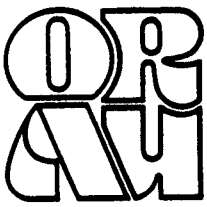

Prepared by
Oak Ridge Associated
Universities

Prepared for
U.S. Nuclear
Regulatory
Commission's
Region V Office

Supported by
Safeguards and
Materials Programs
Branch;
Division of
Inspection Programs;
Office of
Inspection and
Enforcement

CONFIRMATORY RADIOLOGICAL SURVEY NUCLEAR MATERIALS DEVELOPMENT FACILITY (BUILDING T-055) ROCKWELL INTERNATIONAL SANTA SUSANA, CALIFORNIA

D. R. STYERS

Radiological Site Assessment Program
Manpower Education, Research, and Training Division

FINAL REPORT
JULY 1987

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Prepared by

D. R. Styers

Radiological Site Assessment Program
Manpower Education, Research, and Training Division
Oak Ridge Associated Universities
Oak Ridge, Tennessee 37831-0117

Project Staff

J.D. Berger
R.D. Condra
M.A. Edwards
F.T. Lange
G.L. Murphy
E.A. Powell
R.C. Rookard
T.J. Sowell
C.F. Weaver

Prepared for

Safeguards and Materials Programs Branch
Division of Inspection Programs
Office on Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Region V Office

FINAL REPORT

July 1987

This report is based on work performed under Interagency Agreement DOE No. 40-816-83 NRC Fin. No. A-9076-3 between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Associated Universities performs complementary work under contract number DE-AC05-760R00033 with the U.S. Department of Energy.

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CONFIRMATORY RADIOLOGICAL SURVEY
NUCLEAR MATERIALS DEVELOPMENT FACILITY
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SANTA SUSANA, CALIFORNIA

INTRODUCTION

The Nuclear Materials Development Facility, also known as Building T-055, was designed, constructed, and operated by the Rocketdyne Division of Rockwell International Corporation for research, development, and production of nuclear fuels and radioactive sources. The final products were solid reactor fuel materials, radionuclide heat sources, and other radioactive sources. Feed materials for these projects included various forms of plutonium and depleted uranium.

Operation of the facility began in April 1956 and continued under Nuclear Regulatory Commission (NRC) license number SNM-21, until November 1982. At this time decontamination and decommissioning of the facility were initiated by Rockwell International. Cleanup was completed in August 1986 and a report to the NRC in December 1986 indicates that the facility meets the requirements for release from licensing restrictions.[1]

At the request of NRC Region V, the Radiological Site Assessment Program of Oak Ridge Associated Universities (ORAU) conducted a confirmatory radiological survey during February 2 thru 13, 1987. This report describes the procedures and results of that survey.

SITE DESCRIPTION

The Nuclear Materials Development Facility (NMDF) is located at Rockwell International Corporation's Santa Susana Field Laboratories, northwest of Canoga Park, California (Figure 1). The facility consists of a 61 m x 18 m, single-story building on approximately 0.5 ha of land (Figure 2). Building construction is of 15 cm precast concrete slab walls on a concrete slab; the roof is lightweight concrete, supported on steel deck panels and girders. The entire facility was designed as a controlled access area; although, the building was

divided into posted (radiologically controlled) and nonposted (nonradiologically controlled) areas (Figure 3). The building housed an administration area, change rooms, chemistry and service laboratories, glove box room, vault, and maintenance equipment rooms. A liquid waste holding tank and concrete retention well were located southeast of the building.

During decontamination, all contaminated equipment and surfaces, drain lines, and ventilation ducts were removed from the facility. The waste holding tank was removed, and the retention well was decontaminated.

SURVEY PROCEDURES

Objective

The objective of the survey was to determine the radiological conditions of the site, relative to the licensee's data and the NRC guidelines for release for unrestricted use. Radiological information obtained included:

1. direct radiation levels inside and outside the building,
2. contamination levels on building surfaces, and
3. concentrations of radionuclides in surface and subsurface soil.

Procedures

Document Review

Rockwell's final survey report and supporting documentation concerning decontamination and decommissioning of the NMDF were reviewed.

Facility Survey

Gridding

Confirmatory measurements were referenced to a grid system established by ORAU. A 2 m x 2 m grid was established on the floors and lower walls in the radiologically posted areas of Building T-055 (Figure 4). The unposted areas and

rooms with a floor area of less than 10 m^2 were not gridded. Measurements and samples from ungridded surfaces were referenced to the floor and lower grid, or to pertinent building features.

Surface Scans

Alpha, beta-gamma, and gamma scans were performed on floors, using an alpha/beta gas-proportional floor monitor and NaI(Tl) gamma scintillation detectors. Floor surfaces not accessable to the floor monitor, lower walls (up to 2 m), upper walls, ceilings, and overhead surfaces such as ledges, beams, piping, fixtures, equipment, and ductwork were scanned using hand held alpha and beta-gamma detectors. Areas of elevated radiation levels were marked for additional measurements.

Measurement of Surface Contamination Levels

Sixty-three grid blocks on the floors and lower walls in the radiologically controlled areas of the NMDF were randomly selected for surface contamination measurements. Measurements of total alpha and beta-gamma contamination levels were systematically performed at the center and four points, midway between the center and corners of each of the grid blocks. Smears for removable alpha and beta contamination were performed at the location in each grid block having the highest direct alpha reading. Total and removable contamination levels were also measured at 94 locations on the upper walls, ceilings, and miscellaneous overhead objects. Ten locations on the roof, including roof exhaust vents, were selected for measurement.

In the non-radiologically controlled areas of the building, total and removable contamination levels were measured at 73 randomly selected locations on the floors and lower walls and at 43 randomly selected locations on the upper walls, ceilings, and miscellaneous overhead objects.

Locations of surface contamination measurements are indicated on Figures 5 through 17.

Exposure Rate Measurements

Gamma exposure rates at one meter above the floor were measured throughout the facility, using a NaI(Tl) gamma scintillation detector and ratemeter, cross-calibrated with a pressurized ionization chamber (PIC).

Paint Sampling

Seventeen paint samples were collected from approximately 200 cm^2 areas of the walls, at random locations throughout the facility, using commercial paint stripper (Figure 18).

Soil Sampling

Six soil samples were collected from the backfilled trench, dug to remove contaminated subfloor drain lines (Figure 19). In addition, five samples, collected by Rockwell from the excavated trench before backfilling, were obtained for independent, confirmatory analyses.

Miscellaneous Media Sampling

Samples of residue were obtained from four anchor bolt holes in the floor of the radiologically controlled area of the building, using moistened cotton swabs; samples of dust were also collected from a trench, an air duct, and a ceiling area.

Outside Area Survey

Surface Scans

Surface scans of the outside area adjacent to the building were performed using NaI(Tl) gamma scintillation detectors and ratemeters.

Roof

Beta-gamma and gamma scans were conducted on the roof, exhaust vents, and gutters of the NMDF (Figure 20).

Waste Tank Area

Alpha, beta-gamma, and gamma scans of the waste tank retention well were conducted. Total and removable alpha and beta-gamma contamination levels were measured on retention well surfaces.

Exposure Rate Measurements

Gamma exposure rates at one meter above the surface were measured at eight locations (Figure 21) in the vicinity of the building.

Soil Sampling

Seven shallow boreholes (up to one meter) were dug in the backfilled trench area leading to the liquid waste retention well (Figure 22). Subsurface soil samples were collected from each borehole at the interface between the backfill material and the bottom of the original excavation.

Water Sampling

A water sample was collected from the waste tank retention well.

Sample Analysis and Interpretation of Results

Smears for the determination of removable contamination were counted for gross alpha and beta activity. Soils were analyzed by gamma spectroscopy for uranium 235/238, americium 241, and other identifiable photopeaks. Paint samples, soils, and miscellaneous residues were analyzed for isotopic plutonium. The water sample was analyzed for gross alpha and gross beta concentrations. Major analytical equipment used in support of this survey is listed in Appendix A, while Appendix B describes the measurement and analytical procedures.

Results were compared with guidelines established by the Nuclear Regulatory Commission for release of facilities for unrestricted use (Appendix C).

RESULTS

Document Review

Rockwell's decommissioning plan appears adequately developed and implemented to ensure that NRC guidelines were met. ORAU's review indicates that the procedures and instrumentation were consistent with industry accepted practices, and that the data support the final conclusions of the report.

Facility Survey

Surface Scans

No areas of elevated beta-gamma or gamma contamination were identified by building surface scans. One small area of elevated direct alpha activity was identified in Room 127, at grid coordinate 0N, 10.5E along the south wall (Figure 14).

Measurement of Surface Contamination Levels

Table 1 summarizes the results of surface contamination measurements performed in the radiologically controlled areas of Building T-055. The total contamination data presented in this table are direct measurements which include removable and non-removable activity. The total alpha activity ranged from a minimum detectable activity (MDA) of 18 to 390 dpm/100 cm^2. The maximum alpha level (south wall of Room 127 at 0N, 10.5E) was reduced to 120 dpm/100 cm^2 after a smear was taken. All other measurements indicated total alpha levels below 100 dpm/100 cm^2.

The highest average grid block results (64 dpm/100 cm^2) for alpha activity occurred along the lower east wall (24N, 18.4E) of Room 127. Removable alpha activity ranged from a MDA of 3 to 140 dpm/100 cm^2. The maximum removable alpha level occurred along the south wall of Room 127 (0N, 10.5E); a resurvey of this location after cleanup indicated a MDA of 3 dpm/100 cm^2. The total beta activity ranged from a MDA of 480 to 3900 dpm/100 cm^2. The maximum individual measurement and highest grid block average (1700 dpm/100 cm^2) occurred in Room 126 at coordinates 30N, 0E. Removable beta activity ranged from a MDA of 6 to 23 dpm/100 cm^2.

Table 2 presents the results of the surface contamination measurements performed in the non-radiologically controlled areas of the building. The total alpha activity ranged from a MDA of 22 to 110 dpm/100 cm^2. The highest total alpha activity was measured near the floor drain in Room 109. All smears for removable alpha activity were less than the MDA of 3 dpm/100 cm^2. The total beta activity ranged from a MDA of 450 to 1400 dpm/100 cm^2. The maximum total beta activity was measured along the lower east wall of Room 101 and on a sink top in Room 110. Smears for the determination of removable beta activity ranged from a MDA of 6 to 10 dpm/100 cm^2.

Exposure Rate Measurement

Exposure rate measurements inside Building T-055 ranged from 12 to 14 μR/h at one meter above the surface.

Paint Samples

Plutonium concentrations in paint samples are presented in Table 3. Isotopic plutonium analyses revealed that the concentration of Pu-238 for all samples were less than 1 dpm/100 cm^2, while the concentration of Pu-239/240 ranged from an MDA of 1 to 2 dpm/100 cm^2.

Radionuclide Concentrations in Trench Soil

Table 4 presents the results of the analyses performed on soil samples from excavated drain line trenches. With the exception of locations 1 and 2, the trenches had been backfilled with the original material taken from the trench. Because the soil had been mixed before and during backfilling, surface samples were considered representative of the average conditions of the backfill material. In most cases, the measured concentrations of the radionuclides of concern were less than the minimum detectable levels for that radionuclide. The concentrations are typical of these normally associated with surface soil samples.

Radionuclide Concentrations in Confirmatory Soil Samples

Five soil samples, originally collected by the licensee from areas near the interior drain line, were chosen by ORAU for confirmatory analyses (Table 5). ORAU analyzed these samples by gamma spectroscopy techniques and wet chemistry for isotopic plutonium. Concentrations measured by ORAU were: U-235, <0.36 to <0.46 pCi/g; U-238, 1.7 to 5.1 pCi/g; Am-241, <0.11 to <0.13 pCi/g; Pu-238, <0.01 to 0.01 pCi/g; and Pu-239/240, <0.01 to 0.06 pCi/g. Rockwell did not analyze those samples for uranium or Am-241; plutonium concentrations measured by the licensee were: Pu-238, 0.0003 to 0.0552 pCi/g and Pu-239/240, 0.0007 to 0.6130 pCi/g. Both sets of analyses demonstrate that no significant concentrations of radionuclides are present in the trench soil.

Plutonium Concentrations in Miscellaneous Residue Samples

Table 6 presents the results of plutonium analyses on residues from anchor bolt holes and other facility locations. Plutonium-238 content ranged from 0.1 to 0.5 pCi; Pu-239/240 content was 0.2 to 2.1 pCi.

Outside Area Survey

Surface Scans

No locations of elevated direct radiation levels were identified by gamma scans of the areas within 10 meters of the building, in the adjacent parking lots and drainage ditches, or in the waste retention well.

Roof Survey

The results of the contamination measurements on roof surfaces and exhaust ventilation equipment are presented in Table 7. The hightest total contamination measurements were: 120 dpm/100 cm^2 alpha, and 890 dpm/100 cm^2 beta-gamma. The smear analyses for removable contamination showed that the results were less than the minimum detectable activity of 3 dpm/100 cm^2 alpha, and 6 dpm/100 cm^2 beta.

Waste Tank Area

Exposure rates in the retention well ranged from 12 to 16 μR/h. No locations of elevated alpha, beta-gamma, or gamma radiation were noted. Total alpha measurements ranged from a MDA of 22 to 49 dpm/100 cm^2; removable alpha was less than the MDA of 3 dpm/100 cm^2. Total and removable beta-gamma levels were 470 to 1200 dpm/100 cm^2 and less than a MDA of 6 dpm/100 cm^2, respectively.

Exposure Rate Measurements

The exposure rates measured at one meter above the surface ranged from 12 to 14 μR/h (Table 8); this is comparable to the background range of 10 to 13 μR/h, typical of the middle California region.

Radionuclide Concentrations in Soil Samples

Results of analyses on soil samples from the outside drainline trenches are presented in Table 9. Only photopeaks associated with naturally occurring radionuclides were detected and concentrations were generally less than the measurement sensitivities. The seven samples were composited and the plutonium concentrations were found to be 0.01 pCi/g for Pu-238 and was 0.04 pCi/g for Pu-239/240.

Water Sample

The gross alpha and gross beta concentrations in the water sample from the liquid waste retention well were 3.1 ± 1.0 pCi/l (picocuries per liter) and 95.3 ± 3.0 pCi/l, respectively.

COMPARISON OF RESULTS WITH GUIDELINES

NRC surface contamination guidelines for release of facilities for unrestriced use are presented in Appendix C. The principal radioactive materials in this facility were plutonium and uranium. The guidelines for plutonium alpha contamination are the most restrictive and have been used for the NMDF

decommissioning. These guidelines are:

Total Alpha Contamination

300 dpm/100 cm^2 (maximum in a 100 cm^2 area)
100 dpm/100 cm^2 (averaged over 1 m^2)

Removable Alpha Contamination

20 dpm/100 cm^2

In addition to the alpha contamination guidelines, the results were compared with the following NRC guidelines for beta-gamma contamination:

Total Beta-gamma Contamination

15,000 dpm/100 cm^2 (maximum in a 100 cm^2 area)
5,000 dpm/100 cm^2 (averaged over 1 m^2)

Removable Beta-gamma Contamination

1,000 dpm/100 cm^2

A review of survey results indicates that all surface contamination levels are within the alpha and beta-gamma guidelines.

Soil samples, collected in and around the NMDF, were compared to the NRC guidelines for depleted uranium (35 pCi/g) and for total plutonium (25 pCi/g). All samples had concentrations well within these levels. In addition, ORAU's analyses on the samples collected by the licensee support the licensee's sample data of no significant contamination, given the inherent variability of sampling non-homogeneous materials and the very low concentrations being measured.

The exposure rate criteria for the site is 10 μR/h above background at one meter above the surface. The average background determined in the area was 12 μR/h, giving a total guideline level of 22 μR/h. The exposure rate guideline was met by all measurements performed.

