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**Annual LMS Radiological Characterization  
Survey Plan for the BONUS, Puerto Rico,  
Decommissioned Reactor Site  
LMS RadCon Survey Plan Number: 24-001**

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## Attachment

Attachment 1 BONUS Annual Survey Location and Results Data Sheet

## Abbreviations

BONUS	Boiling Nuclear Superheater
dpm/100 cm <sup>2</sup>	disintegrations per minute per 100 centimeters squared
LMS	Legacy Management Support
μR/h	microroentgens per hour
RadCon	Radiological Control
RCT	radiological control technician
S&H	Safety and Health

## Forms Referenced in This Manual

LMS forms are accessible on the **Document Management** homepage > **LMS Forms**.

*Radiological Survey Map*

LMS 1553

## 1.0 Introduction

Legacy Management Support (LMS) contractor personnel are responsible for performing the annual LMS radiological characterization survey (characterization survey) at the BONUS, Puerto Rico, Decommissioned Reactor Site in Rincon, Puerto Rico.

This Annual LMS Radiological Characterization Survey Plan provides information and guidance necessary for an LMS qualified radiological control technician (RCT) to perform the survey. The results of the survey will be used to verify that:

1. Accessible site surfaces are below established regulatory limits of Title 10 *Code of Federal Regulations* Section 835 (10 CFR 835) Appendix D, “Surface Contamination Values,” for surface radioactive contamination.
2. Accessible area radiation levels are below established regulatory limits of 10 CFR 835.2, “Definitions,” for a radiation area.
3. Accessible areas or surfaces that exceed regulatory radiological limits are properly controlled and posted in accordance with *Radiological Control Manual* (LMS/POL/S04322).
4. Survey results have not changed by more than 2 sigma (standard deviations) when compared to the previous year’s survey results, and if they have changed by more than 2 sigma, a review and evaluation of the change(s) will be performed and documented by an LMS senior health physicist and the evaluation results shared with the LMS site lead.

### 1.1 Purpose and Scope

1. The purpose of this survey plan is to provide guidance to the RCT conducting the characterization survey. It also provides the requirements associated with the evaluation of the characterization survey results, including the comparison of the current characterization survey results to the previous year’s survey results and to the regulatory limits associated with both surface contamination and general area gamma radiation exposure rates.
2. The scope of the plan pertains only to the characterization survey performed at the site (specifically the internal parts of the enclosed domed building).

### 1.2 Limitations

- Beta-gamma contamination and gamma radiation surveys performed during this survey should only be used as described in the introduction section of this plan. Survey results shall not be used to make release decisions for the site.
- The characterization survey shall be performed by a qualified LMS RCT using functional and calibrated LMS radiological survey instruments and equipment or appropriate and acceptable vendor-supplied radiological instrumentation.
- Characterization surveys, instrument preoperational checks, and recording of the survey results shall be performed in accordance with the *Radiation Protection Program Plan* (LMS/POL/S04373), *Radiological Control Manual* (LMS/POL/S04322), and Radiological Control (RadCon) implementing procedures. If a conflict exists between this plan and the *Radiation Protection Program Plan*, *Radiological Control Manual*, or the RadCon

implementing procedures, then the RCT shall follow the requirements and guidance identified in the *Radiation Protection Program Plan*, *Radiological Control Manual*, and the RadCon implementing procedures.

- As of 2024, the enclosed domed building is not ventilated or heated or cooled, and ambient outside temperatures likely drive internal dome temperatures. During the summer months, it is expected that internal dome temperatures will reach temperatures at which heat stress monitoring and controls will be required and implemented. During the winter months, it is expected that internal dome temperatures will reach temperatures at which cold stress monitoring and controls will be required and implemented. Work restrictions and controls for heat or cold stress will be identified on the site's job safety analysis and shall be followed in accordance with appropriate LMS Safety and Health (S&H) procedure and requirements.

## **2.0 Survey and S&H Equipment and Supplies**

Knowing that the site is located out of the country and that necessary LMS S&H and RadCon supplies and equipment might be limited or not available in San Juan or Rincón, Puerto Rico, it is necessary to identify needed equipment and supplies and then purchase them in the United States and have the equipment and supplies shipped to the site (if equipment and supplies are not already there) along with other LMS radiological instrumentation.

Recommended S&H and RadCon supplies and equipment include the following:

- 2 each: Bicon/ThermoScientific Microrem Meter instrument or equivalent
- 2 each: Ludlum Model 26 instrument or equivalent
- 200 Rad Dawg smears or equivalent
- 5 radiological waste plastic bags
- 3 each: Radioactive Material Area and Contamination Area signs and attachment mechanisms
- 10 pairs of Tyvek coveralls (appropriate sizes) or equivalent
- 2 boxes of nitrile gloves (appropriate sizes) or equivalent
- 1 roll of duct tape
- 2 pairs of rubber overshoes
- 10 pairs of plastic liners
- 2 one-gallon pump-sprayer bottles
- 4 pairs of clear safety glasses
- 1 Wet Bulb Globe Temperature thermometer or equivalent thermometer

## 3.0 Survey Requirements

In accordance with the *Long-Term Surveillance and Maintenance Plan for the Boiling Nuclear Superheater (BONUS) Reactor Facility, Rincón, Puerto Rico* (LMS/BON/S01091); *Radiation Protection Program Plan*; and the *Radiological Control Manual*, several different characterization surveys are required for the site and are included as part of this plan.

