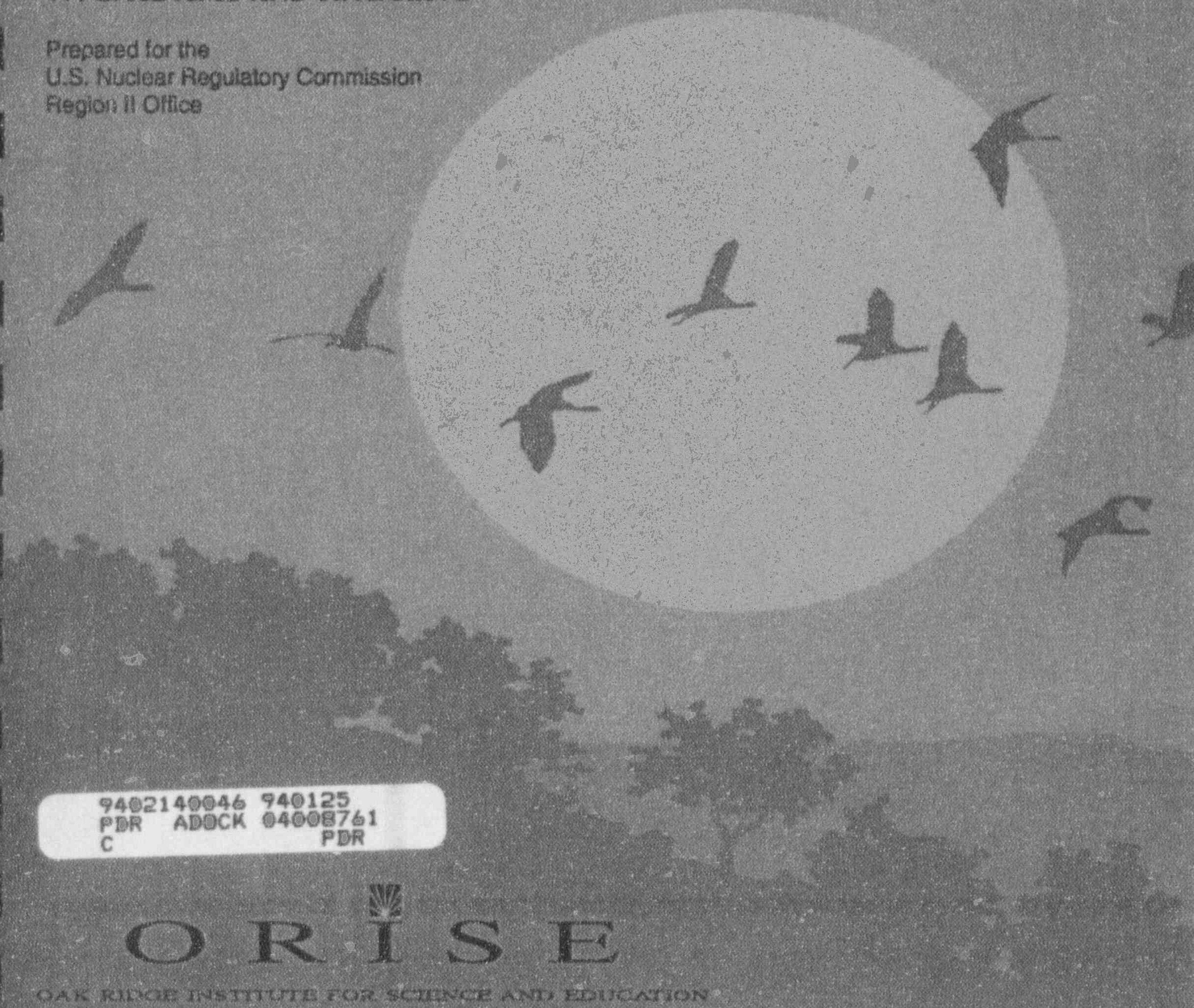
RADIOLOGICAL SURVEY OF THE ITT ELECTRO-OPTICAL PRODUCTS DIVISION PLANTATION ROAD FACILITY ROANOKE, VIRGINIA

[DOCKET 040-08761]

W. C. ADAMS AND K. A. KING

Prepared for the
U.S. Nuclear Regulatory Commission
Region II Office



ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Environmental Survey and Site Assessment Program
Energy/Environment Systems Division

RADIOLOGICAL SURVEY OF THE ITT ELECTRO-OPTICAL PRODUCTS DIVISION PLANTATION ROAD FACILITY ROANOKE, VIRGINA

[DOCKET 040-08761]

W. C. ADAMS AND K. A. KING

Prepared for the
U.S. Nuclear Regulatory Commission
Region II Office

ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Environmental Survey and Site Assessment Program
Energy/Environment Systems Division

The **Oak Ridge Institute for Science and Education** (ORISE) was established by the U.S. Department of Energy to undertake national and international programs in science and engineering education, training and management systems, energy and environment systems, and medical sciences. ORISE and its programs are operated by Oak Ridge Associated Universities (ORAU) through a management and operating contract with the U.S. Department of Energy. Established in 1946, ORAU is a consortium of 65 colleges and universities.

ORISE 94/A-26

RADIOLOGICAL SURVEY
OF THE
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
PLANTATION ROAD FACILITY
ROANOKE, VIRGINIA

Prepared by

W. C. Adams and K. A. King

Environmental Survey and Site Assessment Program
Energy/Environment System Division
Oak Ridge Institute for Science and Education
Oak Ridge, Tennessee 37831-0117

Prepared for the

U.S. Nuclear Regulatory Commission
Region II Office

Sponsored by the
Office of Nuclear Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission

January 1994

FINAL REPORT

This report is based on work performed under an Interagency Agreement (NRC Fin. No. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Institute for Science and Education performs complementary work under contract number DE-AC05-76OR00033 with the U.S. Department of Energy.

