 dpm/100 cm<sup>2</sup> total surface contamination. The pipe flange is located approximately 5 ft above the floor, so it is not directly applicable to the verification survey for the new concrete floor, but provided to document items/areas where elevated readings are present. The pipe flange surface has been painted to prevent corrosion of the flange surface.

In addition to the annual survey locations, 29 survey locations were randomly distributed over the basement floor. Again, none of these locations exhibited removable surface contamination levels above MDA. One location, R6, recorded an initial reading of 684 dpm/100 cm<sup>2</sup> total surface contamination, which is slightly above MDA. However, a duplicate measurement at R6, Location R6Dup, and a location immediately adjacent to R6, Location R6A, produced no readings above MDA.

**Table 6**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Routine Sampling</b>					
Floor	29	7	<MDA	<MDA	
Floor	30	15	<MDA	<MDA	
Floor	31	17	<MDA	<MDA	
Floor	32	6	<MDA	<MDA	
Floor	33	6	<MDA	<MDA	
Floor	34	6	<MDA	<MDA	
Floor	35	6	<MDA	<MDA	
Floor	36	6	<MDA	<MDA	
Floor	37	5	<MDA	<MDA	
Floor	38	6	<MDA	<MDA	
Floor	38 DUP	6	<MDA	<MDA	
Floor	39	11	<MDA	<MDA	
Floor	40	10	<MDA	<MDA	
Adjacent to 40 Floor	40A	14	1,411	<MDA	
Adjacent to 40 Wall	40B	14	3,549	<MDA	
Floor	41	7	<MDA	<MDA	
Floor	42	4	<MDA	<MDA	
Floor	43	4	<MDA	<MDA	
Floor	44	8	<MDA	<MDA	
Floor	45	7	<MDA	<MDA	
Floor	46	13	<MDA	<MDA	
Floor	47	13	<MDA	<MDA	
Floor	48	5	<MDA	<MDA	
Floor	48 DUP	5	<MDA	<MDA	
Floor	49	8	<MDA	<MDA	
Floor	50	7	<MDA	<MDA	
Wall Block	50A	5	<MDA	<MDA	
Wall Concrete	50B	5	<MDA	<MDA	
Floor	51	6	<MDA	<MDA	
Floor	52	6	<MDA	<MDA	
Floor	53	7	<MDA	<MDA	
Floor	54	6	<MDA	<MDA	
Floor	55	5	<MDA	<MDA	
Floor	56	4	<MDA	<MDA	
Floor	56 DUP	4	<MDA	<MDA	
Decon Room Pipe Flange	84	6	7,782	<MDA	Flange located approximately 5 ft above floor in Decon Room
Sink	85	7	<MDA	<MDA	
Sump Pump #1 Floor	86	10	<MDA	<MDA	

MDA = Minimum Detectable Activity

**Table 6 (Continued)**

Sampling Location	Sample Number	Dose Rate (uR/hour)	Total Contamination (dpm/100 cm <sup>2</sup> )	Removable Contamination (dpm/100 cm <sup>2</sup> )	Comments
<b>Routine Sampling</b>					
Random Location	R1	8	<MDA	<MDA	
Random Location	R2	9	<MDA	<MDA	
Random Location	R3	9	<MDA	<MDA	
Random Location	R4	7	<MDA	<MDA	
Random Location	R5	6	<MDA	<MDA	
Random Location	R6	7	684	<MDA	
Random Location DUP	R6Dup	NA	<MDA	NA	
Adjacent to R6 Floor	R6 A	NA	<MDA	NA	
Random Location	R7	6	<MDA	<MDA	
Random Location	R8	7	<MDA	<MDA	
Random Location	R9	7	<MDA	<MDA	
Random Location	R10	7	<MDA	<MDA	
Random Location DUP	R10 DUP	7	<MDA	<MDA	
Random Location	R11	11	<MDA	<MDA	
Random Location	R12	10	<MDA	<MDA	
Random Location	R13	4	<MDA	<MDA	
Random Location	R14	4	<MDA	<MDA	
Random Location	R15	4	<MDA	<MDA	
Random Location	R16	4	<MDA	<MDA	
Random Location	R17	4	<MDA	<MDA	
Random Location	R18	4	<MDA	<MDA	
Random Location	R19	5	<MDA	<MDA	
Random Location	R20	4	<MDA	<MDA	
Random Location DUP	R20 DUP	4	<MDA	<MDA	
Random Location	R21	5	<MDA	<MDA	
Random Location	R22	4	<MDA	<MDA	
Random Location	R23	4	<MDA	<MDA	
Random Location	R24	6	<MDA	<MDA	
Random Location	R25	4	<MDA	<MDA	
Random Location	R26	4	<MDA	<MDA	
Random Location	R27	5	<MDA	<MDA	
Random Location	R28	4	<MDA	<MDA	
Random Location	R29	5	<MDA	<MDA	
Random Location DUP	R29 DUP	5	<MDA	<MDA	
Radioactive Waste Storage Tank South	RWST-S	4	<MDA	<MDA	
Radioactive Waste Storage Tank North	RWST-N	4	<MDA	<MDA	
Monitoring Well 1	MW-1	4	NA	NA	Dose rate only
Monitoring Well 2	MW-2	4	NA	NA	Dose rate only
Monitoring Well 3	MW-3	4	NA	NA	Dose rate only

MDA = Minimum Detectable Activity

Two underground storage tanks and three monitoring wells, which were filled with concrete, were also evaluated during the verification survey. The structures were inspected to assess physical condition as noted above. Although none of these structures has historically exhibited elevated surface contamination or dose rate levels, verification measurements were made and are presented in Table 6 (RWST-S, RWST-N, MW-1, MW-2, and MW-3). Surface contamination measurements at the tanks resulted in no total or removable levels above MDA, and dose rate measurements made at the monitoring well locations were within background levels.

**2.4.1 Verification Survey QA/QC**

Instrument calibration records and daily response check records are maintained at the BONUS facility. Duplicate field measurements were also made at a rate of 10% and are summarized in Table 7.

**Table 7**

Location	Result (dpm/100 cm <sup>2</sup> )		RPD (%)	Comments
	Initial	Duplicate		
R6	684	<MDA	NA	Initial very close to MDA
R10	<MDA	<MDA	NA	Good
R20	<MDA	<MDA	NA	Good
R29	<MDA	<MDA	NA	Good

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

All QA/QC checks performed within limits.

**2.5 Data Reduction And Analysis**

The statistical analysis planned for the random verification survey was not required. All results were below MDA with one anomaly (Location R6) as discussed above.

**3. RECOMMENDATIONS**

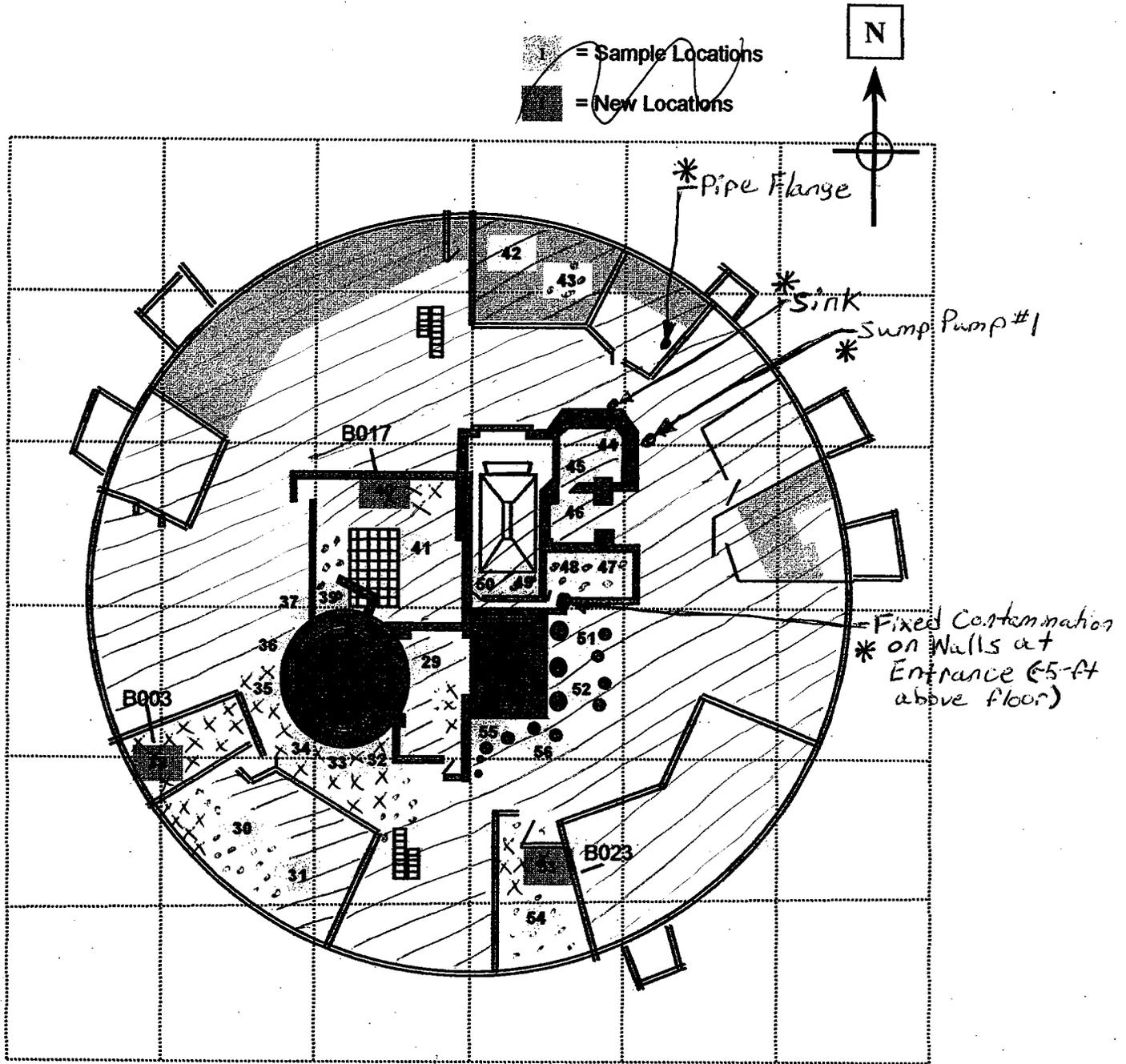
Based on the annual comprehensive survey and subsequent verification survey results presented above, the following recommendations are provided:

- It is recommended that the Entombment Top be designated as a controlled area due to the presence of elevated fixed surface beta/gamma contamination and exposure rate levels. Marking/posting of this area is not required; however, administrative procedures should be in place to ensure that no intrusive (disturbing the entombment surface) work is performed on this level without review and approval by the RCM.
- 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). Minimum entry/exit requirements for this area should include signing a log-in/log-out sheet and frisking feet, as well as other areas/equipment that contact area surfaces, upon exit from the area.
- Due to the presence of fixed contamination beneath the 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.