The water sample collected from the liquid waste retention well was compared to the Environmental Protection Agency (EPA) drinking water screening guidelines of 15 pCi/l, gross alpha, and 50 pCi/l, gross beta. The gross alpha result was approximately 20% of the EPA value, while the gross beta concentration was approximately twice the EPA value. The elevated beta concentration is believed due to natural activity leached from the concrete. (It should also be noted that the EPA drinking water guidelines are used only for comparison purposes and are not applicable to this site, because the water is not used for a community drinking water system).

SUMMARY

At the request of the Nuclear Regulatory Commission, Region V Office, Oak Ridge Associated Universities conducted a confirmatory radiological survey of Rockwell International Corporation's Nuclear Materials Development Facility (Building T-055), located in Santa Susana, California. Based on the results of this survey and a review of the decommissioning documentation, it is ORAU's opinion that the remedial action has been effective in satisfying the NRC's radiological guidelines for release for unrestricted use and that the documentation accurately describes the radiological status of the NMDF.

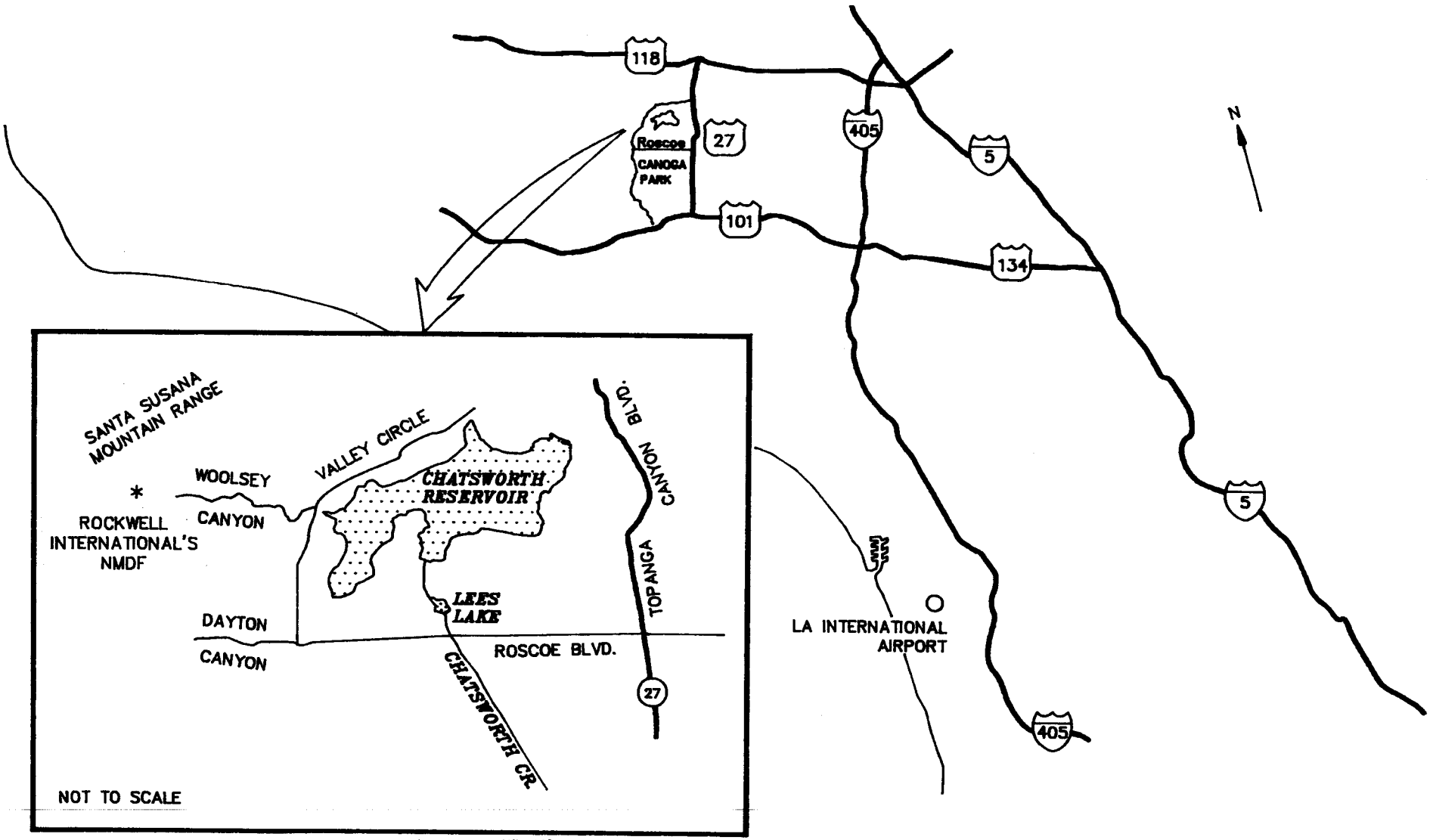

FIGURE 1: Map of Canoga Park, California Area Showing the Location of Rockwell International's Nuclear Materials Development Facility