RADIOLOGICAL SURVEY
OF THE
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
PLANTATION ROAD FACILITY
ROANOKE, VIRGINIA

Prepared by: Wade C. Adams Date: 1/7/94
W. C. Adams, Project Leader
Environmental Survey and Site Assessment Program

Reviewed by: WLBeck Date: 1/7/94
W. L. Beck, Acting Laboratory Manager
Environmental Survey and Site Assessment Program

Reviewed by: Michael R. Landis Date: 1/7/94
M. R. Landis, Project Manager
Environmental Survey and Site Assessment Program

Reviewed by: Ann T. Payne Date: 1/7/94
A. T. Payne, Quality Assurance Officer
Environmental Survey and Site Assessment Program

Reviewed by: James D. Berger Date: 1/10/94
J. D. Berger, Program Director
Environmental Survey and Site Assessment Program

ACKNOWLEDGEMENTS

The authors would like to acknowledge the significant contributions of the following staff members:

FIELD STAFF

T. L. Bright
J. M. Burton

LABORATORY STAFF

R. D. Condra
J. S. Cox
R. L. Epperson
M. J. Laudeman
S. T. Shipley

CLERICAL STAFF

T. T. Claiborne
D. A. Cox
R. D. Ellis
M. S. Perry
K. E. Waters

ILLUSTRATOR

E. A. Powell

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ASME	American Society of Mechanical Engineers
BKG	background
cm^2	square centimeter
cpm	counts per minute
dpm/100 cm^2	disintegrations per minute/100 square centimeters
EML	Environmental Measurement Laboratory
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
ft	foot
GM	Geiger-Mueller
in	inches
IT	International Technologies Corporation
ITT	ITT Electro-Optical Products Division
kg	kilogram
km	kilometer
m	meter
m^2	square meter
MDA	Minimum Detectable Activity
mi	mile
NaI	Sodium Iodide
NIST	National Institute for Standards Technology
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocurie per gram
PIC	Pressurized Ionization Chamber
$\mu R/h$	microroentgen per hour
ZnS	Zinc Sulfide

RADIOLOGICAL SURVEY
OF THE
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
PLANTATION ROAD FACILITY
ROANOKE, VIRGINIA

INTRODUCTION AND SITE HISTORY

ITT Electro-Optical Products Division is located in a small industrialized area in Roanoke, Virginia. The site consists of three principal buildings and several smaller structures. The facility is located at 7635 Plantation Road. ITT is in the process of closing out its Nuclear Regulatory Commission (NRC) source material license No. SMB-1374 (Docket File No. 040-08761).

The plant operations are devoted principally to the development and manufacture of night vision equipment. The process involved the use of LAK-3 thoriated glass rods which are 9.6% thorium (Th-232) by weight. A unique part of the process was that the thorium incorporated within the thoriated glass was not incorporated into the end product. Instead, the thorium was removed and collected as a sludge in liquid waste. This process subsequently led to the contamination of equipment, floors, drains, and other items within the facility.

Approximately four years ago, ITT discontinued using licensed thoriated glass, and switched to a thorium-powder polishing compound containing exempt quantities of thorium. Because there was no longer use of a licensed material, ITT initiated termination of their NRC license.

At present, ITT is responsible for overseeing the decontamination of the facility and has contracted International Technologies Corporation (IT) to perform characterization surveys, remedial decontamination activities, and final radiological surveys. In October of 1990, IT performed radiological characterization surveys in the process areas (Landis Grinder Room, Glass Saw Room, MCP Slice Room, Multi-Draw Tower Room, Single-Draw Tower Room, the Greenhouse, the Drum Storage Area, and the MCP Final Etch Room).[1] A radiological survey of the MCP Final Etch Room at the Knoll Road facility was performed on July 30-31, 1991 and a letter report was submitted on August 2, 1991.[2]

At the request of the NRC's Region II Office, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) conducted a radiological survey of the ITT Plantation Road facility.

SITE DESCRIPTION

ITT is located on Plantation Road in a mixed industrial and residential area approximately 3.2 km (2 miles) northeast of the Roanoke Regional Airport (Figure 1). The facility is comprised of two main buildings with several smaller support structures and several parking lots (Figure 2). The designated areas to be surveyed were in Building 1 and the Drum Storage Pad Area located on the south side of the main facility near the security fence (Figures 2 and 3).

Building 1 consists of a main level and basement area that is primarily used as a laboratory and office building. The major night vision manufacturing areas are located on the main level. The building is primarily a concrete and steel structure; main support walls are of concrete block construction, but some of the rooms have sheetrock walls. The floors of the MCP Waste Holding Area and the Shipping and Receiving Area were bare concrete; the remaining surveyed areas had tiled floors.

The Drum Storage Pad is a 6.7 m x 6.7 m (20 ft x 20 ft) concrete pad, that is surrounded by a security fence. The pad slopes toward the southeast corner where a valved discharge drain pipe was installed. Drainage from the storage pad discharges onto the ground and runs off a 1 m bank into a low lying area to the south of the pad. A small 1.8 m x 3 m metal and corrugated plastic greenhouse had been adjacent to the eastern side of the storage pad. The greenhouse was dismantled and the soil underneath down to 9 cm has been removed.

At the time of the survey, the Landis Grinder and Glass Saw Rooms were not being used and were devoid of equipment. The remaining designated areas were currently occupied; some of the areas had been renovated and equipment had to be removed to perform the survey.

OBJECTIVES

The objectives of the radiological survey were to provide document reviews and develop independent radiological data, for use by the NRC in evaluating the adequacy and accuracy of data presented in the licensee's final status report.

DOCUMENT REVIEW

As part of the survey procedures, ESSAP reviewed the licensee's final survey results and supporting documentation concerning site decommissioning activities.[1,4-5] Analytical procedures and methods utilized by the licensee were reviewed for adequacy and appropriateness. The data were reviewed for accuracy, completeness, and compliance with guidelines.

