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CONFIRMATORY RADIOLOGICAL SURVEY OF THE BUILDING D LABORATORY AREA GENERAL ELECTRIC COMPANY EVANDALE, OHIO

G. L. MURPHY AND A. D. LUCK

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

FINAL REPORT
AUGUST 1988

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CONFIRMATORY RADIOLOGICAL SURVEY
OF THE
BUILDING D LABORATORY AREA
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

INTRODUCTION

In 1951 the Jet Engine Department of the General Electric Company (GE) formed the Aircraft Nuclear Propulsion (ANP) Project, a joint venture contract between the U. S. Air Force, the Atomic Energy Commission (AEC), and GE, to develop a nuclear powered aircraft. The developmental operations were conducted in Buildings C-West and D at Air Force Plant No. 36, located at the General Electric Plant in Evandale, Ohio. The ANP project was terminated in 1961; however, radioactive materials use continued under other AEC prime contracts and licensed arrangements until 1973. At that time initial decontamination was performed under direction of the Air Force; final decontamination responsibilities were assumed later by GE's Advanced Energy Program's Department.

In 1984, decontamination of Building C-West was completed and, following a verification survey by Oak Ridge Associated Universities (ORAU), that facility was released from licensing restrictions. During 1985, ORAU conducted measurements and sampling of excavated drains and piping, throughout Building D. Decontamination of the Building D laboratory area continued through 1986. A report describing the decontamination procedures and survey results was submitted by GE in November 1986.[1] In April 1987, at the request of Region III of the Nuclear Regulatory Commission (NRC), the Radiological Site Assessment Program of ORAU conducted a confirmatory radiological survey of the Building D laboratory area. The purpose of this survey was to evaluate the radiological status of the building, relative to the NRC guidelines for unrestricted use. Preliminary measurements identified significant residual contamination exceeding the release guidelines. As a result of these findings, General Electric retained Nuclear Support Services, Inc. (NSS), to perform further remedial action, and in July 1987 an addendum report, documenting the results of the post remedial action monitoring, was submitted to the NRC.[2] ORAU resurveyed the building during August 1987.

SITE DESCRIPTION

The General Electric Plant is located adjacent to Interstate 75 in Evandale, Ohio, just north of Cincinnati, Ohio (Figures 1 and 2). Air Force Plant No. 36 is located in the extreme southern portion of the GE plant site. Building D is a single story, steel frame and brick structure, approximately 207 m by 137 m, with a partial basement under the Laboratory Area and a small second story area covering the Nuclear Experimental Area (NEA). This building was the main operational center for the ANP program and included office, engineering, shop, and miscellaneous laboratory facilities. Enriched uranium was the major fuel material processed, although other source and special nuclear materials were handled in small quantities. In addition to the fuel materials, operations in Building D involved samples containing a variety of fission and activation products.

The radioactive materials use area covers approximately 170 m by 70 m, and includes a laboratory space (110 m x 60 m), divided into six blocks of alternate single and double rows of laboratories or rooms, a high bay area, and support facilities (Figure 3). There is a mezzanine, located above the western portion of the Laboratory Area, which contained offices, change rooms, and other support facilities (Figure 4). The NEA contained a complete 2nd floor, comprised of offices, source storage vault, and heavily shielded work rooms. A Waste Storage Pad and sheet metal building are located inside the fenced area, north of the NEA. Major Building D areas in which radioactive materials were processed or stored included Fuel Element Production (L6), Metallurgical Powder Lab (L5), Warm Cell (L4), Fuel Element Development and Processing (L3), Metallography and Measurement Labs (L2), Radiochemical and Uranium Analysis (L1), Radioactive Material Lab (RML), Nuclear Critical Experiments (NEA -602, 605, 607, 615), and Storage (waste storage pads, vaults, and basement).

Process control equipment, control exhaust ventilation systems, and potentially contaminated drains have been removed. Other contaminated surfaces were either physically removed or cleaned, using a combination of methods.

SURVEY PROCEDURES

The confirmatory survey was conducted August 18-27, 1987, by the Radiological Site Assessment Program of ORAU, in accordance with a proposed survey plan, submitted to the NRC for review and concurrence.[3] The objectives of the survey were to confirm the accuracy and adequacy of the licensee's data and to provide information which would enable the NRC to evaluate the facility's radiological status, relative to guidelines for release from licensing restrictions. This section summarizes the procedures and techniques employed in this survey. Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B.

Document Review

ORAU reviewed the November 1986 Decontamination Report and supporting documentation for the Building D Laboratory Area, but noted that it contained many discrepancies, when compared to the actual radiological condition at the facility. Following further remedial action, ORAU reviewed the Addendum Report (July 1987) and determined that the information was not adequate to determine the site release status. Additional figures and data summaries were submitted by GE. NRC concurred with ORAU's findings and requested GE to decontaminate and resurvey to satisfy NRC guidelines.

Facility Survey

Gridding

The 2 m grid pattern, established by the licensee, was used to reference floor and lower wall (to 2 m high) measurements. ORAU utilized a different grid coordinate identification system than was used for the licensee's survey. Upper walls and ceilings were not gridded; measurements and samples from these surfaces were referenced to the floor grid or pertinent building features.

Surface Scans

Systematic alpha, beta-gamma, and gamma scans were performed on floors and lower walls using a gas proportional alpha/beta floor monitor, zinc sulfide alpha detectors, "pancake" GM detectors, and NaI(Tl) scintillation detectors coupled to scalers/ratemeters with audible indicators. Representative areas on overhead surfaces, such as upper walls, ceilings, ledges, beams, pipes, lighting fixtures, and miscellaneous equipment were also scanned. Locations of elevated direct radiation were noted for further investigation.

Measurements of Surfa Contamination

Based on the use history and results of previous surveys twelve rooms were identified as having the highest potential for residual surface contamination. These rooms are indicated on Figures 3 and 4. Figures 5 thru 16 show the locations of floor grid blocks surveyed. Locations of lower wall grid blocks and single point measurements are available but have not been included in this report. One hundred-twelve grid blocks on the floors and lower walls in these rooms were randomly selected for 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 block corners. Smears for removable alpha and beta contamination were performed at the location in each grid block where the highest direct reading was obtained. Total and removable contamination levels were also measured at 97 locations on the upper walls, ceilings and miscellaneous overhead objects in these twelve rooms.

One hundred-twenty-two single point measurements for total alpha and beta-gamma contamination were performed on the floors and lower walls in 16 rooms of lower potential for surface contamination (Figures 3 and 4). Smears for removable alpha and beta contamination were performed at each location. Total and removable contamination measurements were also performed at 58 random locations on the upper walls and ceilings of these 16 rooms.

Exposure Rate Measurements

Gamma exposure rates at 1 meter above the floor were measured at six locations throughout the Building using NaI(Tl) gamma scintillation detectors cross calibrated onsite with a pressurized ionization chamber.

Paint Sampling

Fifty eight paint samples were collected from 100 cm^2 areas on the floors, walls, and ceilings at random locations throughout the laboratory area (Figures 17 and 18).

Miscellaneous Sampling

Nine samples of residue were collected from floor, upper walls, and overhead structure locations (Figure 19).

Outdoor Survey

Gridding

The outdoor area associated with Building D was not gridded; measurement and sampling locations were referenced to building features.

Surface Scans

Walkover gamma surface scans were conducted at 1 to 2 m intervals up to a distance of 10 meters from Building D or to the boundary of the restricted area associated with the North and East sides of Building D, using gamma scintillation detectors (NaI) coupled to ratemeters with audible indicators. These were areas where radioactive waste was stored, and other areas within the Building D fenced boundary.

Exposure Rate Measurements

Exposure rate measurements were made at 1 m above the surface at six locations (Figure 20).

Soil Sampling

Six surface (0-15 cm) soil samples were collected from the Waste Storage area (Figure 20). Soil sampling locations were limited due to concrete and asphalt driveways, walkways, and streets.

Water Sampling

Five water samples were collected from the General Electric Plant site. Sampling locations included two storm drains, one sanitary drain and two storage tanks (Figure 21).

Roof

Beta-gamma scans were conducted on the roof of Building D, using GM pancake detectors coupled to ratemeters with audible indicators. No samples were collected.

Background Measurements and Baseline Samples

Samples of surface soil were collected and background exposure rates were measured at 8 offsite locations (Figure 22) in the area around the General Electric Plant, to establish baseline radionuclide soil concentrations and background exposure rates for comparison purposes.

Sample Analysis and Interpretation of Results

Samples and direct measurement data were returned to Oak Ridge, Tennessee for analysis and interpretation. Residue, concrete, and soil samples were analyzed by solid state gamma spectrometry. Radionuclides of primary interest were Co-60, Cs-137, Th-228, Th-232, and U-238; however, spectra were reviewed for other identifiable radionuclides. Smears, and the water samples were analyzed for gross alpha and beta contamination using a low-background proportional counter. Paint samples were analyzed for uranium and thorium by neutron activation analysis. Results were compared with NRC guidelines, established for release of facilities for unrestricted use, (Appendix C).

RESULTS

Document Review

In general, the decontamination and monitoring plans appear to have been adequately developed to ensure the NRC guidelines were met. However, the report

submitted in November 1986 did not accurately represent the radiological status of the facility, as evidenced by the initial ORAU survey. The followup report of July 1987 briefly summarized the additional cleanup and monitoring. Data in this report appears accurate, but in ORAU's opinion the report is lacking in certain details regarding measurement locations and an assessment of the site status. Because of incomplete or inconsistent information it was recommended to the NRC that the ORAU confirmatory survey be used to independently evaluate the sites final status, rather than attempt comparison of ORAU and licensee data. The NRC Region III concurred with this approach.

Background Levels and Baseline Concentrations

Background exposure rates and baseline radionuclide concentrations in soil from the vicinity of the General Electric site are presented in Table 1. Exposure rates ranged from 8 to 10 μR/h, at one meter from the surface. Uranium 238 concentrations ranged from <0.4 to 2.5 pCi/g. Cobalt 60 concentrations were less than 0.1 pCi/g, and Cs-137 ranged from 0.2 to 1.5 pCi/g. Thorium 228 concentrations ranged from 0.2 to 0.4 pCi/g; Th-232 concentrations ranged from 0.3 to 1.5 pCi/g. These levels are typical of radionuclide concentrations, normally occuring in the environment.

Facility Survey

Surface Scans

Numerous small areas of surface contamination were identified by alpha and beta-gamma scans. These areas were indicated to GE, and Nuclear Support Services performed additional remedial action. Resurveys of these areas after remediation indicated that cleanup was effective in reducing the contamination to within guideline levels.

Surface Contamination Measurements

Results of total and removable contamination measurements are summarized in Tables 2 and 3. Alpha and beta-gamma levels were generally well below the release criteria and, in many instances, less than the lower limit of detection

of the instrumentation. The maximum alpha measurement was 410 dpm/100 cm^2, measured on the floor in the metallurgical powder laboratory; the maximum beta-gamma level was 1400 dpm/100 cm^2 measured on the floor in the Radioactive Materials Laboratory. Highest grid block averages were 110 dpm/100 cm^2, alpha, and 1000 dpm/100 cm^2, beta-gamma.

The maximum removable alpha and beta contamination levels were 30 dpm/100 cm^2 and 190 dpm/100 cm^2, respectively.

Exposure Rate Measurements

Exposure rates measured at six locations ranged from 5 to 10 μR/h (Table 4). In addition to these individual measurements, general gamma scans indicated a similiar range of exposure rates throughout the building.

Radionuclide Concentrations in Paint Samples

Results of analyses for total uranium and total thorium in paint samples are presented in Table 5. Total uranium concentrations were less than 2.2 dpm/100 cm^2, total thorium concentrations ranged from <0.7 to 24 dpm/100 cm^2.

Miscellaneous Samples

Radionuclide concentrations in nine residue samples collected from floor and upper wall areas are presented in Table 6. Samples included dust and residue from floors and overhead structures, as well as, concrete chips from floors and walls. Residue samples are reported in dpm/100 cm^2 for comparison to removable contamination guidelines while concrete samples are reported in pCi/g. Uranium concentrations were less than 2.2 pCi/g (concrete rubble), and ranged from less than 64 to 140 dpm/100 cm^2 (residue). Cobalt 60 concentrations were less than 0.3 pCi/g (concrete rubble), and less than 24 dpm/100 cm^2 (residue); Cs-137 concentrations ranged from less than 0.1 to 1.5 pCi/g (concrete rubble), and less than 12 to 417 dpm/100 cm^2 (residue). Thorium 228 concentrations ranged from less than 0.1 to 0.8 pCi/g, (concrete rubble), and were less than 11 dpm/100 cm^2 (residue). Thorium 232 concentrations were less than 0.2 to 2.4 pCi/g (concrete rubble), and less than 74 dpm/100 cm^2 (residue).

Outdoor Area Survey

Surface Scans

Walkover surface scans of the outdoor areas up to 10 m from the building and/or the restricted area fence, indicated no areas of elevated radiation levels. Random beta-gamma scans of the Building D roof also did not identify any areas of elevated direct radiation or the presence of contamination.

Exposure Rates

Gamma exposure rates measured at soil sampling locations ranged from 8 to 14 uR/h, with an average exposure rate at 1 meter of 10 uR/h.

Radionuclide Concentrations in Soil Samples

Results of analyses of soil samples collected from the Waste Storage Area are presented in Table 7. Cobalt 60 and U-238 levels were less than the lower limit of detection for the instrumentation (0.1 and 0.7 pCi/g respectively). Cesium 137 ranged from 0.5 to 4.1 pCi/g; Th-228 ranged from 0.2 to 0.4 pCi/g; and Th-232 ranged from 0.6 to 1.7 pCi/g.

Water Samples

Gross alpha and beta concentrations in water samples collected from storage tanks, storm sewers and a sanitary sewer line are presented in Table 8. Gross alpha concentrations ranged from less than 0.3 to 2.0 pCi/l. Gross beta concentrations ranged from less than 0.6 to 26.7 pCi/l.