- Due to the presence of fixed contamination beneath the new concrete flooring in the basement, it is recommended that the Basement Level (proposed public access area) 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. Otherwise, no RWP is required for access to this area.
- Due to the presence of elevated removable surface contamination levels, which have been fixed through control measures, it is recommended that the Basement Level (proposed non-public access area) 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). This non-public access area includes 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. Minimum entry/exit requirements from this controlled area should include signing a log-in/log-out sheet and frisking feet, as well as other areas/equipment that contact area surfaces, upon exit from the area. 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. Otherwise, no RWP is required for access to these areas.
- 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. After the next subsequent annual survey, the use of masslim smears to replace the historical Basement Level floor sample locations will be evaluated. 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 Liquid Waste Retention Tank Room). The possibility of reducing quarterly surveys to a bi-annual survey will also be evaluated after subsequent annual surveys.

**Attachment 1**  
**Annual Survey Forms and Sketches**

**Figure 7 - BONUS Basement Floor Plan - Elevation 16' - 0"**

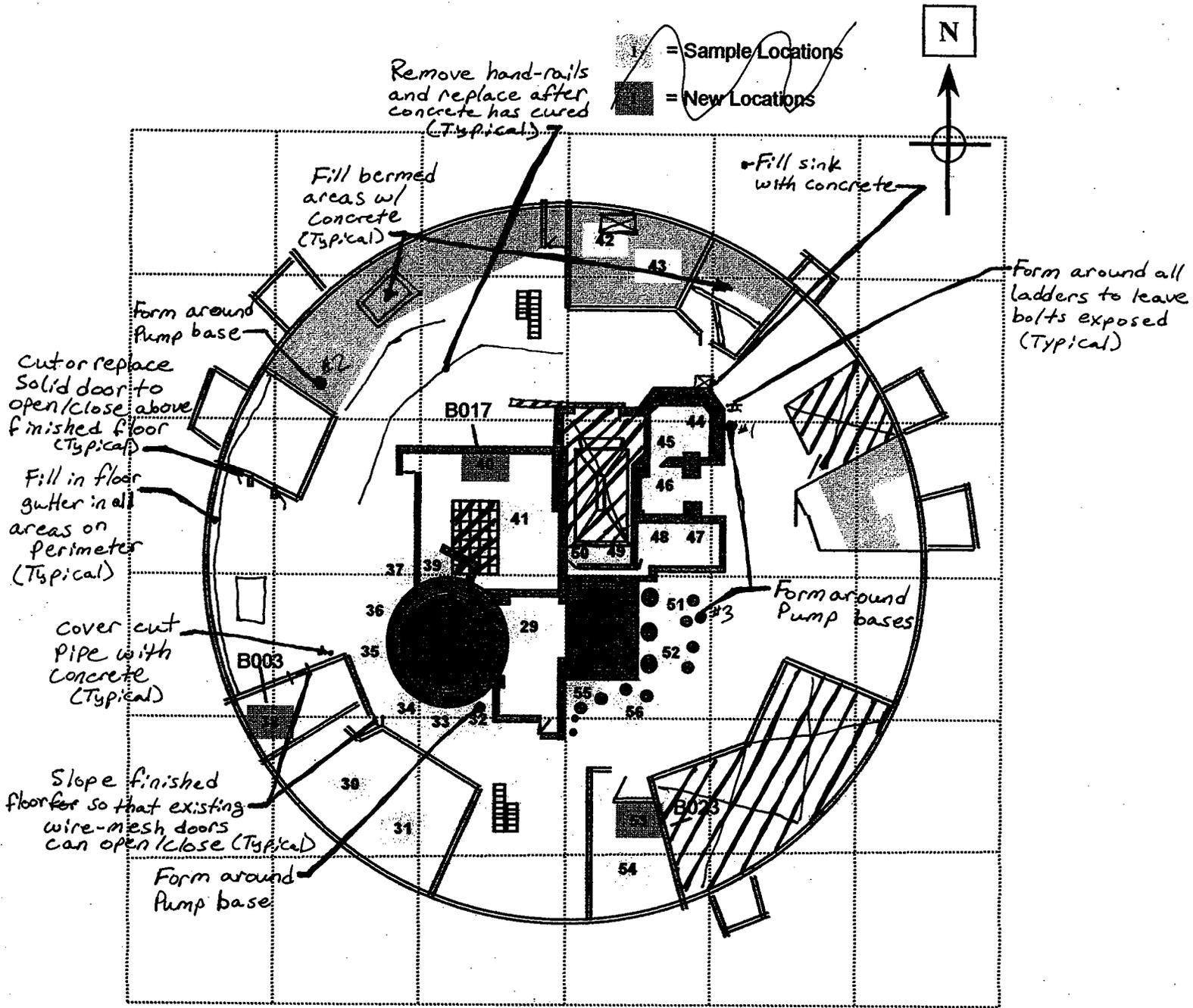


June 2004

-  <math>< 1,000 \text{ dpm}/100 \text{ cm}^2</math> Total Contamination
-  <math>1,000 - 5,000</math>
-  >math>5,000</math>
-  = SCM Survey Above 100 cm<sup>2</sup> limit

\* Areas/items above the floor exhibiting elevated levels of fixed contamination

**Figure 7 - BONUS Basement Floor Plan - Elevation 16' - 0"**



July 2004

[Solid Black Box] = SCM Survey Above 100 cm<sup>2</sup> limit

[Hatched Box] Areas where no concrete is required. All other general areas will be finished w/ concrete to ~ 3-in. above current grade

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: 002987 BONUS Date/Time 6/29/04 0735 Task Number 0402 01

Specific Area of Survey: Entombment System - North View

Purpose of Survey: Year 2004 Annual Survey

*Tber/TS*

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	14991	<sup>17</sup> 5/1 Dec 04	44-9	PR154535	17 Jun 05	14 %	10/2	44	82/1
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
1	North Side	See smear	9145	See	<MDA
2	"	Data	28	Smear	<MDA
3	"	}	57	Data	<MDA
4	"		53		<MDA
24	"		40		<MDA
26	North Side		35		<MDA

Survey Technician: M. Weakley  
Reviewed By: C. Webb

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

$$MDA = \frac{2.71}{10} + \frac{3.3 \sqrt{\frac{44}{10} + \frac{44}{1}}}{.14} \times 6.67$$

MDA ≈ 61 or below

~~LW CPM~~

$$A = \frac{CPM_s - CPM_{Bkg}}{E} \times CF$$

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: BONUS Time: 0735 Date: Yr 04 Mo 6 Dy 29

Task: Annual 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: Reactor Location: Entombment System

Sketch:

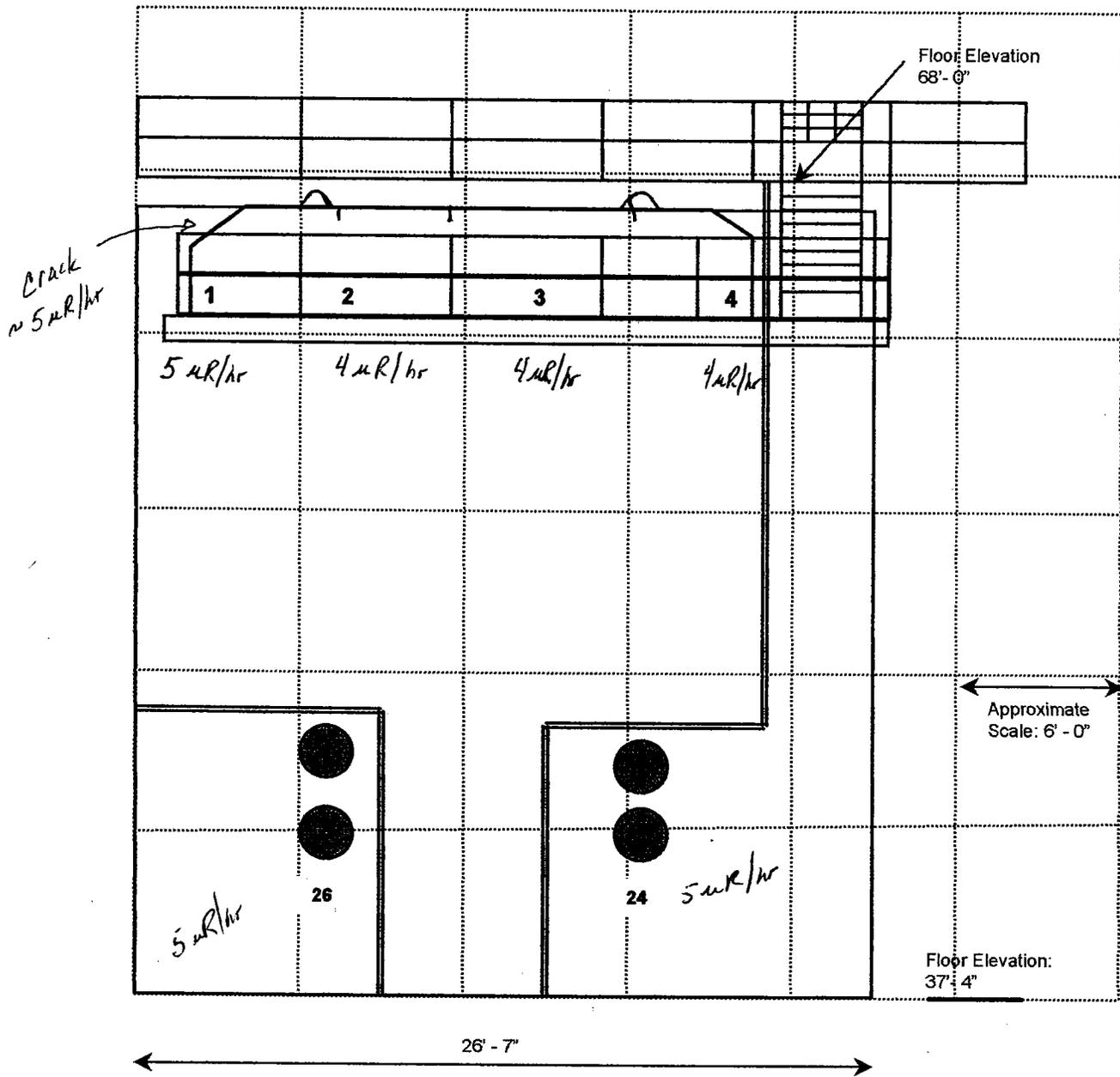
See attached.