PROCEDURES

During the period of June 15-18, 1993, ESSAP performed a radiological survey of the ITT Plantation Road facility. Radiological survey activities included surface scans for alpha, beta and gamma activity, direct measurements for alpha and beta activity, smears for removable activity, exposure rates and miscellaneous sampling. This data is not sufficient to meet the recommendations of NUREG/CR-5849 for final status surveys, but may be used by the NRC in evaluating the radiological status of the facility. The survey was conducted in accordance with a survey plan which was submitted to and approved by the NRC Region II Office.[6]

SURVEY PROCEDURES: INTERIOR

The areas identified for survey were: Landis Grinder Room, Glass Saw Room, Multi-Draw Tower Room, Single-Draw Tower Room, MCP Slice Room, the Shipping and Receiving Area, the former Greenhouse Area, and the Drum Storage Area.[3] At the site, the NRC site representative decided not to survey the MCP Slice Room, because the licensee had not provided enough radiological data and the room had been extensively remodeled. Also, the Multi-Draw Tower Room had been remodeled and a wall had divided the room into two separate rooms.

It was decided that the two rooms would be referred to as the Multi-Draw Tower Room, North and Multi-Draw Tower Room, South. The MCP Waste Holding Area was added after it was determined that waste products from the process had been stored in this area. In addition, the Landis Grinder, which had been removed from the Landis Grinder Room and stored on site, was surveyed as requested.

Reference Grid

A 1 m x 1 m reference grid was established by ESSAP in the Landis Grinder Room, Glass Saw Room, Multi-Draw Tower Room, Single-Draw Tower Room, and MCP Waste Holding Area. The connecting hallways and the Shipping and Receiving Area were not gridded. All ESSAP measurement and sampling locations were referenced to grids, to prominent building features, and/or recorded on appropriate drawings.

Surface Scans

Surface scans for alpha, beta, and gamma activity were performed on floors and lower walls (up to 2 m), using large area gas proportional and NaI detectors, coupled to ratemeters and ratemeter-scalers with audible indicators. Approximately 95% of the accessible floor and lower walls were scanned in the designated rooms and approximately 80% of the floors in the adjacent hallways were scanned. The Landis Grinder was also scanned for alpha and beta activity using gas proportional detectors. Cursory scans were performed in the Shipping and Receiving Area. Locations of elevated direct radiation were marked for further investigation.

Surface Activity Measurements

Direct measurements to determine total alpha and total beta activity were performed in 41 selected grid blocks on the floors and lower walls. The majority of the measurement locations were randomly selected; the other locations were based on elevated direct radiation surface scan results. Measurements in grid blocks were systematically performed at the center and at four points equidistant from the center and grid block corners (Figure 4). Additional measurements were also performed within these grid blocks at locations of elevated direct radiation, identified by surface scans in an effort to determine grid block averages and to define the boundaries of those areas that exceeded guidelines.

A total of 115 single-point direct measurements to determine total alpha and total beta activity were performed on other interior gridded and non-gridded surfaces including upper walls and ceilings in the designated rooms and the floors and lower walls in the adjacent hallways. All such measurements were performed using gas proportional detectors coupled to ratemeter-scalers.

A smear sample for determining removable activity was obtained from each grid block, at the location corresponding to the maximum direct measurement, and from each single-point measurement location; a total of 156 smear samples were collected. Measurements and sampling locations for total and removable activity are illustrated in Figures 5 through 14.

Direct measurements for total alpha and total beta activity were also performed at 9 locations on the Landis Grinder (Figure 15). A smear for removable contamination was collected at each direct measurement location.

<u>Exposure Rate Measurements</u>

Background exposure rate measurements at 1 m above the surface were obtained from 6 locations in Building 1 hallways which have similar construction to the surveyed areas and a history that indicates no use of radiological materials. Measurement locations are indicated in Figure 14.

Exposure rate measurements were performed at 1 m above the surface at 8 locations within Building 1 using a pressurized ionization chamber (PIC). Measurement locations are shown in Figures 7 through 12.

Miscellaneous Sampling

Seven paint samples were collected from the Landis Grinder Room, Glass Saw Room, Multi-Draw Room and Single-Draw Room. One glue sample was collected from an area of elevated direct radiation, area where floor tile was removed in the Glass Saw Room. Sample locations are shown on Figures 7 through 11.

SURVEY PROCEDURES: EXTERIOR

Reference Grid

A 5 m x 5 m reference grid system was established on the area surrounding the former Greenhouse and Drum Storage Pad. A 1 m x 1 m reference grid was established on the Drum Storage Pad.

Surface Scans

Surface scans for gamma activity were performed over gridded surfaces using NaI scintillation detectors. The Drum Storage Pad was scanned for alpha and beta activity using large area gas proportional detectors. All detectors were coupled to instruments with audible indicators. Areas of elevated direct radiation, suggesting the presence of surface or near surface contamination, were marked for further investigation.

Surface Activity Measurements

Direct measurements to determine total alpha and total beta surface activity were performed at 22 locations on The Drum Storage Pad. A smear sample for determining removable activity was obtained at each location. Measurement and sampling locations for total and removable activity are shown in Figure 16.

Exposure Rate Measurements

Background exposure rate measurements were made at 6 locations within 0.5 to 10 km of the site (Figure 17). All exposure rate measurements were performed using a PIC.

Exposure rate measurements were performed 1 m above the surface at 4 locations in the Drum Storage Pad Area (Figures 16 and 18).

Soil Sampling

Background soil samples were collected from 6 off-site locations within 0.5 to 10 km of the site (Figure 17).

Surface soil (0-15 cm) samples were collected from 20 randomly selected locations (Figure 18).

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and survey data were returned to the ESSAP Oak Ridge laboratory for analyses and interpretation. Exposure rate measurements were reported in microroentgens per hour (μR/h). Smears were analyzed with a low background proportional counter for gross alpha and gross beta activity. Direct measurement and smear data were converted to units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2). Soil and miscellaneous samples were analyzed by gamma spectrometry and were reviewed for thorium decay series radionuclides and any other identifiable photopeaks. Total thorium concentrations were calculated by adding Th-232 to Th-228 concentrations. Soil sample results were reported in units of picocuries per gram (pCi/g). Paint sample results were converted to dpm/100 cm^2. Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to the NRC guidelines provided in Appendix C.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP reviewed the licensee's radiological survey data and comments were provided to the NRC.[7-9] In ESSAP's opinion, the documents do not provide an adequate description of the radiological condition of the facility relative to the NRC guidelines for release to unrestricted use. The review process identified that data had been lost and that survey equipment used by the licensee had not been appropriate.