COMPARISON OF RESULTS WITH GUIDELINES

NRC surface contamination guidelines for release of facilities for unrestricted use are presented in Appendix C. The principal radionuclides of interest in Building D are Co-60, and Cs-137, uranium and thorium. Alpha contamination measurements in the facility were compared with the guideline levels for thorium, because they are more restrictive than the levels for

uranium. Beta-gamma measurements were compared with the guideline levels for miscellaneous beta-gamma emitters expected to be present at the site. The guideline levels selected for comparsion are summarized below:

Alpha

1,000 dpm/100 cm^2, averaged over 1 m^2
3,000 dpm/100 cm^2, maximum in 100 cm^2
1,000 dpm/100 cm^2, removable

Beta-Gamma

5,000 dpm/100 cm^2, averaged over 1 m^2
15,000 dpm/100 cm^2, maximum in 100 cm^2
1,000 dpm/100 cm^2, removable

All total and removable alpha and beta-gamma measurements were within these guidelines. Miscellaneous residues and paint samples also contained radionuclide concentrations within the guideline levels for surface contamination.

Exposure rate guidelines limit the level at 1 m above the surface to 10 μR/h above background, or approximately 19 μR/h total for the Evandale area. All exposure rates measured were well below that level with a maximum level of only 16 μR/h.

Soil samples were compared to the NRC guideline of 10 pCi/g of total thorium and 30 pCi/g of enriched uranium.[4] Concentrations of 15 pCi/g and 8 pCi/g have been used at other NRC licensed facilities for residual levels of Cs-137 and Co-60, respectively.[5] All of the soil samples, collected near Building D were typical of background radionuclide concentrations and well within these guideline levels.

The water samples were well within the NRC guidelines for unrestricted use (10 CFR 20 Appendix B, Table II, Column 2).[6]

Previous surveys of trenches, resulting from excavation of contaminated piping and drains, are presented in separate letter reports.[7,8] These surveys

indicated that decontamination of the excavated areas had also been effective in satisfying the NRC guideline levels.

SUMMARY

On August 18-27, 1987, Oak Ridge Associated Universities performed a confirmatory radiological survey of the Laboratory Area of Building D, at the General Electric Company Plant in Evandale, Ohio. The survey included surface alpha, gamma and beta-gamma scans, measurement of direct and removable contamination levels, and the measurement of radionuclide concentrations in soil, paint, residue, and water samples. The findings indicate that remedial action efforts have been effective in removing residual radioactive contamination and that the present radiological conditions of the facility satisfy the NRC guidelines for release for unrestricted use.

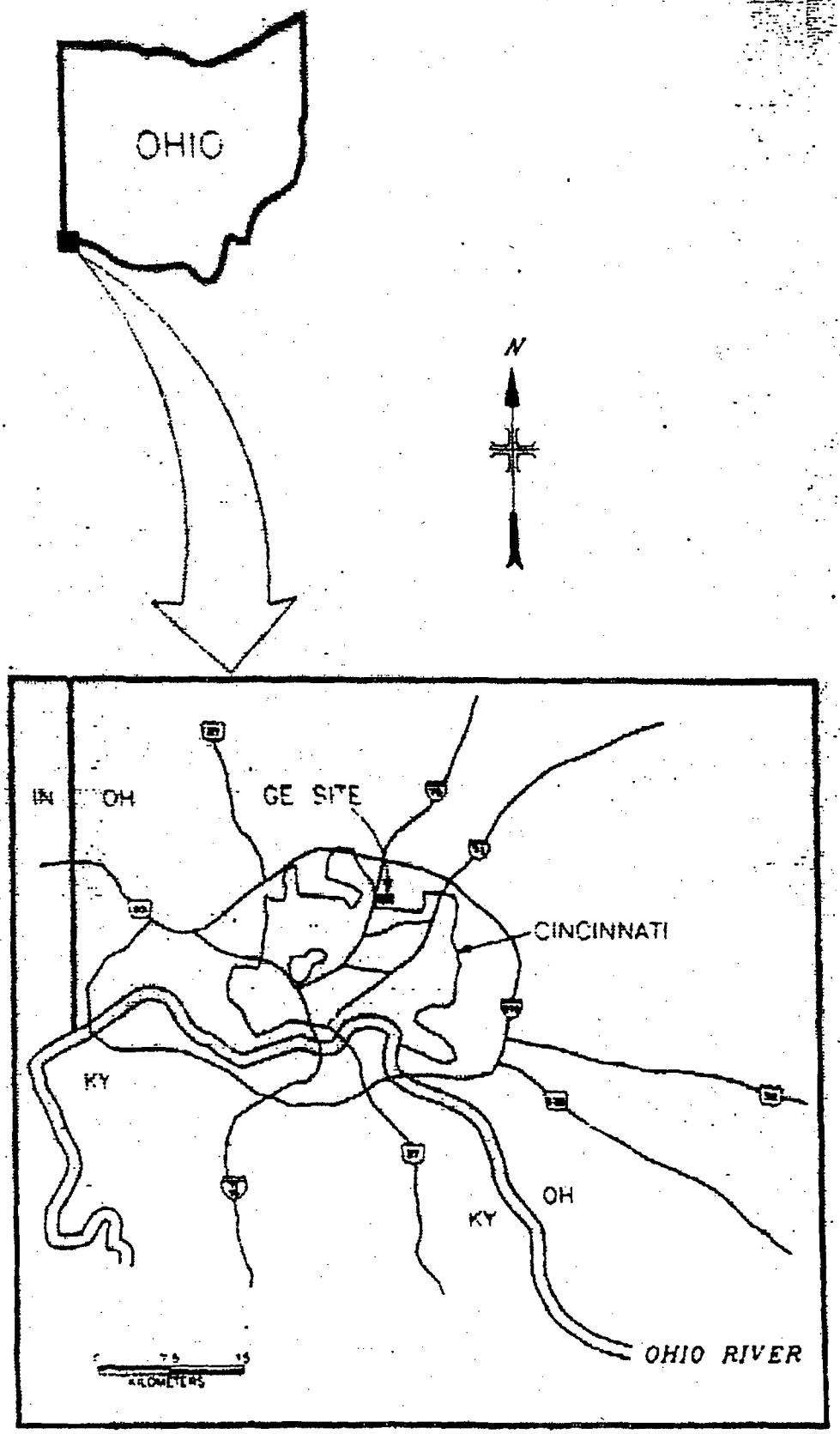


FIGURE 1 Southwestern Ohio Area Indicating the Location of the General Electric Plant Site

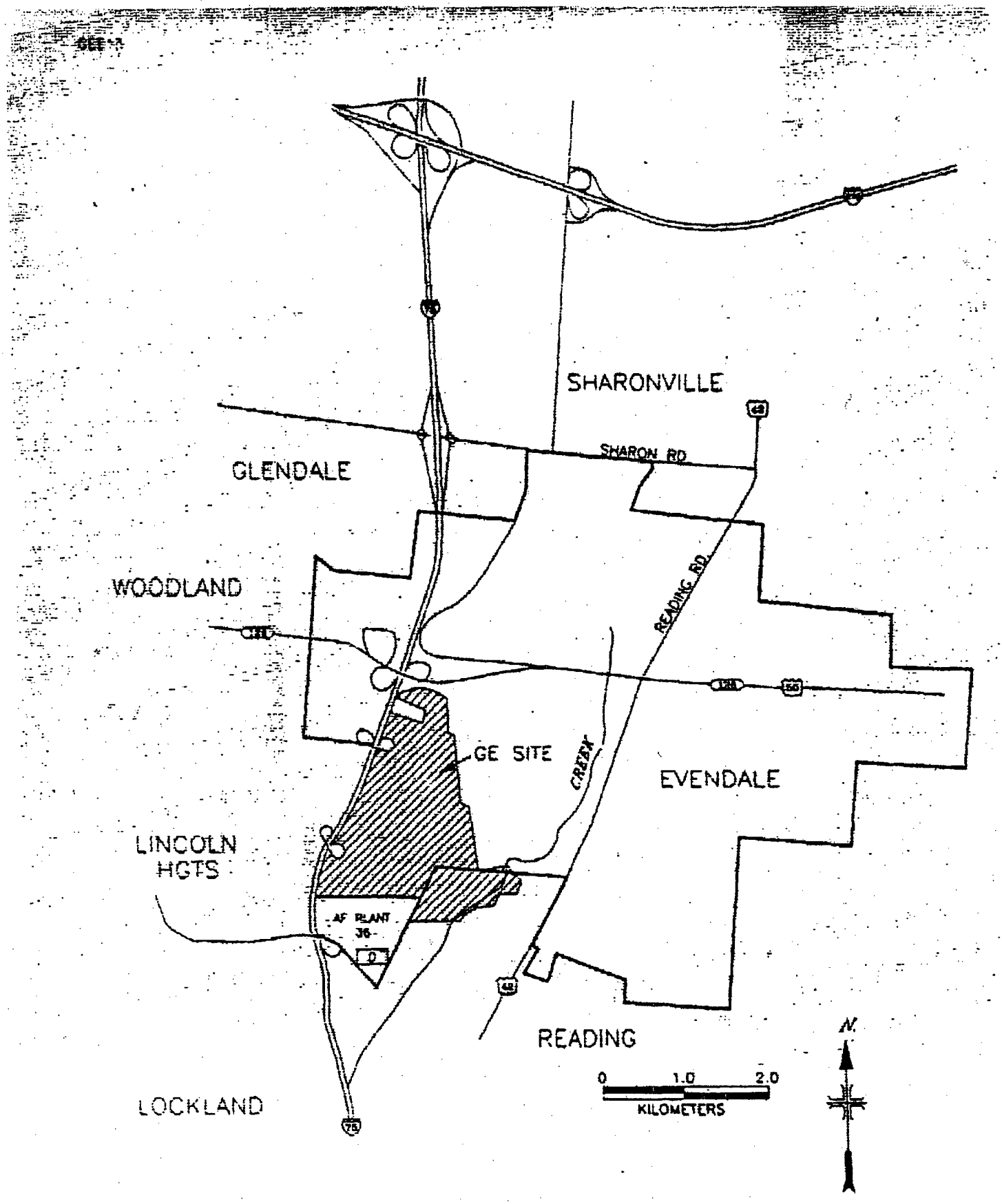


FIGURE 2: General Electric Plant Site Showing the Location of Air Force Plant No. 36 and Building D

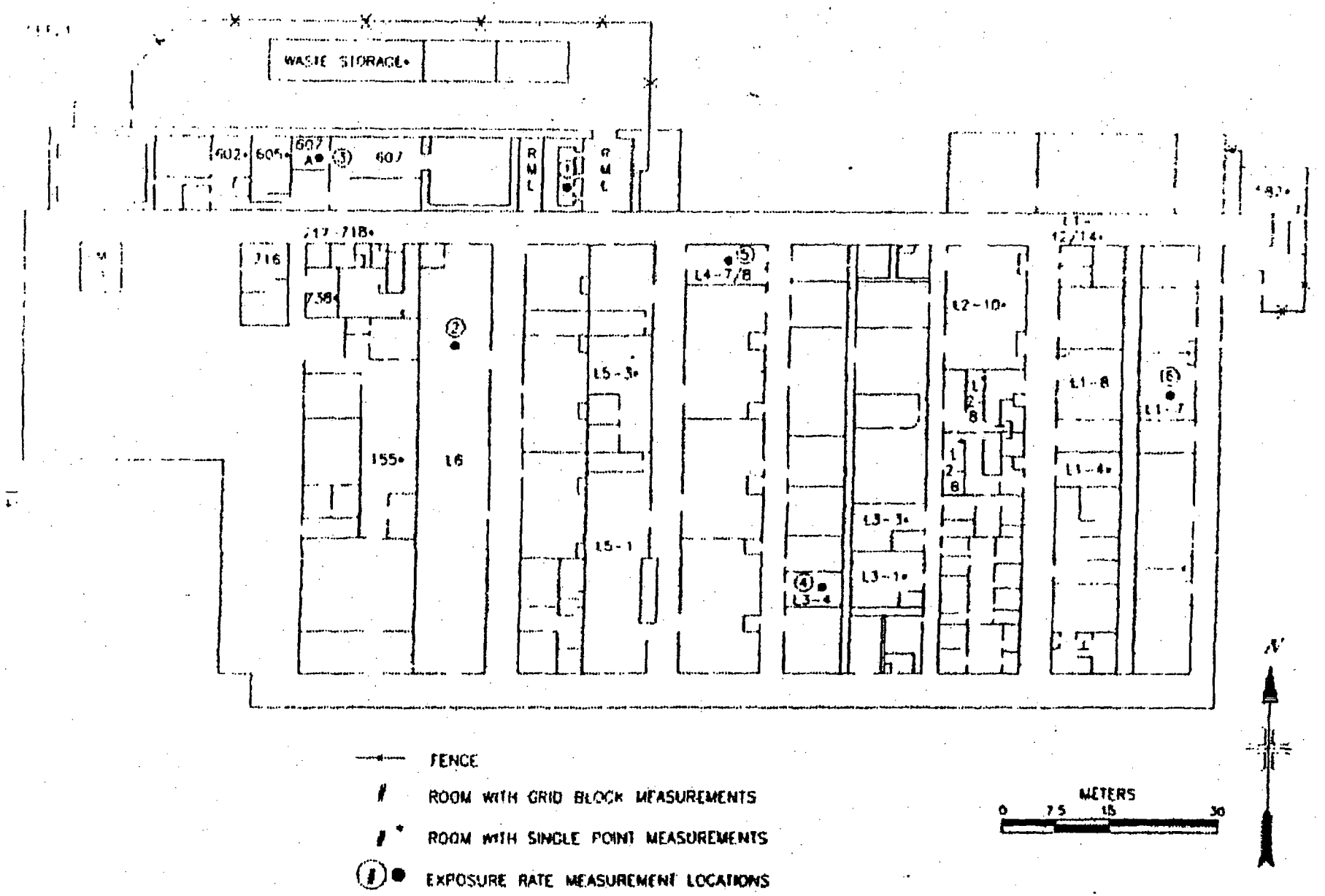


FIGURE 3: Main Floor Plan of the Building D Laboratory Area Indicating Locations of Surveyed Rooms