Instruments (Model and Serial Numbers): Ludlum Model 19, No.: 148190

Survey Technician(s): M. Weakley Reviewer: C. Webb

Figure 2 - Entombment System - North View

1 = Sample Locations



BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: ~~002987~~ BONUS Date/Time 6/29/04 0750 Task Number ~~0402~~ 01

Specific Area of Survey: Entombment System at Elevation 68' - 0"

Purpose of Survey: Year 200<sup>4</sup> Annual Survey

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	14991	<del>11/5/03</del> <u>17 Jun 05</u>	44-9	PR154535	171 6 105	14 %	10/1	44	8211
		1 1			1 1	%			1

SURVEY DATA					
Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
5	Top Plug Face	See Smear	59	See Smear	<MDA
6	"	Data	54	Data	<MDA
7	"		44		<MDA
8	"		56		<MDA
9	"		69		1191
10	"		79		1668
11	"		71		1286
12	"		72		1334
13	"		62		<MDA
14	"		61		<MDA
15	"		59		<MDA
16	"		43		<MDA
17	Top Plug - Top Surface		63		905
18	"		53		<MDA
19	"		59		<MDA
19 Dup	"		58		<MDA

Survey Technician: M. Weakley  
Reviewed By: C. Webb

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: BONUS Time: 0750 Date: Yr 04 Mo 6 Dy 29

Task: Annual 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: Reactor Location: Entombment System

Sketch:

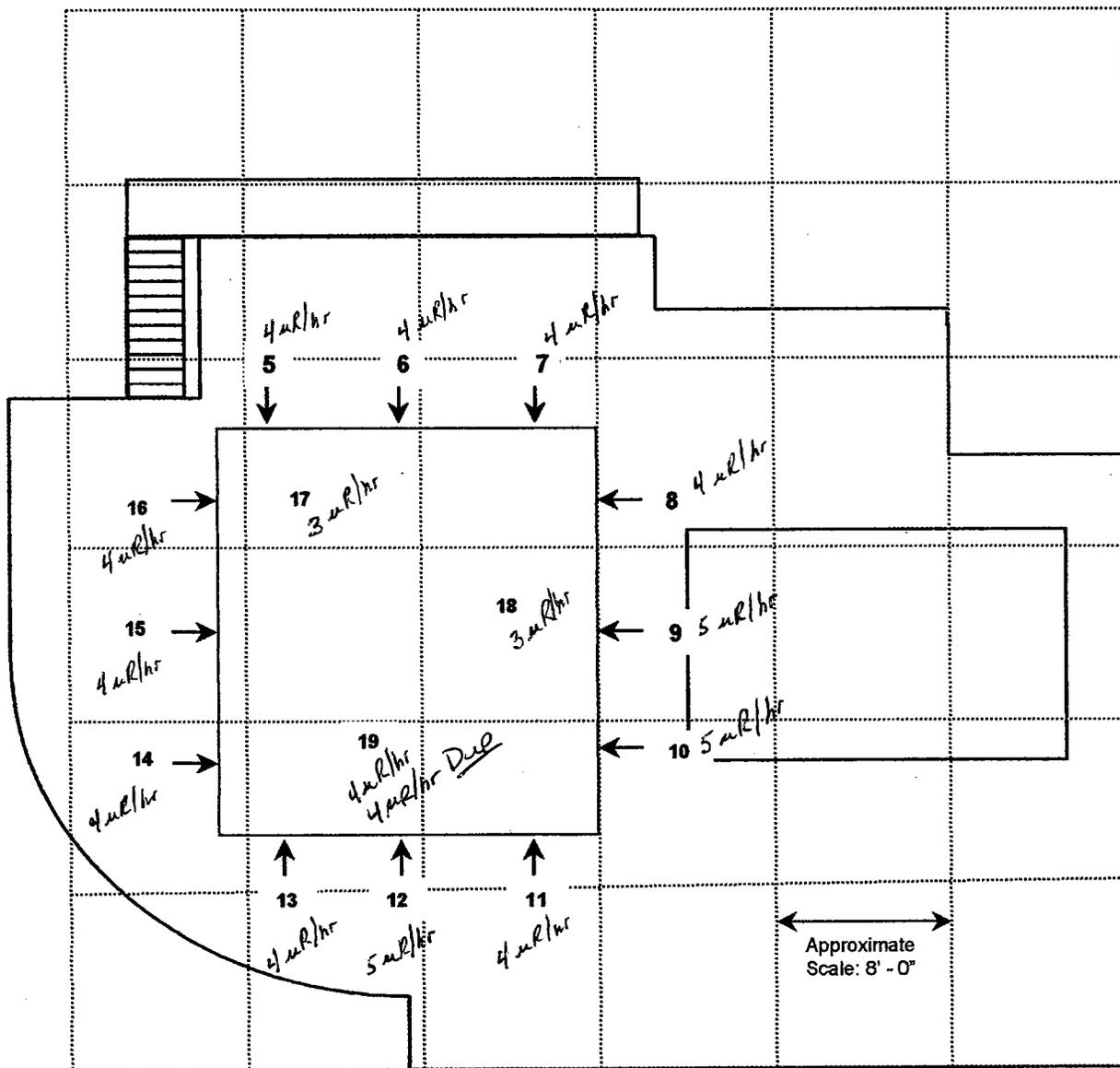
See attached.

Instruments (Model and Serial Numbers): Ludlum Model 19, No.: 148190

Survey Technician(s): M. Weasley Reviewer: C. Webb

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

1 = Sample Locations





BONUS REACTOR FACILITY  
Rincón, Puerto Rico

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: BONUS Time: 0900 Date: Yr 04 Mo 6 Dy 29

Task: Annual 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: Reactor Location: Entombment System

Sketch:

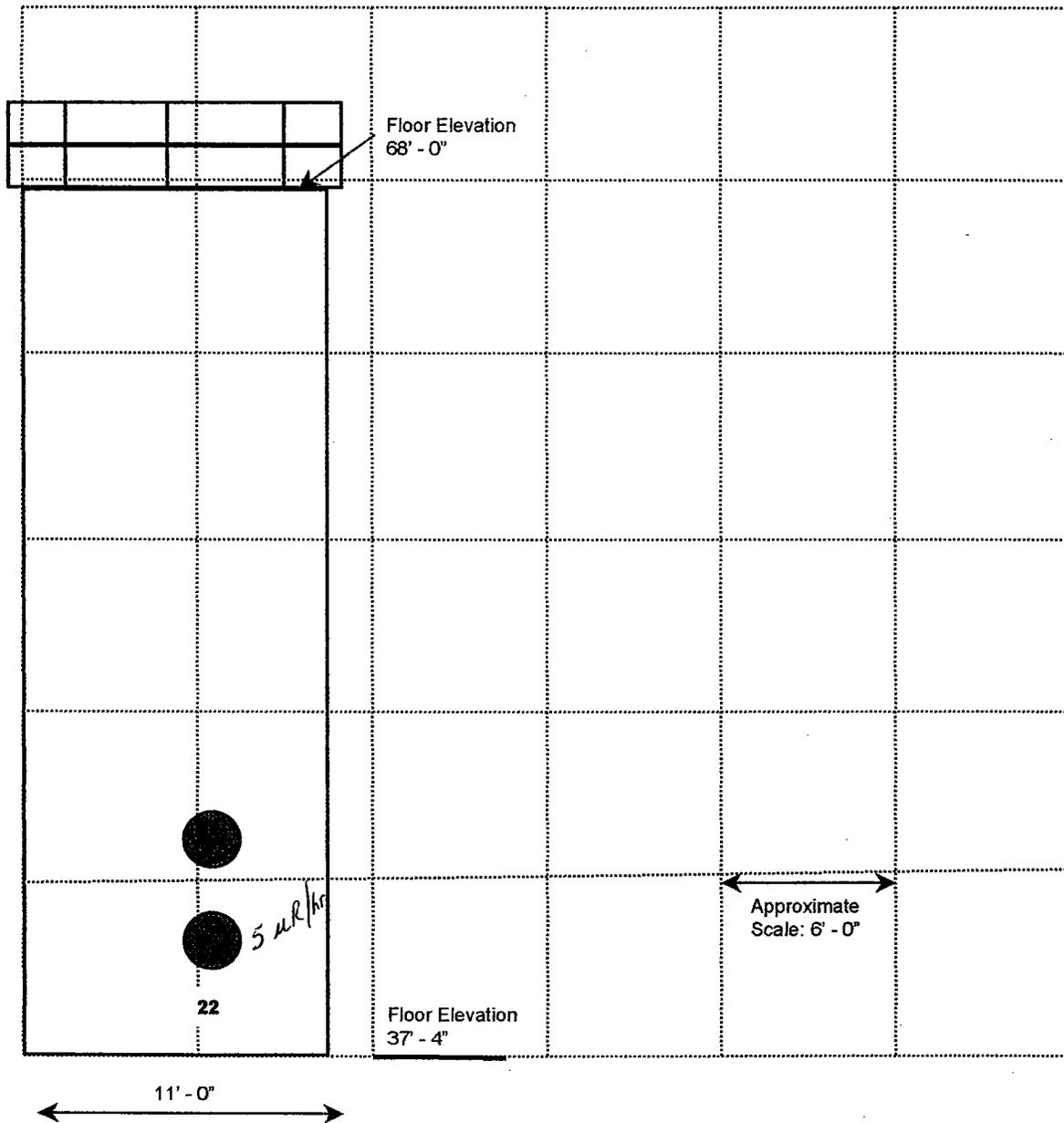
See attached.