INTERIOR SURVEY

Surface Scans

Surface scans for alpha, beta, and gamma activity performed on the floors, lower walls, and equipment identified 4 locations of elevated direct radiation in the Landis Grinder Room, 7 locations of elevated direct radiation in the Glass Saw Room, and elevated direct radiation inside the Landis Grinder bowl. Prior to ESSAP survey activities, the licensee had removed some floor tiles from the area where the Landis Grinder had been positioned. During the ESSAP survey, surface scans detected elevated direct radiation at several of the remaining floor tile seams. At ESSAP's request, the licensee removed additional floor tiles from several locations. ESSAP personnel performed surface scans on those areas where the tile had been removed and identified additional areas of elevated alpha and beta direct radiation.

Surface Activity Levels

Direct measurements for total and removable surface activity are summarized in Tables 1-3. Table 1 presents results of grid block and individual measurements which exceeded average and maximum guideline levels of 1000 dpm/100 cm^2 and 3000 dpm/100 cpm^2, respectively. The results of single-point measurements ranged from 900 to 4000 dpm/100 cm^2 for alpha activity and 1700 to 5500 dpm/100 cm^2 for beta activity. The grid block (1 m^2) averages for these elevated areas ranged from 120 to 830 dpm/100 cm^2 and from <320 to 1700 dpm/100 cm^2 for alpha and beta activity, respectively. Removable activity for these measurement locations was as follows: <12 to 22 dpm/100 cm^2 for alpha activity; and <20 dpm/100 cm^2 for beta activity.

Results of surface activity measurements at locations which do not exceed guidelines are summarized in Table 2 (single-point measurements) and Table 3 (grid-block average measurements). Single-point measurements ranged from <39 to 1200 dpm/100 cm^2 for alpha activity and ranged from <230 to 2600 dpm/100 cm^2 for beta activity. Individual measurements in grid-blocks ranged from <39 to 640 dpm/100 cm^2, for alpha activity, and ranged from <290 to 2800 dpm/100 cm^2, for beta activity; grid block averages ranged from <39 to 350 dpm/100 cm^2 for alpha activity, and ranged from <290 to 940 dpm/100 cm^2 for beta activity. Removable activity for these measurement locations was <12 alpha dpm/100 cm^2 and <20 beta dpm/100 cm^2.

Results of activity measurements on the Landis Grinder are summarized in Table 4. Alpha activity measurements ranged from <39 to 5100 dpm/100 cm^2 and beta activity measurements ranged from <290 to 7000 dpm/100 cm^2. The removable activity levels were <12 dpm/100 cm^2 for alpha and <20 dpm/100 cm^2 for beta.

Exposure Rates

Exposure rate measurements are summarized in Table 5. Background exposure rates ranged from 7 to 12 μR/h. Exposure rate measurements in the surveyed areas ranged from 7 to 9 μR/h. The background exposure rate of 12 μR/h was measured in the North Hallway (exposure rate location #10) near a glass rod production room. A glass rod containing thorium was found in a locked storage cabinet near this measurement location.

Activity Levels in Miscellaneous Samples

Miscellaneous sample results are presented in Table 6. Results of total activity from the paint and glue samples ranged from <120 to 1600 dpm/100 cm^2 of total thorium. The highest total activity was from a paint sample from the west wall in the Glass Saw Room at grid coordinate A,0.6,1.

EXTERIOR SURVEY

Surface Scans

Scans for gamma radiation of the area surrounding the Drum Storage Pad did not identify any areas above background. Alpha and beta scans on the storage pad indicated uniform elevated direct radiation levels.

Gamma scans of the Drum Storage Pad area did not identify any locations of elevated direct radiation. Alpha and beta scans on the Drum Storage Pad identified several areas of elevated direct radiation.

Surface Activity Levels

Results of total and removable activity for the Drum Storage Pad are presented in Table 2. Total activity measurement ranges are <79 to 1100 dpm/100 cm^2 alpha and <290 to 2300 dpm/100 cm^2 beta.

Removable activity was <12 dpm/100 cm^2 for alpha and <20 dpm/100 cm^2 for beta.

Exposure Rates

Background exposure rates ranged from 8 to 10 μR/h (Table 7). Exposure rate measurements for the Drum Storage Pad area ranged from 7 to 10 μR/h (Table 5).

Radionuclide Concentrations in Soil Samples

Background thorium concentrations for soil samples ranged from 1.0 to 2.5 pCi/g. The results are presented in Table 7.

Thorium concentrations for soil samples are presented in Table 8. Total thorium concentrations ranged from 0.4 to 5.6 pCi/g. The sample with the highest concentration was collected from the middle of the former greenhouse site at grid coordinate N 14.5, E 16.5.

COMPARISON OF RESULTS WITH GUIDELINES

The NRC guidelines for surface contamination and residual concentrations of radionuclides in soil, established for license termination or release of a facility for unrestricted use, are presented in Appendix C.[10] The primary contaminant of concern at this site is natural thorium.

The surface contamination guidelines for thorium are:

1000 dpm/100 cm^2, total, averaged over 1 m^2
3000 dpm/100 cm^2, total, maximum in 100 cm^2
200 dpm/100 cm^2, removable

As interpreted by the NRC, the average 1000 dpm/100 cm^2 and maximum 3000 dpm/100 cm^2 should apply to both alpha and beta measurements independently for surface contamination involving natural thorium.[11] ESSAP's experience has shown that beta measurements typically provide a more accurate evaluation of thorium contamination on most building surfaces, due to problems inherent in measuring alpha contamination on rough, porous, painted, and/or dusty surfaces.