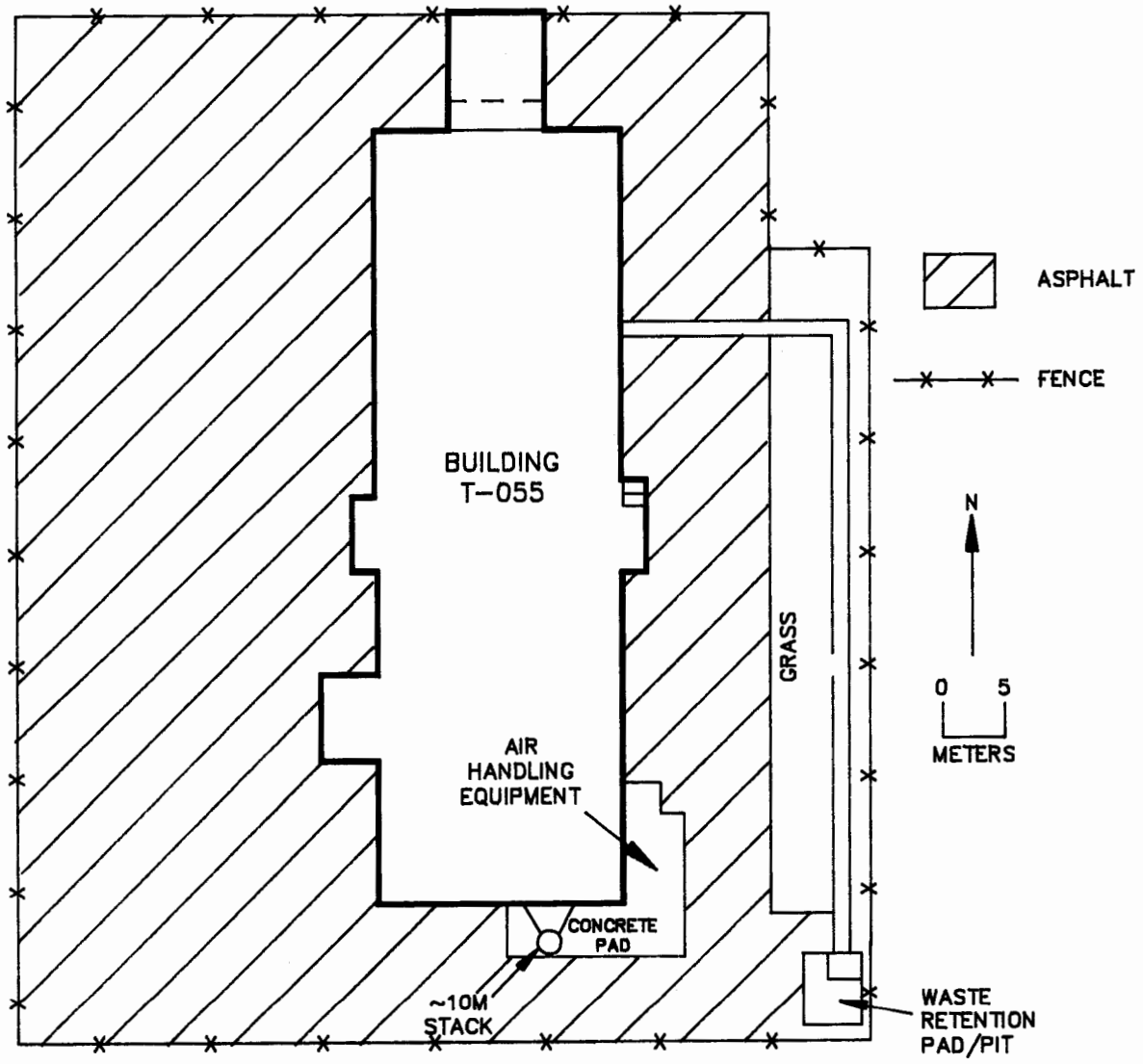

FIGURE 2: Nuclear Materials Development Facility
Plot Plan

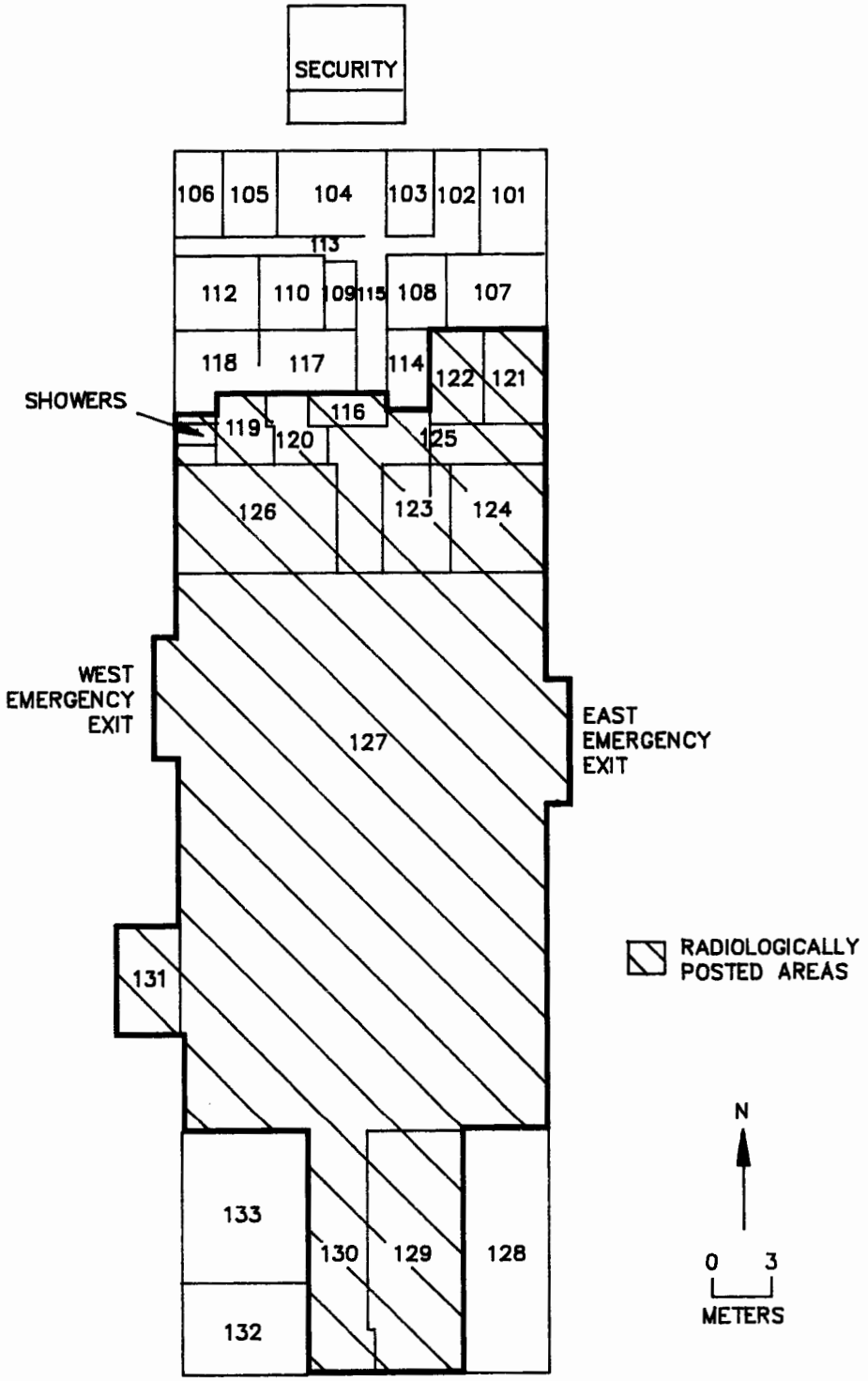

FIGURE 3: Nuclear Materials Development Laboratory (Building T-055) Floor Plan

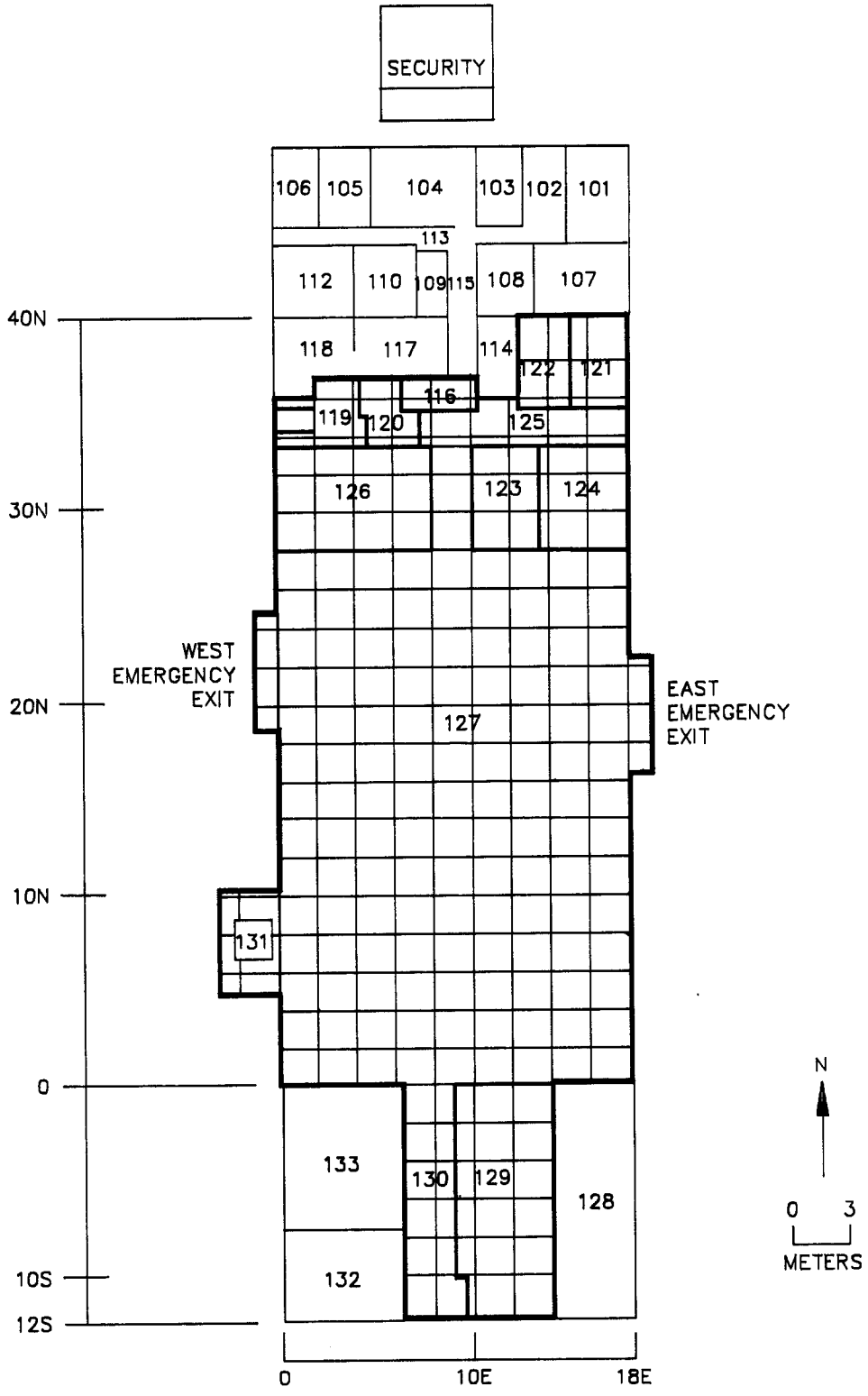

FIGURE 4: Grid System Established for Radiologically Posted Areas

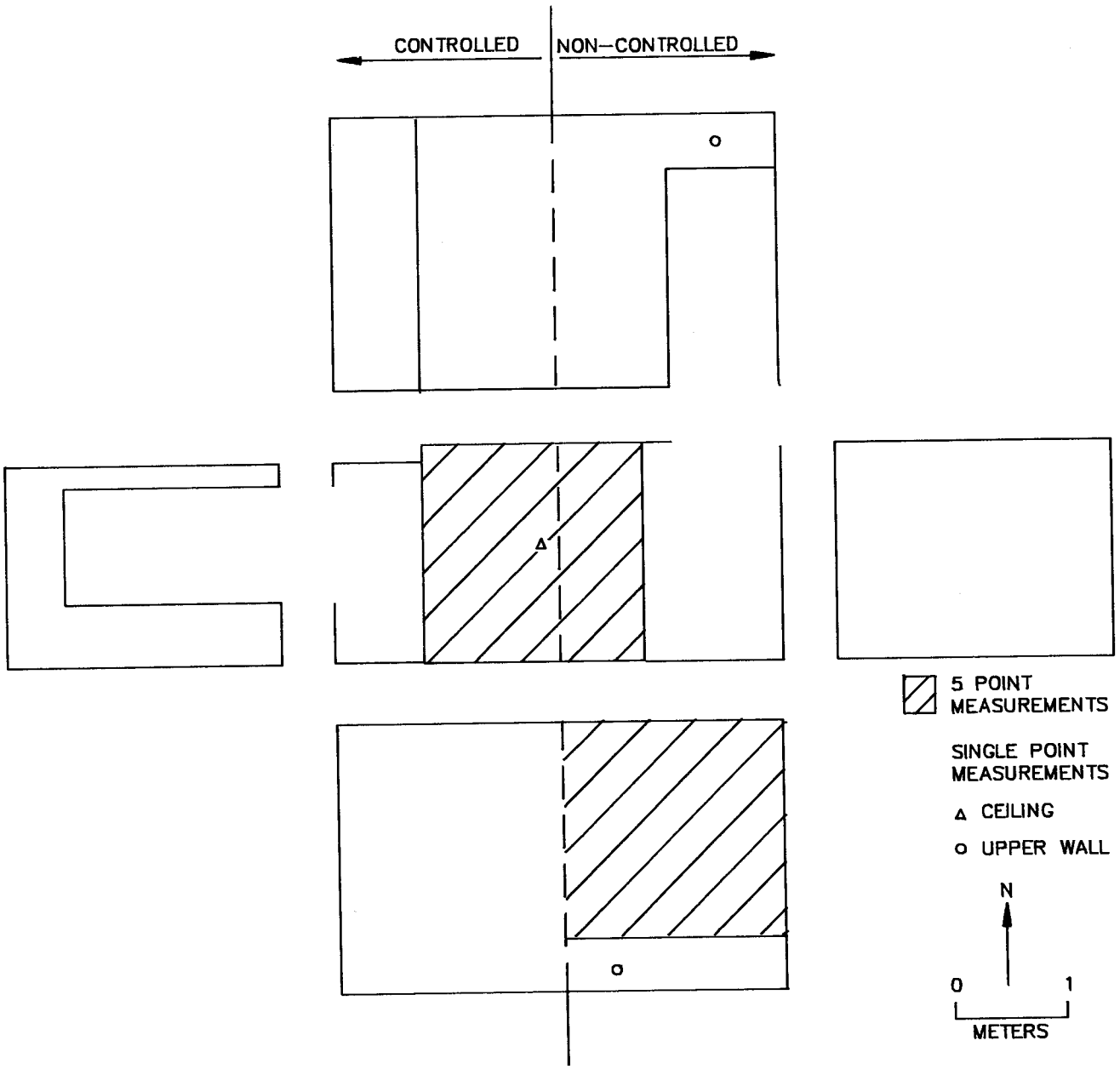

FIGURE 5: Location of Measurements in Room 116–Change Room

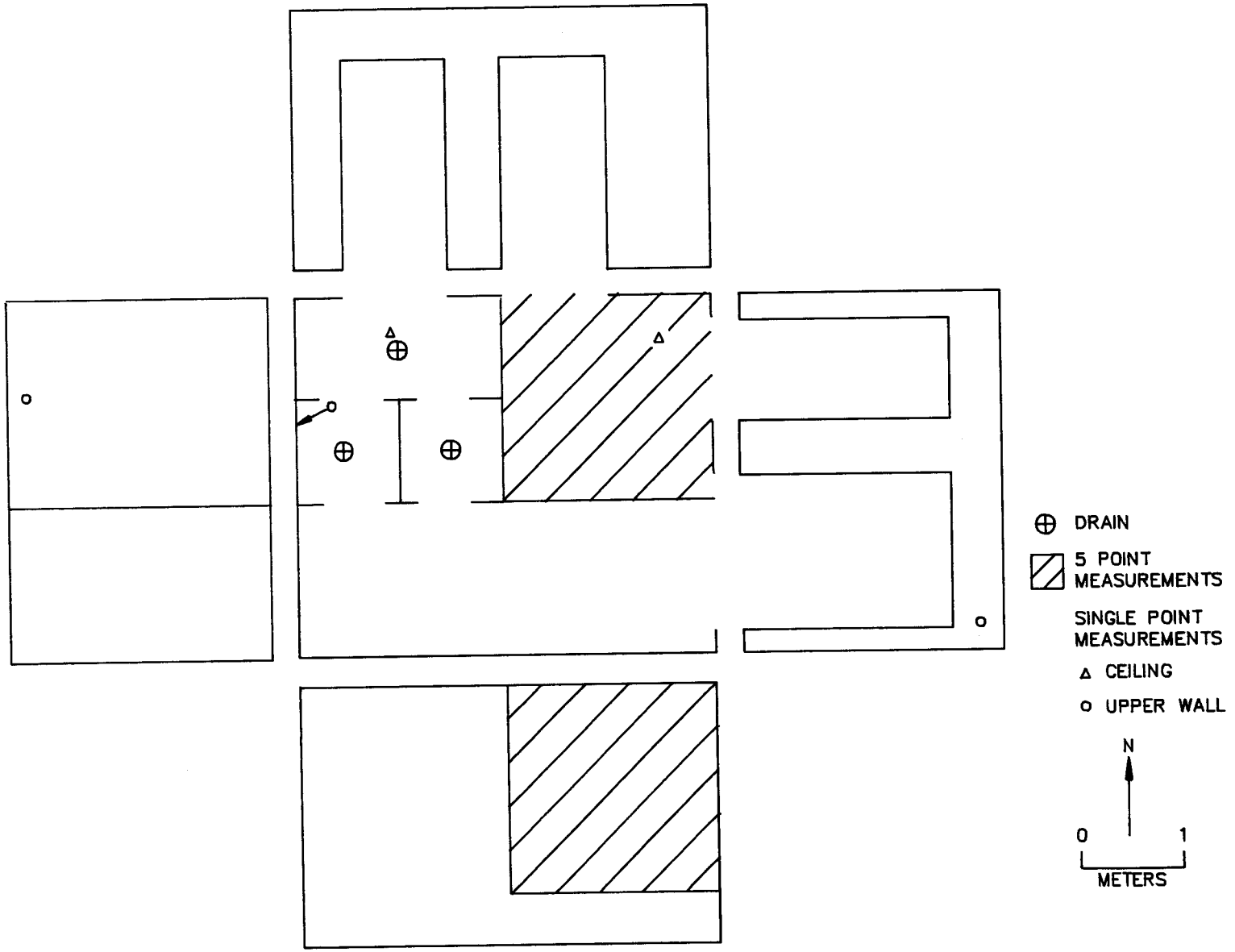

FIGURE 6: Location of Measurements in Room 119—Shower and Change Room

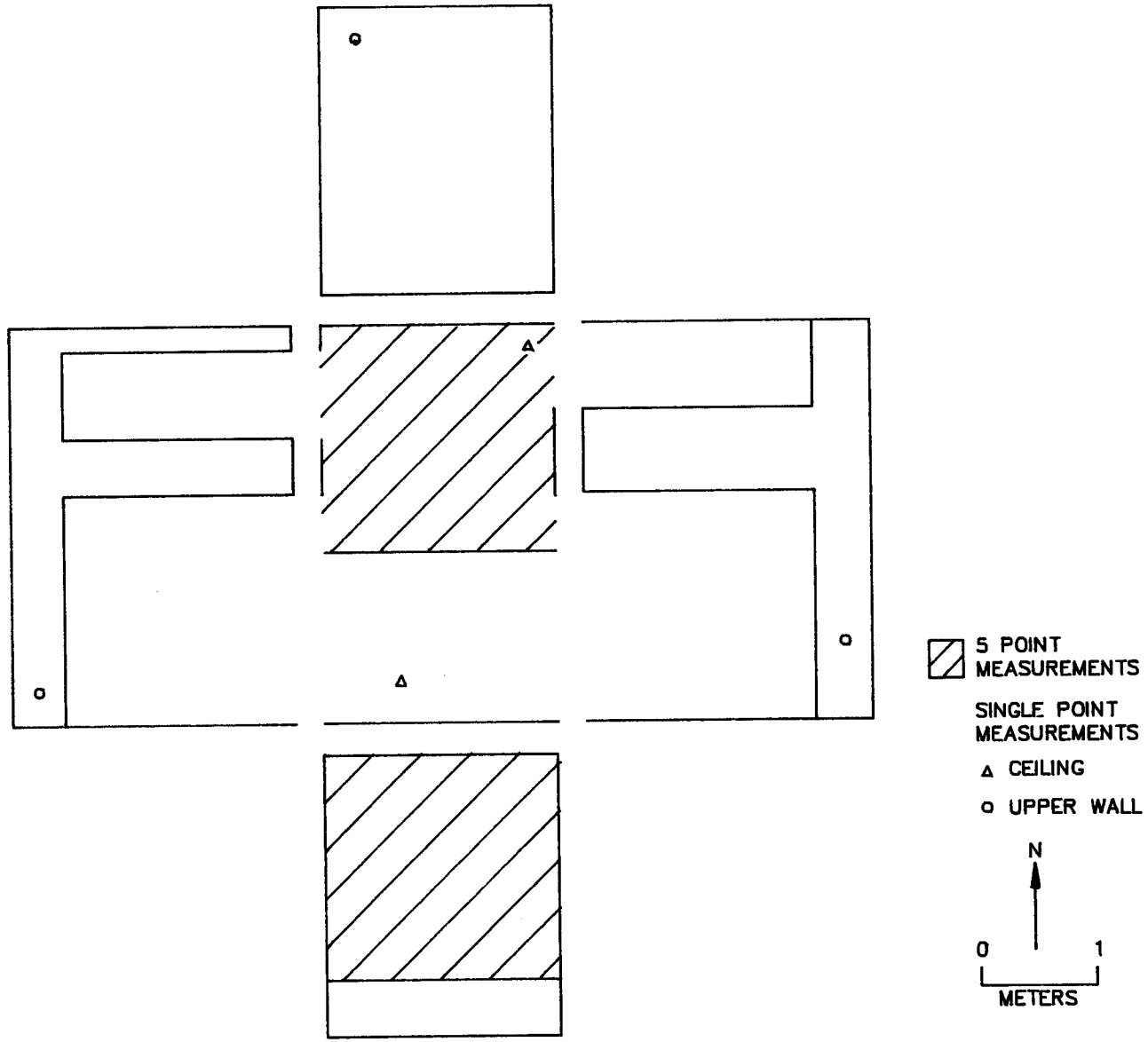

FIGURE 7: Location of Measurements in Room 120—Airlock to Controlled Area

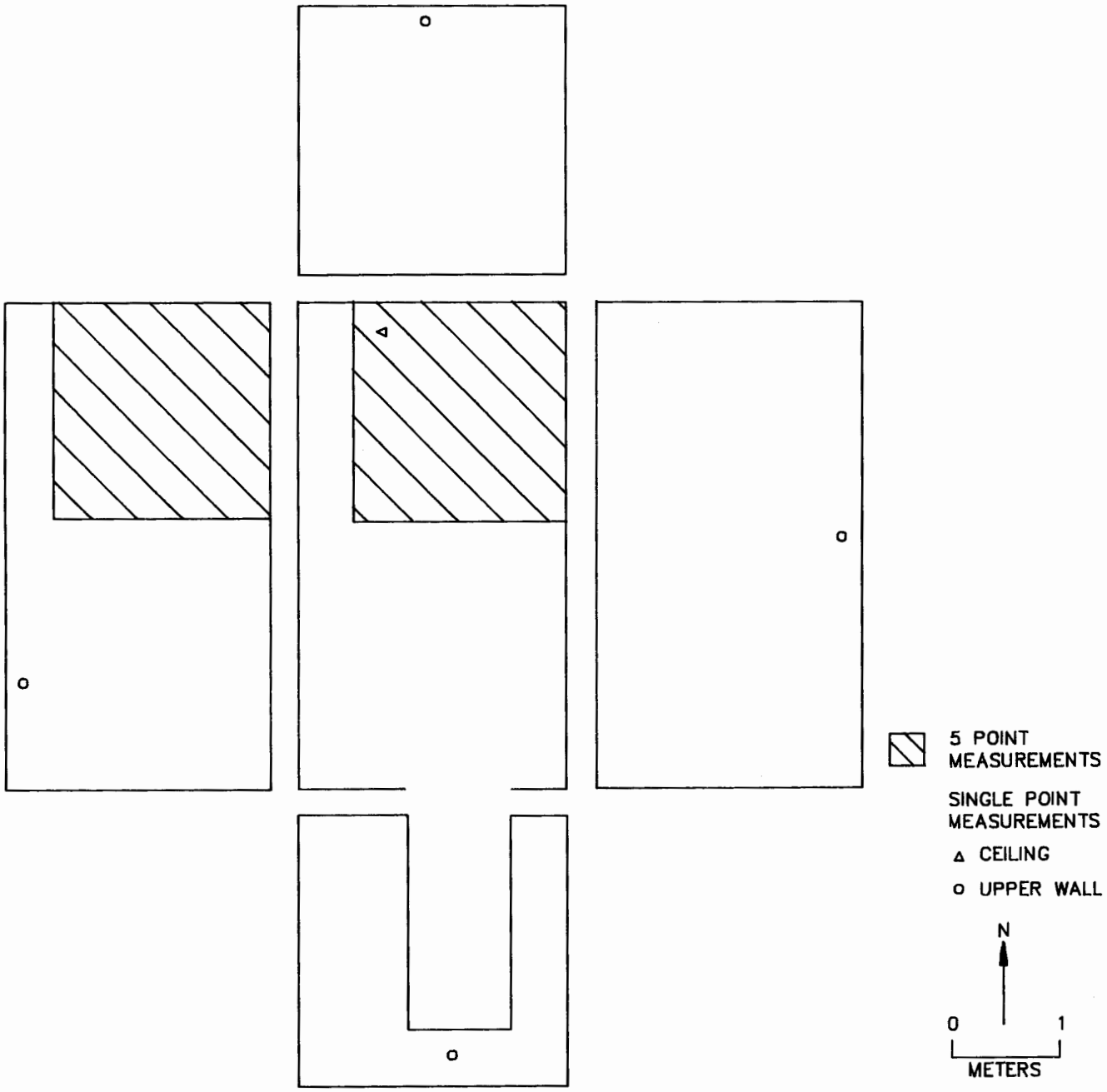

FIGURE 8: Location of Measurements in Room 121—Health and Safety/Counting Laboratory