Instruments (Model and Serial Numbers): Ludlum Model 19, No.: 148190

Survey Technician(s): M. Weahley Reviewer: C. Webb

**Figure 3 - Entombment System - South View**

1 = Sample Locations





BONUS REACTOR FACILITY  
Rincón, Puerto Rico

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: BONUS Time: 0910 Date: Yr 04 Mo 6 Dy 29

Task: Annual 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: Reactor Location: Entombment System

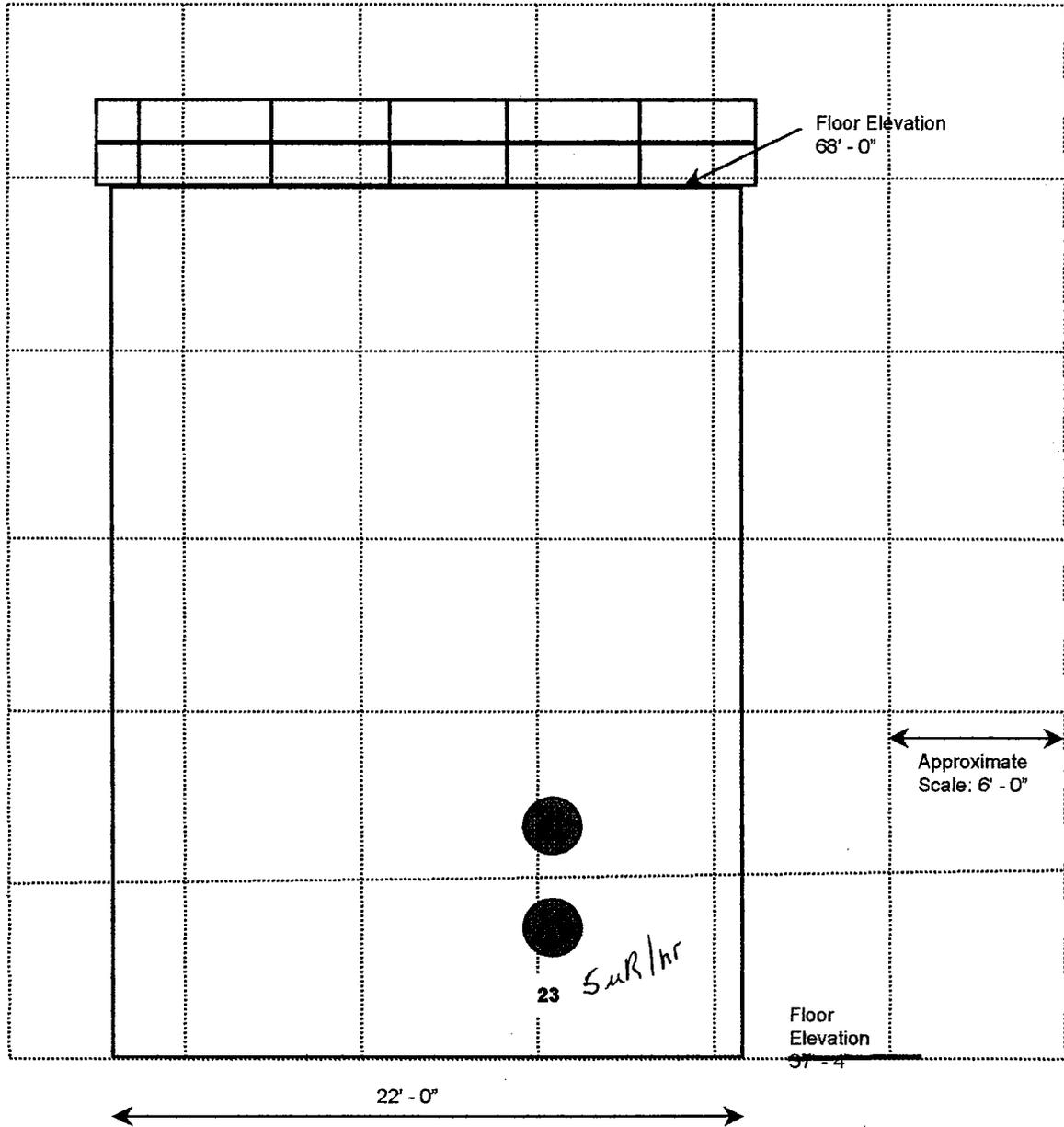
Sketch:  
  
See attached.

Instruments (Model and Serial Numbers): Ludlum Model 19, No.: 148190

Survey Technician(s): M. Weakley Reviewer: C. Webb

**Figure 4 - Entombment System - Southwest View**

1 = Sample Locations



BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: ~~802987~~ BONUS Date/Time 6/29/04 0920 Task Number 8402-01

Specific Area of Survey: Entombment System – Northwest View

Purpose of Survey: <sup>4</sup>Year 2001 Annual Survey

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	14991	<sup>17 Jan 5</sup> <del>5</del> / Dec / 04	44-9	PR154535	<sup>TBKR/TS</sup> 17 JAN 10S	14 %	10/2	47	848
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
25	North West Side	See Smear Date	43	See Smear Data	<MDA

Survey Technician: M. Weather  
Reviewed By: C. Webb

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: BONUS Time: 0920 Date: Yr 04 Mo 6 Dy 29

Task: Annual 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: Reactor Location: Entombment System

Sketch:

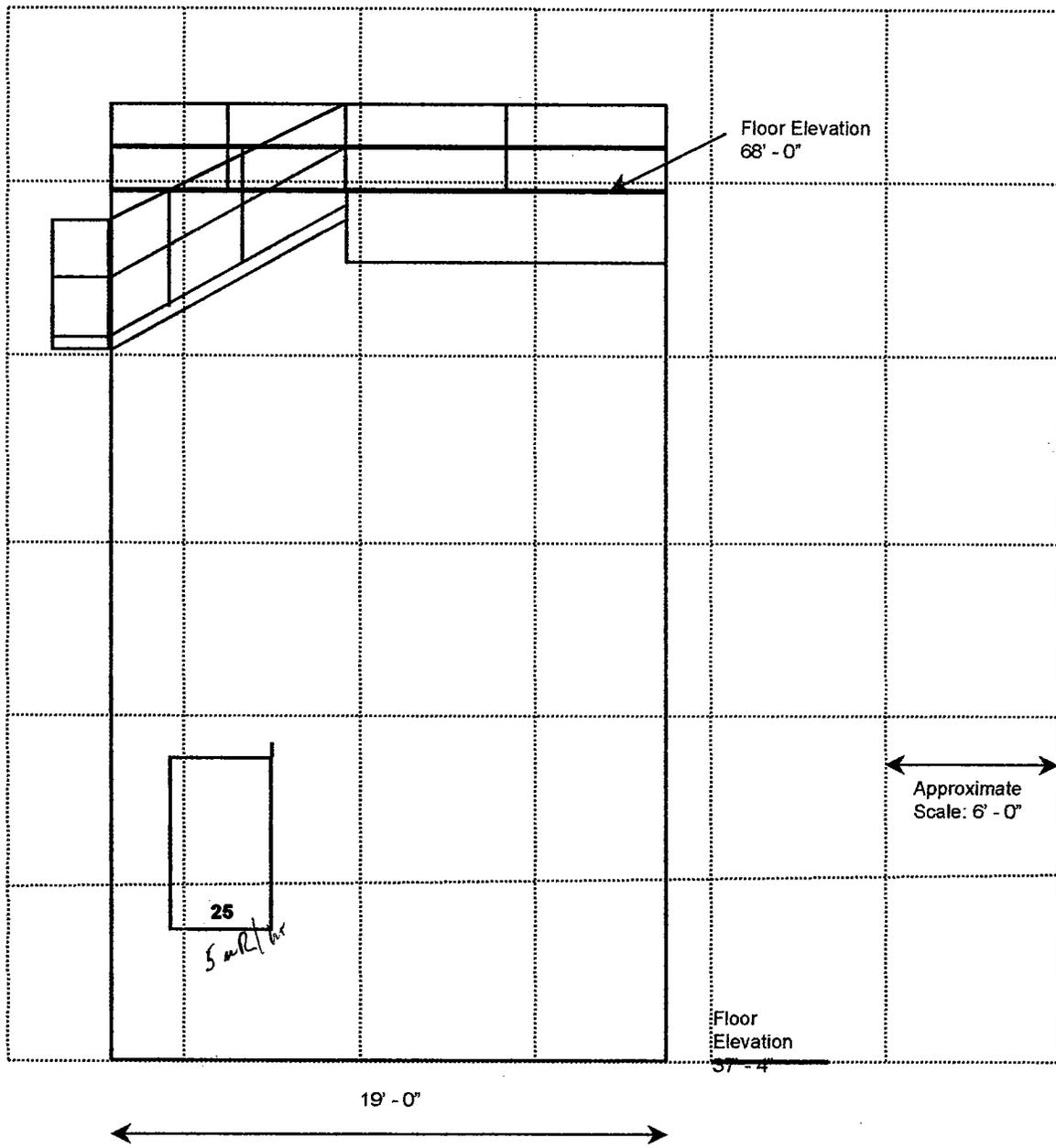
See attached.

Instruments (Model and Serial Numbers): Ludlum Model 19, No.: 148190

Survey Technician(s): Mr Weakley Reviewer: c. webb

**Figure 5 - Entombment System - Northwest View**

1 = Sample Locations



BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: ~~802987~~ BONUS Date/Time 6/29/04 0935 Task Number 0402-01

Specific Area of Survey: Main Floor

Purpose of Survey: Year 2004 Annual Survey

*Taks / Ts*

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	14991	<del>5/1 Dec/03</del> <i>17 Jun 05</i>	44-9	PR154535	<del>171 Jun 05</del> <i>171 Jun 05</i>	14 %	10 / 2	47	848
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
20	Main Floor	See Smear	71	See Smear	1,143
21	Main Floor	Data	87	Data	1,906
27	Main Floor	}	232	}	8,814
28	Main Floor		2257		105,291
27A	Main Floor		82		1,668
27B	Main Floor		70		1,096

Survey Technician: M. Wehley  
Reviewed By: C. Webb

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS Date/Time 6/29/04 1000hrs Task Number 01

Specific Area of Survey: Main Floor - Maslim

Purpose of Survey: 2004 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	149991	17 Jun 105	44-9	154535	17 Jun 105	14 %	10/2	HT6/1271145	
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
* 65-68	Main Floor - Maslim Zones 1-4	139 <del>201</del> 166	NA	Maslim	NA
* 69-74	Main Floor - Maslim Zones 5-8	76 <del>100</del> 118	}	Maslim	}
<del>75-80</del>	<del>Main Floor - Maslim Zones 9-13</del>		}	<del>Maslim</del>	}
* 75-76	Maslim Zones 9-10	190-200	}	"	}
* 77-80	Maslim Zones 11-14	170-190	}	"	}

Survey Technician: M. Weakley  
Reviewed By: C. Webb

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

\* 65-68 ≈ 800 ft<sup>2</sup>      Levels are above MDA,  
 69-74 ≈ 800 ft<sup>2</sup>      but below (well below)  
 75-76 ≈ 400 ft<sup>2</sup>      1,000 dpm/100cm<sup>2</sup> levels.  
 77-80 ≈ 800 ft<sup>2</sup>

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

RADIOLOGICAL SURVEY REPORT (MAP)