Surface activity measurements for total and removable activity identified several areas of elevated direct radiation exceeding the guideline levels for both the average 1000 dpm/100 cm^2 and the maximum 3000 dpm/100 cm^2 limits. The Landis Grinder Room had four locations exceeding the 3000 dpm/100 cm^2 guideline. There were 3 grid blocks and 5 single-point measurements that exceeded the guidelines in the Southwest corner of the Glass Saw Room.

Six locations inside the Landis Grinder bowl were identified as exceeding the maximum guidelines — the highest elevated direct radiation being 7000 dpm/100 cm^2 beta.

Eight of twenty-two direct measurements performed on the Drum Storage Pad exceeded the averagable surface contamination guideline of 1000 dpm/100 cm^2 but were less than the maximum surface contamination guideline of 3000 dpm/100 cm^2. The results are representative of elevated activity that still exists over the surface of the pad. Removable activity measurements were all below the minimum detectable activity of the procedure which was <12 dpm/100 cm^2 for alpha and <20 dpm/100 cm^2 for beta.

Analyses of soil samples collected from the Drum Storage Pad area were all within the soil concentration guideline of 10 pCi/g above background for total thorium.

One paint sample from the Landis Grinder Room and two paint samples and one glue sample from the Glass Saw Room indicated elevated activity. A beta activity of 1600 dpm/100 cm^2, located in the Glass Saw Room at grid location A,0.6,1, was the highest activity found.

The NRC guideline for exposure rate at 1 m above the surface is 5 μR/h above background.[12] All interior and exterior exposure rates were within this guideline.

SUMMARY

At the request of the NRC Region II Office, during the period of June 15-18, 1993, the Environmental Survey and Site Assessment Program of ORISE performed radiological surveys of the following areas of Building 1 at ITT Electro-Optical Products Division: Landis Grinder Room; Glass Saw Room; Single-Draw Room; North and South Multi-Draw Rooms; MCP Waste Holding Area; portions of the east-west hallways; and the shipping and receiving dock. In addition a radiological survey was performed on the Drum Storage Pad and surrounding area.

Survey activities included document reviews, surface scans, total and removable activity measurements, exposure rate measurements, and paint, glue, and soil sampling.

Residual thorium activity, exceeding NRC guideline levels, was identified at numerous locations on the floors and lower walls in the Landis Grinder Room and the Glass Saw Room. The majority of the contamination, in the Landis Grinder Room, was confined to the area where the Landis Grinder had been located and the west entrance to the room. Contamination in the Glass Saw Room was confined to the southwest corner of the room on the floor and lower walls. Analysis of the paint and glue samples, as well as, direct measurements indicates that residual activity is within and underneath the paint and glue surface coverings. Floor tile removal indicated that additional areas of residual contamination were present underneath floor tiles in the Landis Grinder Room.

Residual thorium activity, exceeding NRC guideline levels, was identified on the interior surface of the Landis Grinder bowl. These values were above the maximum guideline levels.

Residual surface activity levels, measured on the Drum Storage Pad, were greater than the average, but less than the maximum, contamination guideline. ESSAP recommends that additional surveys be performed to insure that the average surface activity level in any $1 m^2$ area complies with the NRC guidelines.

Total thorium concentrations in soil samples collected from the area around the Drum Storage Pad were within guideline level.