### 3.1 Gamma Radiation Exposure Rate Survey

General area gamma radiation exposure rate surveys will be obtained at the 73 defined locations (Figure 1 through Figure 6) to determine the radiation level (in microroentgens per hour [ $\mu\text{R/h}$ ] or similar dose rate result units) associated with the entombment structure and the accessible enclosed domed building. Additionally, five nonbiased gamma radiation exposure rate surveys will be performed in accessible areas commonly permitted for public access.

Results of the gamma radiation exposure rate surveys will be evaluated in real time and confirmatory, biased gamma radiation exposure rate surveys performed when any of the following survey result or physical site conditions exist:

- The RCT observes excessive deterioration of the structure(s) during the survey when compared to the previous year's structural condition
- Survey results from the identified survey locations indicate a gamma radiation exposure rate in excess of 0.4 milliroentgen per hour (400  $\mu\text{R/h}$ )
- The RCT observes any conditions that justify an additional gamma radiation exposure rate survey be performed, at their discretion

Gamma radiation exposure rate survey results will be reported on the *BONUS Annual Survey Location and Results Data Sheet* (Attachment 1). In addition, gamma radiation exposure rate survey results will be recorded on a *Radiological Survey Map* form (LMS 1553) and be considered the official record of the characterization survey and its results.

If additional gamma radiation exposure rate surveys are performed, then identify the following information on the *BONUS Annual Survey Location and Results Data Sheet* (Attachment 1) and on the *Radiological Survey Map* form in the comments section:

- The reason for performing the additional survey(s)
- The location of the additional survey(s)
- Observations and conclusions relative to the survey(s), such as site conditions or equipment or item physical condition (e.g., extreme rust, paint chipping)

### 3.2 Contamination Level Survey

Direct beta-gamma surface contamination and transferable surface contamination smear surveys will be obtained at the 73 defined locations (Figure 1 through Figure 6) to determine the surface's contamination levels (in disintegrations per minute per 100 centimeters squared [ $\text{dpm}/100\text{ cm}^2$ ] or similar surface contamination result units) for both transferable and total surface activity associated with the entombment structure and the accessible enclosed domed building. Additionally, five nonbiased direct beta-gamma surface contamination and transferable

surface contamination smear surveys will be performed in accessible areas commonly permitted for public access.

Results of the direct beta-gamma surface contamination and transferable surface contamination smear surveys will be evaluated in real-time and confirmatory, biased beta-gamma surface contamination and transferable surface contamination smear surveys will be performed when any of the following survey result or physical site conditions exist:

- The RCT observes excessive deterioration of the structure(s) during the survey when compared to the previous year's structural condition
- Survey results from the identified survey locations indicate contamination levels in excess of 1000 dpm (beta/gamma)/100 cm<sup>2</sup> transferable contamination or 5000 dpm (beta/gamma)/100 cm<sup>2</sup> total surface contamination
- The RCT observes any conditions that justify additional surface contamination surveys be performed, at their discretion

Results of direct beta-gamma surface contamination and transferable surface contamination smear surveys will be reported on the *BONUS Annual Survey Location and Results Data Sheet* (Attachment 1). In addition, the same results will be recorded on a *Radiological Survey Map* form and be considered the official record of the characterization survey and its results.

If additional direct beta-gamma surface contamination and transferable surface contamination smear surveys are performed, then identify the following information on the *BONUS Annual Survey Location and Results Data Sheet* (Attachment 1) and on the *Radiological Survey Map* form in the comments section:

- The reason for performing the additional survey(s)
- The location of the additional survey(s)
- Observations and conclusions relative to the survey result(s), such as site conditions or equipment or item physical condition (e.g., extreme rust, paint chipping)

## 4.0 Survey Instrumentation

Calibrated and functional radiological survey instruments shall be used to perform the characterization survey at the site. Appropriate beta-gamma surface contamination survey instruments include Ludlum Model 26, Ludlum Model 3000 with 44-9 Geiger Mueller (GM) probe, and Thermo Scientific FH40 Geiger (G) with FHZ 732 GM probe. Appropriate gamma radiation exposure rate survey instruments include Thermo Scientific or Bicon microrem meter, ThermoScientific FH 40 G, and Ludlum ion chamber meters. Instruments shall be operated in accordance with the instrument's operating manual and LMS RadCon implementing procedures.

Knowing that the site is located out of the country and that radiological survey instrumentation is likely not available in San Juan or Rincón, it is recommended that two of each instrument type (gamma radiation exposure rate and surface contamination) be acquired (either from the LMS radiological instrument inventory or from an acceptable radiological instrument vendor), packaged for shipment, and then shipped to the site (if radiological instrumentation is not already there).



## 5.0 Survey Documentation

Characterization surveys shall be documented on a *Radiological Survey Map* in accordance with the *Radiological Control Manual* and the *Documenting Radiological Surveys* (LMS/PRO/S20073) procedure. In addition, characterization survey results shall be recorded on the *BONUS Annual Survey Location and Results Data Sheet* (Attachment 1).

## 6.0 Survey Result Evaluation

Characterization survey results shall be evaluated initially for correctness and completeness. This is accomplished by submitting the completed survey documentation (e.g., *Radiological Survey Map*) to an LMS senior health physicist for review and approval.