SITE: BONUS Time: 0935 Date: Yr 04 Mo 6 Dy 27

Task: Annual 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: Reactor Location: Main Floor

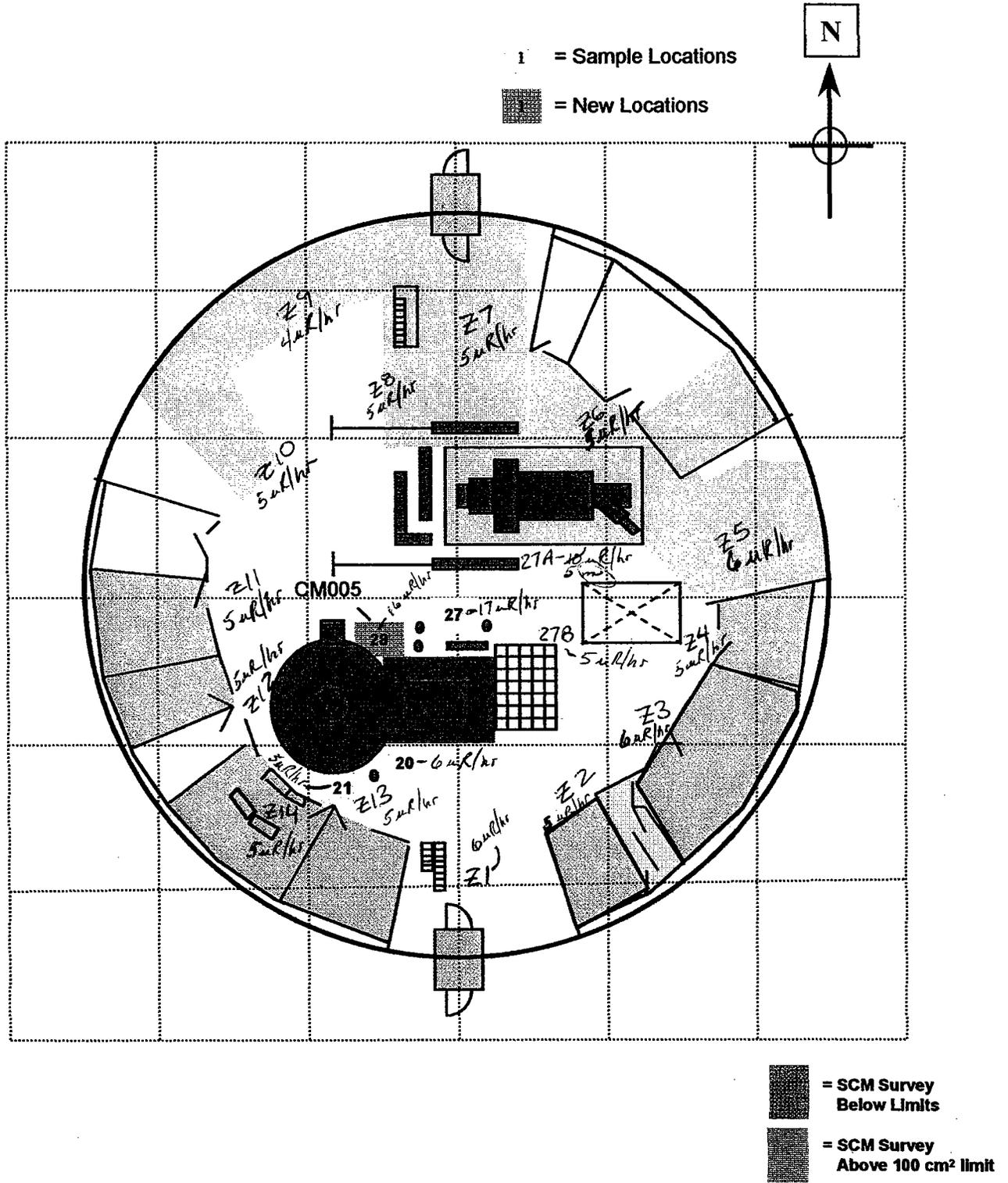
Sketch:

See attached.

Instruments (Model and Serial Numbers): Ludlum Model 19, No.: 148190

Survey Technician(s): M. Weasley Reviewer: C. Webb

**Figure 6 - BONUS Main Floor Plan**



BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: ~~802987~~ BONUS Date/Time 6/29/04  
1100 hrs Task Number 0402 01

Specific Area of Survey: Basement

Purpose of Survey: Year 2004 Annual Survey

TBkor/TS

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	14991	<del>17 Jun 05</del> 17 Dec 04	44-9	PR154535	17 Jun 05	14 %	10/5	71	7381
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
29	Floor	See smear	45	See smear	<MDA
32	Floor	Data	284	Data	10,148
30	Floor - Between Tk 1-2	}	61	}	<MDA
30A	Floor - Near Wall		225		7,337
31	Floor - Between Tk 2-3		65		<MDA
33	Floor		252		8,623
34	Floor		116		2,144
35	Floor		1,158		51,788
36	Floor		71		<MDA
37	Floor		81		<MDA
37dup	Duplicate		65		<MDA
39	Floor		137		3,144

Survey Technician: M. Weakley  
Reviewed By: C. Webb

MDA is ~~removable~~ total in dpm/100 cm<sup>2</sup>

MDA = 86 cpm or below

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS Date/Time 6/29/04 Task Number 01  
 Specific Area of Survey: Basement 1140hrs  
 Purpose of Survey: 2004 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludl. 2221	149991	171Jun105	44-9	154535	171Jun105	14 %	10/5	71	7381
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
40	Floor	See smear	71	See smear	<MDA
41	Floor	Data	58	Data	<MDA
42	}	}	48	}	<MDA
43			50		<MDA
44			42		<MDA
45			62		<MDA
46			58		<MDA
47			98		1286
48			84		619
49			88		816
50			60		<MDA
50 Dup			Duplicate		

Survey Technician: M. Wankley  
 Reviewed By: C. Webb

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

Project: Bonus Date/Time 6/29/04 0840 Task Number 01

Specific Area of Survey: Basement

Purpose of Survey: 2004 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	14999	17 Jun 05	44-9	154535	17 Jun 05	14 %	1015	71	7381
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
50A	Wall (Block)	See smear	894	See smear	39,210
50B	Wall (concrete)	Data	701	Data	30,015
51	Floor	}	57	}	< MDA
52	Floor		47		< MDA
53	Floor		548		22,726
54	Floor		98		1,286
55	Floor		49		< MDA
56	Floor		48		< MDA
82	Floor		NA		NA
84	Decor Room - Sink Pipe				267
84D	Duplicate		274		9,671
86	Sump Pump 1		693		29,634

Survey Technician: M. Cartagea  
Reviewed By: C. Webb

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

91 Shield Pump No. 2  
On Floor at pipe } 112 } 1,953

\* Pump motor stand  
had readings 2,000 - 20,000 dpm/100 cm<sup>2</sup>  
from floor/plate to ~12 in above floor

**BONUS REACTOR FACILITY**  
Rincón, Puerto Rico

**RADIOLOGICAL SURVEY REPORT (MAP)**

**SITE:** \_\_\_\_\_ **Time:** \_\_\_\_\_ **Date:** Yr \_\_\_\_ Mo \_\_\_\_ Dy \_\_\_\_\_

**Task:** \_\_\_\_\_ **RWP:** \_\_\_\_\_

**Map key:** ○ = Sample Location □ = Air Sampler Location △ = Core Sample

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

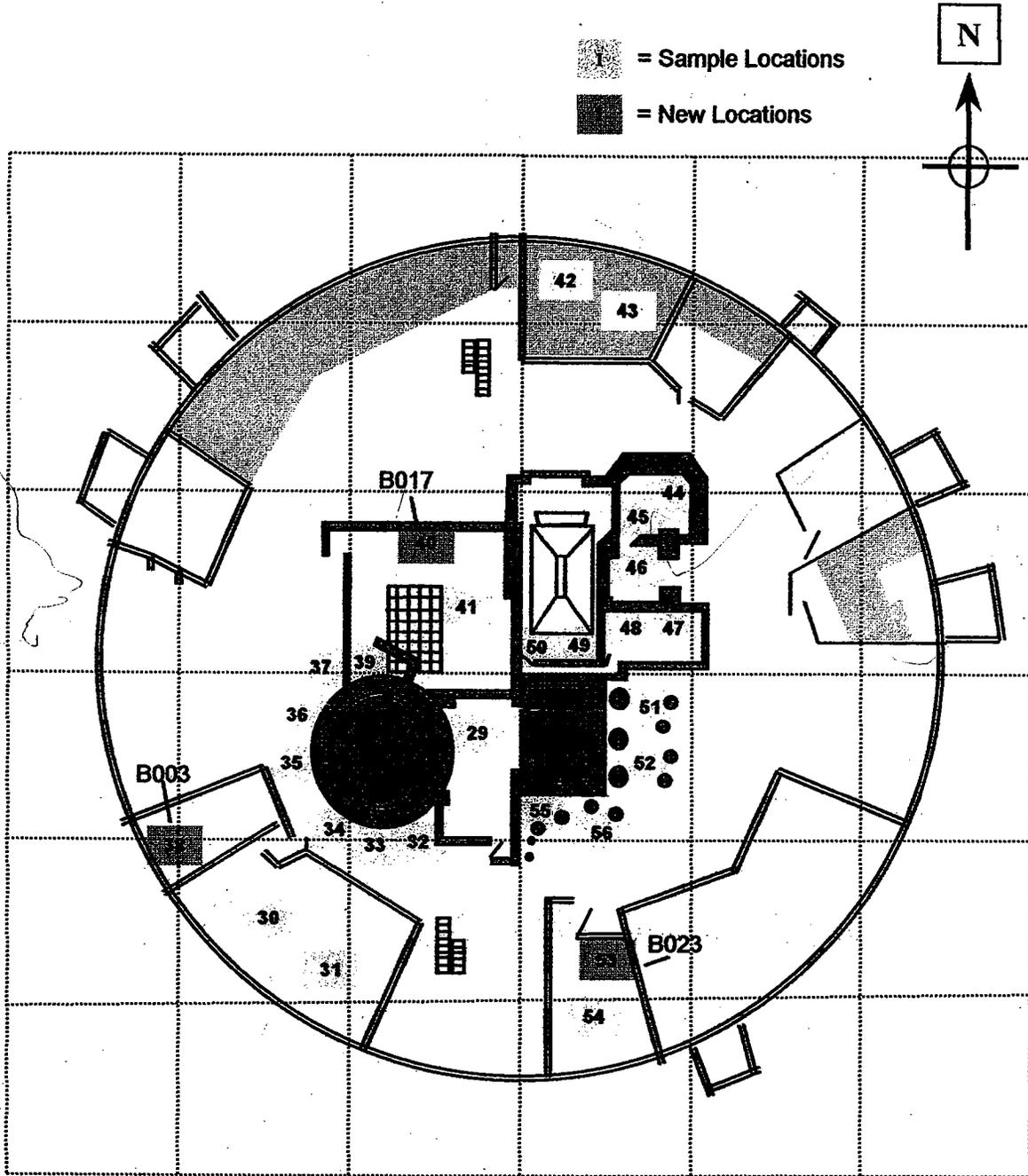
**Building:** \_\_\_\_\_ **Location:** \_\_\_\_\_