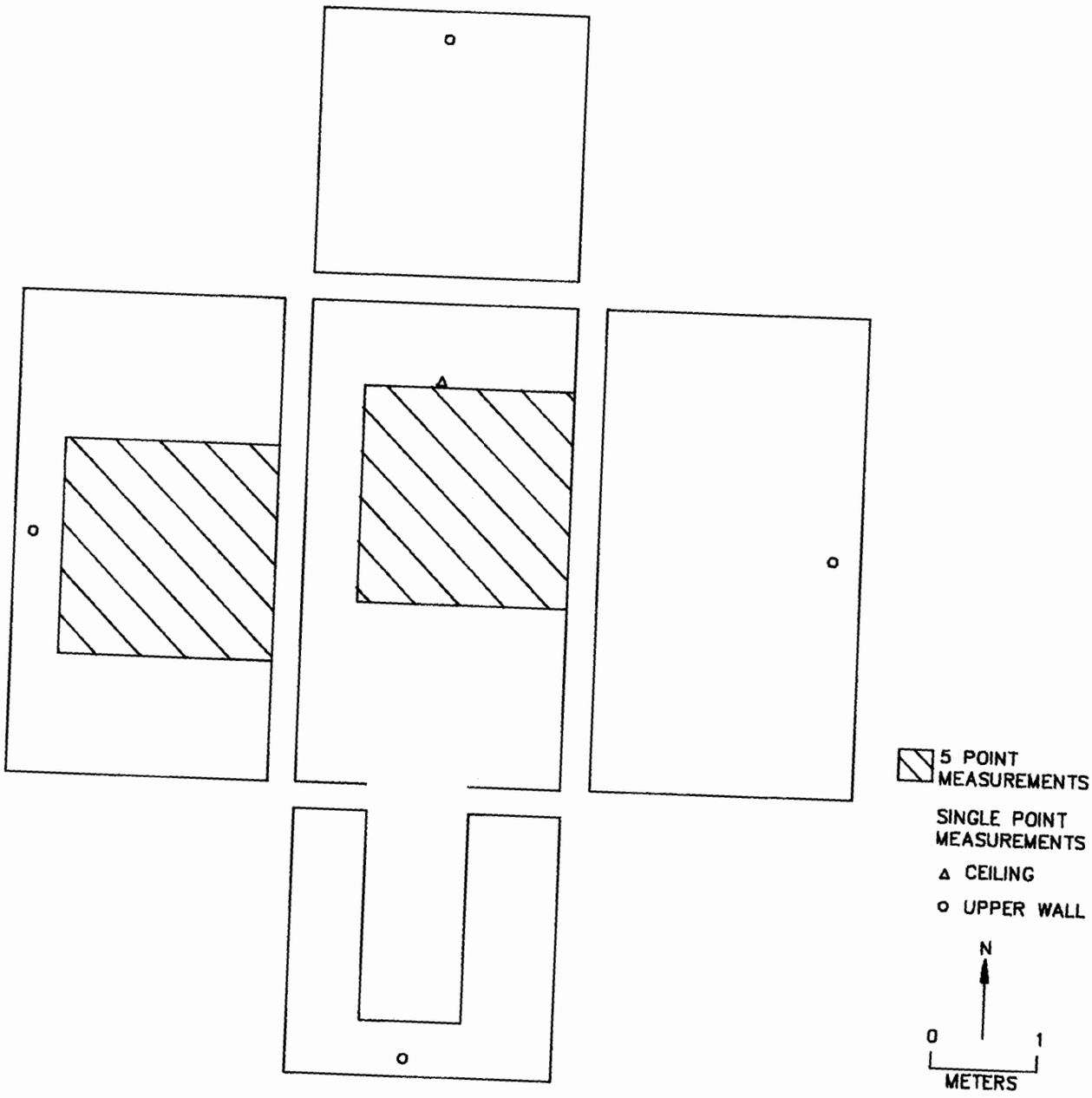

FIGURE 9: Location of Measurements in Room 122--Photographic Darkroom

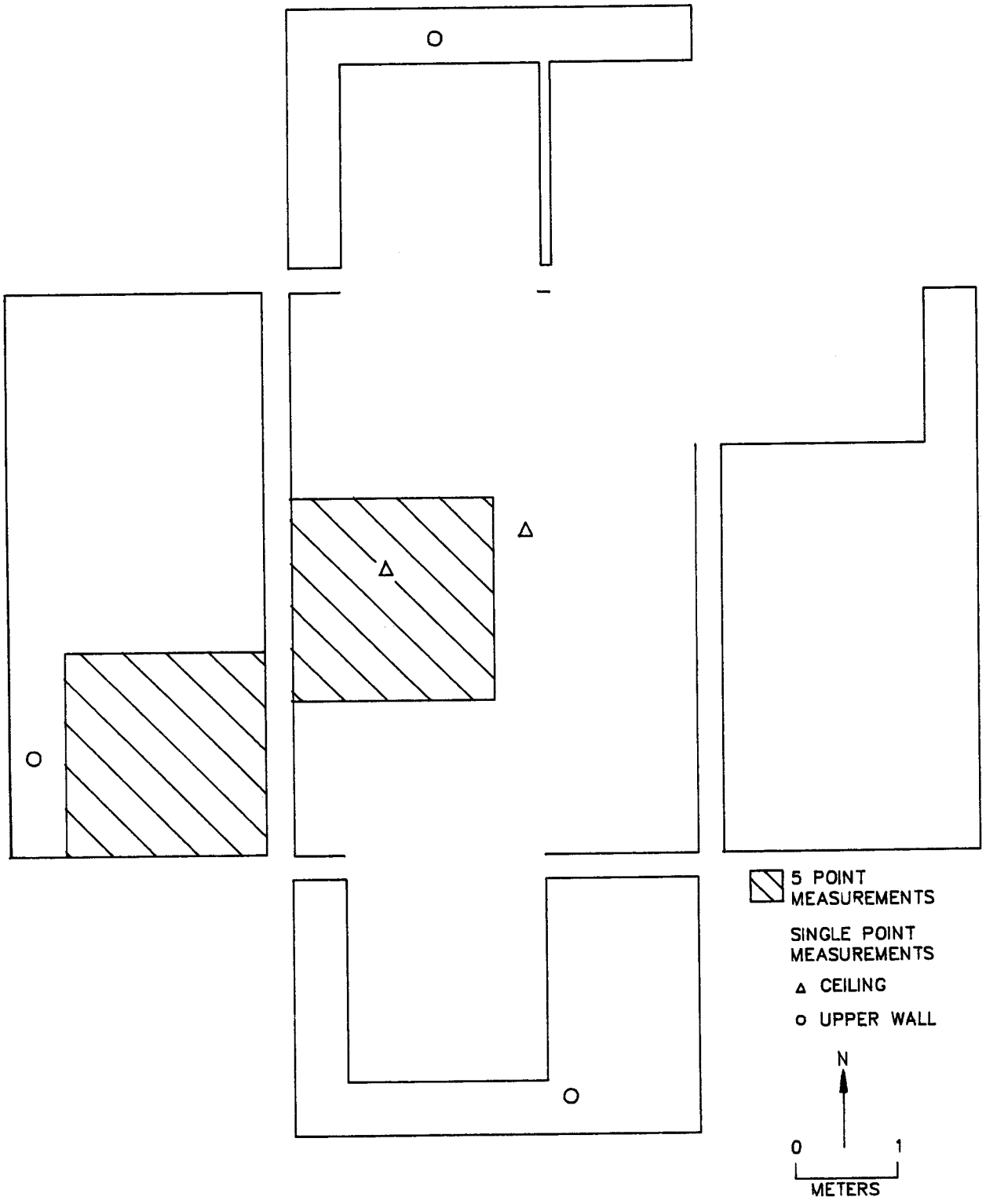

FIGURE 10: Location of Measurements in Room 123–Instrument Laboratory

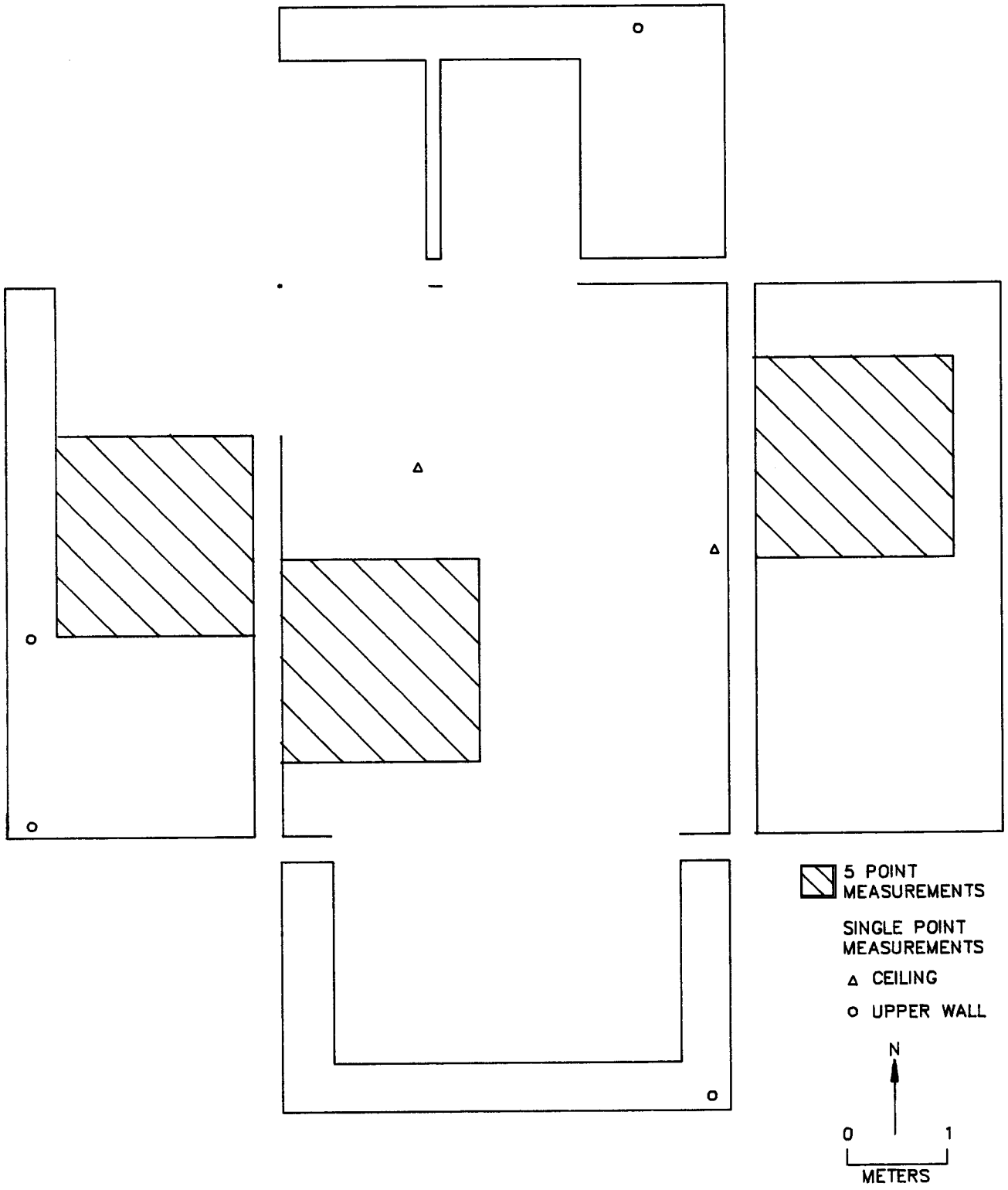

FIGURE 11: Location of Measurements in Room 124—Chemistry Laboratory

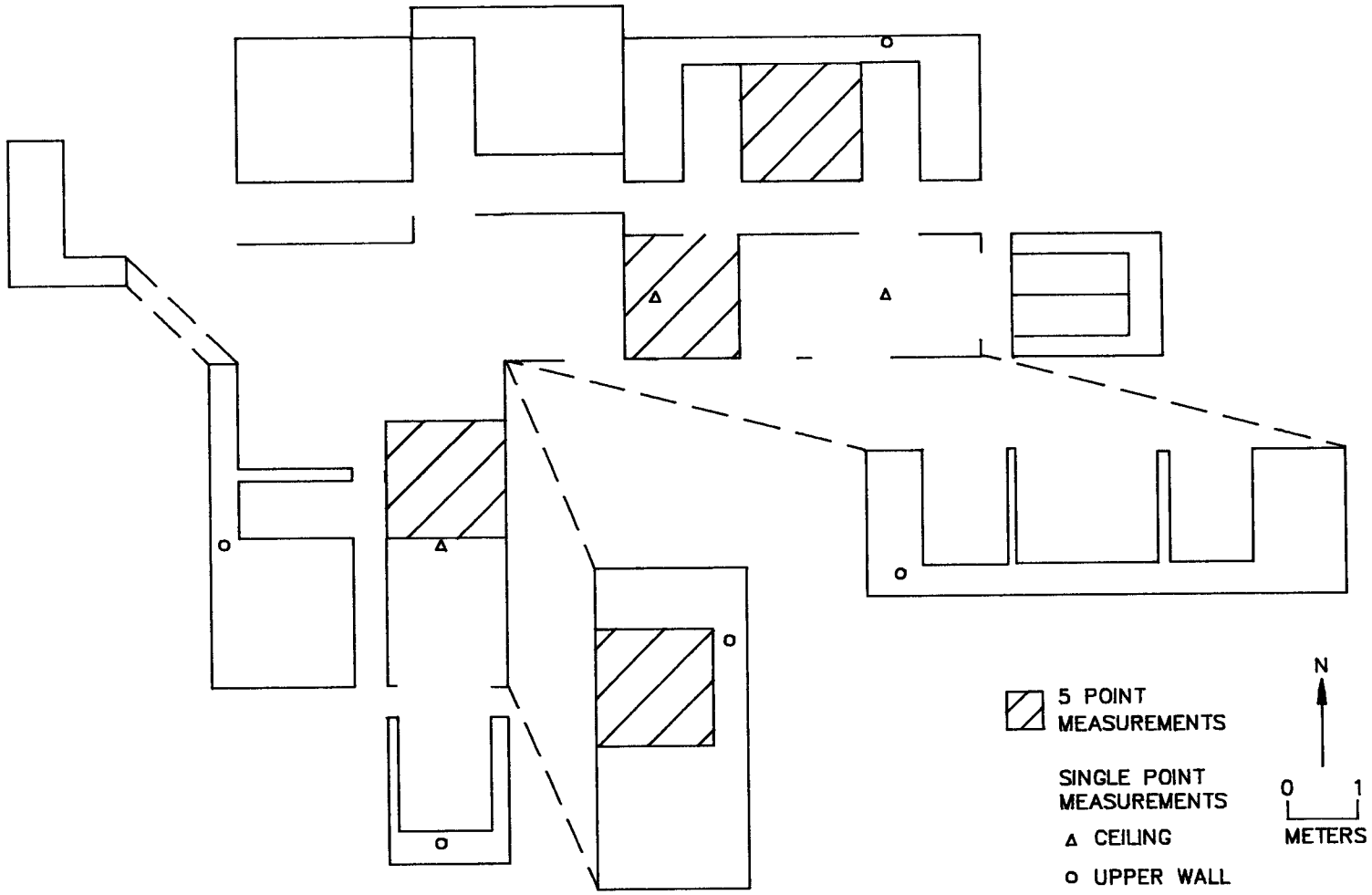

FIGURE 12: Location of Measurements in Room 125—Corridor

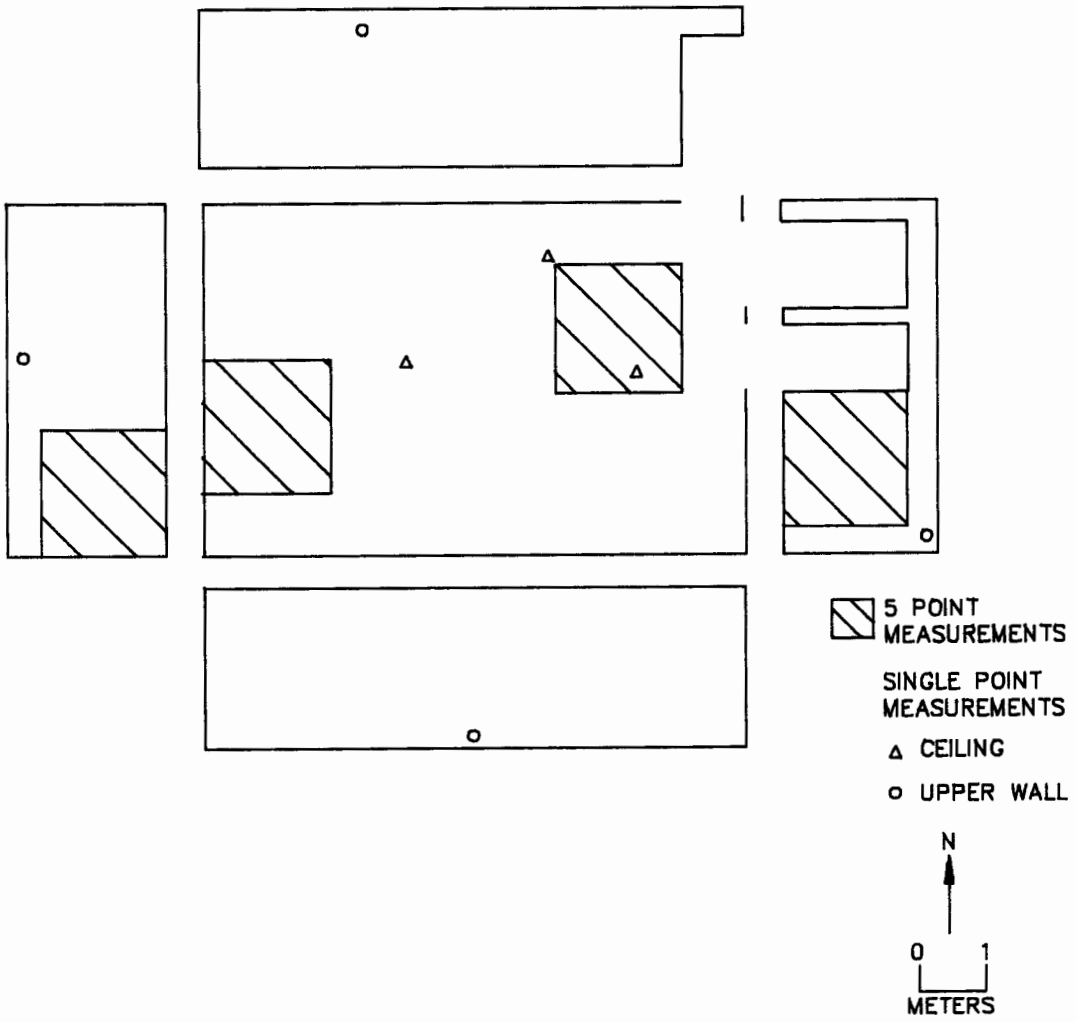

FIGURE 13: Location of Measurements in Room 126–Process Laboratory

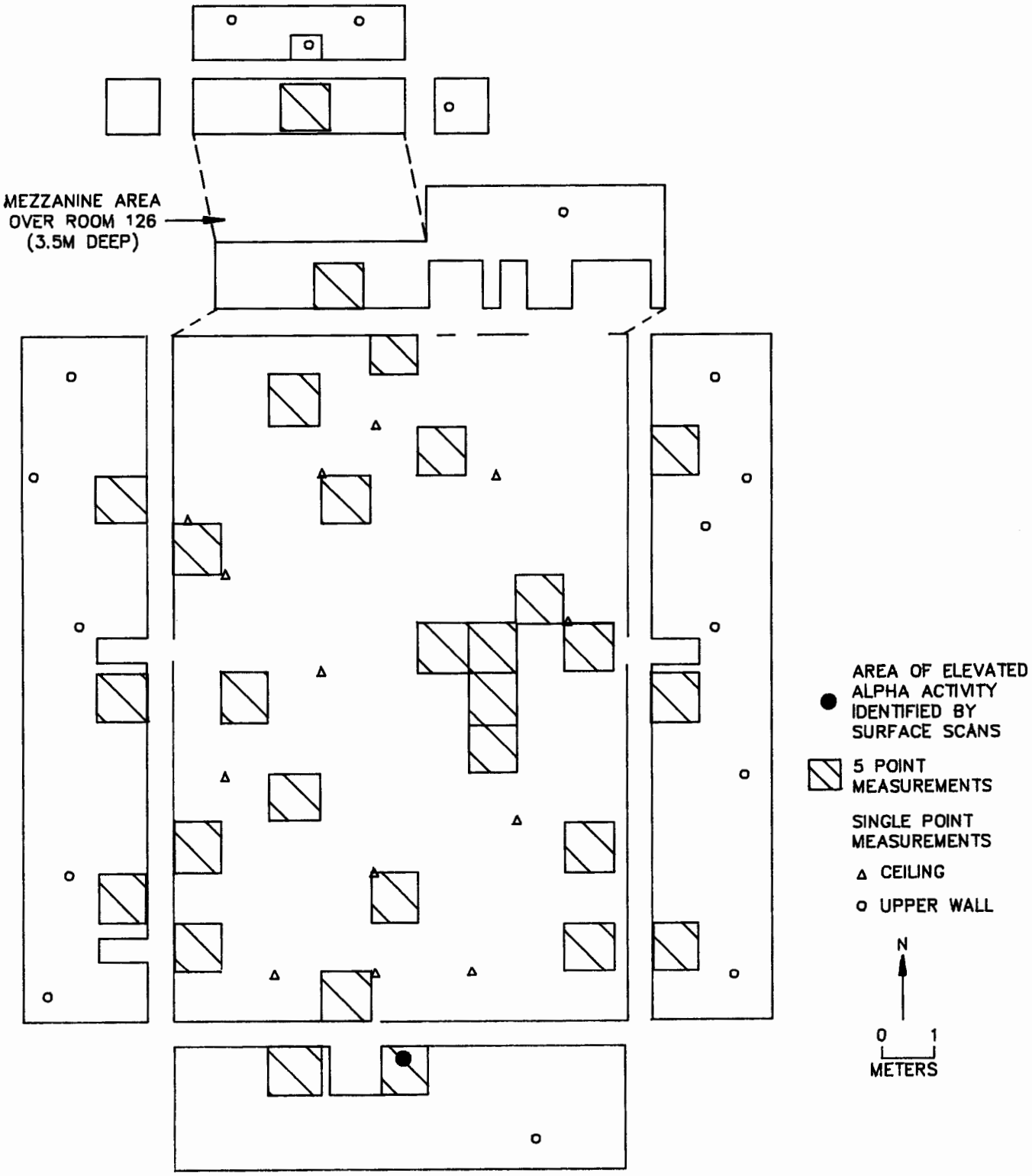

FIGURE 14: Location of Measurements in
Room 127–Glove Box Laboratory

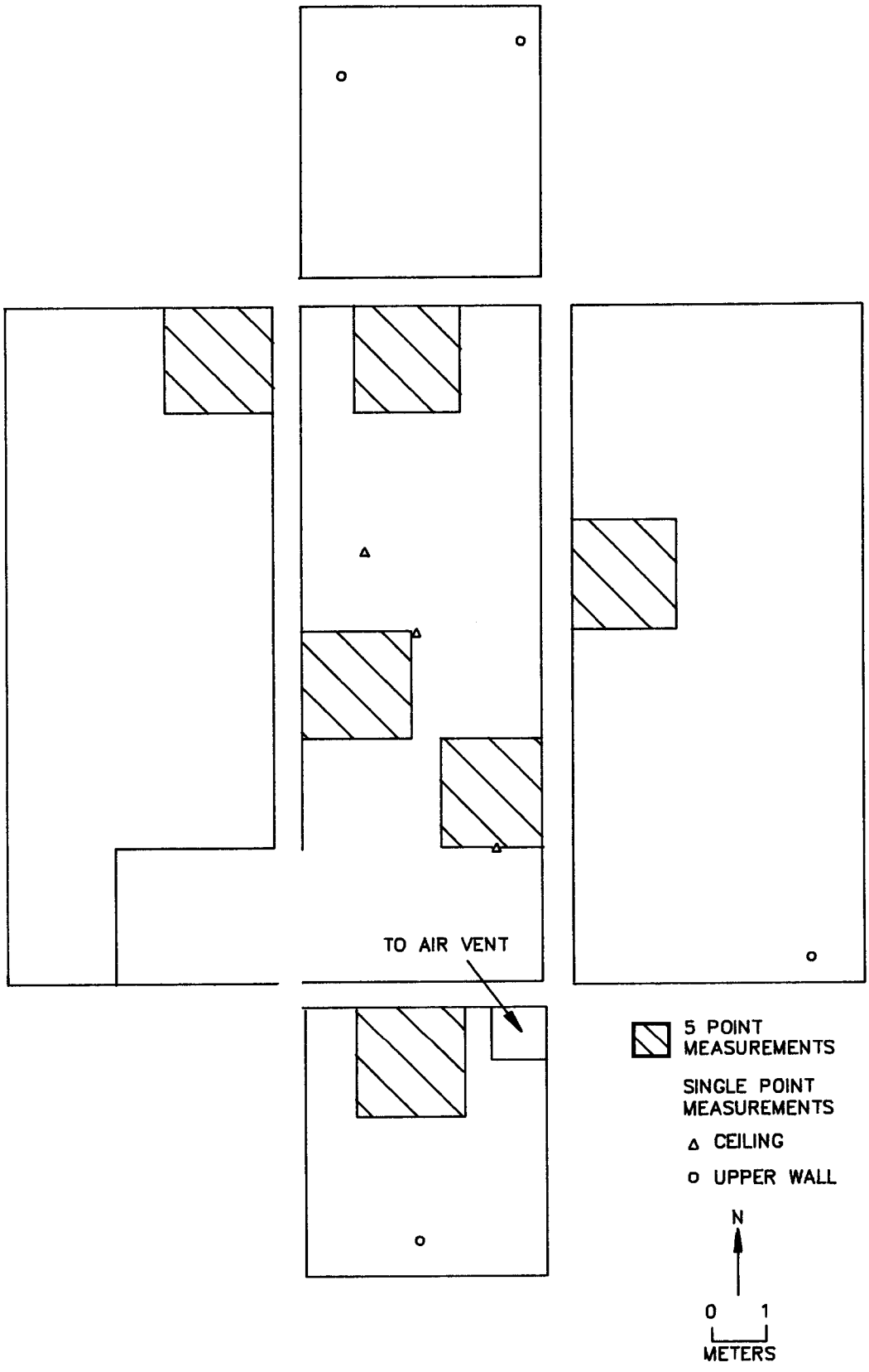

FIGURE 15: Location of Measurements in Room 129—Radioactive Exhaust Equipment Room