## 7.0 Survey Result Comparison

Reviewed and approved characterization survey results shall be compared against regulatory limits and also against the previous year's characterization survey results.

### 7.1 Regulatory Limit Comparison

- [1] Using reviewed and approved characterization survey results, compare surface contamination values against Table 2, "Summary of Surface Contamination Values in dpm/100 cm<sup>2</sup> (10 CFR 835 Appendix D)," in the *Radiological Control Manual*.
  - [a] If removable or fixed surface contamination characterization survey results exceed *Radiological Control Manual* limits for areas at the site that are not currently radiologically controlled, then contact the RadCon manager immediately.
  - [b] If removable or fixed surface contamination characterization survey results are equal to or below *Radiological Control Manual* limits for areas at the site that are not currently radiologically controlled, then inform the site lead that surface contamination is within regulatory limits.
- [2] Using reviewed and approved characterization survey results, compare gamma radiation exposure rate values against 400  $\mu\text{R/h}$  (above background).
  - [a] If gamma radiation exposure rate characterization survey results exceed 400  $\mu\text{R/h}$  (above background) for areas at the site that are not currently radiologically controlled, then contact the RadCon manager immediately.
  - [b] If gamma radiation exposure rate characterization survey results are equal to or less than 400  $\mu\text{R/h}$  (above background) for areas at the site that are not currently radiologically controlled, then inform the site lead that gamma radiation exposure rates are equal to or below 400  $\mu\text{R/h}$  (above background).

## 7.2 Previous Year's Results Comparison

Using the characterization survey results recorded on the *BONUS Annual Survey Location and Results Data Sheet* (Attachment 1), compare them against the previous year's characterization survey results.

If current characterization survey results are different by more than 2 sigma of the previous year's characterization survey results, then an LMS senior health physicist shall perform a review of the difference(s), document the review, and submit the review to the LMS site lead.