**Sketch:**

**Instruments (Model and Serial Numbers):** \_\_\_\_\_

**Survey Technician(s):** \_\_\_\_\_ **Reviewer:** \_\_\_\_\_

Figure 7 - BONUS Basement Floor Plan - Elevation 16' - 0"



Survey Pt.	uR/hr
30	7.18
31	7.16
32	11.9
33	11.9
34	11.11
35	11.11
36	6
37	5
38	NA 8
39	15
40	9

Survey Pt.	uR/hr
41	8
42	5
43	6
44	9
45	8
46	13
47	15
48	9
49	8
50	8

Survey Pt.	uR/hr
51	6
52	6
53	10
54	9
55	7
56	7
84	6
30A	15
43	

 = SCM Survey Above 100 cm<sup>2</sup> limit



**BONUS REACTOR FACILITY**  
Rincón, Puerto Rico

**CONTAMINATION SURVEY FORM**

Project: BONUS Date/Time 6/30/04 12:10 Task Number 01

Specific Area of Survey: Smears

Purpose of Survey: 2004 Annual Survey

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	149991	171 Jun 05	44-9	154535	171 Jun 05	14 %	10/1	35	1481
		1 1			1 1	%			1

**SURVEY DATA**

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
50 D	Smear	22	NA	< MDA	NA
46	"	44	}	< MDA	}
45	"	26		< MDA	
44	"	24		< MDA	
42	"	38		< MDA	
43	"	18		< MDA	
54	"	30		< MDA	
86	"	34			
91	"	29			
29	"	26			
50A	"	34			
84D	Duplicate Smear	34			

Survey Technician: M. Wesley  
Reviewed By: C. Webb

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

Project: Bonus Date/Time 6/30/04 0952 Task Number 01

Specific Area of Survey: Smears - Before Paint

Purpose of Survey: 2004 Annual Survey

Tsbr/Ts

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Leadline 2221	149991	171 Jun 105	414-9	154535	171 Jun 105	14%	10/1	35	1481
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No See other form

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
NT- <del>E</del> W	Neutralization Tank West Side	33	NA	<MDA	NA
NT-E	Neutr. Tank East Side	40	}	<MDA	}
NT-S	Neutr. Tank South Side	32		<MDA	
NT-N	Neutr. Tank North Side	32		<MDA	
NT-TopW	W = Neutr. Tank Top West End	42		<MDA	
NT-TopE	Neutr. Tank Top East End	48		<MDA	
NT-B	Neutr. Tank Bottom	48		<MDA	
NT-B	Duplicate Count	27		<MDA	
RTI-N	Ret. Tank #1 - North Side	40		<MDA	
RTI-E	Ret. Tank #1 - East Side	38		<MDA	
RTI-S	Ret. Tank #1 - South Side	42		<MDA	
RTI-W	Ret. Tank #1 - West Side	36	<MDA		

Survey Technician: M. Weakley  
Reviewed By: C. Webb

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

$$MDA = \frac{2.71}{10} + 3.3 \sqrt{\frac{35}{10} + \frac{35}{1}} = 148, \text{ which is less than } 200 \text{ dpm/100 cm}^2$$

.14

$MDA_{cpm} \approx 55$  or below is less than MDA

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/30/04 1010 Task Number 01

Specific Area of Survey: Smears - Before Paint

Purpose of Survey: 2004 Annual Survey

Tbksr / Ts

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	149991	171 Jun 05	44-9	154535	171 Jun 05	14 %	10/1	35	1481
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>See Other Form</u>			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
RT1-B	Ret. Tank #1 - Bottom	150	NA	821	NA
RT2-B	Ret. Tank #2 - Bottom	294	}	1,850	}
RT2-B	Duplicate Count	313		<del>336,986</del>	
RT3-B	Ret. Tank #3 - Bottom	82		336	
RT2-E	Ret. Tank #2 - East Side	36		<MDA	
RT2-S	Ret. Tank #2 - South Side	32		<MDA	
RT2-W	Ret. Tank #2 - West Side	39		<MDA	
RT2-N	Ret. Tank #2 - North Side	40		<MDA	
RT3-W	Ret. Tank #3 - West Side	71		257	
RT3-S	Ret. Tank #3 - South side	53		<MDA	
RT3-E	Ret. Tank #3 - East Side	57		157	
RT3-N	Ret. Tank #3 - North Side	54	<MDA		

Survey Technician: M. Weakley  
Reviewed By: C. Webb

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/30/04 ~~10/10/03~~ Task Number 01

Specific Area of Survey: smears - Before Paint

Purpose of Survey: 2004 Annual Survey

*T<sub>1/2</sub> / T<sub>s</sub>*

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	149991	171 Jun 05	44-9	154535	171 Jun 05	14 %	10 / 1	35	1481
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <i>See Other Form</i>			
No.	Description/Location <i>(side)</i>	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
RT1-F	Ret. Tank #1 - Floor Under Pipe	38	NA	<MDA	NA
RT1-BA	Ret. Tank #1 Bottom 6" from Pipe	37		<MDA	
RT1-P	Ret. Tank #1 Pipe (side)	44		<MDA	
PT1-PC	Ret. Tank #1 Center Pipe	37		<MDA	
RT1-BB	Ret. Tank #1 Bottom 6" from Center Pipe	468		3,093	
RT1-FC	Ret. Tank #1 Floor Under Center Pipe	36		<MDA	
34	smear	28		<MDA	
37D	Duplicate Smear	35		<MDA	
39	smear	30		<MDA	
28	smear	30		<MDA	
27B	smear	35		<MDA	
27A	smear	41			

Survey Technician: M. Weahley  
Reviewed By: C. Webb

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS Date/Time 7/11/04 0720 hrs Task Number 01

Specific Area of Survey: Smears - Post Painting

Purpose of Survey: 2004 Annual Survey

*T60C/T5*

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Luclon 2221	149991	17 Jun 105	44-9	154535	17 Jun 105	14%	10/1	35	1401
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
40B	F.W. Heater Room Wall near Floor	28	NA	<MDA	NA
40A	F.W. Heater Room Wall	30	}	<MDA	}
RT3-T	Ret. Tank Top (#3)	20		<MDA	
RT2-T	Ret. Tank #2 - Top	42		<MDA	
RT2-B	Ret. Tank #2 - Bottom	91		400	
RT1-B	Ret. Tank #1 - Bottom	33		<MDA	
RT1-T	Ret. Tank #1 - Top	24		<MDA	
RT3-B	Ret. Tank #3 - Bottom	34		<MDA	
RT3-W	Ret. Tank #3 - West side	36		<MDA	
* RT2-B	Ret. Tank #2 - Bottom	15		<MDA	

Survey Technician: M. Weahley  
Reviewed By: C. Webb

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

\* Taken after second coat of yellow paint

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS Date/Time 6/30/04 1155 Task Number 01

Specific Area of Survey: Smears

Purpose of Survey: 2004 Annual Survey

T6#175

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	149991	171 Jun 05	44-9	154535	171 Jun 05	14 %	10 / 1	35	1981
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <u>See other Form</u>			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
27	Smear	35	NA	2MDA	NA
26	Smear	33	}	2MDA	}
25	Smear	30		<MDA	
24	Smear	22		<MDA	
23	Smear	39		<MDA	
22	Smear	36		<MDA	
22D	Duplicate Smear	39		<MDA	
21	Smear	44		<MDA	
20	Smear	45		<MDA	
19D	Duplicate Smear	30		<MDA	
19	Smear	36		<MDA	
18	Smear	24	<MDA		

Survey Technician: M. Weahley  
Reviewed By: C. Webb

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: Bonus Date/Time 6/30/04  
1215 Task Number 01

Specific Area of Survey: Smear

Purpose of Survey: 2004 Annual Survey

TBker/TS

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 222	149991	171 Jun 05	44-9	154535	171 Jun 05	14 %	10/1	35	1481
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No See Other Form

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
17	Smear	22	NA	<MDA	NA
16	Smear	33	}	<MDA	}
15	Smear	32		<MDA	
14	Smear	27		<MDA	
13	Smear	30		<MDA	
12	Smear	31		<MDA	
30	Smear	28		<MDA	
11	Smear	28		<MDA	
10	Smear	26		<MDA	
9	Smear	39		<MDA	
8	Smear	34		<MDA	
7	Smear	31	<MDA		

Survey Technician: M. Weasley  
Reviewed By: C. Webb

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS Date/Time 6/30/04 1235 Task Number 01

Specific Area of Survey: Smears

Purpose of Survey: 2004 Annual Survey

*Terry HS*

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Endlin 2221	149991	07 Jun 05	44-9	154535	17 Jun 05	14 %	10/1	35	1481
		1 1			1 1	%			1

SURVEY DATA						Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No	
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	By Removable	By Total		
6	Smear	41	NA	<MDA	NA		
5	Smear	28	}	<MDA	}		
4	Smear	33		<MDA			
3	Smear	36		<MDA			
2	Smear	32		<MDA			
1	Smear	44		<MDA			
41	Smear	31		<MDA			
40	Smear	31		<MDA			
53	Smear	32		<MDA			
30A	Smear	38		<MDA			
31	Smear	28		<MDA			
37	Smear	40	<MDA				

Survey Technician: M. Weahley  
Reviewed By: C. Webb

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: BONUS Date/Time 6/30/04 1248 Task Number 01

Specific Area of Survey: Smears

Purpose of Survey: 2004 Annual Survey

*Ther/Ts*

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	149991	171 Jun 05	44-9	154535	171 Jun 05	14 %	10/1	35	1481
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
36	smear	31	NA	<MDA	NA
35	"	24	}	<MDA	}
33	"	36		<MDA	
32	"	42		<MDA	
55	"	41		<MDA	
56	"	27		<MDA	
52	"	30		<MDA	
51	"	28		<MDA	
47	"	26		<MDA	
48	"	37		<MDA	
49	"	35		<MDA	
50	"	30	<MDA		