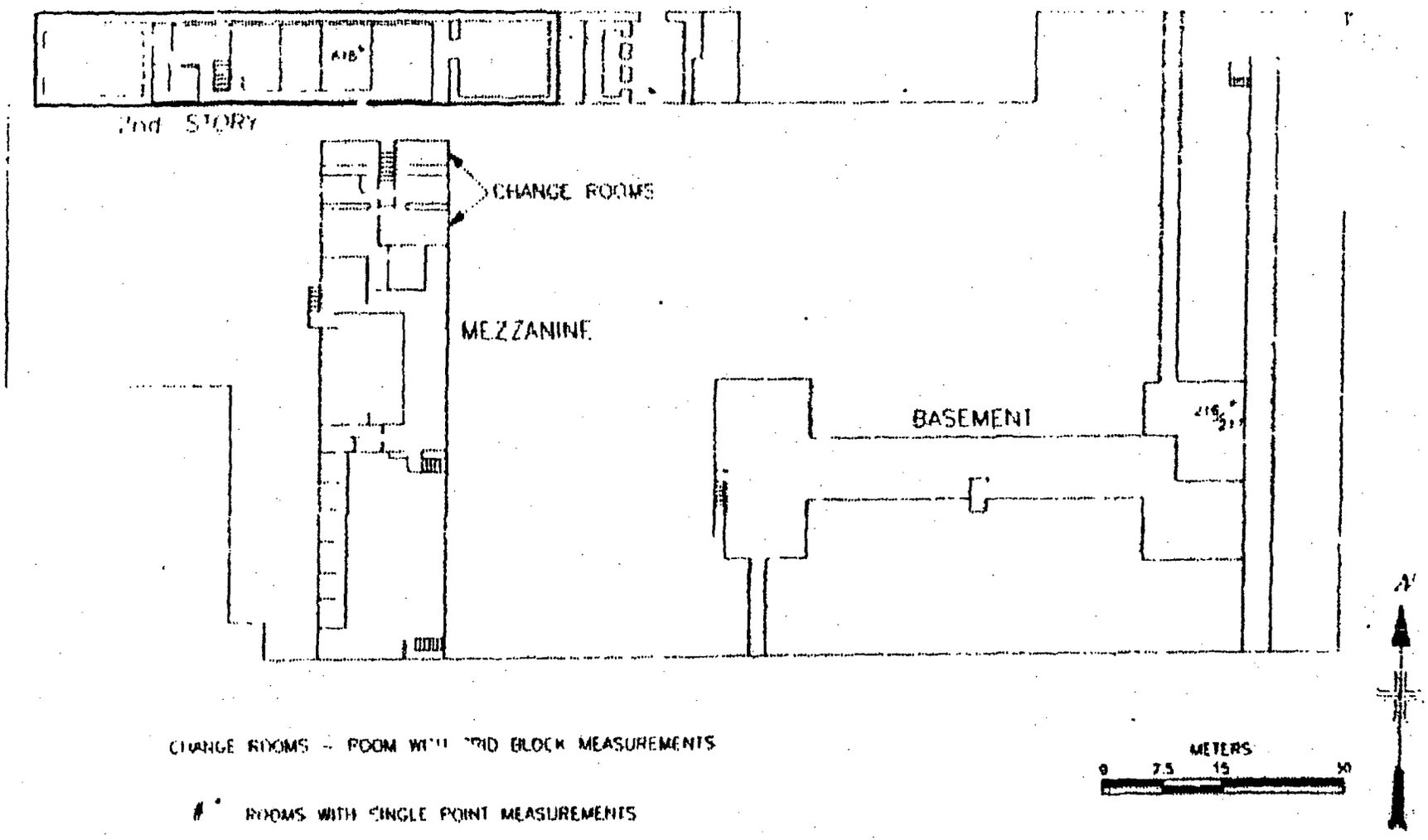


FIGURE 4. Layout of Building D Laboratory Area Showing Locations of Surveyed Rooms on the Mezzanine, Basement, and Second Story Levels

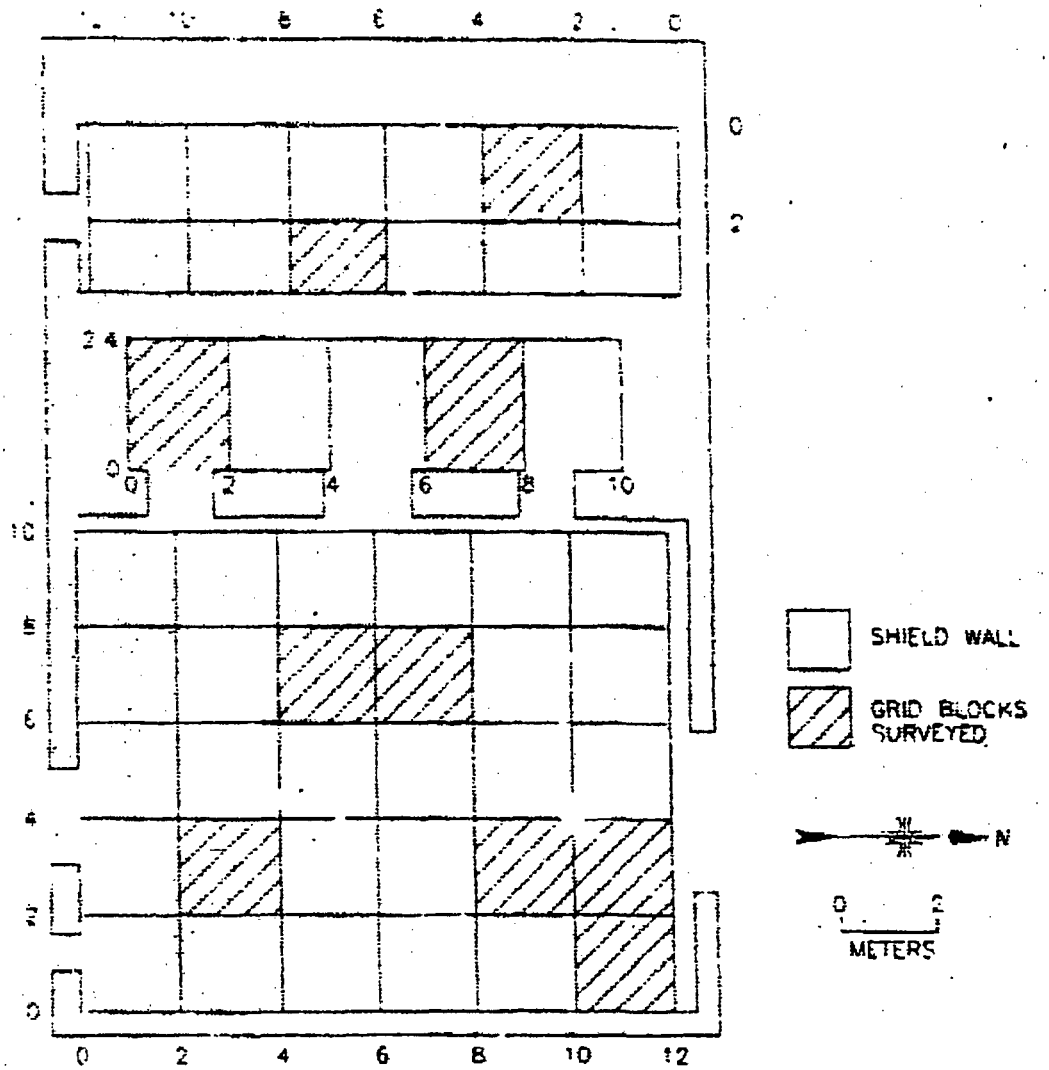


FIGURE 5. Radioactive Materials Laboratory Showing Locations of Floor Grid Blocks Surveyed