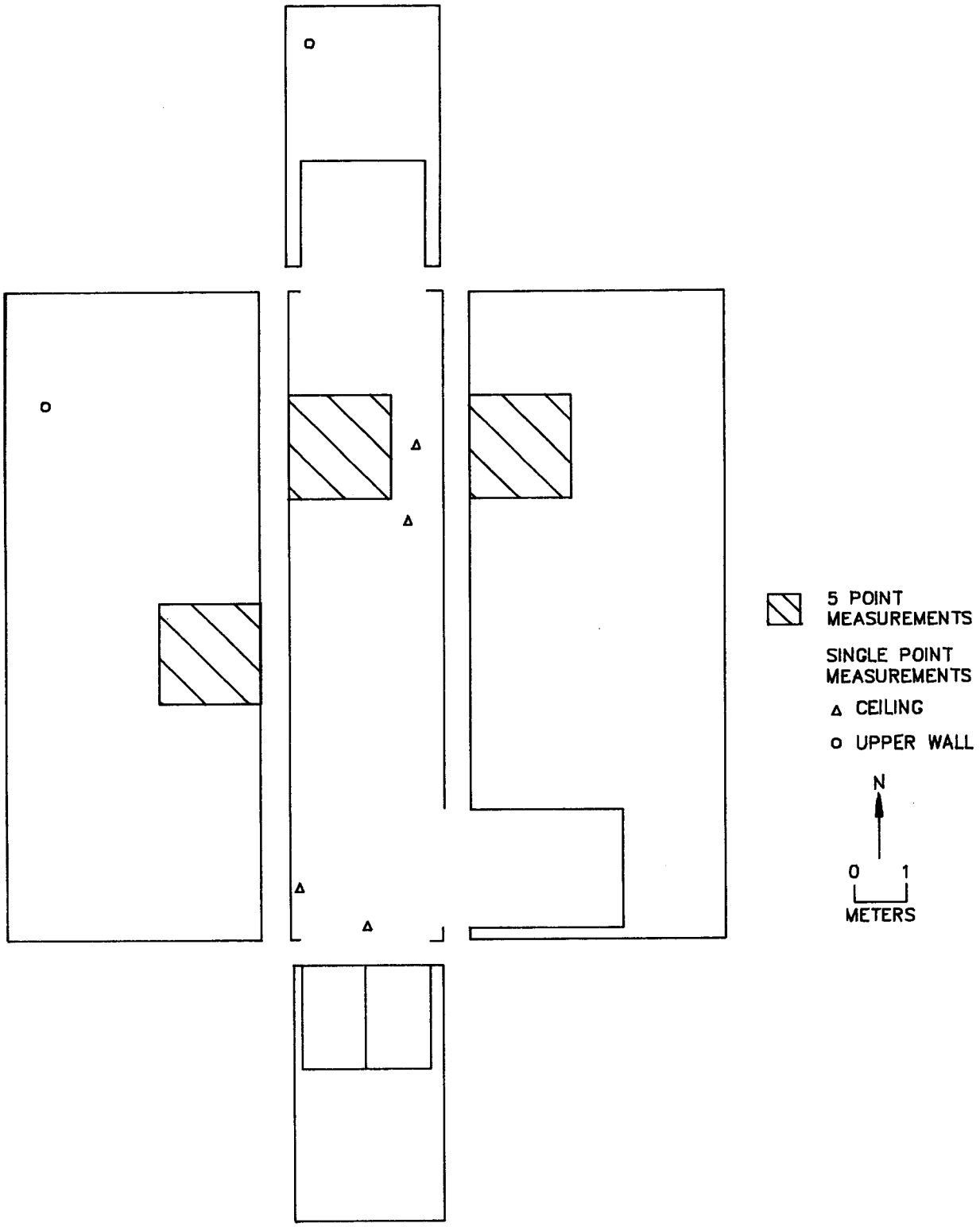

FIGURE 16: Location of Measurements in Room 130–Airlock to Controlled Area

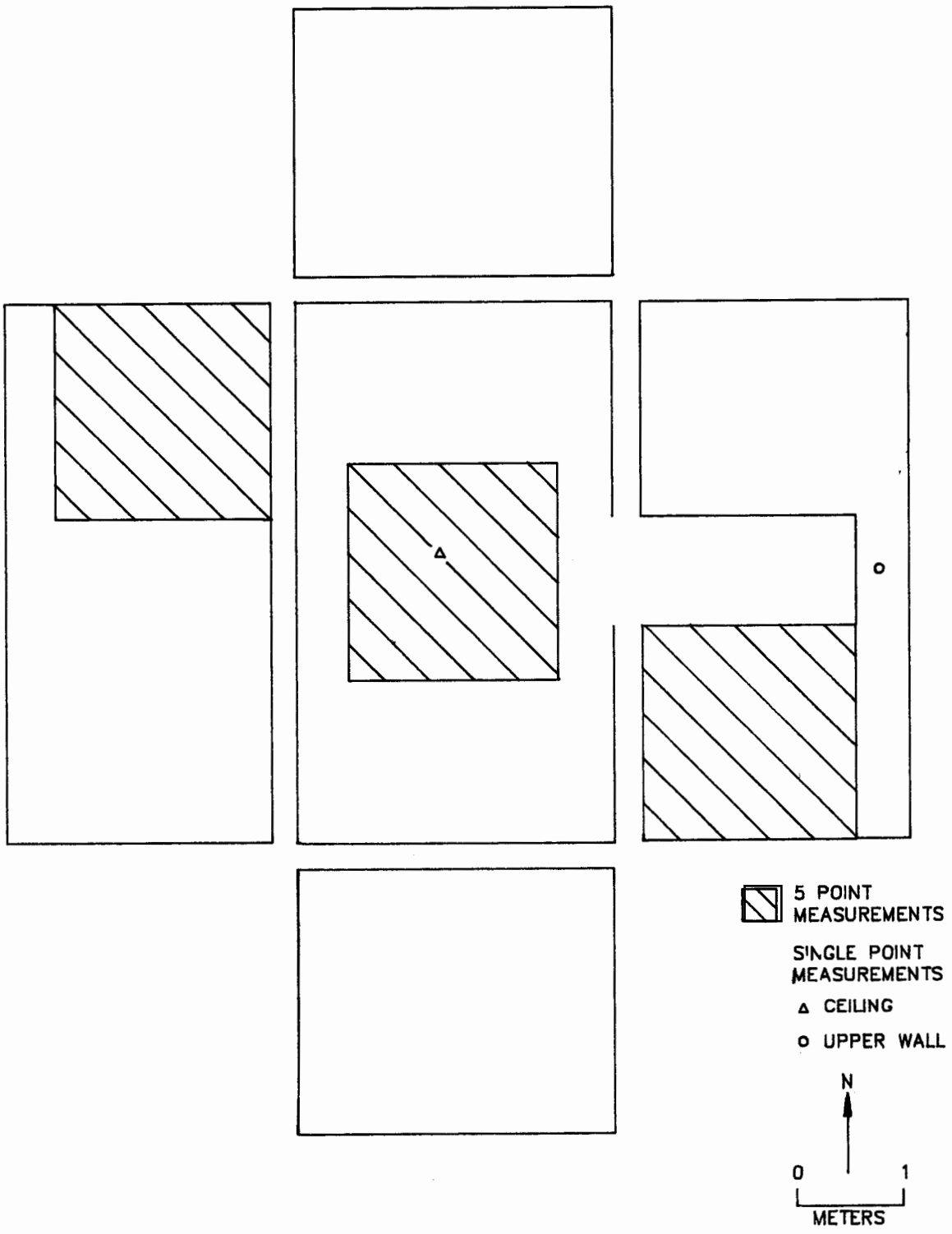

FIGURE 17: Location of Measurements in Room 131–Radioactive Materials Storage Vault