Survey Technician: M. Weahley  
Reviewed By: C. Webb

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







**BONUS REACTOR FACILITY**  
Rincón, Puerto Rico

**RADIOLOGICAL SURVEY REPORT (MAP)**

**SITE:** BONUS **Time:** \_\_\_\_\_ **Date:** Yr \_\_\_\_ Mo \_\_\_\_ Dy \_\_\_\_\_

**Task:** Annual Survey **RWP:** \_\_\_\_\_

**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:** Reactor **Location:** Basement

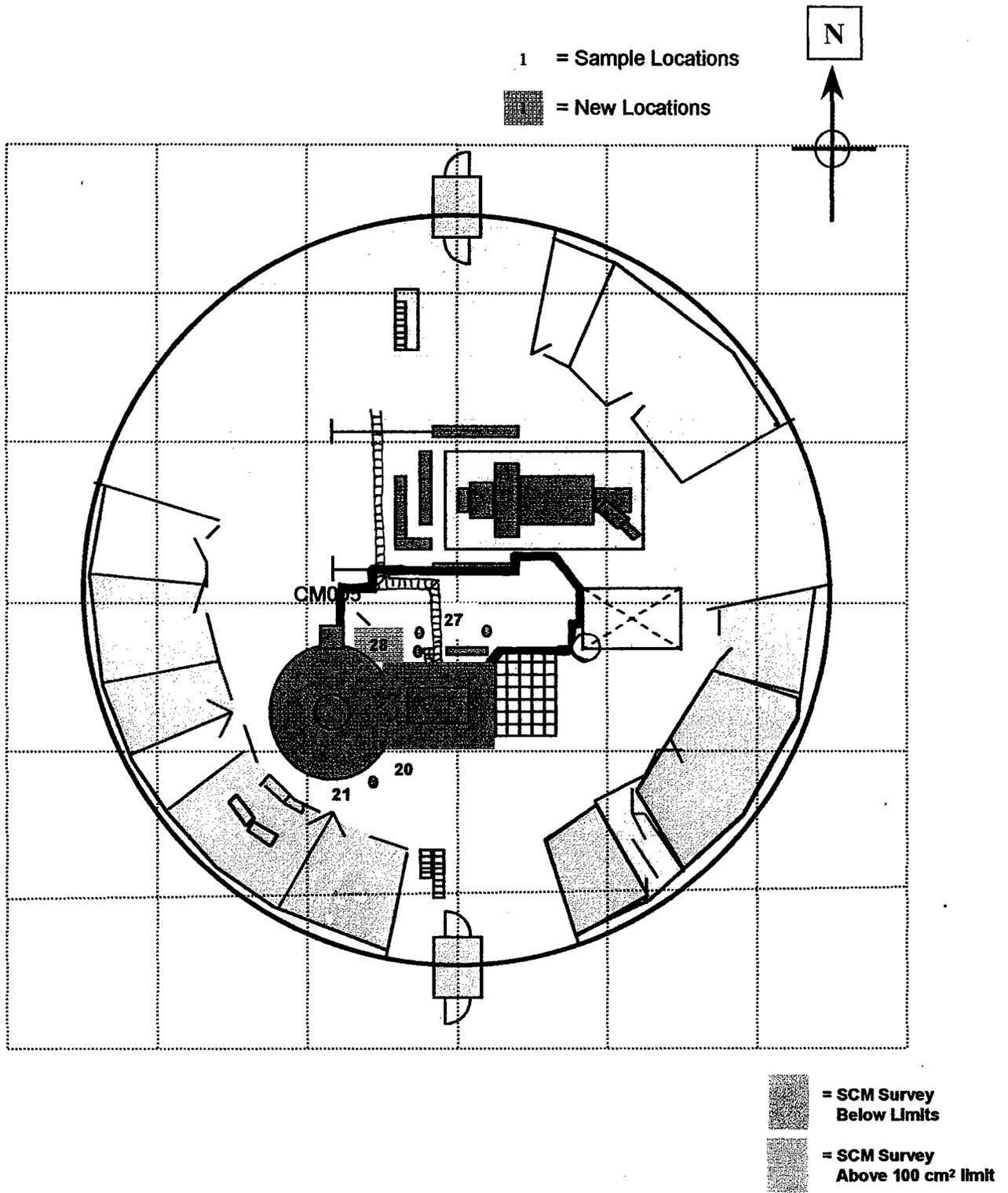
**Sketch:**  
  
See attached.

**Instruments (Model and Serial Numbers):** Ludlum Model 19, No.: 148190

**Survey Technician(s):** \_\_\_\_\_ **Reviewer:** \_\_\_\_\_



**Figure 6 - BONUS Main Floor Plan**



**Attachment 2**  
**Verification Survey Forms and Sketches**

Project: PREPA BONUS Date/Time 1/12/06 1510 Task Number 05050

Specific Area of Survey: Basement

Purpose of Survey: Verification Survey

$T_B / T_S$

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	14991	1/6/06	44-9	PR154535	1/6/06	15.6%	10   2	31	573   1
		1   1			1   1	%			1

SURVEY DATA		Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	By Removable	By Total		
R1	Random Location - Floor	See	31	See	<MDA		
R2	Random Location - Floor	Smear	30	Smear	<MDA		
R3	Random Location - Floor	Date	37	Date	<MDA		
R4	"	}	32	}	<MDA		
R5	"		36		<MDA		
R6	"		47		684		
R7	"		28		<MDA		
R8	"		26		<MDA		
R9	"		31		<MDA		
R10	"		30		<MDA		
R10Dup	R10-Duplicate				22		<MDA

Survey Technician: C. Webb  
Reviewed By: R. Williams

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

~~834~~

$$MDA = \frac{2.71}{T_B} + 3.0 \sqrt{\frac{B_{ck}}{T_B} + \frac{B_{ksr}}{T_S}} \times CF$$

$$573 = \frac{CPM - 31}{.156} \times 6.67$$

$$MDA \approx \underline{\underline{44 \text{ cpm}}}$$

$$A = \frac{CPM_S - CPM_{Bk}}{E} \times CF$$

$$CF = 6.67$$

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA Bonus Date/Time 11/2/05 1600hr Task Number 05050  
11/3/05 0800hr

Specific Area of Survey: Basement

Purpose of Survey: Verification Survey

T<sub>Bks</sub> T<sub>s</sub>

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	14991	116/06.	44-9	PR154535	116 106	15.6 %	10   2	31	5731
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
R11	Random Location - Floor	see	33	see	<MDA
R12	"	Smear	28	Smear	<MDA
R13	"	Data	31	Data	<MDA
R14	"	}	39	}	<MDA
R15	"		32		<MDA
R16	"		36		<MDA
R17	"		35		<MDA
R18	"		26		<MDA
R19	"		37		<MDA
R20	"		29		<MDA
R20 Dup	R20-Duplicate				33

Survey Technician: C. Webb  
 Reviewed By: R. Williamson

MDA is ~~removable~~ total in dpm/100 cm<sup>2</sup>

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA BONUS Date/Time 1/13/05 0830hr Task Number 05050

Specific Area of Survey: Basement

Purpose of Survey: Verification Survey

T<sub>B</sub> / T<sub>S</sub>

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	14991	1/06/06	44-9	PR154535	1/06/06	15.6%	10   2	31	5731
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	By Removable	By Total		
R21	Random Location - Floor	See	24	See	<MDA		
R22	"	Smear	37	Smear	<MDA		
R23	"	Date	29	Date	<MDA		
R24	"	}	23	}	<MDA		
R25	"		33		<MDA		
R26	"		33		<MDA		
R27	"		36		<MDA		
R28	"		32		<MDA		
R29	"		33		<MDA		
R29 Dup	R29 - Duplicate				35		<MDA
R6 Dup	R6 - Duplicate (Fixed)				28		<MDA
R6A	Adjacent to R6 - Floor	No smear	39	No smear	<MDA		

Survey Technician: C. Webb  
Reviewed By: R. Williamsen

MDA is ~~removable~~ total in dpm/100 cm<sup>2</sup>

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA BONUS Date/Time 1/13/05/0830 Task Number 05050

Specific Area of Survey: Basement

Purpose of Survey: Verification Survey

T<sub>B</sub> / T<sub>s</sub>

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	14991	1/06/06	44-9	PR154535	1/06/06	15.6 %	10/2	31	5731
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No					
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	By Removable	By Total		
29	Floor	See	32	See	<MDA		
30	Floor	Smear	37	Smear	<MDA		
31	Floor	Data	43	Data	<MDA		
32	"	}	32	}	<MDA		
33	"		29		<MDA		
34	"		28		<MDA		
35	"		22		<MDA		
36	"		26		<MDA		
37	"		29		<MDA		
38	"		37		<MDA		
38 Dup	38 Duplicate				34		<MDA
40B	Adjacent to 40-Wall				114		3,549

Survey Technician: C. Webb  
Reviewed By: R. Williamson

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA Bonus Date/Time 1/13/05/0955 Task Number 05050

Specific Area of Survey: Basement

Purpose of Survey: Verification Survey

T<sub>B</sub>/T<sub>F</sub>

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	14991	1/16/06	44-9	PR154535	1/16/06	15.6 %	10   2	31	5731
		1 1			1 1	%			1

SURVEY DATA						Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>			
		By Removable	By Total	By Removable	By Total		
39	Floor	see	44	see	<MDA		
40	"	Smear	33	Smear	<MDA		
41	"	Data	34	Data	<MDA		
42	"	}	33	}	<MDA		
43	"		28		<MDA		
44	"		25		<MDA		
45	"		32		<MDA		
46	"		<sup>EW</sup> 24 41 1/13/05		<MDA		
47	"		32		<MDA		
48	"		28		<MDA		
48 Dup	48-Duplicate				29		<MDA
40A	Adjacent to 40 - Floor		+2864		4,147 <sup>EW</sup> 1/13/05		
Survey Technician: <u>C. Webb</u>						1,411	
Reviewed By: <u>R. Williams</u>							

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA BONUS Date/Time 1/13/08 1100hrs Task Number 65050

Specific Area of Survey: Basement

Purpose of Survey: Verification Survey

T<sub>B</sub>/T<sub>S</sub>

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	14991	1/6/06	44-9	PR154535	1/6/06	15.6 %	10/2	31	5731
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
49	Floor	See	37	See	<MDA
50	"	Smear	29	Smear	<MDA
51	"	Data	28	Data	<MDA
52	"	}	27	}	<MDA
53	"		30		<MDA
54	"		33		<MDA
55	"		21		<MDA
56	"		33		<MDA
56 Dup	56-Duplicate		29		<MDA
85	Sink		33		<MDA
84	Decon Room - Pipe Flange		213		7,782
86	Sump Pump #1 - Floor	26	<MDA		