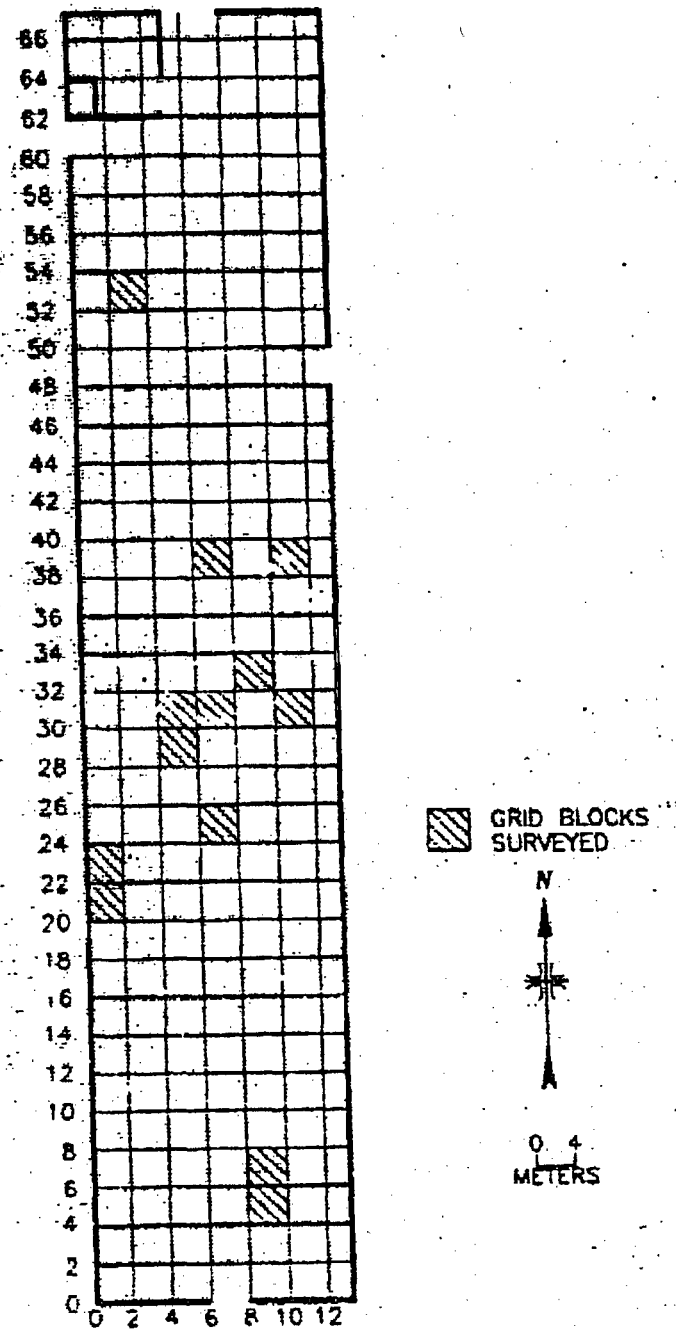


FIGURE 6: Room L-6 Showing Locations of Floor Grid Blocks Surveyed

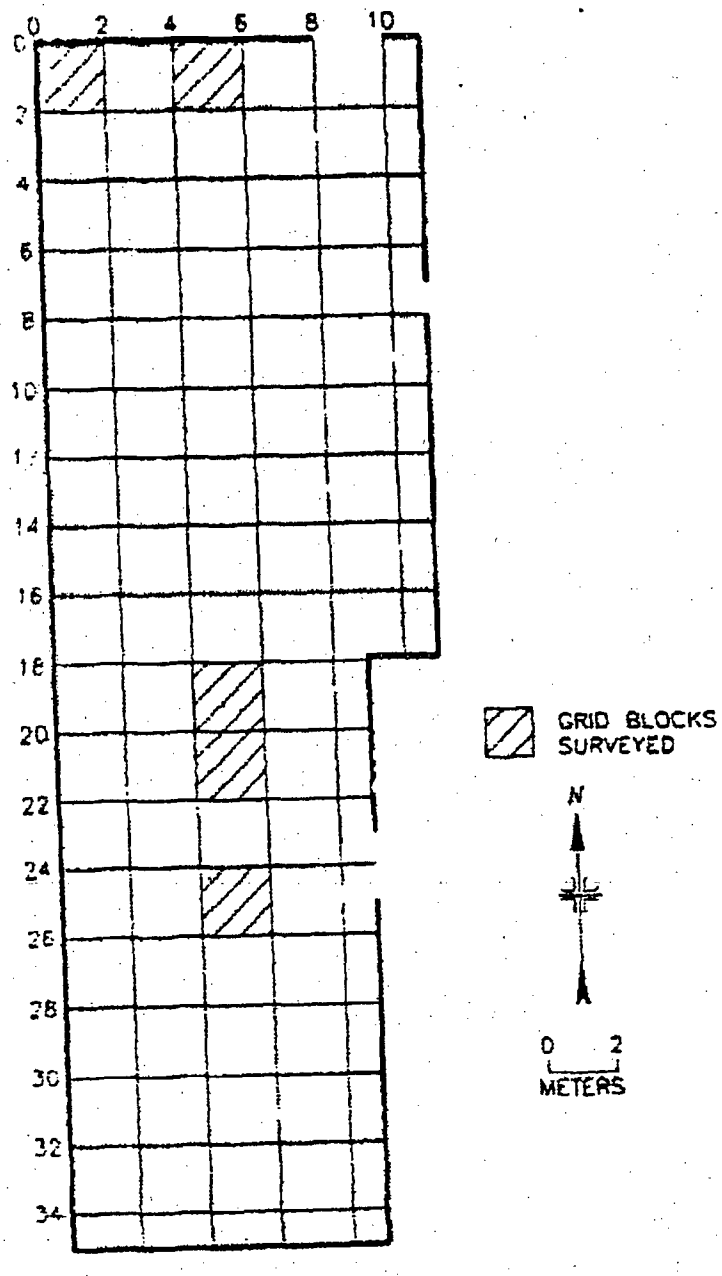


FIGURE 7: Room L5-1 Showing Locations of the Floor Grid Blocks Surveyed

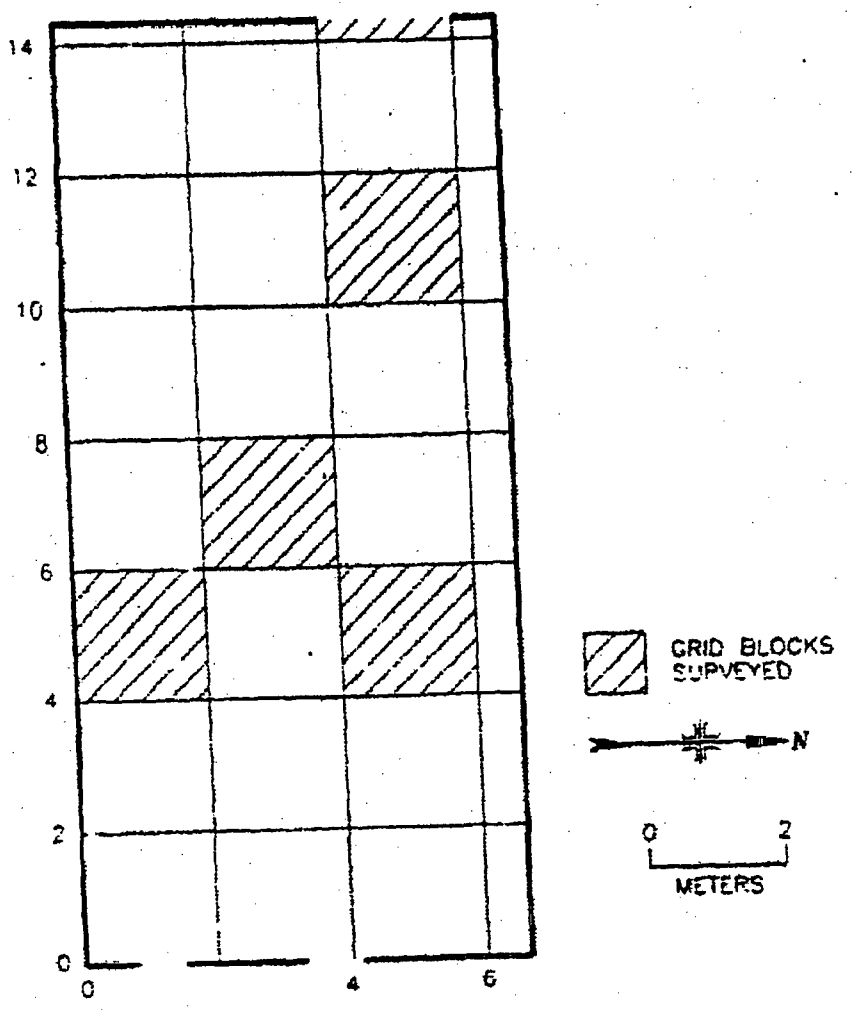


FIGURE 8: Rooms L4-7/8 Showing Locations of Floor Grid Blocks Surveyed

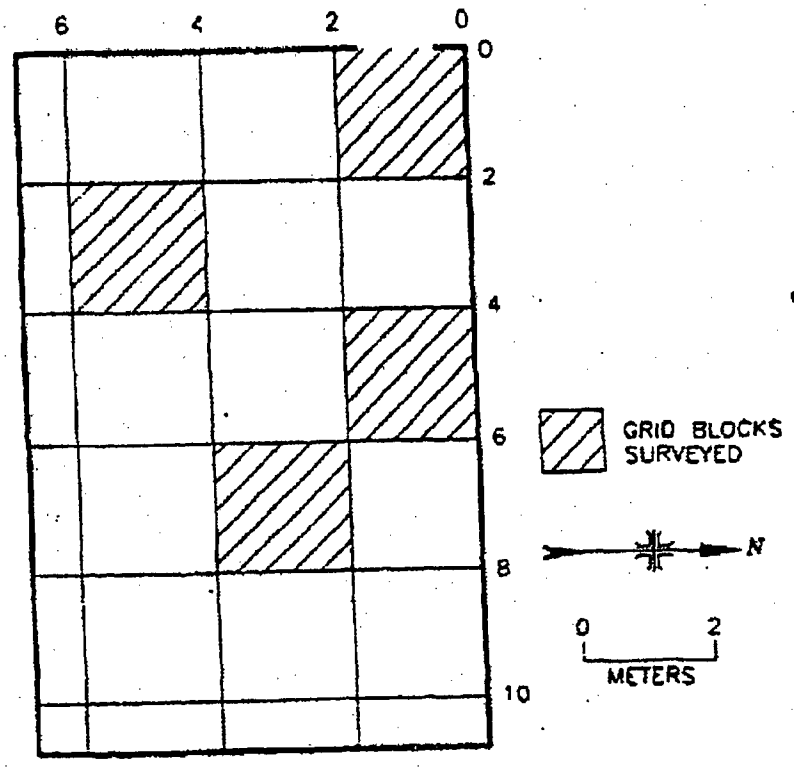


FIGURE 9: Room L3-4 Showing Locations of Floor Grid Blocks Surveyed

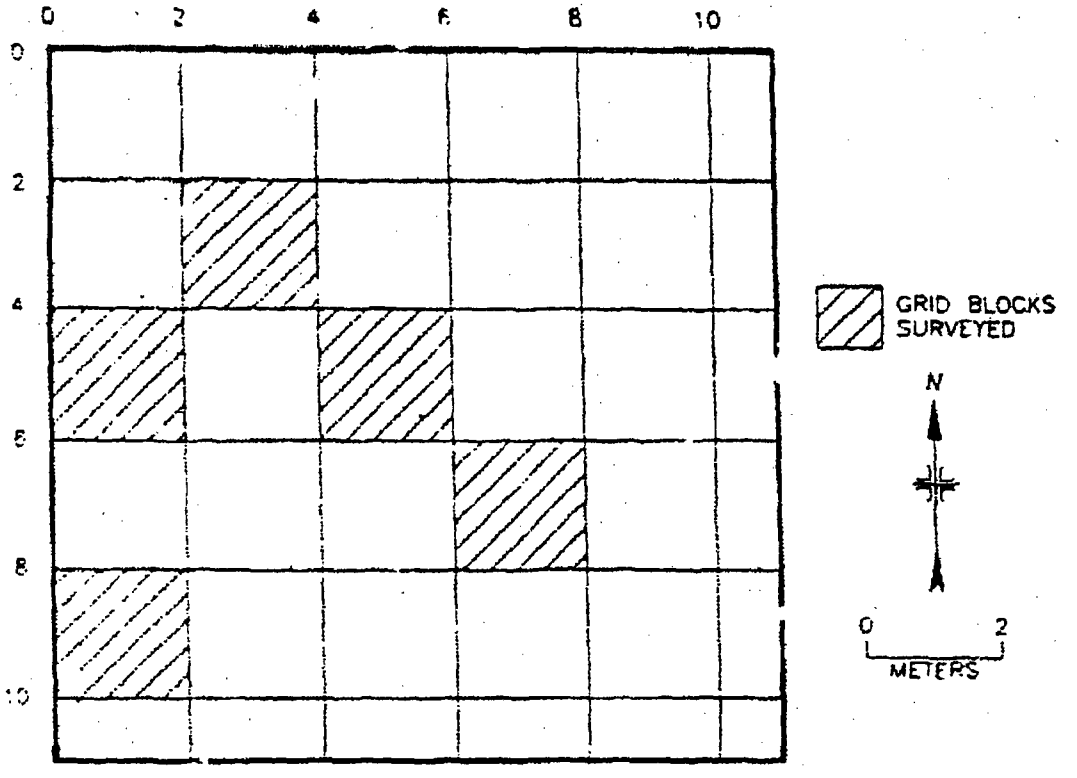


FIGURE 10: Room L1-7 Showing Locations of Four Grid Blocks Surveyed

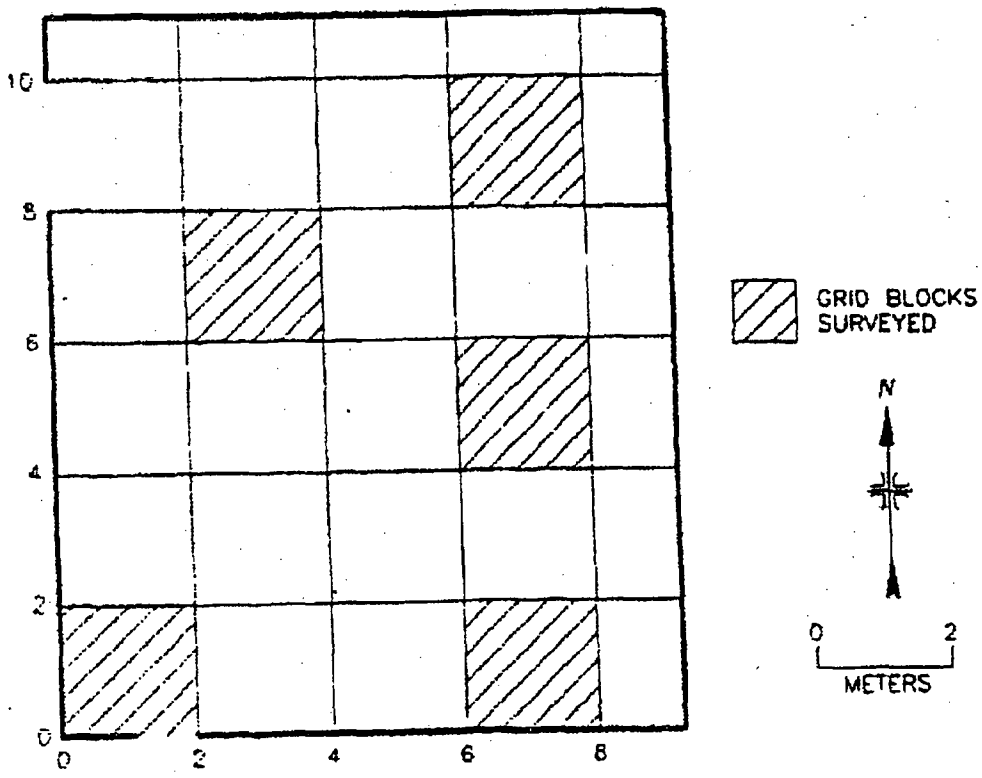


FIGURE 11 Room L1-8 Showing Locations of Floor Grid Blocks Surveyed

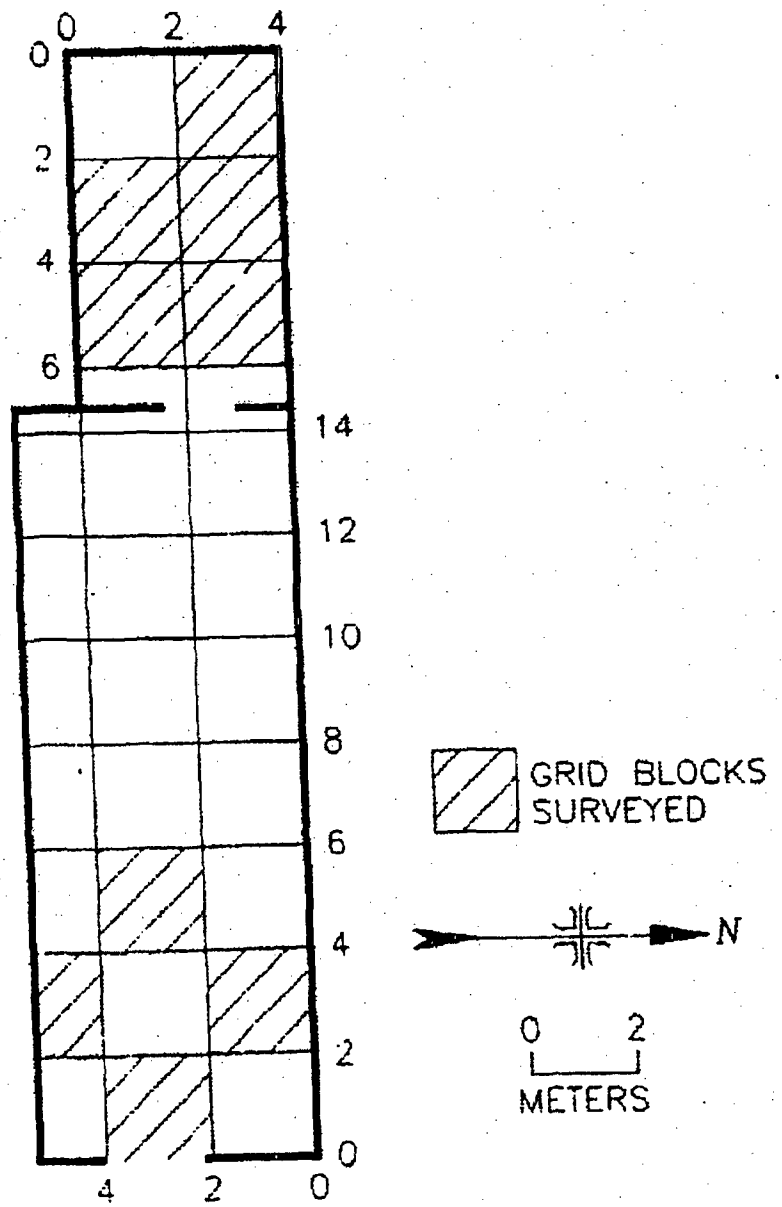
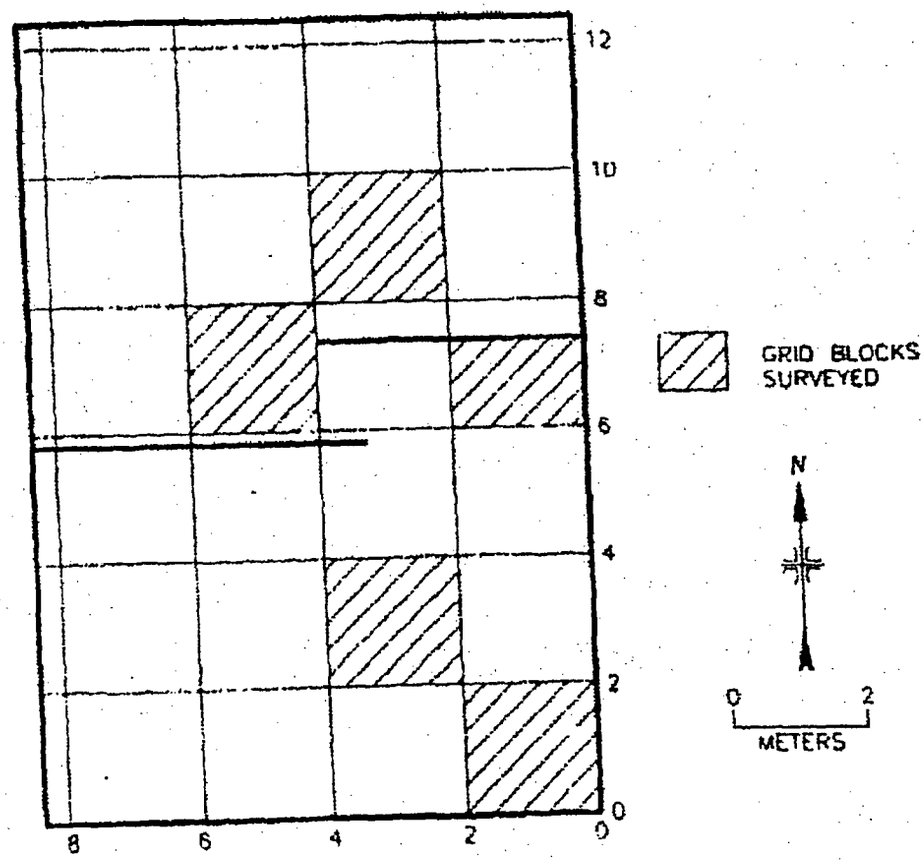