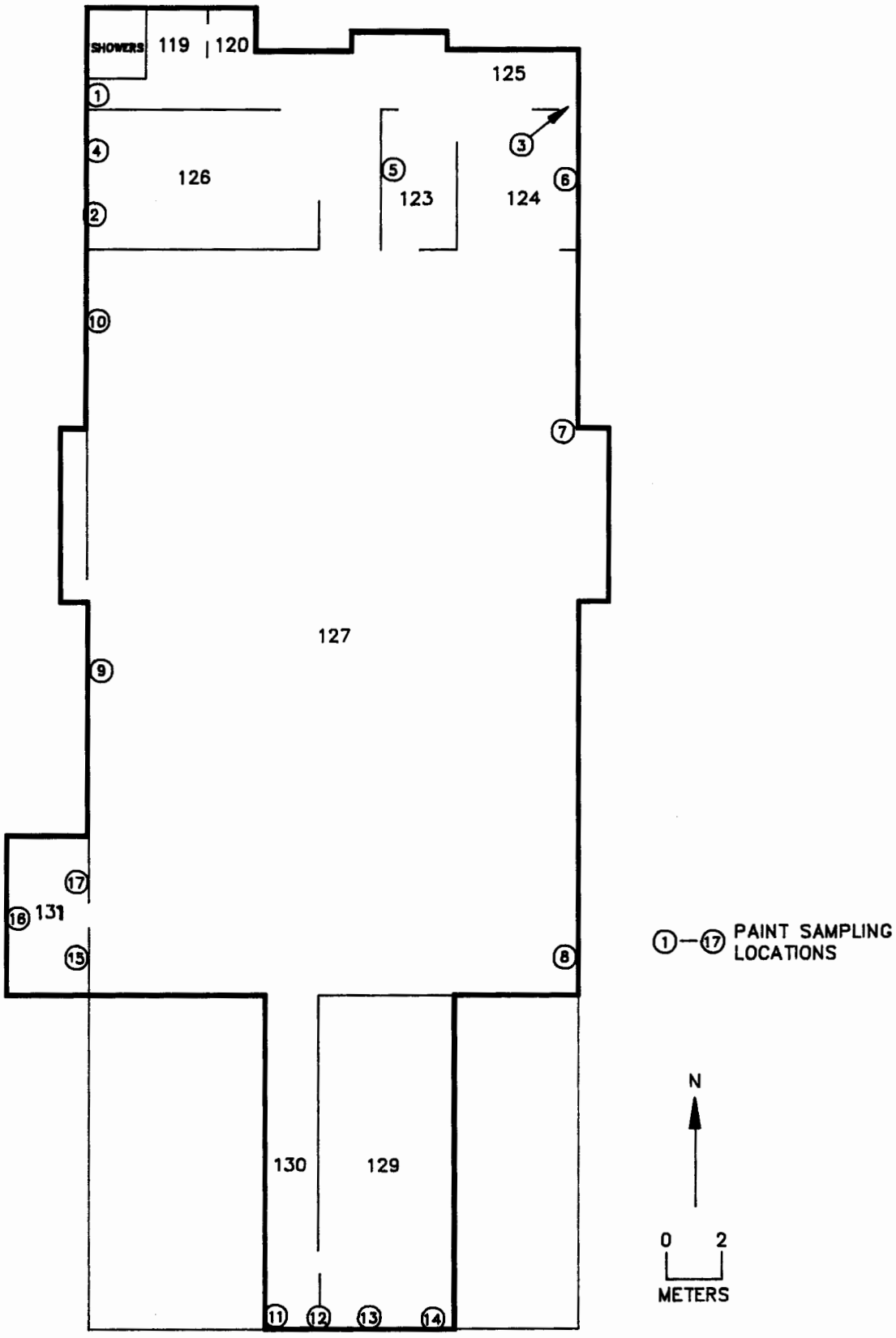

FIGURE 18: Location of Paint Samples in Radiologically Posted Areas

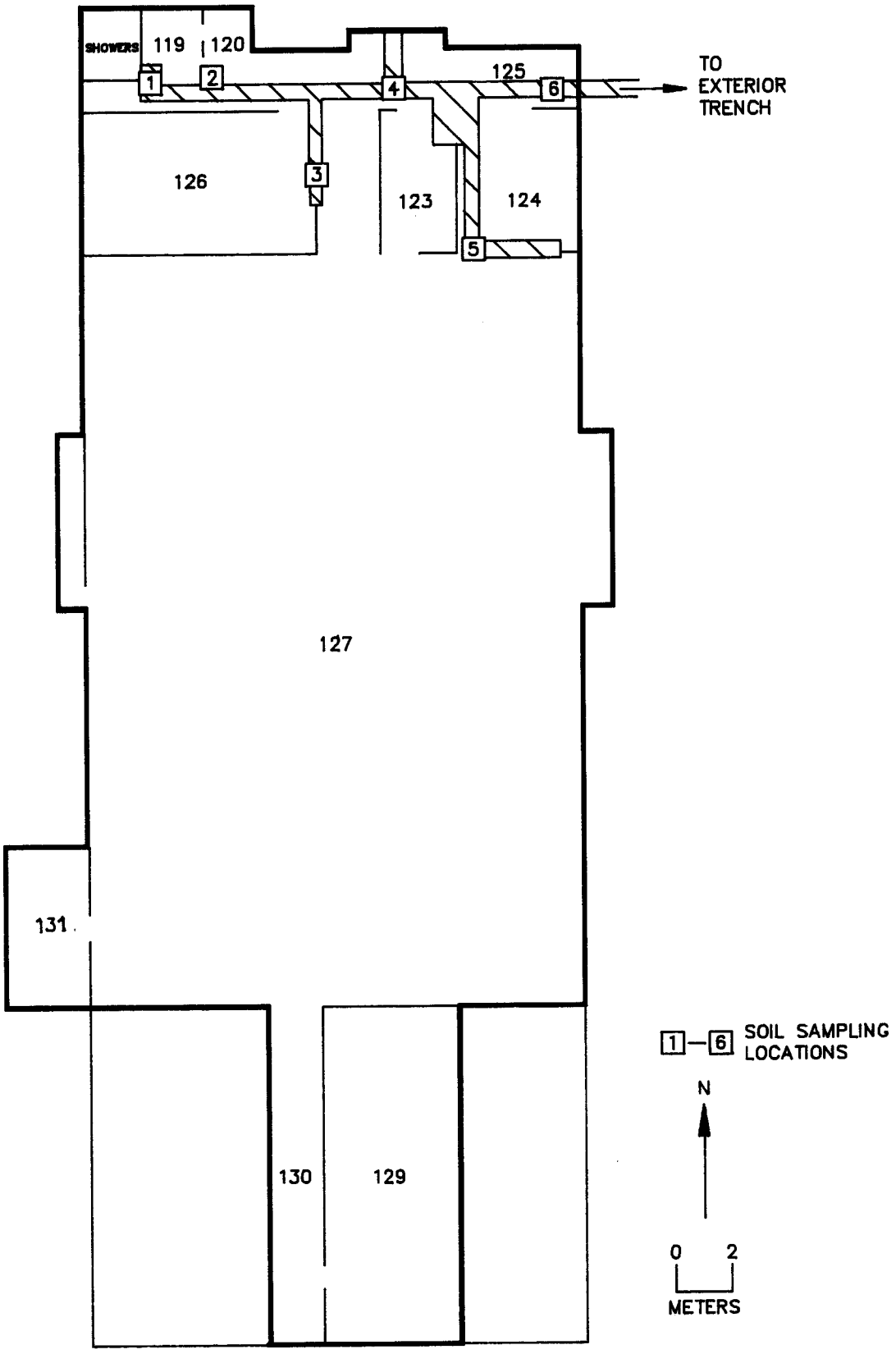

FIGURE 19: Location of Interior Soil Samples from Excavated Trenches

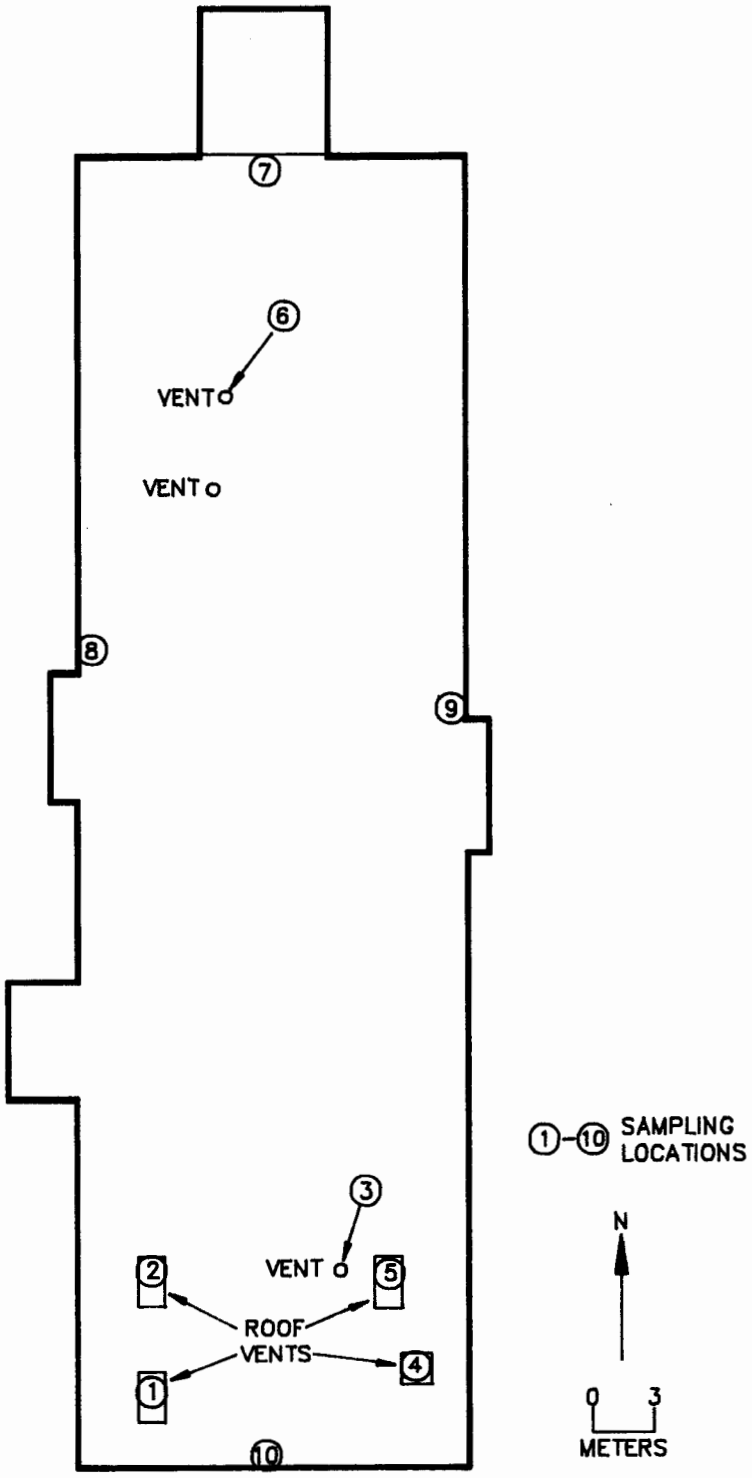

FIGURE 20: Location of Roof Surface Contamination Measurements

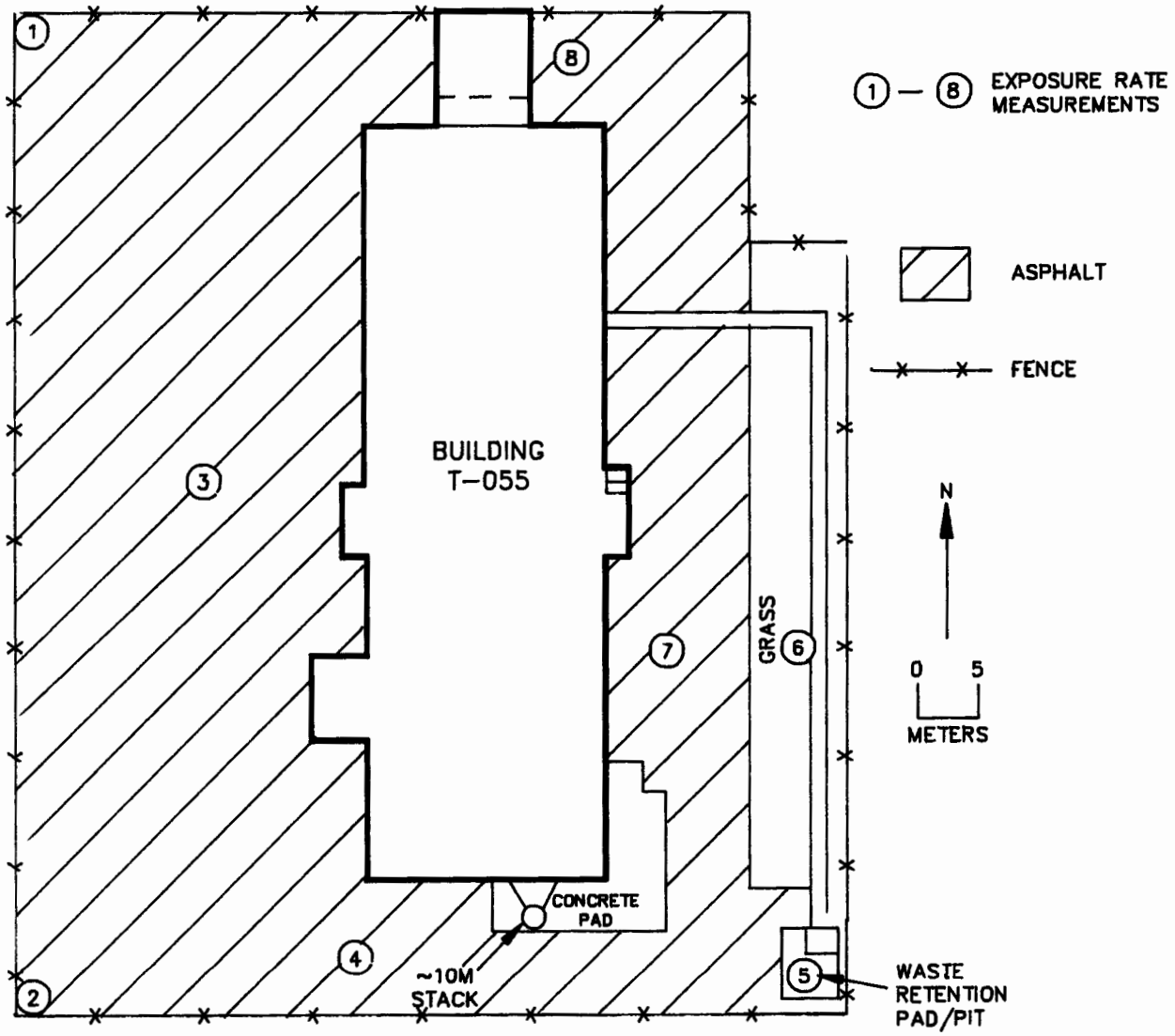

FIGURE 21: Location of Exposure Rate Measurements Outside Building T-055

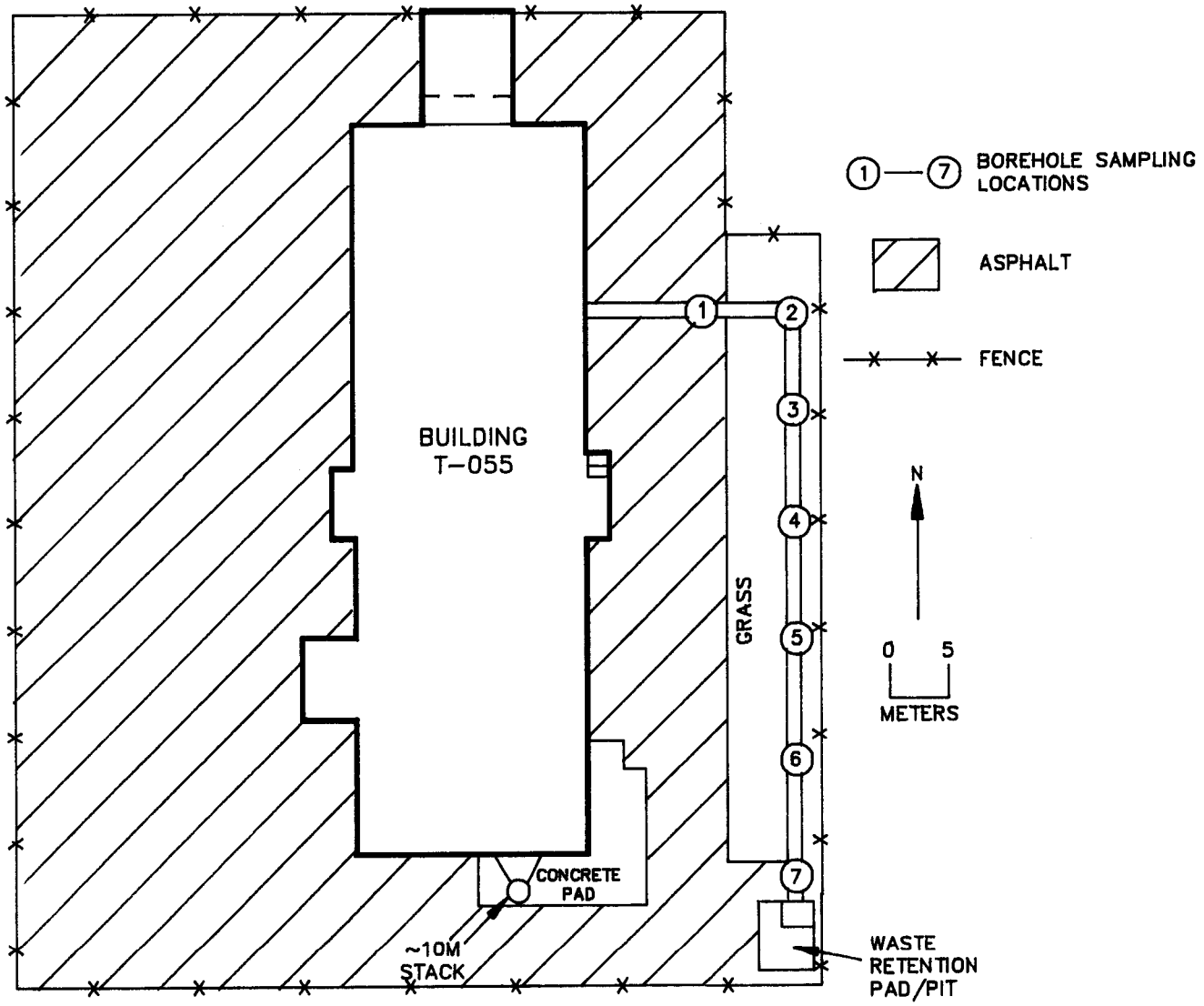

FIGURE 22: Location of Sampling from Waste Line Trench

TABLE 1

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location[a]	Number of Grid Blocks Surveyed	TOTAL CONTAMINATION				REMOVABLE CONTAMINATION		Number of Grid Blocks Exceeding Criteria
		Alpha (dpm/100 cm^2)		Beta-Gamma (dpm/100 cm^2)				
		Highest Grid Block Avg.	Range of Measurements	Highest Grid Block Avg.	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 116								
Floors/lower walls[b]	2	32	<25-45	570	<440-730	<3	<6	0
Upper walls/ ceilings[c]	3	n/a[d]	45-89	n/a	<440	<3	<6	0
ROOM 119								
Floors/lower walls[b]	2	41	<18-62	840	<440-1200	<3-5	<6	0
Upper walls/ ceilings[c]	5	n/a	<25-62	n/a	<440	<3	<6	0
ROOM 120								
Floors/lower walls[b]	2	28	<25-36	650	<440-830	<3	<6	0
Upper walls/ ceilings[c]	5	n/a	<25-62	n/a	<440	<3	<6-7	0

TABLE 1 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Grid Blocks Surveyed	TOTAL CONTAMINATION				REMOVABLE CONTAMINATION		Number of Grid Blocks Exceeding Criteria
		Alpha (dpm/100 cm^2)		Beta-Gamma (dpm/100 cm^2)				
		Highest Grid Block Avg.	Range of Measurements	Highest Grid Block Avg.	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 121								
Floors/lower walls[b]	2	35	<25-54	810	<440-1000	<3	<6	0
Upper walls/ ceilings[c]	5	n/a	<25-36	n/a	<440	<3	<6-7	0
ROOM 122								
Floors/lower walls[b]	2	31	<25-54	700	<440-1100	<3	<6	0
Upper walls/ ceilings[c]	5	n/a	<25-71	n/a	<440	<3	<6	0
ROOM 123								
Floors/lower walls[b]	2	41	<18-62	620	<440-830	<3	<6	0
Upper walls/ ceilings[c]	5	n/a	<18-62	n/a	<480	<3	<6	0

TABLE 1 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Grid Blocks Surveyed	TOTAL CONTAMINATION				REMOVABLE CONTAMINATION		Number of Grid Blocks Exceeding Criteria
		Alpha (dpm/100 cm^2)		Beta-Gamma (dpm/100 cm^2)				
		Highest Grid Block Avg.	Range of Measurements	Highest Grid Block Avg.	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 124								
Floors/lower walls[b]	3	43	<18-71	980	<480-1600	<3	<6	0
Upper walls/ ceilings[c]	6	n/a	<18-44	n/a	<480	<3	<6	0
ROOM 125								
Floors/lower walls[b]	4	62	<18-89	980	<440-1400	<3	<6	0
Upper walls/ ceilings[c]	8	n/a	<25-62	n/a	<440	<3	<6	0
ROOM 126								
Floors/lower walls[b]	4	44	<18-80	1700	<440-3900	<3	<6	0
Upper walls/ ceilings[c]	7	n/a	<25-54	n/a	<440	<3	<6-9	0

TABLE 1 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Grid Blocks Surveyed	TOTAL CONTAMINATION				REMOVABLE CONTAMINATION		Number of Grid Blocks Exceeding Criteria
		Alpha (dpm/100 cm^2)		Beta-Gamma (dpm/100 cm^2)				
		Highest Grid Block Avg.	Range of Measurements	Highest Grid Block Avg.	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 127[e]								
Floors/lower walls[b,e]	29	64	<18-390	1200	<440-2000	<3-140	<6- 23	1[f]
Upper walls/ ceilings[c,e]	30	n/a	<18- 84	n/a	<420-1300	<3	<6- 10	0
ROOM 129								
Floors/lower walls[b]	6	37	<18- 80	990	<450-1300	<3	<6	0
Upper walls/ ceilings[c]	7	n/a	<18- 80	n/a	<480- 830	<3	<6- 10	0
ROOM 130								
Floors/lower walls[b]	3	34	<18- 62	1100	<480-1500	<3	<6- 8	0
Upper walls/ ceilings[c]	6	n/a	<18- 44	n/a	<480	<3	<6	0

TABLE 1 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Grid Blocks Surveyed	TOTAL CONTAMINATION				REMOVABLE CONTAMINATION		Number of Grid Blocks Exceeding Criteria
		Alpha (dpm/100 cm^2)		Beta-Gamma (dpm/100 cm^2)				
		Highest Grid Block Avg.	Range of Measurements	Highest Grid Block Avg.	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 131								
Floors/lower walls[b]	3	36	<18-54	1100	<440-1300	<3	<6	0
Upper walls/ ceilings[c]	2	n/a	<18-54	n/a	760- 860	<3	<6	0
ROOM 127 (After Remediation)								
Floors/lower walls[b]	29	64	<18-120	1200	<440-2000	<3	<6-9	0
GUIDELINES		100	300	5000	15000	20	1000	

[a]Refer to Figures 5 - 17.
[b]Five Point measurements.
[c]Single point measurements.
[d]N/A = not applicable.
[e]Includes mezzanine area, over room 126.
[f]Further remedial action performed. Area resurveyed with final data presented at end of Table 1.

TABLE 2

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
NON-RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location[a]	Number of Measurements	TOTAL CONTAMINATION[a] Alpha (dpm/100 cm^2) Range of Measurements	TOTAL CONTAMINATION[a] Beta-Gamma (dpm/100 cm^2) Range of Measurements	REMOVABLE CONTAMINATION Alpha Range (dpm/100 cm^2)	REMOVABLE CONTAMINATION Beta Range (dpm/100 cm^2)	Number of Measurements Exceeding Criteria