## 8.0 Figures

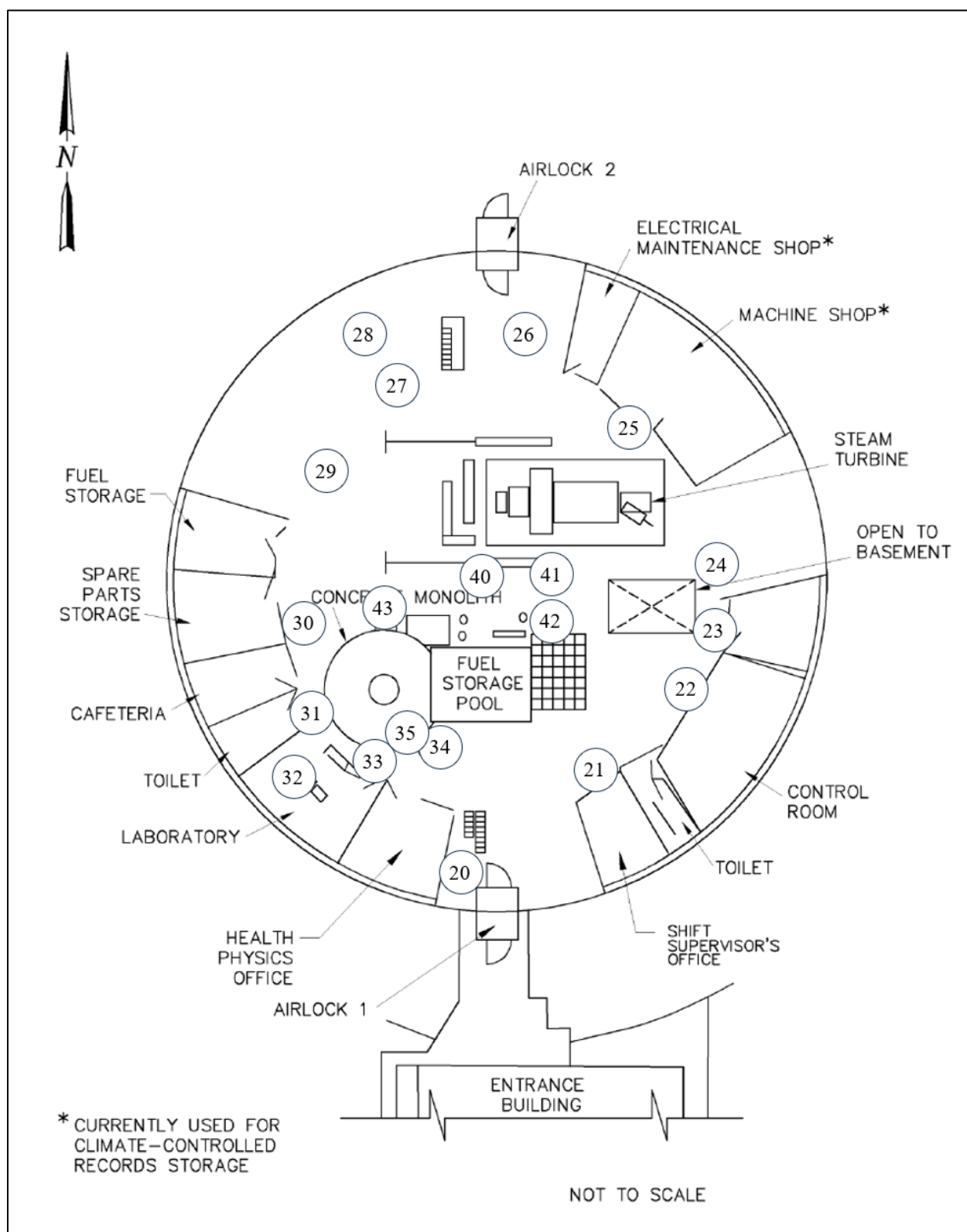


Figure 1. Main Floor Survey Locations

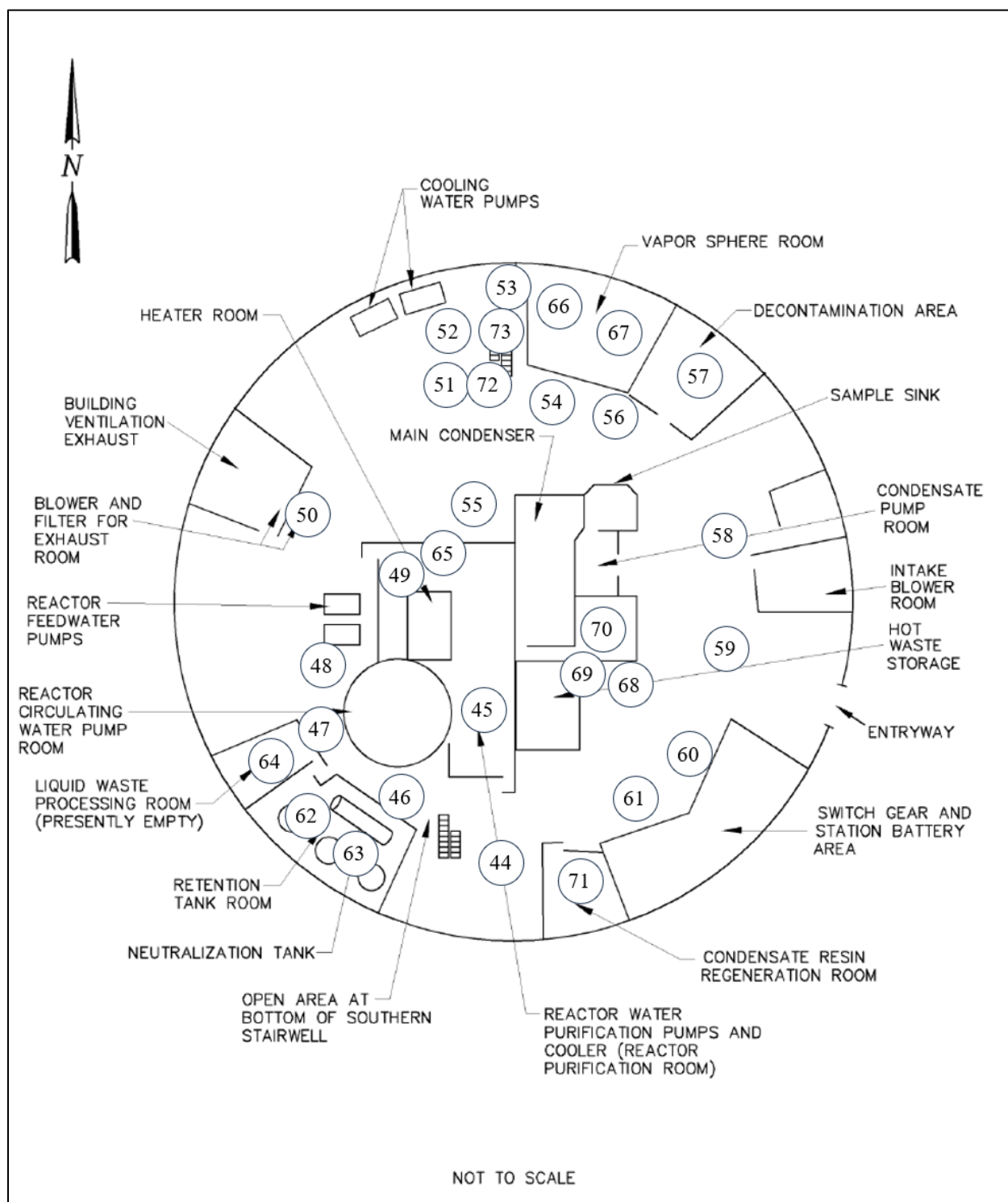


Figure 2. Basement Floor Survey Locations

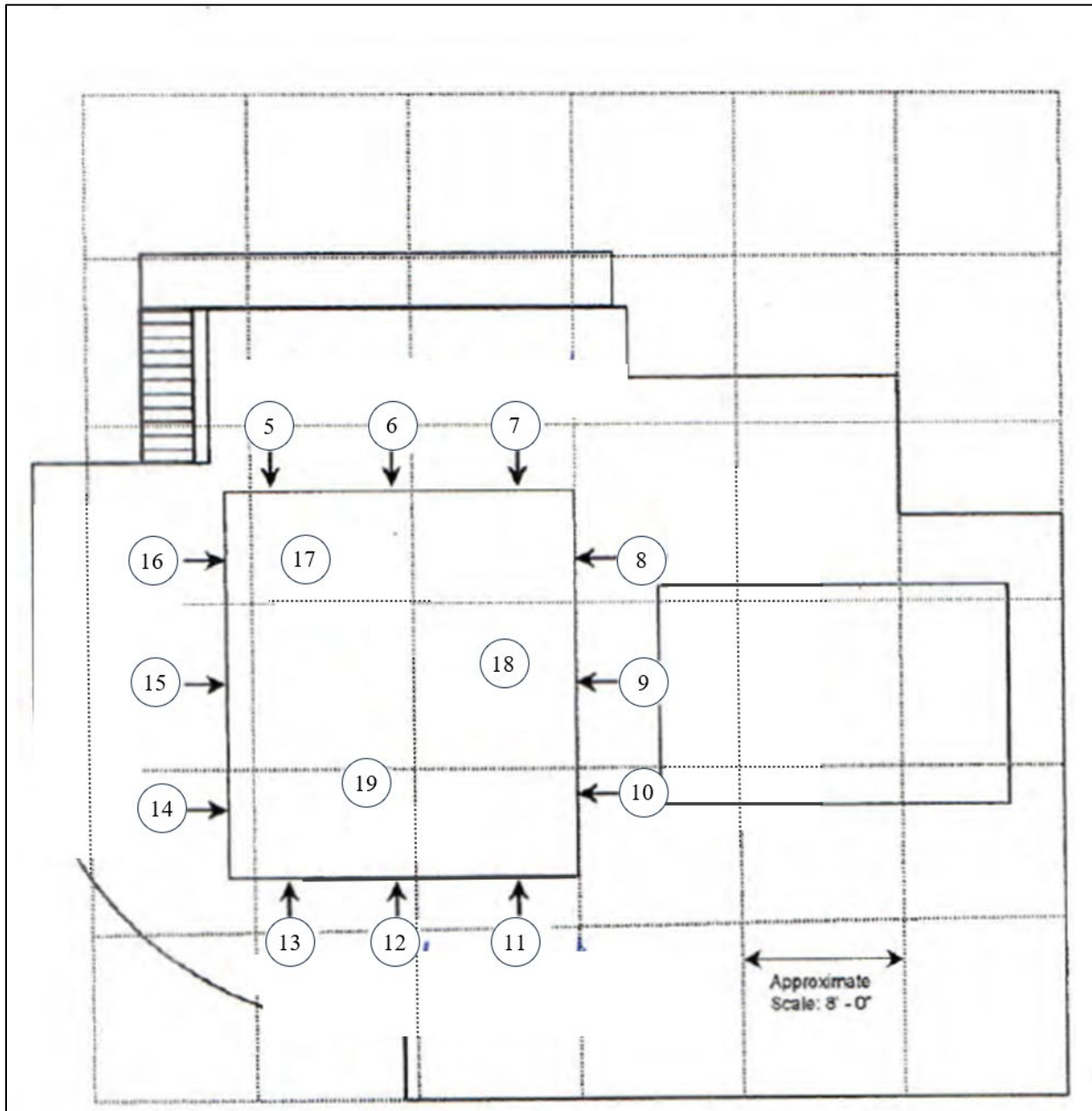


Figure 3. Monolith Top Plug Structure

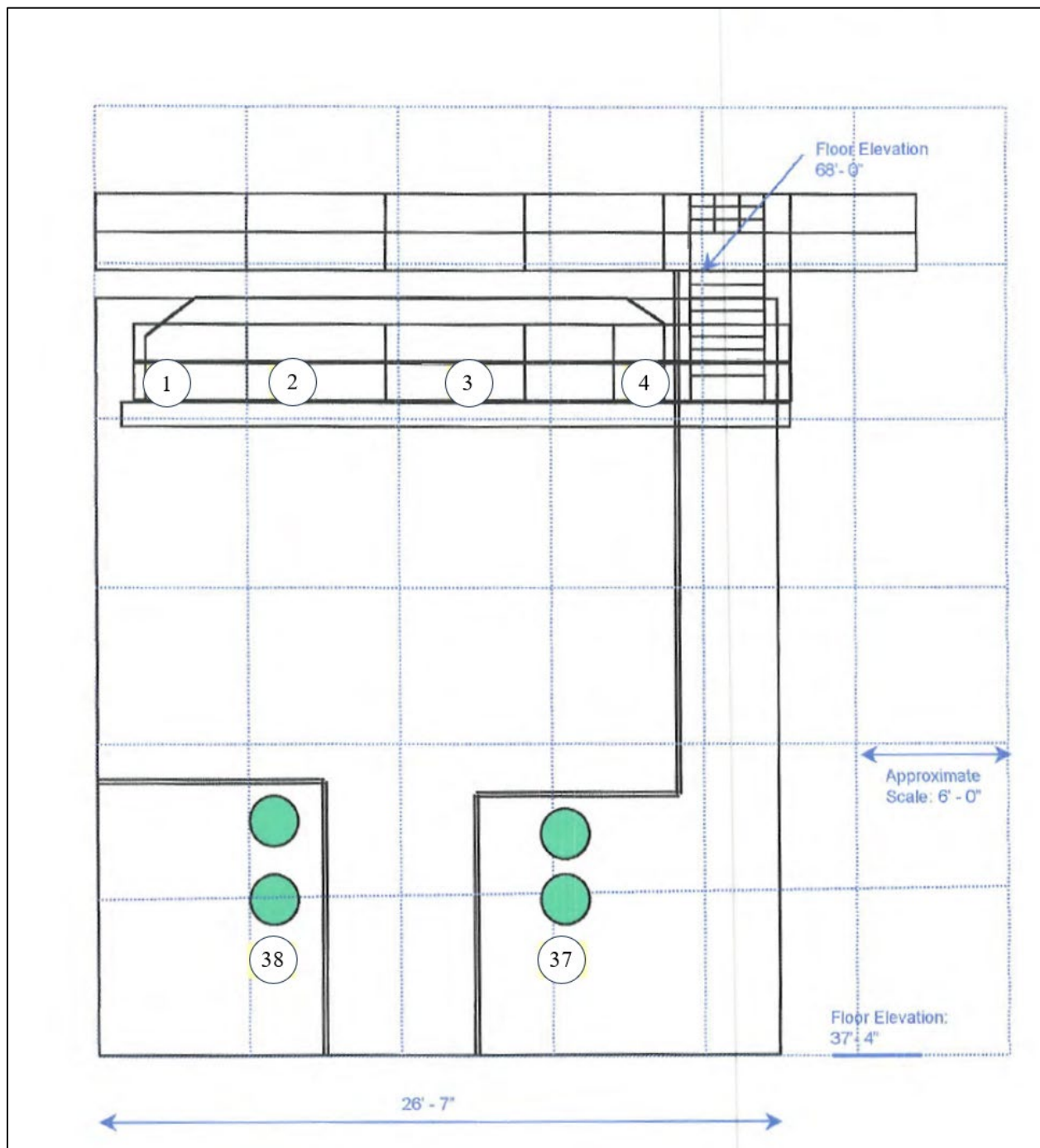