FIGURE 1[illegible] Rooms 607/607A Showing Locations of Floor Grid Blocks Surveyed



[illegible] Room 716 Showing Locations of [illegible] Grid Blocks Surveyed

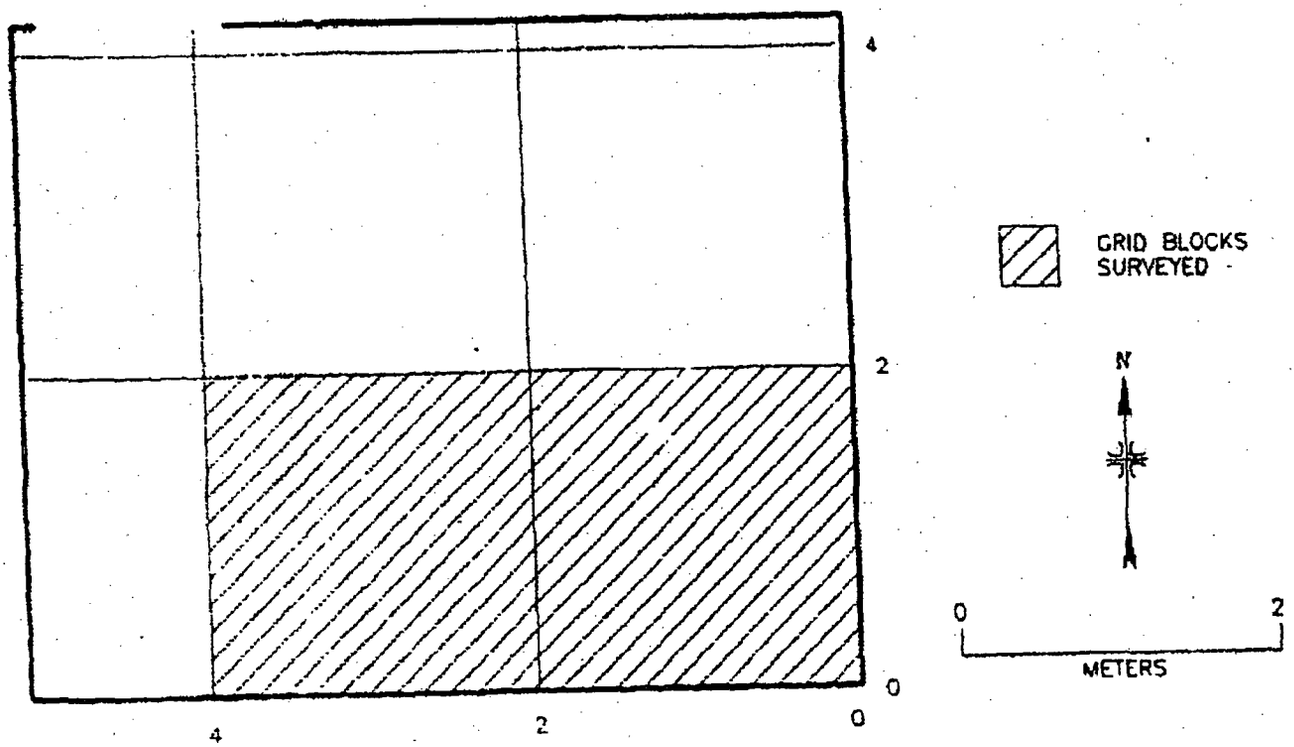


FIGURE 14: Room 717 Showing Locations of Floor Grid Blocks Surveyed

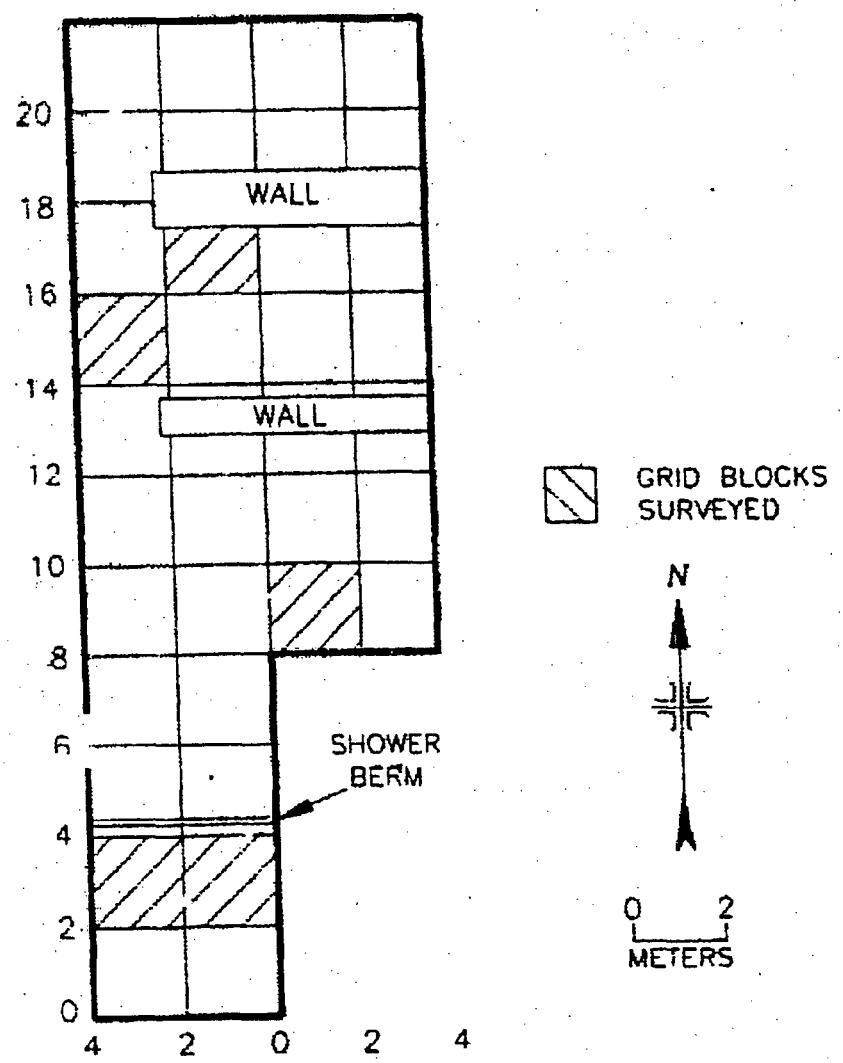


FIGURE 15. Mezzanine Change Room Showing Locations of Floor Grid Blocks Surveyed

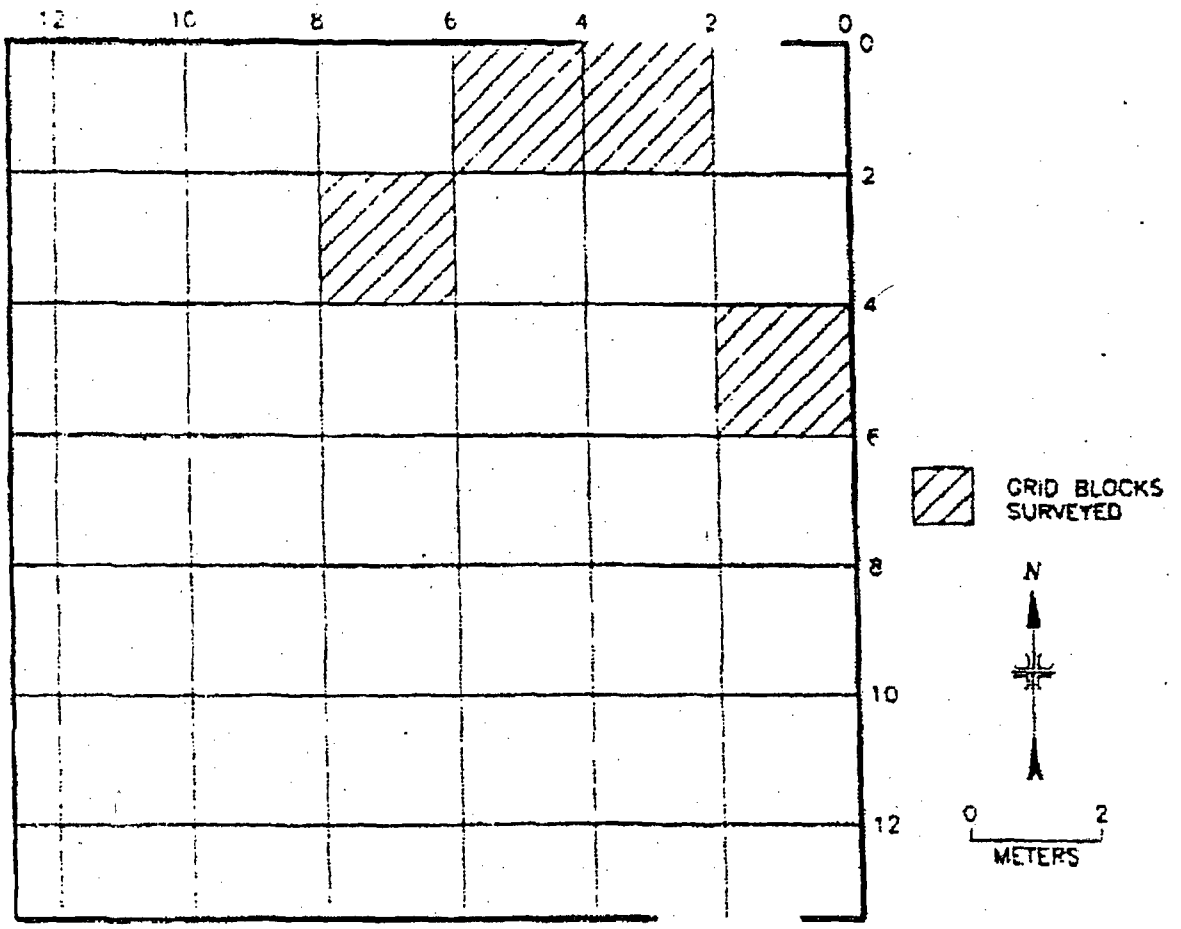


FIGURE 10. Machine Shop Showing Locations of Floor Grid Blocks Surveyed