ROOM 101						
Floors/lower walls	2	<22	550-1400	<3	<6	0
Upper walls/ ceilings	2	<22-67	990-1100	<3	<6	0
ROOM 102						
Floors/lower walls	2	40-67	640- 990	<3	<6-8	0
Upper walls/ ceilings	2	67-85	<420	<3	<6	0
ROOM 103						
Floors/lower walls	2	31-58	<420	<3	<6	0
Upper walls/ ceilings	2	40-85	<420- 740	<3	<6-8	0

TABLE 2 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
NON-RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Measurements	TOTAL CONTAMINATION		REMOVABLE CONTAMINATION		Number of Measurements Exceeding Criteria
		Alpha (dpm/100 cm^2)	Beta-Gamma (dpm/100 cm^2)			
		Range of Measurements	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 104						
Floors/lower walls	5	<22-100	<420-800	<3	<6	0
Upper walls/ ceilings	4	<22- 67	<420	<3	<6-7	0
ROOM 105						
Floors/lower walls	2	<22- 67	<420	<3	<6	0
Upper walls/ ceilings	2	49- 85	<420-770	<3	<6	0
ROOM 106						
Floors/lower walls	2	<22- 40	680-740	<3	<6	0
Upper walls/ ceilings	2	<22- 58	840-1100	<3	<6	0

TABLE 2 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
NON-RADIOLOGICALLY POSTED AREAS NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Measurements	TOTAL CONTAMINATION		REMOVABLE CONTAMINATION		Number of Measurements Exceeding Criteria
		Alpha (dpm/100 cm^2)	Beta-Gamma (dpm/100 cm^2)			
		Range of Measurements	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 107						
Floors/lower walls	3	40-58	<450	<3	<6	0
Upper walls/ ceilings	2	<22-58	<450	<3	<6-9	0
ROOM 108						
Floors/lower walls	2	<22-93	<450	<3	<6	0
Upper walls/ ceilings	2	<22-40	<450	<3	<6	0
ROOMS 109						
Floors/lower walls	2	<22-110	<450-990	<3	<6-7	0
Upper walls/ ceilings	2	31-49	<450	<3	<6	0

TABLE 2 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
NON-RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Measurements	TOTAL CONTAMINATION		REMOVABLE CONTAMINATION		Number of Measurements Exceeding Criteria
		Alpha (dpm/100 cm^2) Range of Measurements	Beta-Gamma (dpm/100 cm^2) Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 110						
Floors/lower walls	3	<22-84	<450-1400	<3	<6	0
Upper walls/ ceilings	2	<22-40	<450	<3	<6-7	0
ROOM 112						
Floors/lower walls	3	<22-49	<450	<3	<6-10	0
Upper walls/ ceilings	2	31-49	<450	<3	<6	0
ROOMS 113/115						
Floors/lower walls	7	<22-75	<450-750	<3	<6	0
Upper walls/ ceilings	5	<22-40	<450-920	<3	<6	0

TABLE 2 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
NON-RADIOLOGICALLY POSTED AREAS OF NMFD
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Measurements	TOTAL CONTAMINATION		REMOVABLE CONTAMINATION		Number of Measurements Exceeding Criteria
		Alpha (dpm/100 cm^2)	Beta-Gamma (dpm/100 cm^2)			
		Range of Measurements	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 114						
Floors/lower walls	2	31-40	<420	<3	<6	0
Upper walls/ ceilings	2	31-49	<420	<3	<6	0
ROOM 116						
Floors/lower walls	2	90-100	<420	<3	<6	0
Upper walls/ ceilings	2	40- 49	<420	<3	<6-8	0
ROOM 117						
Floors/lower walls	3	<22-70	<420-490	<3	<6	0
Upper walls/ ceilings	2	<22	<420	<3	<6	0

TABLE 2 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
NON-RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Measurements	TOTAL CONTAMINATION		REMOVABLE CONTAMINATION		Number of Measurements Exceeding Criteria
		Alpha (dpm/100 cm^2)	Beta-Gamma (dpm/100 cm^2)			
		Range of Measurements	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 118						
Floors/lower walls	3	<22-40	<420-610	<3	<6	0
Upper walls/ ceilings	2	<22-31	520-870	<3	<6	0
ROOM 128						
Floors/lower walls	7	<22-40	<420-840	<3	<6	0
Upper walls/ ceilings	b	b	b	b	b	b
ROOM 132						
Floors/lower walls	4	<22-40	<420-770	<3	<6-7	0
Upper walls/ ceilings	1	40	<420	<3	<6	0

TABLE 2 (Continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN
NON-RADIOLOGICALLY POSTED AREAS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location	Number of Measurements	TOTAL CONTAMINATION		REMOVABLE CONTAMINATION		Number of Measurements Exceeding Criteria
		Alpha (dpm/100 cm^2)	Beta-Gamma (dpm/100 cm^2)			
		Range of Measurements	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
ROOM 133						
Floors/lower walls	4	<22-40	<420-900	<3	<6	0
Upper walls/ ceilings	1	<22	<420	<3	<6	0
AIR HANDLING ROOM						
Floors/lower walls	5	<20-82	<440-480	<3	<6	0
Upper walls/ ceilings	2	<20-41	<440	<3	<6	0
ENTRY						
Floors/lower walls	8	<22-40	<450-920	<3	<6	0
Upper walls/ ceilings	2	<22-85	<450	<3	<6	0
GUIDELINES		300	15000	20	1000	

[a]Single point measurement.
[b]No measurements taken because of safety considerations.