Figure 4. Entombment System—North View

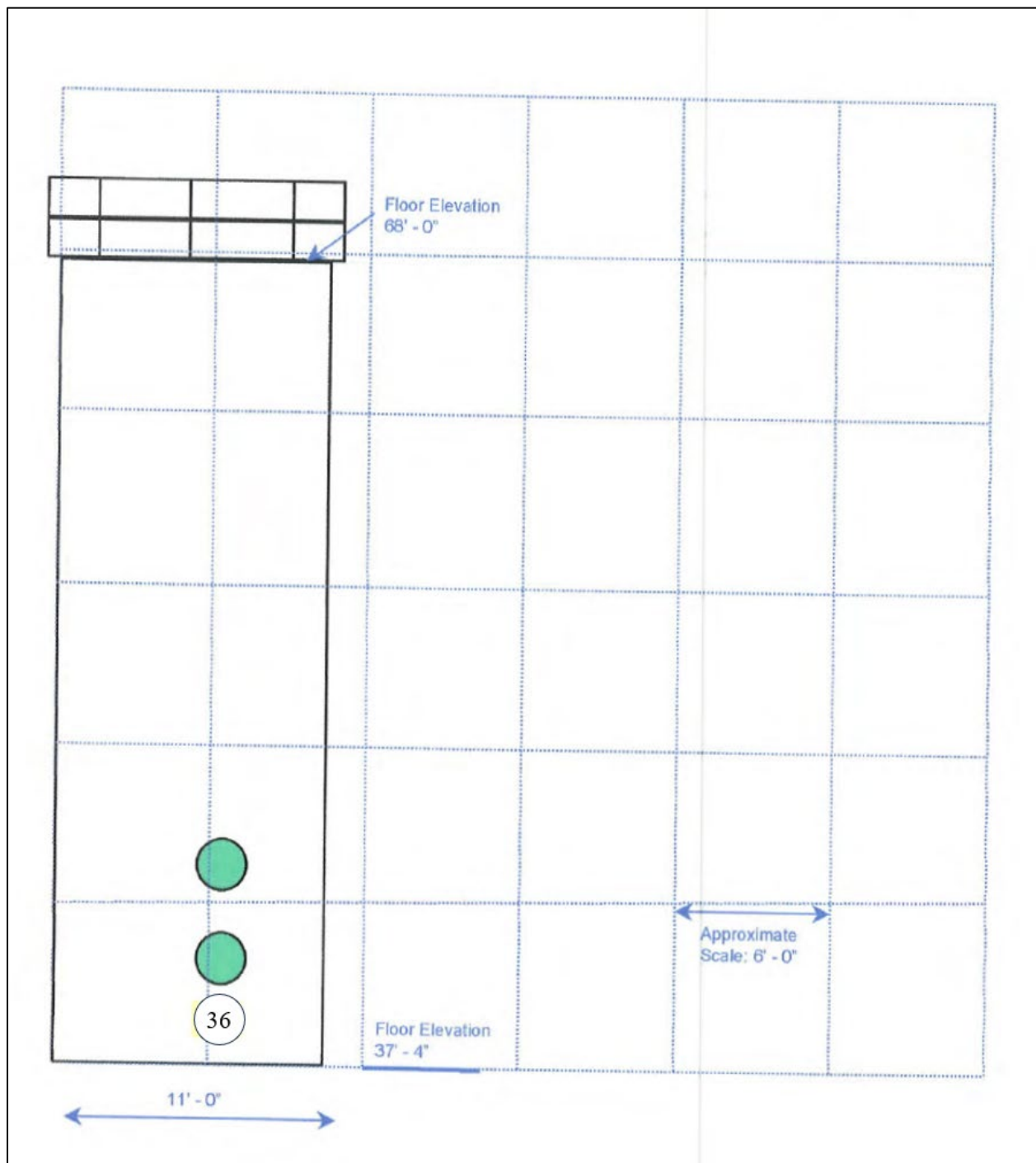


Figure 5. Entombment System—South View



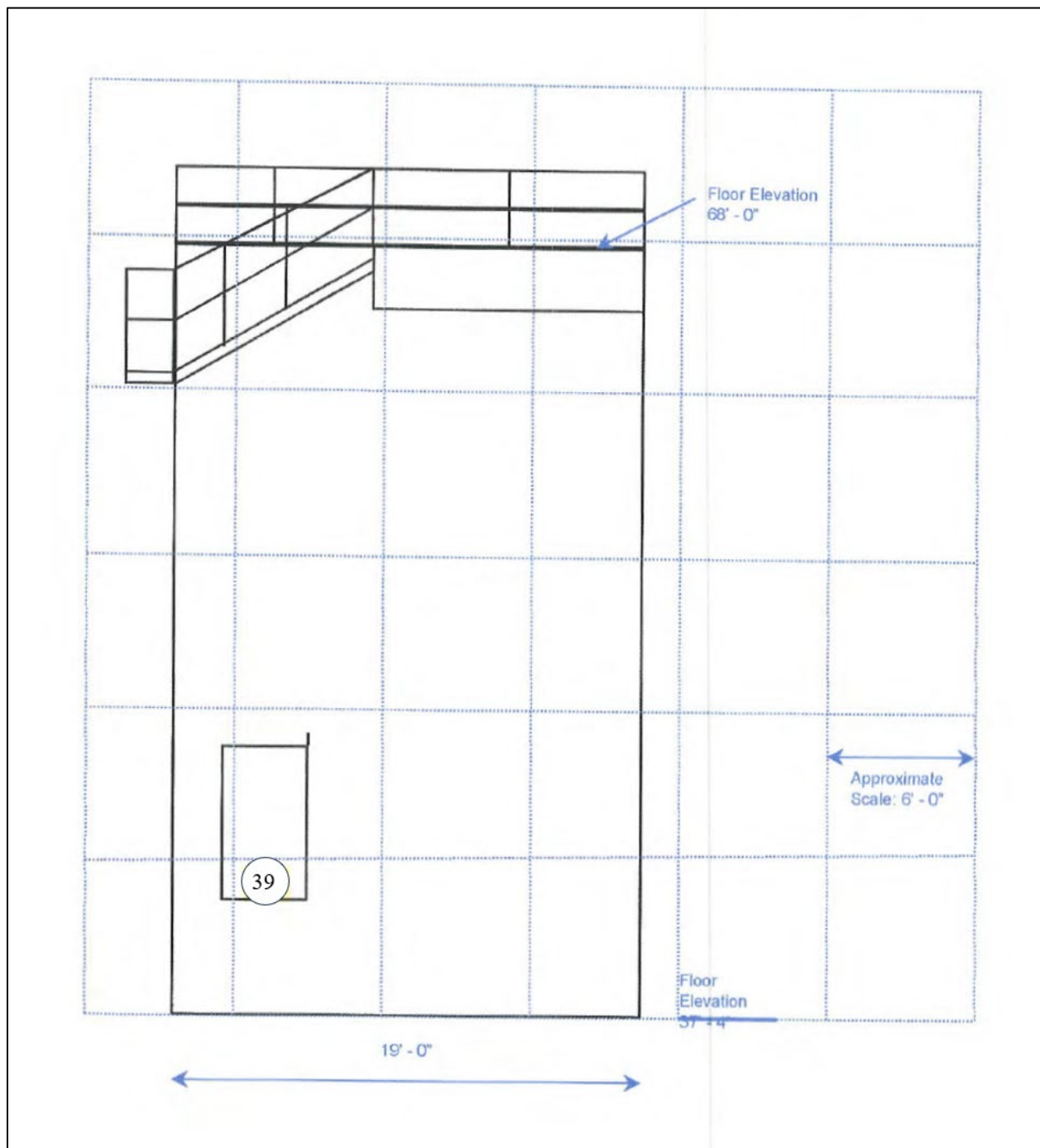


Figure 6. Entombment System—North View



## 9.0 References

10 CFR 835. "Occupational Radiation Protection," *Code of Federal Regulations*.

*Documenting Radiological Surveys*, LMS/PRO/S20073, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

*Long-Term Surveillance and Maintenance Plan for the Boiling Nuclear Superheater (BONUS) Reactor Facility, Rincón, Puerto Rico*, LMS/BON/S01091, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

*Radiation Protection Program Plan*, LMS/POL/S04373, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

*Radiological Control Manual*, LMS/POL/S04322, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

*Records and Information Management*, LM-Policy-1-11-1.0, continually updated, prepared by the Office of Legacy Management, March.