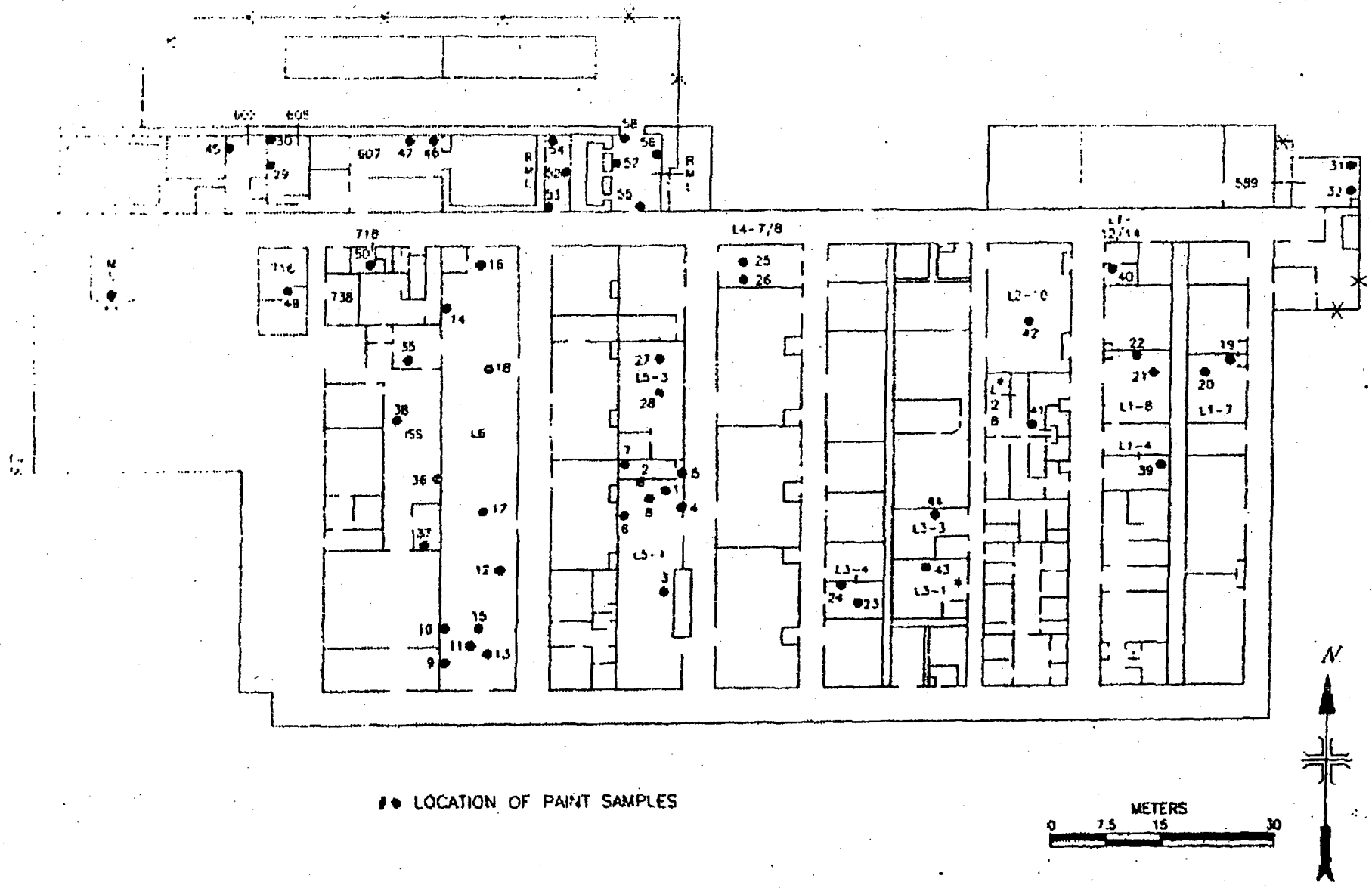


FIGURE 17: Locations of Paint Samples – Main Floor Level

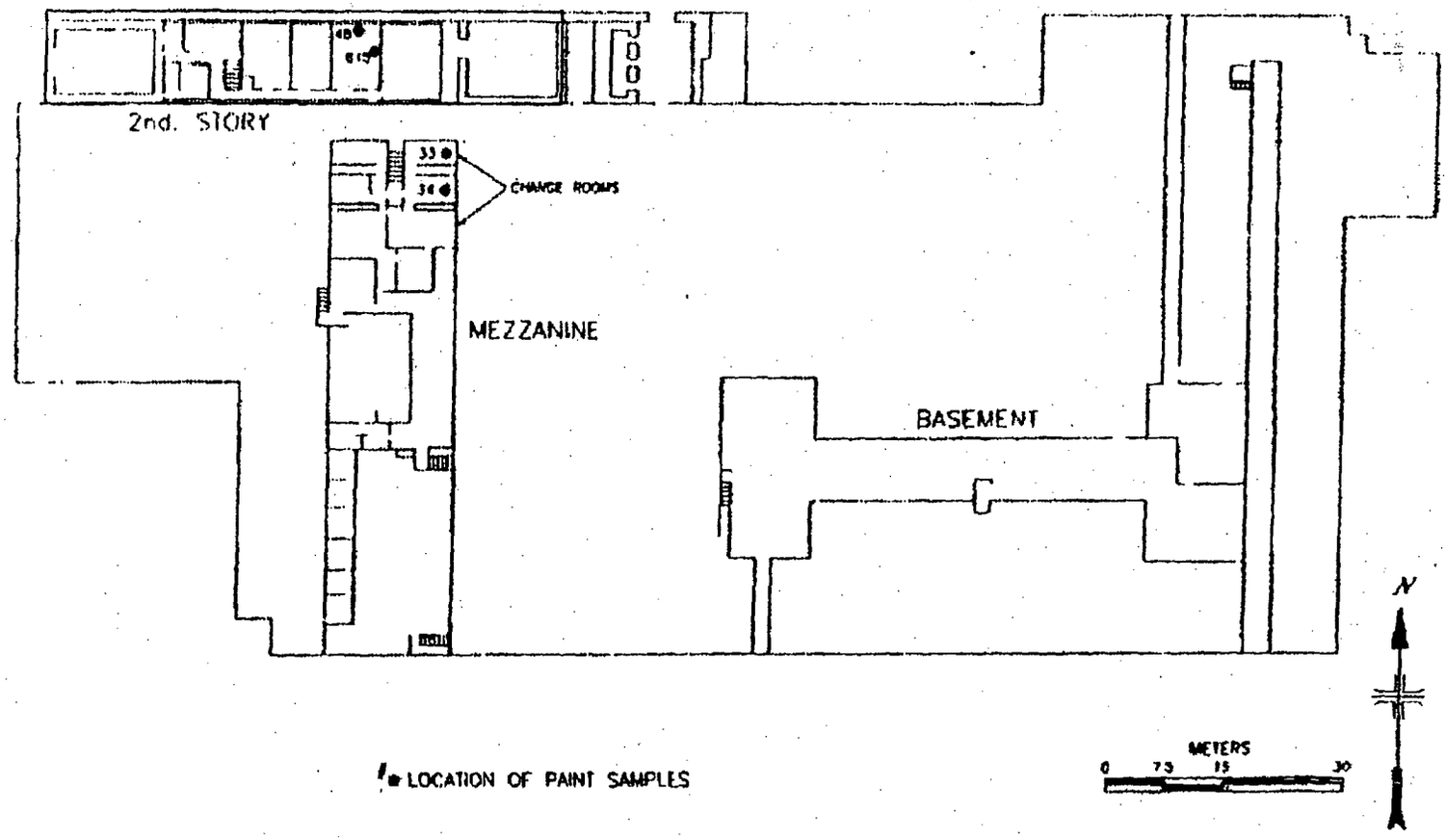


FIGURE 18: Locations of Paint Samples – Mezzanine and Second Floor Levels

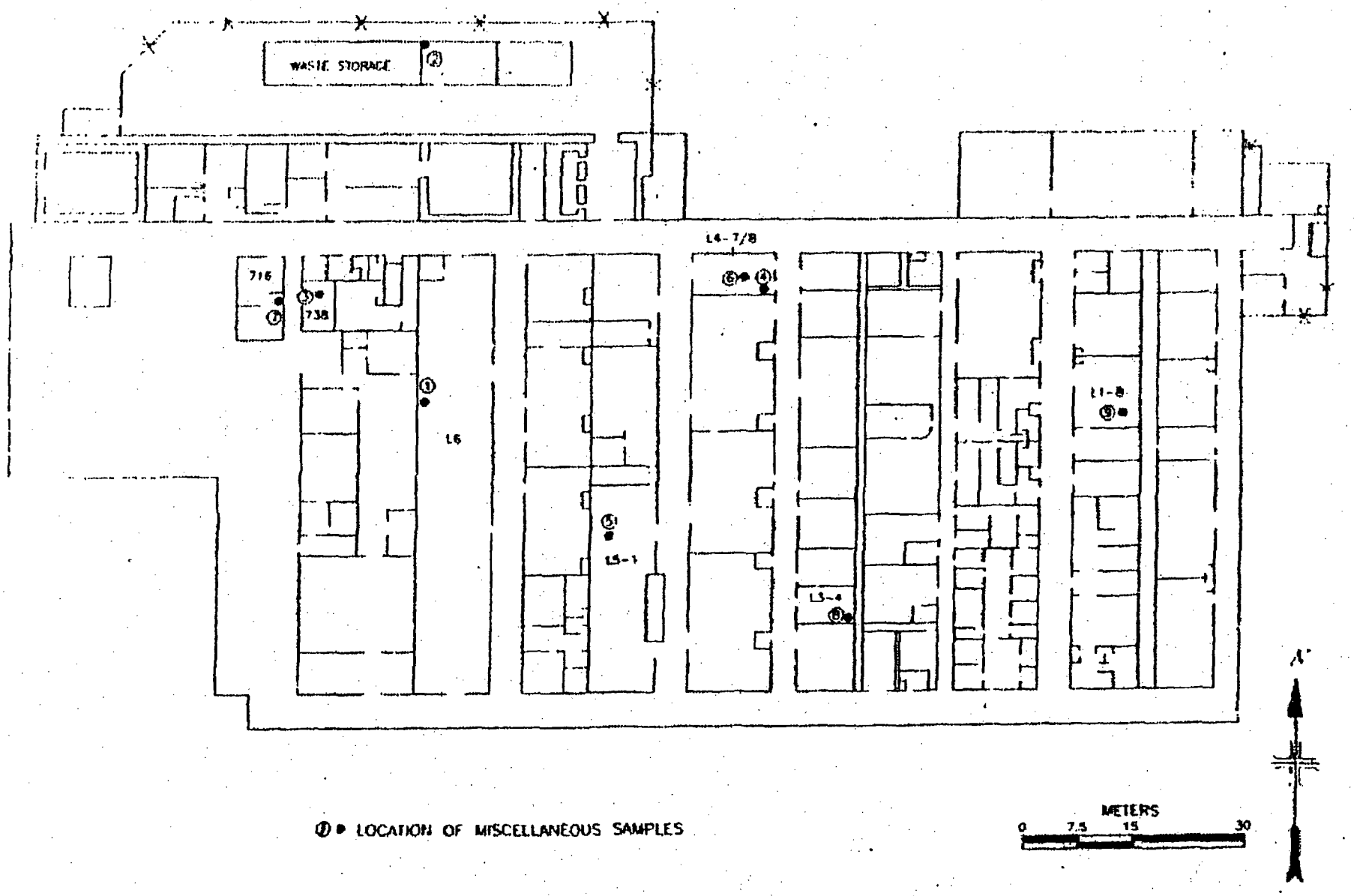


FIGURE 19: Locations of Miscellaneous Samples from Building D

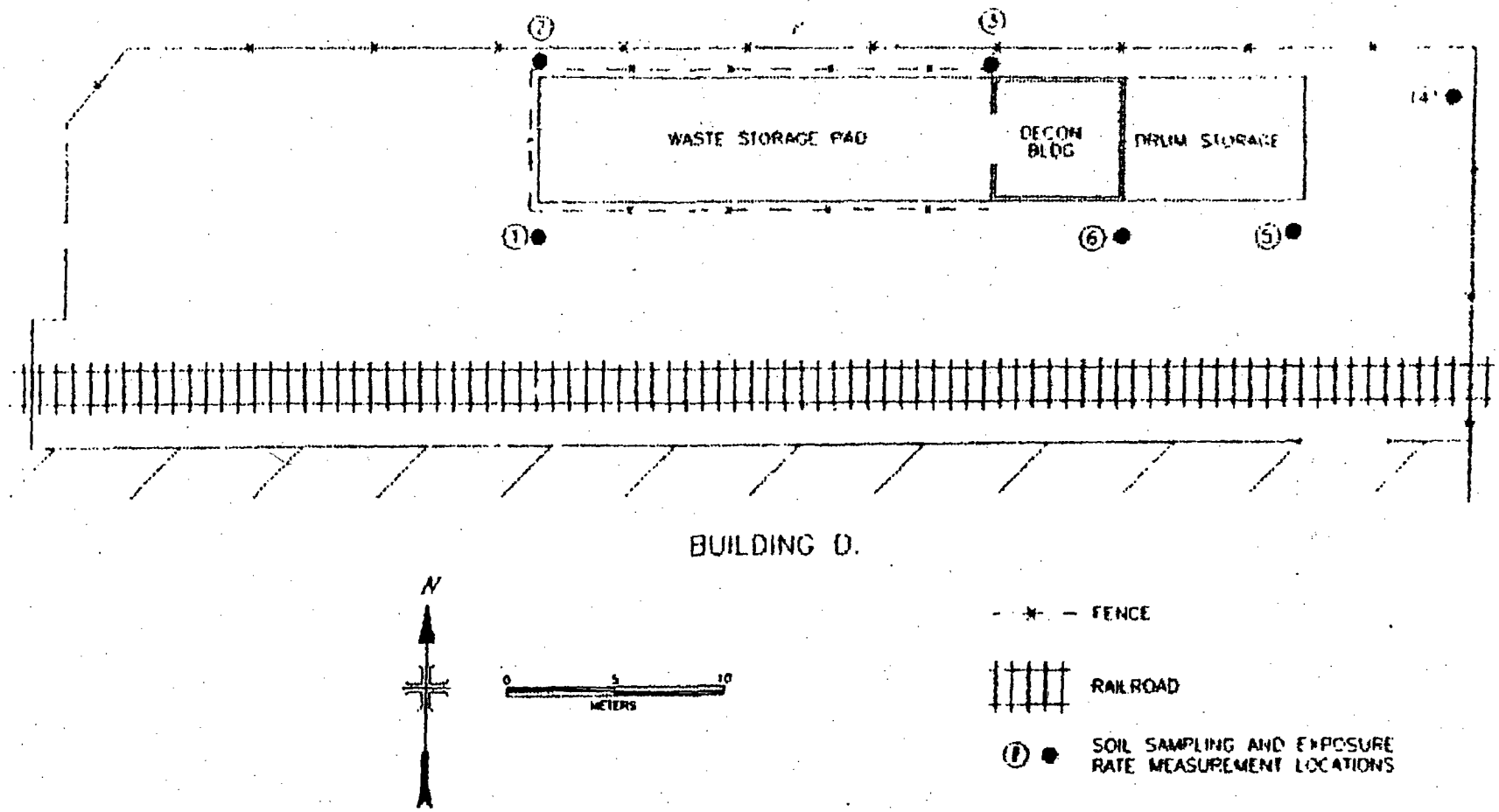


FIGURE 20: Waste Storage Area Indicating Locations of Soil Samples and Exposure Rate Measurements