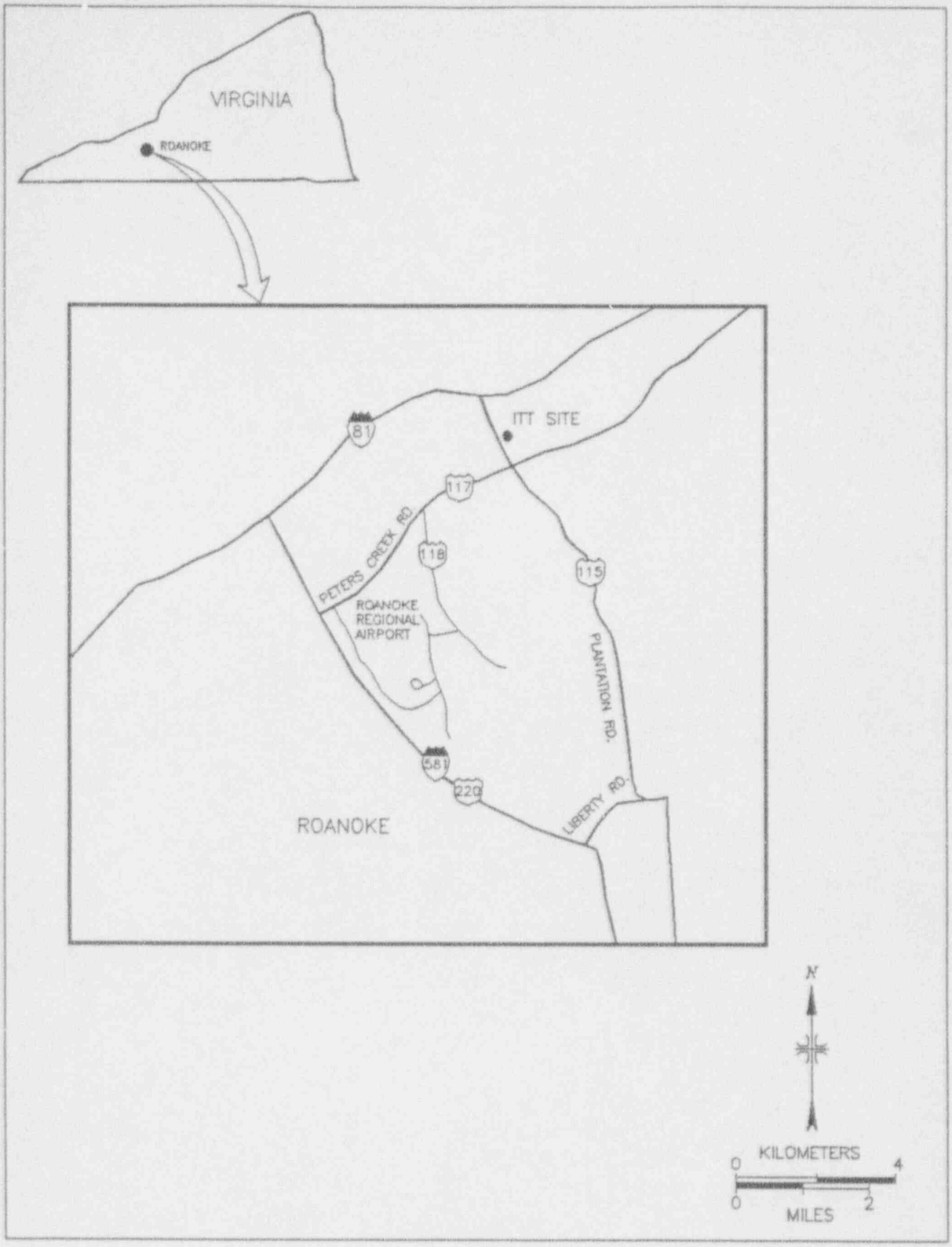


FIGURE 1: Location of the ITT Electro-Optical Products Division, Roanoke, Virginia