Survey Technician: C. Webb  
Reviewed By: R. Williamson

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

50A Walk-Block } 34 } <MDA  
50B Wall-Concrete } 28 } <MDA



BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA BONUS Date/Time 1/13/05 1430 Task Number 65050

Specific Area of Survey: Basement - Smears

Purpose of Survey: Verification Survey

T<sub>B</sub> / T<sub>S</sub>

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA
Ludlum 2221	14991	1/16/06	44-9	PR154535	1/16/06	15.6 %	10/1	27	1171
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
R1	Smear Sample	31	NA	<MDA	NA
R2	"	26	}	<MDA	}
R3	"	27		<MDA	
R4	"	33		<MDA	
R5	"	24		<MDA	
R6	"	34		<MDA	
R7	"	34		<MDA	
R8	"	29		<MDA	
R9	"	30		<MDA	
R10	"	35		<MDA	
R10dup	R10-Duplicate	34		<MDA	
R11	Smear Sample	33		<MDA	

Survey Technician: C. Webb  
Reviewed By: R. Williams

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

MDA ≈ 45 cpm

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA BONUS Date/Time 1/13/05 1445 Task Number 05050

Specific Area of Survey: Smears

Purpose of Survey: Verification Survey

TB/TS

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	14991	1/6/06	44-9	PR154535	1/6/06	15.6%	10/1	27	1171
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
R12	Smear	37	NA	<MDA	NA
R13	"	37	}	<MDA	}
R14	"	27		<MDA	
R15	"	33		<MDA	
R16	"	29		<MDA	
R17	"	37		<MDA	
R18	"	30		<MDA	
R19	"	31		<MDA	
R20	"	41		<MDA	
R20Dup	R20-Duplicate	39		<MDA	
R21	Smear	30		<MDA	
R22	"	23		<MDA	

Survey Technician: C. Webb  
Reviewed By: R. Williamsen

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA BONUS Date/Time 1/13/05 1500 Task Number 05050

Specific Area of Survey: Smears

Purpose of Survey: Verification Survey

TB/TS

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	14991	1/6/06	44-9	PR154535	1/6/06	15.6 %	10/1	27	1171
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
R23	Smear Sample	35	NA	< MDA	NA
R24	"	28	}	< MDA	}
R25	"	32		< MDA	
R26	"	29		< MDA	
R27	"	33		< MDA	
R28	"	28		< MDA	
R29	"	31		< MDA	
R29Dup	Smear R29-Duplicate	36		< MDA	
29	smear Sample	21		< MDA	
30	"	31		< MDA	
31	"	26		< MDA	
32	"	33		< MDA	

Survey Technician: C. Webb  
Reviewed By: R. Williams

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: DREPA Bonus Date/Time 1/13/05 1505 Task Number 05050

Specific Area of Survey: Smears

Purpose of Survey: Verification Survey

TB/TS

Inst. type	Serial #	Cal. due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Ludlum 2221	14991	1/6/06	44-9	PR154535	1/6/06	15.6 %	10/1	27	1171
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
33	Smear Sample	22	NA	< MDA	NA
34	"	37	}	< MDA	}
35	"	34		< MDA	
36	"	19		< MDA	
37	"	31		< MDA	
38	"	33		< MDA	
38 Dup	38 Duplicate Smear Ct.	29		< MDA	
39		27		< MDA	
40		26		< MDA	
40A		44		< MDA	
40B		35		< MDA	
41		44	< MDA		

Survey Technician: C. Webb  
Reviewed By: R. Villanueva

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA BONUS Date/Time 11/3/05 1515 Task Number 05050

Specific Area of Survey: Smears

Purpose of Survey: Verification Survey

TB/TS

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
4d 2221	149991	116 106	44-9	154535	116 106	15.6 %	10/1	27	1171
		1 1			1 1	%			1

SURVEY DATA

Survey Map Attached  Yes  No

No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
42	Smear Sample	37	NA	<MDA	NA
43	"	21	}	<MDA	}
44	"	41		<MDA	
45	"	32		<MDA	
46	"	28		<MDA	
47	"	28		<MDA	
48	"	29		<MDA	
48 Dup	48 Duplicate Count	33		<MDA	
49	Smear Sample	40		<MDA	
50	"	27		<MDA	
50A	"	30		<MDA	
50B	"	30	<MDA		

Survey Technician: C. Webb  
Reviewed By: R. Williamson

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

BONUS REACTOR FACILITY  
Rincón, Puerto Rico

CONTAMINATION SURVEY FORM

Project: PREPA BONUS Date/Time 1/13/05 1330 Task Number 05050

Specific Area of Survey: Smears

Purpose of Survey: Verification Survey

TB/TS

Inst. type	Serial #	Cal. Due date	Probe type	Serial #	Cal. due date	Efficiency	Ct. time	Bkgd	MDA*
Lud 2221	149991	116 106	44-9	154535	116 106	15.6 %	10/1	27	1171
		1 1			1 1	%			1

SURVEY DATA		Survey Map Attached <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			
No.	Description/Location	Gross Counts in CPM		Contamination in dpm/100 cm <sup>2</sup>	
		By Removable	By Total	By Removable	By Total
51	Smear Sample	25	NA	*	NA
52	"	22	}	*	}
53	"	35		*	
54	"	28		*	
55	"	33		*	
56	"	142		*	
56 Dup	56 Duplicate Count	24		*	
84	Smear Sample	33		*	
85	"	32		*	
86	"	37		*	
RWST-S	"	29		*	
RWST-N	"	31	*		

Survey Technician: C. Webb  
Reviewed By: R. Williams

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

Note:  
\* = < MDA

**BONUS REACTOR FACILITY**  
Rincón, Puerto Rico

**RADIOLOGICAL SURVEY REPORT (MAP)**

SITE: BONUS Time: 12-13 Jan 05 Date: Yr 05 Mo 1 Dy 12-13  
*0800 - 1600hrs*

Task: verification 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: Reactor Location: Basement level

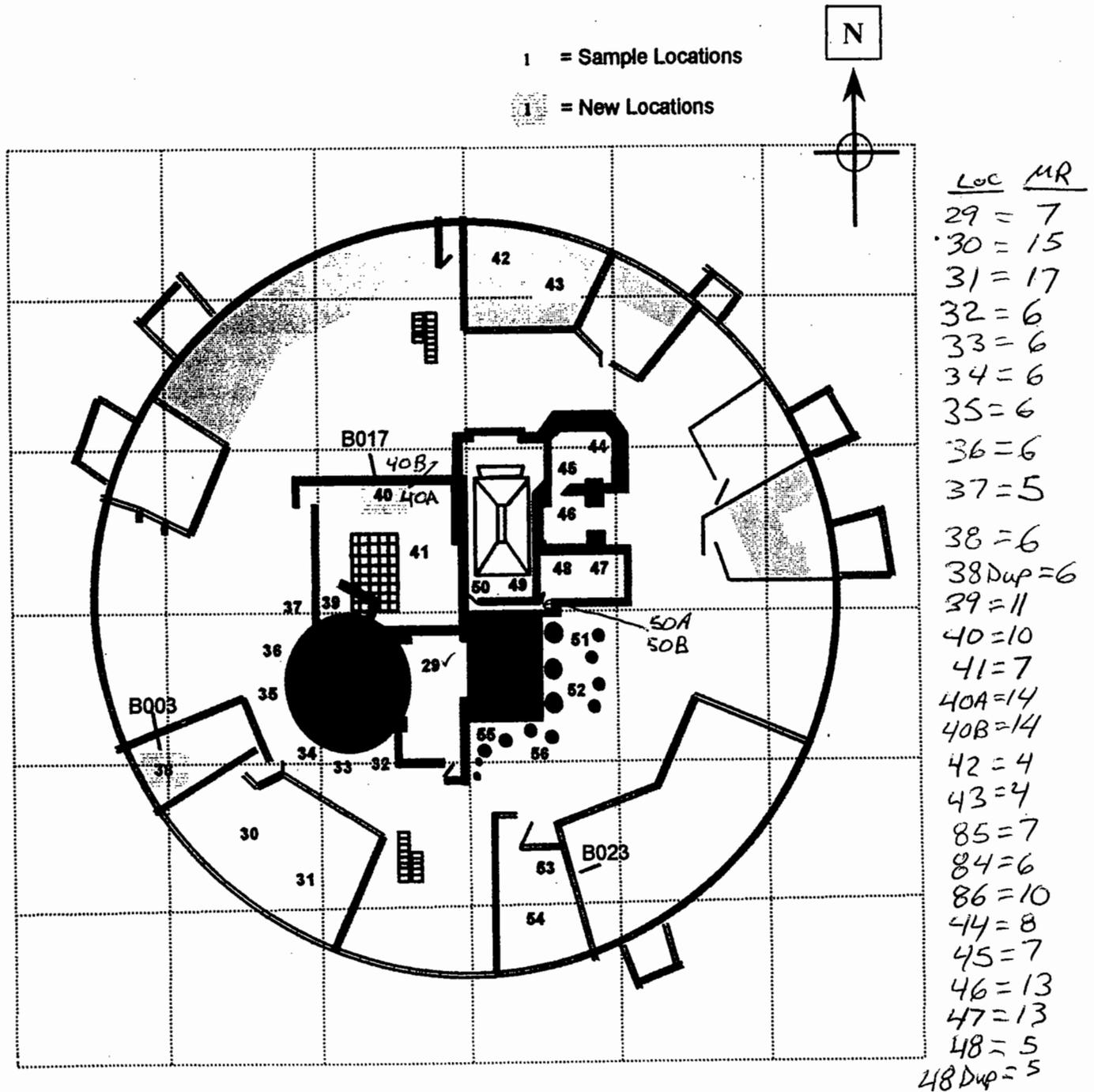
Sketch:  
  
See attached. —

Instruments (Model and Serial Numbers): Ludlum Model 19, No.: 148190 *for dose rate*

Survey Technician(s): C Webb Reviewer: R Williams



# Sampling and Analysis Plan for the Boiling Nuclear Superheat (BONUS) Reactor located in Rincon, Puerto Rico



Loc	MR
49	8
50	7
50A	5
50B	5
51	6
52	6
53	7
54	6

**Figure 6 BONUS Reactor - Main Floor Plan**  
 Basement

Loc	MR
55	5
56	4
56 dup	4

■ = SCM Survey Above 100 cm<sup>2</sup> limit