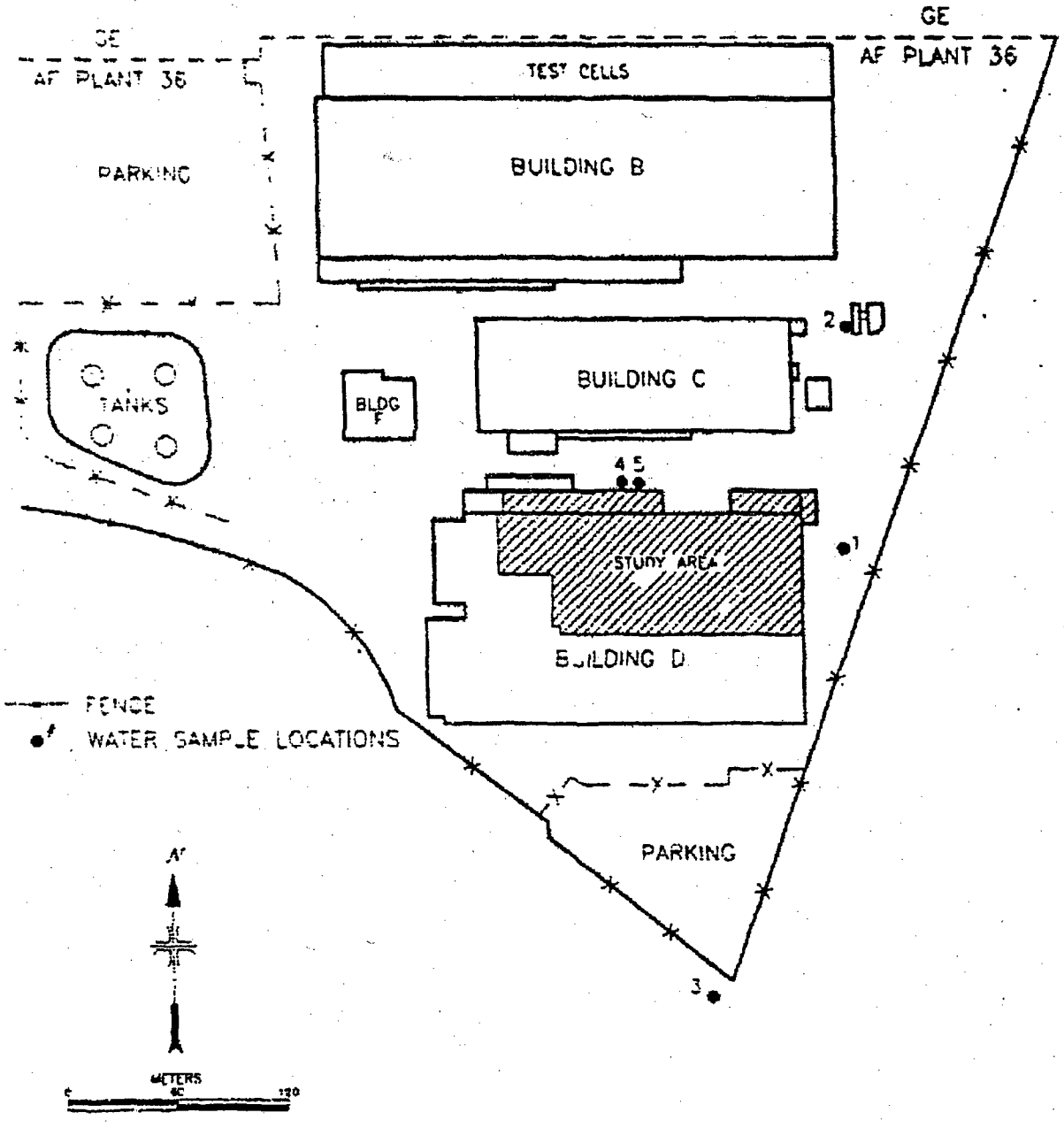


FIGURE 21 Location of Water Samples from the Vicinity of Building D

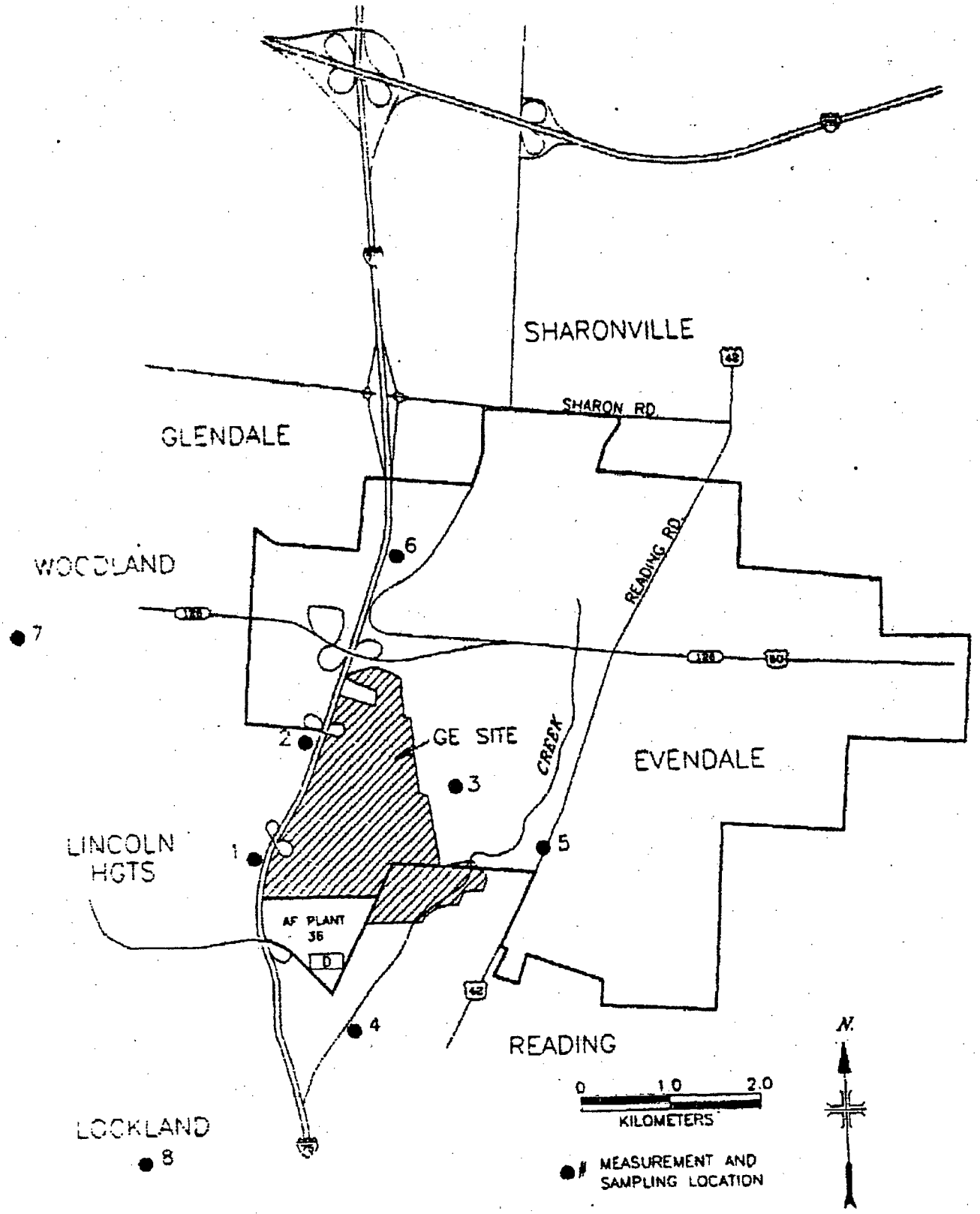


FIGURE 22 Locations of Background Measurements and Baseline Samples from the Evendale, Ohio Area

TABLE 1

DIRECT RADIATION LEVELS AND RADIONUCLIDE CONCENTRATIONS
MEASURED AT BACKGROUND SAMPLING LOCATIONS
GENERAL ELECTRIC COMPANY
AIRCRAFT ENGINE BUSINESS GROUP
EVANDALE, OHIO

Location[a]	Gamma Exposure Rates 1 m above the surface μR/h	Radionuclide Concentrations (pCi/g)				
		Co-60	Cs-137	Th-228	Th-232	U-238
1	9	<0.1	0.5 ± 0.2[b]	0.3 ± 0.1	1.2 ± 0.4	<0.9
2	9	<0.1	0.2 ± 0.1	0.2 ± 0.1	1.1 ± 0.4	2.5 ± 1.5
3	8	<0.1	0.3 ± 0.1	0.2 ± 0.1	0.7 ± 0.3	<0.7
4	8	<0.1	0.5 ± 0.1	0.2 ± 0.1	0.3 ± 0.2	<0.4
5	10	<0.1	0.3 ± 0.1	0.3 ± 0.1	1.5 ± 0.4	1.5 ± 1.2
6	8	<0.1	1.0 ± 0.1	0.3 ± 0.1	1.4 ± 0.4	1.9 ± 0.7
7	9	<0.1	0.3 ± 0.1	0.4 ± 0.1	1.2 ± 0.4	<0.9
8	10	<0.1	1.5 ± 0.2	0.3 ± 0.1	0.9 ± 0.4	1.4 ± 1.5

[a]Refer to Figure 22.
[b]Uncertainties represent the 95% confidence levels based only on counting statistics; additional laboratory uncertainties of 6 to 10% have not been propagated into these data.

TABLE 2

SUMMARY OF 5-POINT SURFACE CONTAMINATION MEASUREMENTS ON GRID BLOCKS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location	Figure	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)		Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
			Highest Grid Block Avg.	Range of Measurements	Highest Grid Block Avg.	Range of Measurements			
RML									
Floors & Lower Walls	5	16	46	<26 - 74	1000	<480 - 1400	<3	<6 - 15	0
Upper Walls & Ceiling[a]		9	---	<26 - 37	---	<480 - 12[illegible]	<3 - 5	<6 - 16	0
L - 6									
Floors & Lower Walls	6	25	110	<26 - 220	560	<480 - 690	<3 - 23	<6 - 15	0
Upper Walls & Ceiling[a]		26	---	<26 - 150	---	<460	<3 - 28	<6 - 12	0
L5 - 7									
Floors & Lower Walls	7	10	120	<26 - 410	<480	<480	<3 - 23	<6 - 12	0
Upper Walls & Ceiling[a]		9	---	<26 - 37	---	<480	<3 - 5	<6	0

TABLE 2 (Continued)

SUMMARY OF 5-POINT SURFACE CONTAMINATION MEASUREMENTS ON GRID BLOCKS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location	Figure	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)	
L4 - 7/8									
Floors & Lower Walls	8	9	45	<26 - 93	<480	<480	<3	<6 - 9	0
Upper Walls & Ceiling[a]		0	---	---	---	---	---	---	---
L3 - 4									
Floors & Lower Walls	9	6	79	<26 - 110	664	<480 - 1100	<3	<6 - 9	0
Upper Walls & Ceiling[a]		4	---	<26 - 110	---	<480	<3 - 7	<6 - 190	0
L1 - 2									
Floors & Lower Walls	10	7	47	<26 - 74	540	<480 - 760	<3	<6	0
Upper Walls & Ceiling[a]		3	---	<26 - 110	---	<480 - 630	<3	<6 - 10	0

TABLE 2 (Continued)

SUMMARY OF 5-POINT SURFACE CONTAMINATION MEASUREMENTS ON GRID BLOCKS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location	Figure	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)		Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
			Highest Grid Block Avg.	Range of Measurements	Highest Grid Block Avg.	Range of Measurements			
L 1- E									
Floors & Lower Walls	11	8	64	<26 - 190	540	<480 - 630	<3	<6 - 14	0
Upper Walls Ceiling[a]		4	---	37	---	<480	<3	<6	0
607/607A									
Floors & Lower Walls	12	14	87	<26 - 150	<480	<480	<3 - 7	<6	0
Upper Walls Ceiling[a]		3	---	<26 - 37	---	<480	3	<6	0
716									
Floors & Lower Walls	13	5	45	<26 - 75	<480	<480	<3	<6	0
Upper Walls Ceiling[a]		6	---	<26 -110	---	<480 - 1000	<3	<6	0

TABLE 2 (Continued)

SUMMARY OF 5-POINT SURFACE CONTAMINATION MEASUREMENTS ON GRID BLOCKS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location	Figure	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)		Alpha Range (dpm/100 cm^2)	Beta Range (dpm/100 cm^2)	
			Highest Grid Block Avg.	Range of Measurements	Highest Grid Block Avg.	Range of Measurements			
717									
Floors & Lower Walls	14	2	<26	<26	<480	<480	<3	<6	0
Upper Walls & Ceiling[a]		7	---	<26	---	<480	<3 - 5	<6 - 8	0
Mezzanine Change Room									
Floors & Lower Walls	15	9	100	<26 - 150	740	<480 - 1400	<3 - 12	<6 - 10	0
Upper Walls & Ceiling[a]		7	---	<26 - 190	---	<480	<3 - 30	<6 - 21	0
Machine Shop									
Floors & Lower Walls	16	7	43	<26 - 74	<480	<480	<3	<6	0
Upper Walls & Ceiling[a]		2	---	<26	---	<480	<3	<6	0

[a]Single point measurements only performed. Averages not determined.

TABLE 3

SUMMARY OF SINGLE-POINT SURFACE CONTAMINATION MEASUREMENTS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location[a]	Number of Measurements	TOTAL CONTAMINATION		REMOVABLE CONTAMINANT		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)	
L5 - 3						
Floor & Lower Walls	8	<26 - 93	<480	<3 - 5	<6	0
Upper Walls & Ceiling	9	<26 - 130	<480 - 830	<3	<6	0
L3 - 1						
Floor & Lower Walls	8	<26	<480 - 830	<3	<6 - 7	0
Upper Walls & Ceiling	3	<26	<480	<3 - 5	<6 - 7	0
L3 - 3						
Floor & Lower Walls	8	<26 - 75	<480	<3	<6 - 8	0
Upper Walls & Ceiling	4	<26 - 37	<480	<3 - 5	<6	0

TABLE 3 (continued)

SUMMARY OF SINGLE-POINT SURFACE CONTAMINATION MEASUREMENTS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

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)	
12 - 6 + 8						
Floors & Lower Walls	10	<26 - 130	<480 - 700	<3	<6 - 7	0
Upper Walls & Ceiling	8	<26 - 37	<480	<3 - 5	<6 - 7	0
12 - 10						
Floors & Lower Walls	8	<26	<480	<3	<6	0
Upper Walls & Ceiling	8	<26 - 37	<480	<3 - 5	<6	0
11 - 4						
Floors & Lower Walls	8	<26 - 110	<480	<3	<6 - 8	0
Upper Walls & Ceiling	2	<26	<480	<3	<6	0

TABLE 3 (continued)

SUMMARY OF SINGLE-POINT SURFACE CONTAMINATION MEASUREMENTS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

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)	
L1 - 12/14						
Floor & Lower Walls	8	<26 - 56	<480 - 500	<3	<6	0
Upper Walls & Ceiling	2	<26	<480	<3	<6	0
589						
Floor & Lower Walls	8	<26 - 93	<480 - 1200	<3	<6	0
Upper Walls & Ceiling	2	<26	<480	<3	<6	0
602						
Floor & Lower Walls	8	<26	<480	<3	<6	0
Upper Walls & Ceiling	2	<26	<480	<3	<6	0

TABLE 5 (continued)

SUMMARY OF SINGLE-POINT SURFACE CONTAMINATION MEASUREMENTS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

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)	
605						
Floors & Lower Walls	8	<26	<480	<3 - 7	<6 - 7	0
Upper Walls & Ceiling	2	---	<480	<3	<6	0
615						
Floors & Lower Walls	8	<26	<480	<3	<6	0
Upper Walls & Ceiling	2	<26	<480	<3	<6	0
718						
Floors & Lower Walls	6	<26 - 37	<480	<3 - 5	<6 - 7	0
Upper Walls & Ceiling	1	<26	<480	<3	<6	0

TABLE 3 (continued)

SUMMARY OF SINGLE-POINT SURFACE CONTAMINATION MEASUREMENTS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

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)	
73A						
Floors & Lower Walls	7	<26 - 56	<480	<3	<6 - 8	0
Upper Walls & Ceiling	3	<26	<480	<3	<6	0
Basement						
Floors & Lower Walls	8	<26 - 110	<480	<3 - 5	<6 - 8	0
Upper Walls & Ceiling	2	<26	<480	<3	<6	0
1.5						
Floors & Lower Walls	9	<26	<480	<3	<6	0
Upper Walls & Ceiling	8	<26 - 220	<480	<3 - 12	<6 - 8	0

TABLE 3 (continued)

SUMMARY OF SINGLE-POINT SURFACE CONTAMINATION MEASUREMENTS
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

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)	
Waste Storage Pad						
Floors & Lower Walls	10	<26	<480 - 630	<3 - 9	<6	0
Upper Walls & Ceiling	2	<26	<480	<3	<6	0

[a]Refer to Figures 3 and 4.