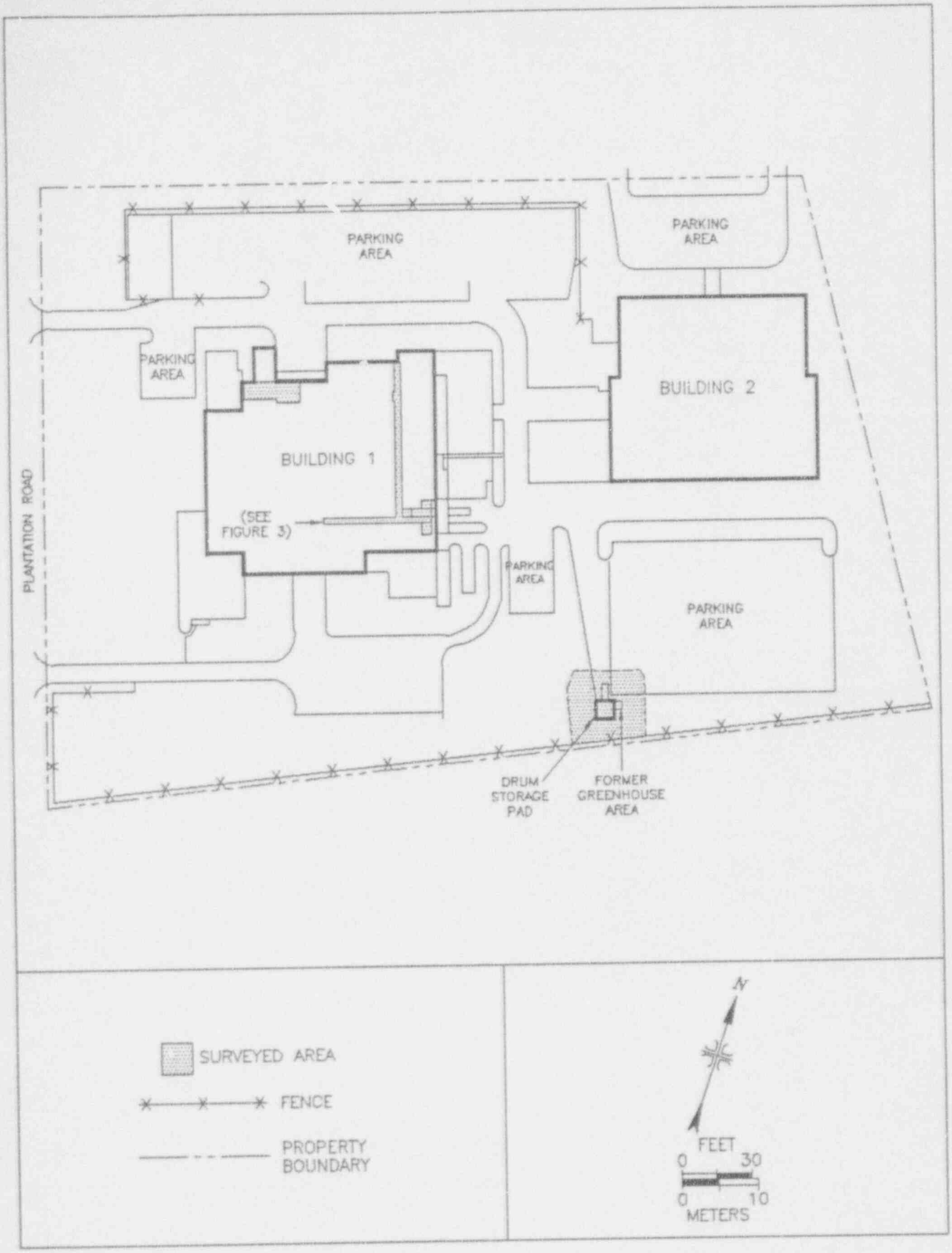


FIGURE 2: Plot Plan of ITT Electro-Optical Products Division, Roanoke, Virginia

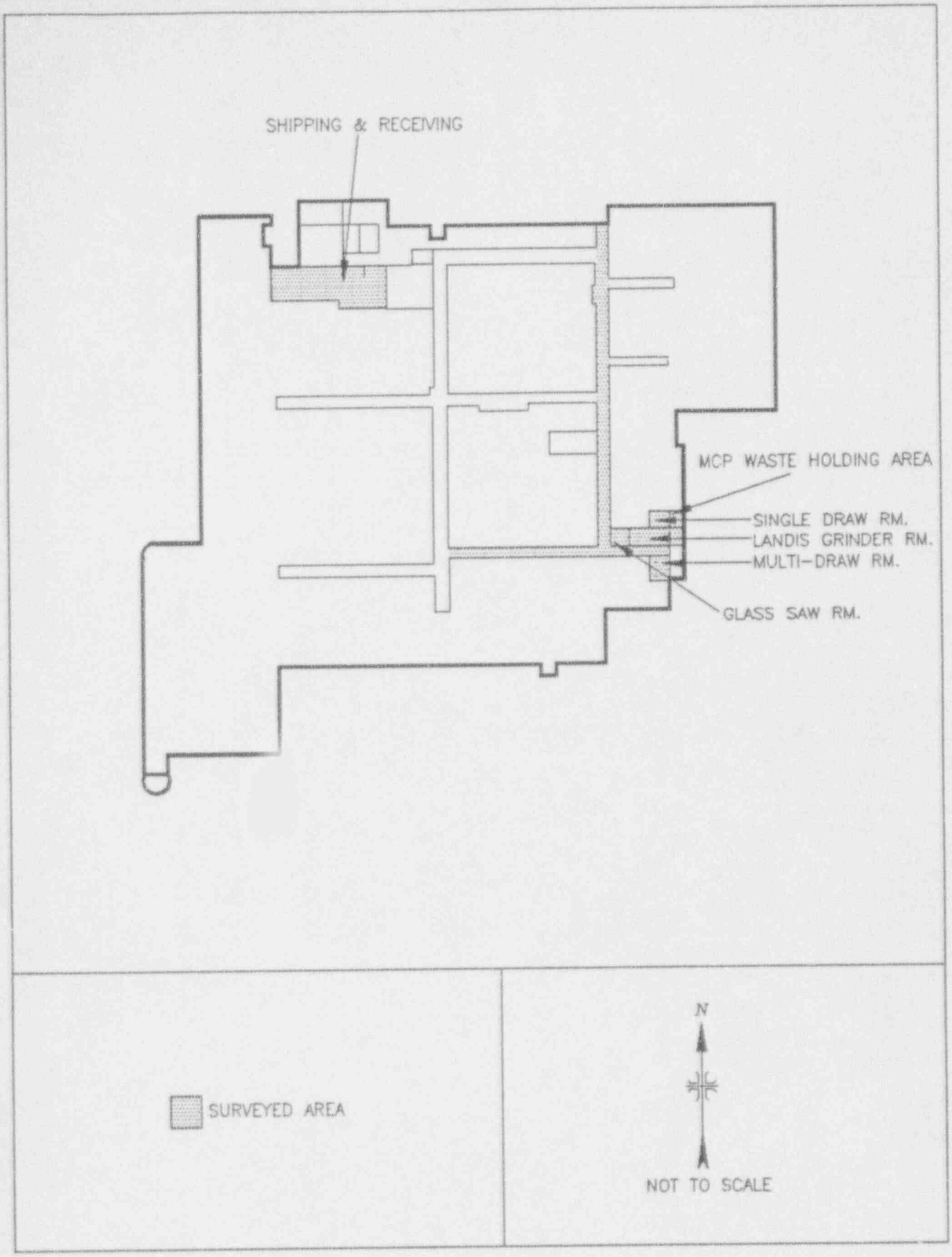
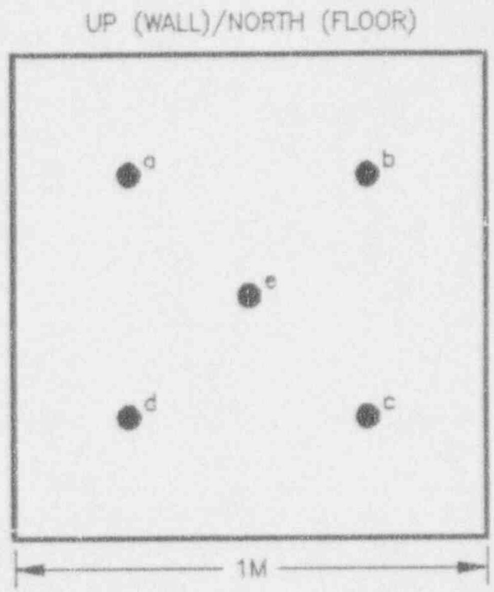


FIGURE 3: Building 1 – Location of Surveyed Areas



This figure shows the location of the systematic 5-point grid block measurements. Additional measurements performed in the grid block at locations other than the systematic locations are on the figure for the subject area.