TABLE 3

PLUTONIUM CONCENTRATIONS IN PAINT SAMPLES
FROM NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location Room Number[a]	Surface	Grid	Radionuclide Concentrations (dpm/100 cm^2) Pu-238	Pu-239/240
1-119	West Wall	b	<1	<1
2-126	West Wall	29N, 0E	<1	<1
3-125	East Wall	b	<1	<1
4-126	West Wall	32.5N, 0E	<1	2 ± 1[c]
5-123	West Wall	32.5N,10E	<1	<1
6-124	East Wall	30N, 18.5E	<1	<1
7-127	East Wall	20N, 18.5E	<1	<1
8-127	East Wall	0N, 18.5E	<1	<1
9-127	West Wall	12.5N, 0E	<1	<1
10-127	West Wall	25.5N, 0E	<1	<1
11-130	South Wall	12.5S, 6.2E	<1	<1
12-130	South Wall	12.5S, 8E	<1	<1
13-129	South Wall	12.5S,10E	<1	<1
14-129	South Wall	12.5S,13E	<1	<1
15-131	East Wall	1N, 0E	<1	<1
16-131	West Wall	2.5N, 3W	<1	<1
17-131	East Wall	5N, 0E	<1	<1

[a]Refer to Figure 18.
[b]No associated grid number.
[c]Uncertainty is 2σ based only on counting statistics.

TABLE 4

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
NMDF - INTERIOR TRENCHES
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location[a]	Radionuclide Concentrations (pCi/g)				
	U-235	U-238	Am-241	Pu-238	Pu-239/240
1	<0.23	<0.48	<0.08		
2	<0.32	<1.01	<0.26		
3	<0.32	<0.96	<0.27		
4	<0.26	<0.49	<0.08		
5	<0.28	1.45 ± 0.86[b,c]	<0.90		
6	<0.30	<0.90	<0.23		
Composite[b]	n/a	n/a	n/a	0.01 ± 0.02	0.04 ± 0.03

[a]Refer to Figure 19.
[b]Composite of samples 1 - 6.
[c]Uncertainties are 2σ based only on counting statistics.

TABLE 5

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES SELECTED FOR CONFIRMATORY ANALYSES
NMDF - INTERIOR TRENCHES
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Rockwell Sample Number	Analysis By	Radionuclide Concentrations (pCi/g)				
		U-235	U-238	Am-241	Pu-238	Pu-239/240
3	ORAU	<0.46	2.33 ± 1.85[a]	<0.13	0.01 ± 0.02	0.06 ± 0.05
	Rockwell	—[b]	—	—	0.0044 ± 0.0011	0.0315 ± 0.0046
5	ORAU	<0.36	1.68 ± 1.88	<0.11	0.01 ± 0.02	0.02 ± 0.02
	Rockwell	—	—	—	0.0421 ± 0.0050	0.4010 ± 0.0340
8	ORAU	<0.42	3.26 ± 1.89	<0.13	0.01 ± 0.01	<0.01
	Rockwell	—	—	—	0.0004 ± 0.0004	0.0007 ± 0.0090
10	ORAU	<0.39	2.07 ± 1.54	<0.12	<0.05	0.02 ± 0.03
	Rockwell	—	—	—	0.0552 ± 0.0060	0.6130 ± 0.0500
11	ORAU	<0.36	5.07 ± 1.66	<0.11	<0.01	0.03 ± 0.03
	Rockwell	—	—	—	0.0003 ± 0.0007	0.0013 ± 0.0007

[a]Uncertainties are 2σ based only on counting statistics.
[b]No analysis performed.

TABLE 6

PLUTONIUM CONCENTRATIONS IN MISCELLANEOUS RESIDUES
NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Room Number	Location[a]	Weight (grams)	Plutonium Concentrations (pCi/g) Pu-238	Pu-239/240
127	3N, 2.5E[a]	3.1	0.5 ± 0.2[b]	5.0 ± 0.6
127	4N, 11.5E[a]	1.2	0.1 ± 0.1	0.2 ± 0.1
127	10.5N,2.5E[a]	4.2	0.1 ± 0.1	0.2 ± 0.2
127	17N, 2.5E[a]	3.7	0.1 ± 0.1	0.3 ± 0.2
127	Trench	12.2	0.5 ± 0.5	2.1 ± 1.0
128	2nd Floor	6.1	0.1 ± 0.2	0.4 ± 0.5
129	Air Duct	9.1	0.5 ± 0.4	1.6 ± 0.7

[a]Refer to Figure 4.
[b]Uncertainties are 2σ based only on counting statistics.

TABLE 7

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS
FROM ROOF LOCATIONS AND EXHAUST VENTS OF NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location[a]	Number of Measurements	TOTAL CONTAMINATION		REMOVABLE CONTAMINATION	
		Alpha (dpm/100 cm^2)	Beta-Gamma (dpm/100 cm^2)		
		Range of Measurements	Range of Measurements	Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)
ROOF	4	<22-75	<450-890	<3	<6
VENTS	6	<22-120	<450	<3	<6
GUIDELINES		300	15000	20	1000

[a]Refer to Figure 20.

TABLE 8

SUMMARY OF EXPOSURE RATE MEASUREMENTS
NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location[a]	Gamma Exposure Rates at 1 m above the Surface (μR/h)
1	12
2	13
3	14
4	12
5	12
6	12
7	13
8	12

[a]Refer to Figure 21.

TABLE 9

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
FROM EXTERIOR TRENCH - NMDF
ROCKWELL INTERNATIONAL
SANTA SUSANA, CALIFORNIA

Location[a]	Radionuclide Concentrations (pCi/g)				
	U-235	U-238	Am-241	Pu-238	Pu-239/240
1	<0.33	<0.95	<0.24		
2	<0.30	3.42 ± 1.32[b]	<0.09		
3	<0.32	<0.99	<0.26		
4	<0.31	<0.60	<0.10		
5	<0.33	<0.94	<0.27		
6	<0.27	<0.57	<0.09		
7	<0.31	<0.94	<0.25		
Composite[c]	n/a	n/a	n/a	0.01 ± 0.02	0.04 ± 0.03[c]

[a]Refer to Figure 22.
[b]Uncertainties are 2σ based only on counting statistics.
[c]Composite of samples 1 - 7.

REFERENCES

1. "Final Radiation Survey of the NMDF" N704SRR990027, Rockwell International, December 1986.

APPENDIX A

MAJOR SAMPLING AND ANALYTICAL EQUIPMENT

APPENDIX A

Major Sampling and Analytical Equipment

The display or description of a specific product is not to be construed as an endorsement of that product or its manufacturer by the authors or their employer.

A. Direct Radiation Measurements

Eberline "RASCAL"
Portable Ratemeter-Scaler
Model PRS-1
(Eberline, Santa Fe, NM)

Eberline PRM-6
Portable Ratemeter
(Eberline, Santa Fe, NM)

Eberline Alpha Scintillation Detector
Model AC-3-7
(Eberline, Santa Fe, NM)

Eberline Beta-Gamma "Pancake" Detector
Model HP-260
(Eberline, Santa Fe, NM)

Ludlum Alpha-Beta Floor Monitor
Model 239-1
(Ludlum, Sweetwater, TX)

Ludlum Ratemeter-Scaler
Model 2220
(Ludlum, Sweetwater, TX)

Victoreen Beta-Gamma "Pancake" Detector
Model 489-110
(Victoreen, Cleveland, OH)

Victoreen NaI Scintillation Detector
Model 489-55
(Victoreen, Cleveland, OH)

B. Laboratory Analyses

Low Background Alpha-Beta Counter
Model LB-5110
(Tennelec, Oak Ridge, TN)

Ge(Li) Detector
Model LGCC2220SD, 23% Efficiency
(Princeton Gamma-Tech, Princeton, NJ)

used in conjunction with:
Lead Shield Model SPG-16
(Applied Physical Technology, Atlanta, GA)

High Purity Germanium Detector
Model GMX-23195-S, 23% Efficiency
(EGG&G ORTEC, Oak Ridge, TN)

used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL)

High Purity Germanium Coaxial Well Detector
Model GWL-110210-PWS-S, 23% Efficiency
(EG&G ORTEC, Oak Ridge, TN)

used in conjuction with:
Lead Shield Model G-16
(Applied Physical Technology, Atlanta, GA)

High Purity Germanium Detector
Model IGC25, 25% Efficiency
(Princeton Gamma-Tech, Princeton, NJ)

used in conjunction with:
Lead Shield
(Nuclear Data, Schaumburg, IL)

Multichannel Analyzer
ND66/680 System
(Nuclear Data, Schaumburg, IL)

Alpha Spectrometry System
Tennelec Electronics
(Tennelec, Oak Ridge, TN)

Surface Barrier Detectors
(EG&G ORTEC, Oak Ridge, TN)

Multichannel Analyzer
Model ND-66
(Nuclear Data, Schaumburg, IL)

APPENDIX B

MEASUREMENT AND ANALYTICAL PROCEDURES

APPENDIX B

Measurement and Analytical Procedures

Surface Scans

Surface scans were performed by passing the probes slowly over the surface. The distance between the probe and the surface was maintained at a minimum - nominally about 1 cm. Identification of elevated levels was based on increases in the audible signal from the recording or indicating instrument. Alpha and beta-gamma scans of large floor surface areas were performed using a gas proportional floor monitor, with a 600 cm^2 sensitive area. The instrument is slowly moved in a systematic pattern to cover 100% of the accessible area. Combinations of detectors and instruments for the scans were:

Beta-Gamma - G-M probe with PRM-6 ratemeter.
Beta-Gamma - G-M probe with "RASCAL" scaler/ratemeter.
Gamma - NaI scintillation detector (3.2 cm x 3.8 cm crystal) with PRM-6 ratemeter.
Alpha - ZnS probe with "RASCAL" scaler/ratemeter.
Alpha/Beta - Gas proportional floor monitor with Ludlum Model 2220 scaler/ratemeter.

Alpha and Beta-gamma Measurements

Measurements of total alpha radiation levels were performed using Eberline Model PRS-1 portable scaler/ratemeters with Model AC-3-7 alpha scintillation probes. Measurements of direct beta-gamma radiation levels were performed using Eberline Model PRS-1 portable scaler/ratemeters with Model HP-260 thin-window "pancake" G-M probes. Count rates (cpm) were converted to disintegration rates (dpm/100 cm^2) by dividing the net rate by the 4π efficiency and correcting for the active area of the detector. Although other factors (i.e. backscatter) can affect the calibration, they are considered insignificant for the measurements performed. Effective window areas were 59 cm^2 for the ZnS detectors and 15 cm^2 for the G-M detectors. Background count rates for ZnS alpha probes averaged approximately 1 cpm; the average background count rate was approximately 44 cpm for the G-M detectors.

Exposure Rate Measurements

Measurements of gamma exposure rates were performed using an Eberline PRM-6 portable ratemeter with a Victoreen Model 489-55 gamma scintillation probe containing a 3.2 cm x 3.8 cm NaI(Tl) scintillation crystal. Count rates were converted to exposure rates (μR/h) by cross-calibrating with a Reuter Stokes model RSS-111 pressurized ionization chamber.

Removable Contamination Measurements

Smear measurements were performed on numbered filter paper disks 47 mm in diameter. Smears was sealed in a labeled envelope with the location and other pertinent information recorded. A ZnS alpha scintillation counting system was used to evaluate individual smears at the site; smears were then returned to Oak Ridge and recounted using a low-background alpha-beta proportional system.

Soil Sample Analysis

Gamma Spectrometry

Soil samples were dried, mixed, and a portion placed in 0.5 l Marinelli beaker. The quantity placed in each beaker was chosen to reproduce the calibrated counting geometry and ranged from 600 to 800 g of soil. Net soil weights were determined and the samples counted using intrinsic germanium and Ge(Li) detectors coupled to a Nuclear Data Model ND-680 pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. Energy peaks used for determination of radionuclides of concern were:

U-235 - 0.144 MeV
U-238 - 0.094 MeV from Th-234. Secular equilibrium was assumed.
Am-241 - 0.059 Mev

Spectra were also reviewed for the presence of other radionuclides related to fuel, activation, or fission products.

Isotopic Plutonium

Aliquots of soil were acidified and evaporated to dryness. The residues were then dissolved by pyrosulfate fusion and precipitated by barium sulfate. The barium sulfate precipitate was redissolved and plutonium separated by liquid-liquid extraction. The purified plutonium was then precipitated with a cerium fluoride carrier and counted using surface barrier detectors (ORTEC), alpha spectrometers (Tennelec), and an ND-66 Multichannel Analyzer (Nuclear Data).

Water Sample Analysis

Gross Alpha and Gross Beta

The water samples were rough-filtered through Whatman No. 2 filter paper. Remaining suspended solids were removed by subsequent filtration through 0.45 μm membrane filters. The filtrate was acidified by addition of 10 ml of concentrated nitric acid. A known volume of each sample was evaporated to dryness and counted for gross alpha and gross beta using a Tennelec Model LB-5100 low-background proportional counter.

Paint Samples Analysis

Samples were dissolved by pyrosulfate fusion and precipitated with barium sulfate. The barium sulfate precipitate was redissolved and the plutonium separated by liquid-liquid extraction. The plutonium was then precipitated with a cerium fluoride carrier and counted using surface barrier detectors (ORTEC), alpha spectrometers (Tennelec), and an ND-66 Multichannel Analyzer (Nuclear Data).

Residues from Anchor Bolt Holes and Miscellaneous Locations

Samples were analyzed for isotopic plutonium using the sample procedure as described above for paint samples.

Uncertainties and Detection Limits

The uncertainties associated with the analytical data presented in the tables of this report, represent the 95% (2σ) confidence levels for that data. These values were calculated, based on both the gross sample count levels and the associated background count levels. Because of variations in sample weight, detector efficiency, and contributions from other radionuclides in the samples, the Minimum Detectable Activity/Minimum Detectable Concentration for specific radionuclides differ from sample to sample.

Calibration and Quality Assurance

Laboratory and field survey procedures are documented in manuals developed specifically for the Oak Ridge Associated Universities' Radiological Site Assessment Program.

With the exception of the measurements conducted with portable gamma scintillation survey meters, all instruments are calibrated with NBS-traceable standards. The calibration procedures for the portable gamma instruments are performed by comparison with an NBS calibrated pressurized ionization chamber.

Quality control procedures on all instruments included daily background and check-source measurements to confirm equipment operation within acceptable statistical fluctuations. The ORAU laboratory participates in the EPA and EML Quality Assurance Programs.

APPENDIX C

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIAL

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIAL

U.S. Nuclear Regulatory Commission
Division of Fuel Cycle & Material Safety
Washington, D.C. 20555

July 1982

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces or premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of

the survey report shall be filed with the Division of Fuel Cycle and Material Safety, USNRC, Washington, D.C. 20555, and also the Administrator of the NRC Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. They survey report shall:

a. Identify the premises.

b. Show that reasonable effort has been made to eliminate residual contamination.

c. Describe the scope of the survey and general procedures followed.

d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE 1

ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclides[a]	Average[b,c,f]	Maximum[b,d,f]	Removable[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223 Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1000 dpm $\beta\gamma$/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.