TABLE 4

DIRECT RADIATION LEVELS MEASURED AT
LOCATIONS IN BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location	Room[a]	Grid Block	Gamma Exposure Rates @ 1 m above the surface (μR/h)
1	RML	4N, 9.5W	5
2	Lo	44N, 6E	9
3	607A	3N, 4E	8
4	L3 - 4	4N, 6E	10
5	L4 - 7 & 8	4N, 5W	10
6	L1 - 7	4N, 4E	10

[a]Refer to Figure 3.

TABLE 5

RADIONUCLIDE CONCENTRATIONS IN PAINT SAMPLES
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location[a]	Surface	Grid Block	Radionuclide Concentrations (dpm/100 cm^2) U Total	Th Total
L5-1	Ceiling	21	<0.7	<1.0
L5-1	Upper Wall	9	<0.6	<0.9
L5-1	Ceiling	56	<1.0	<1.5
L5-1	Upper Wall	30	<0.9	<0.9
L5-1	Upper Wall	15	<1.9	<2.3
L5-1	Upper Wall	55	<0.6	<1.0
L5-1	Upper Wall	1	<1.2	<2.7
L5-1	Upper Wall	25	<0.6	<1.4
L6-1	Upper Wall	24	<0.7	<1.1
L6-1	Upper Wall	38	<1.5	<2.2
L6-1	Upper Wall	34	<1.5	<2.9
L6-1	Ceiling	54	<0.7	<1.0
L6-1	Upper Wall	21	<1.5	<3.2
L6-1	Ceiling	155	<0.6	<1.3
L6-1	Upper Wall	27	<0.9	24
L6-1	Ceiling	164	<0.7	6.8
L6-1	Upper Wall	69	<0.6	<1.9
L6-1	Ceiling	124	<0.7	<1.4
L1-7	Upper Wall	16	<1.2	<2.6
L1-7	Ceiling	7	<0.8	<1.2
L1-8	Ceiling	26	<1.0	<1.3
L1-8	Upper Wall	3	<1.0	<2.0
L3-4	Ceiling	8	<0.8	<1.1
L3-4	Ceiling	4	<0.7	<0.7
L4-7/8	Ceiling	25	<0.6	<0.9
L4-7/8	Ceiling	24	<0.6	<1.6
L5-3	Ceiling	8	<2.0	<3.4
L5-3	Ceiling	18	<1.4	<2.4
605	Lower Wall	1	<0.7	<1.0
605	Lower Wall	2	<1.1	<1.9
518	Ceiling	9	<0.9	<1.9
518	Ceiling	4	<0.7	<1.3
Mezzanine	Lower Wall	21	<1.6	<2.9
Mezzanine	Lower Wall	26	<2.2	<3.8
155	Upper Wall	4	<0.7	<1.7

TABLE 5 (Continued)

RADIONUCLIDE CONCENTRATIONS IN PAINT SAMPLES
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location[a]	Surface	Grid Block	Radionuclide Concentrations (dpm/100 cm^2) U Total	Th Total
ISS	Lower Wall	26	<1.1	<1.7
ISS	Upper Wall	4	<1.6	<2.8
ISS	Upper Wall	7	<1.1	<1.9
L1-4	Ceiling	13	<0.7	<1.5
L1-12/14	Ceiling	4	<0.7	<1.0
L2-6/8	Ceiling	35	<0.7	<0.7
L2-10	Ceiling	18	<0.7	<0.7
L3-1	Ceiling	19	<0.6	<0.9
L3-5	Ceiling	10	<0.7	<1.1
602	Lower Wall	10	<0.7	<1.0
607	Upper Wall	3	<1.0	<1.9
607A	Lower Wall	4	<0.7	<1.0
615	Upper Wall	1	<0.4	<1.7
716	Lower Wall	7	<1.7	<2.8
718	Upper Wall	5	<1.4	<2.3
MS	Upper Wall	9	<1.8	<3.7
RML	Upper Wall	6	<0.7	<1.4
RML	Upper Wall	9	<1.0	<1.5
RML	Upper Wall	2	<0.9	<0.9
RML	Lower Wall	2	<0.8	<1.6
RML	Lower Wall	18	<0.7	<1.0
RML	Lower Wall	15	<0.9	<1.7
RML	Upper Wall	26	<0.4	<0.8

[a]Refer to Figures 17 and 18.

TABLE 6

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS RESIDUE SAMPLES
BUILDING D
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Sample No.	Sample Type	Location[a]	Radionuclide Concentrations (pCi/g)				
			Co-60	Cs-137	Th-228	Th-232	U-238
1	concrete	L6	<0.2	<0.1	<0.1	<0.4	<0.3
2	concrete	Waste Storage Pad	<0.2	0.3 ± 0.1[b]	0.8 ± 0.2	1.4 ± 0.6	<0.6
3	concrete	738	<0.2	1.5 ± 0.8	<0.3	<0.9	<2.2
4	concrete	L4-7/8	<0.3	<0.4	<0.3	<0.9	<1.8
5	concrete	L5-1	<0.1	<0.1	0.2 ± 0.1	<0.2	<0.3
			Radionuclide Concentrations (dpm/100 cm^2)				
			Co-60	Cs-137	Th-228	Th-232	U-238
6	residue	L4-7/8	<15	417 ± 40	<9.3	<35	< 64
7	residue	716	<17	<22	<10	<74	<130
8	residue	L3-4	<24	<12	<11	<6.9	<110
9	residue	L1-8	<7.3	148 ± 24	<6.5	<32	140 ± 110

[a]Refer to Figure 19.
[b]Uncertainties represent the 95% confidence levels based only on counting statistics; additional laboratory uncertainties of 6 to 10% have not been propagated into these data.

TABLE 7

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
COLLECTED FROM THE WASTE STORAGE AREA
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Location[a]	Gamma Exposure Rates 1 m Above the Surface (μR/h)	Radionuclide Concentrations (pCi/g)				
		Co-60	Cs-137	Th-228	Th-232	U-238
1	8	<0.1	0.6 ± 0.1[b]	0.3 ± 0.1	0.6 ± 0.2	<0.7
2	8	<0.1	4.1 ± 0.2	0.4 ± 0.1	1.4 ± 0.4	<0.6
3	10	<0.1	0.6 ± 0.1	0.2 ± 0.1	0.8 ± 0.3	<0.6
4	9	<0.1	2.5 ± .2	0.4 ± 0.1	1.7 ± 0.3	<0.6
5	8	<0.1	0.9 ± 0.1	0.3 ± 0.1	0.8 ± 0.3	<0.7
6	16	<0.1	0.5 ± 0.1	0.3 ± 0.1	0.8 ± 0.4	<0.5

[a]Refer to Figure 20.
[b]Uncertainties represent the 95% confidence levels based only on counting statistics; additional laboratory uncertainties of 6 to 10% have not been propagated into these data.

TABLE 8

RADIONUCLIDE CONCENTRATIONS IN WATER FROM STORAGE TANKS, SANITARY AND STORM SEWER SYSTEMS
GENERAL ELECTRIC COMPANY
EVANDALE, OHIO

Water Samples	Location[a]	Radionuclide Concentrations (pCi/l)	
		Gross Alpha	Gross Beta
1	Sanitary Sewer	2.0 ± 0.9	26.7 ± 1.7
2	Storm Sewer	2.0 ± 1.5	14.6 ± 2.7
3	Storm Sewer	0.6 ± 0.7	3.7 ± 1.0
4	Storage Tank	<0.3	0.6 ± 0.8
5	Storage Tank	<0.3	<0.6

[a]Refer to Figure 21.

REFERENCES

1. "Summary Report, Decontamination of Laboratory Facilities, Building D, USAF Plant No. 36," AEBG-36-110 and 55 supporting reports on specific building sections or areas, General Electric Company, November 1986.

2. Decontamination of Laboratory Facilities, Building D, U.S. Air Force Plant No. 36, Evandale, Ohio, Addendum Report, AEBG-36-110A, General Electric Company, July 1987.

3. "Proposed Confirmatory Radiological Survey Plan for Building D, General Electric Aircraft Engine Business Group, Evandale, Ohio," Oak Ridge Associated Universities, August 3, 1987.

4. "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations," NRC branch Technical Position, Federal Register, October 23, 1981.

5. Report on Decontamination and Decommissioning of GA Technologies Old Waste Processing Facility and Surrounding Areas, Phase I, GA Technologies, San Diego, California, November 11, 1985.

6. Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, January 1985.

7. "Radiological Survey of Building D Trenches, General Electric Corporation (sic), Evandale, Ohio, (Phase I)," Oak Ridge Associated Universities, March 14, 1985.

8. "Radiological Survey of Building D Trenches, General Electric Corporation (sic), Evandale, Ohio, (Phase II)," Oak Ridge Associated Universities, July 23, 1985.

9. "Radiological Survey of Building D Trenches, General Electric Corporation (sic), Evandale, Ohio, (Phase III)," Oak Ridge Associated Universities, November 15, 1985.

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, Sante Fe, NM)

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

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

Eberline Alpha Scintillation Probe
Model AC-3-7
(Eberline, Sante Fe, NM)

Eberline Beta-Gamma "Pancake" Probe
Model HP-260
(Eberline, Sante Fe, NM)

Victoreen Beta-Gamma "Pancake" Probe
Model 489-110
(Victoreen, Inc., Cleveland, OH)

Reuter-Stokes Pressurized Ionization Chamber
Model RSS-111
(Reuter-Stokes, Cleveland, OH)

Victoreen NaI Gamma Scintillation Probe
Model 489-55
(Victoreen, Inc., Cleveland, OH)

B. Laboratory Analyses

Low Background Alpha-Beta Counter
Model LB5110-2080
(Tennelec, Inc., Oak Ridge, TN)

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

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

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

Used in conjunction with:
Lead Shield, G-16
(Gamma Products, Inc., Palos Hills, IL)

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

Multichannel Analyzer
ND-66/ND-680 System
(Nuclear Data, Inc., Schaumburg, IL)

Multichannel Analyzer
TP-5/11 PHA, PDP 11/05 Computer
(Tennecomp Systems, Inc., Oak Ridge, TN)

High Purity Germanium Detector
Model GEN3185, 30% efficiency
(EG&G ORTEC, Oak Ridge, TN)

APPENDIX B

MEASUREMENT AND ANALYTICAL PROCEDURES

APPENDIX B

MEASUREMENT AND ANALYTICAL PROCEDURES

Gamma Scintillation Measurement

Surface scans and measurements of gamma exposure rates were performed using Eberline Model PRM-6 portable ratemeters with Victoreen Model 489-55 gamma scintillation probes containing 3.2 cm x 3.8 cm NaI(Tl) scintillation probes. Count rates were converted to exposure rates (μR/h) by cross-calibrating with a Reuter-Stokes Model RSS-111 pressurized ionization chamber at representative onsite locations.

Alpha and Beta-Gamma Measurements

Floors were scanned for elevated alpha/beta levels by passing slowly over the surface with a Ludlum Model 239-1 Proportional Floor Monitor with a 600 cm^2 sensitive area. Other surfaces were scanned using Eberline Model PRS-1 portable scaler/ratemeters coupled to alpha scintillation probes or HP-260 GM "pancake" probes.

Measurements of total alpha radiation levels were performed using Eberline Model PRS-1 portable scaler/ratemeters with Model AC3-7 alpha scintillation probes. Measurement of direct beta-gamma radiation levels were performed using Eberline Model PRS-1 portable scaler/ratemeters with Model HP-260 thin-window pancake GM 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. The effective window area was 59 cm^2 for the alpha detectors and 15 cm^2 for the GM detectors. The average background count rate was approximately 1-2 cpm for the alpha probes and 40 cpm for the GM probes.

Removable Contamination Measurements

Smears for determination of removable contamination levels were collected on numbered filter paper disks 7 mm in diameter, then placed in individually

labeled envelopes with the location and other pertinent information recorded. The smears were counted on a low background gas proportional alpha-beta counter.

Water Sample Analysis

Water samples were rough-filtered through Whatman No. 2 filter paper. Remaining suspended solids were removed by subsequent filtration through 0.45 um 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 gas proportional counter.

Paint Samples

Paint samples were pulverized using a mortar and pestle. Neutron activation was conducted using a 30 mg Californium 252 source and samples analyzed on a 30% high purity Germanium Detector coupled to a Tennecomp pulse height analyzer and a DEC PDP 11/05 computer.

Soil Samples Analysis

Soil samples were mixed, and a portion placed in a 0.5 liter 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. Spectra were scanned for identifiable photopeaks. The following energy peaks were used for determination of the radionuclides of concern:

Th-232 - 0.911 MeV from Ac-228 (secular equilibrium assumed)
Th-228 - 0.583 MeV from Tl-208 (secular equilibrium assumed)
U-238 - 0.094 MeV from Th-234 (secular equilibrium assumed)
Co-60 - 1.173 MeV
Cs-137 - 0.661 MeV

Residue Sample Analysis

Residue samples were analyzed by determining the sample weight, and performing gamma spectrometry by counting the sample on an intrinsic germanium detector coupled to a Nuclear Data Model ND-680 pulse height analyzer system.

Uncertainties and Detection Limits

The uncertainties associated with the analytical data presented in the tables of this report, represent the 95% confidence levels for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels. When the net sample count was less than the 95% statistical deviation of the background count, the sampl concentration was reported as less than the detection capability of the measurement procedure. Because of variations in background levels, sample volumes or weights, measurement efficiencies, and Compton contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument. Additional uncertainties of ± 6 to 10%, associated with sampling and laboratory procedures, have not been propagated into the data presented in this report.

Calibration and Quality Assurance

Laboratory and field survey procedures are documented in the following manuals, developed specifically for the Oak Ridge Associated Universities' Radiological Site Assessment Program: "Survey Procedures Manual," Revision 3, May 1987; "Laboratory Procedures Manual", Revision 3, May 1987; and "Quality Assurance Manual", Revision 1, June 1987.

With the exception of the measurements conducted with portable gamma scintillation survey meters, instruments were 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 FACILIITES 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 βγ/100 cm^2	15,000 dpm βγ/100 cm^2	1000 dpm βγ/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.