## **Attachment 1**

### ***BONUS Annual Survey Location and Results Data Sheet***

RCT Name: \_\_\_\_\_ Survey Date: \_\_\_\_\_

**Exposure Rate Instrument Information**

Survey Instrument Model: \_\_\_\_\_  
Instrument Serial Number: \_\_\_\_\_  
Calibration Due Date: \_\_\_\_\_  
Time of Daily Response Check: \_\_\_\_\_  
Background Exposure Rate ( $\mu\text{R/h}$ ): \_\_\_\_\_

**Surface Contamination Instrument Information**

Survey Instrument Model: \_\_\_\_\_  
Instrument Serial Number: \_\_\_\_\_  
Calibration Due Date: \_\_\_\_\_  
Time of Daily Response Check: \_\_\_\_\_

Survey ID	Survey Location	Exposure Result ( $\mu\text{R/h}$ )	Removable Contamination (dpm/100cm <sup>2</sup> )	Total Contamination (dpm/100cm <sup>2</sup> )	Comment
1	Pipe Chase Face #1				Monolith Top
2	Pipe Chase Face #2				Monolith Top
3	Pipe Chase Face #3				Monolith Top
4	Pipe Chase Face #4				Monolith Top
5	Top Plug Face #1—Left				Monolith Top
6	Top Plug Face #1—Center				Monolith Top
7	Top Plug Face #1—Right				Monolith Top
8	Top Plug Face #2—Top				Monolith Top
9	Top Plug Face #2—Center				Monolith Top
10	Top Plug Face #2—Bottom				Monolith Top
11	Top Plug Face #3—Right				Monolith Top
12	Top Plug Face #3—Center				Monolith Top
13	Top Plug Face #3—Left				Monolith Top
14	Top Plug Face #4—Bottom				Monolith Top
15	Top Plug Face #4—Center				Monolith Top
16	Top Plug Face #4—Top				Monolith Top
17	Top Plug Top Surface—Upper Left				Monolith Top
18	Top Plug Top Surface—Center Right				Monolith Top
19	Top Plug Top Surface—Center Bottom				Monolith Top
20	Main Floor—Zone 1				Main Level—Public Access
21	Main Floor—Zone 2				Main Level—Public Access
22	Main Floor—Zone 3				Main Level—Public Access
23	Main Floor—Zone 4				Main Level—Public Access
24	Main Floor—Zone 5				Main Level—Public Access
25	Main Floor—Zone 6				Main Level—Public Access

Survey ID	Survey Location	Exposure Result ( $\mu\text{R/h}$ )	Removable Contamination (dpm/100cm <sup>2</sup> )	Total Contamination (dpm/100cm <sup>2</sup> )	Comment
26	Main Floor—Zone 7				Main Level—Public Access
27	Main Floor—Zone 8				Main Level—Public Access
28	Main Floor—Zone 9				Main Level—Public Access
29	Main Floor—Zone 10				Main Level—Public Access
30	Main Floor—Zone 11				Main Level—Public Access
31	Main Floor—Zone 12				Main Level—Public Access
32	Main Floor—Zone 13				Main Level—Public Access
33	Main Floor—Zone 14				Main Level—Public Access
34	Main Floor Water Column #1				Main Level—Controlled Area
35	Main Floor Water Column #2				Main Level—Controlled Area
36	Instrument Thimble #1				Main Level—Controlled Area
37	Instrument Thimble #2				Main Level—Controlled Area
38	Instrument Thimble #3				Main Level—Controlled Area
39	Pipe Chase Exit Hatch				Main Level—Controlled Area
40	Fuel Pool Purifier—Floor #1				Main Level—Contaminated Area
41	Fuel Pool Purifier—Floor #2				Main Level—Contaminated Area
42	Fuel Pool Purifier—Floor #3				Main Level—Controlled Area
43	Fuel Pool Purifier—Floor (CM005)				Main Level—Contaminated Area
44	Basement Floor—Zone 1				Basement Level
45	Basement Floor—Zone 2				Basement Level
46	Basement Floor—Zone 3				Basement Level
47	Basement Floor—Zone 4				Basement Level
48	Basement Floor—Zone 5				Basement Level
49	Basement Floor—Zone 6				Basement Level
50	Basement Floor—Zone 7				Basement Level
51	Basement Floor—Zone 8				Basement Level
52	Basement Floor—Zone 9				Basement Level
53	Basement Floor—Zone 10				Basement Level
54	Basement Floor—Zone 11				Basement Level
55	Basement Floor—Zone 12				Basement Level
56	Basement Floor—Zone 13				Basement Level
57	Basement Floor—Zone 14				Basement Level

Survey ID	Survey Location	Exposure Result ( $\mu\text{R/h}$ )	Removable Contamination (dpm/100cm <sup>2</sup> )	Total Contamination (dpm/100cm <sup>2</sup> )	Comment
58	Basement Floor—Zone 15				Basement Level
59	Basement Floor—Zone 16				Basement Level
60	Basement Floor—Zone 17				Basement Level
61	Basement Floor—Zone 18				Basement Level
62	Side of Liquid Waste Tank #1				Basement Level
63	Side of Liquid Waste Tank #2				Basement Level
64	Column 4 and 5 Inside Room				Basement Level
65	Heater Room (Wall)				Basement Level
66	Vapor Sphere Room—Upper Left				Basement Level
67	Vapor Sphere Room—Center Right				Basement Level
68	Water Pump Room to the Right, Enter 50A				Basement Level
69	Condenser Room Entry Wall—Block				Basement Level
70	Condenser Room Entry Wall—Concrete				Basement Level
71	South Room with 2 pumps				Basement Level
72	Under Stairs Near North Door—Floor #1				Basement Level
73	Under Stairs Near North Door—Floor #2				Basement Level
74					
75					
76					
77					
78					

**Abbreviations:** dpm/100cm<sup>2</sup> = disintegrations per minute per 100 square centimeters, ID = identifier,  $\mu\text{R/h}$  = microrentgens per hour, RCT = radiological control technician