FIGURE 4: Grid Block Measurement Locations

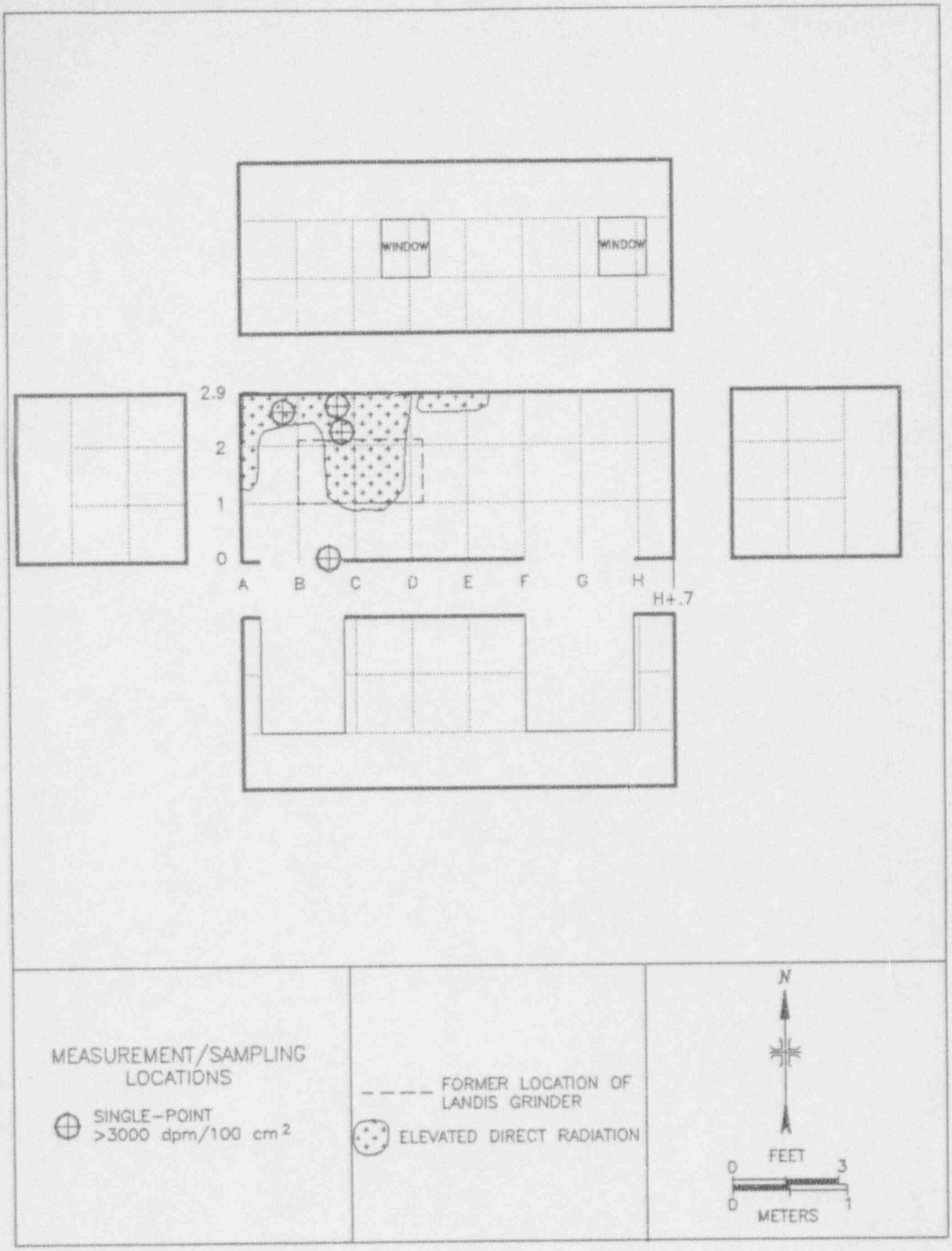


FIGURE 5: Landis Grinder Room – Elevated Measurement and Sampling Locations

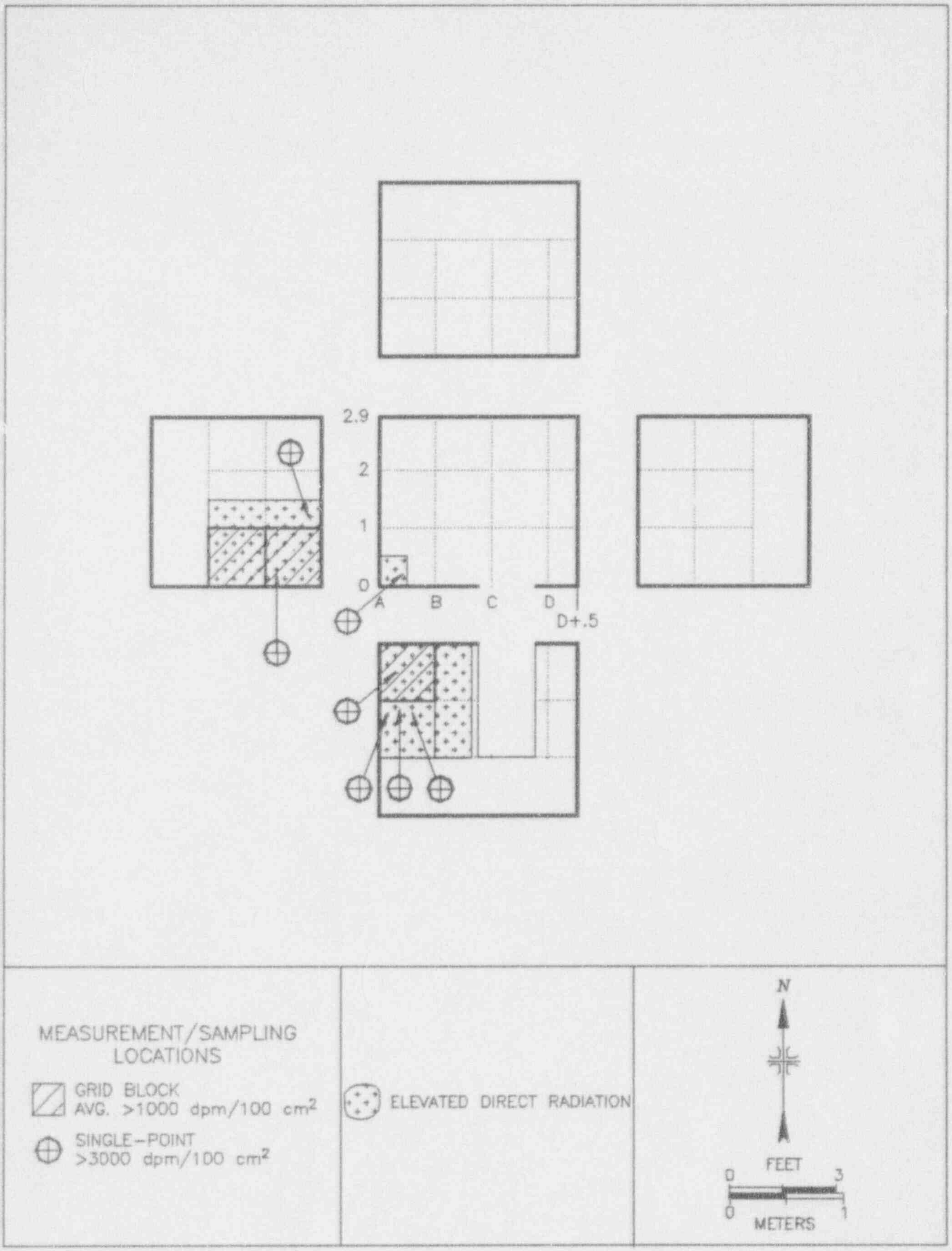


FIGURE 6: Glass Saw Room - Elevated Measurement and Sampling Locations

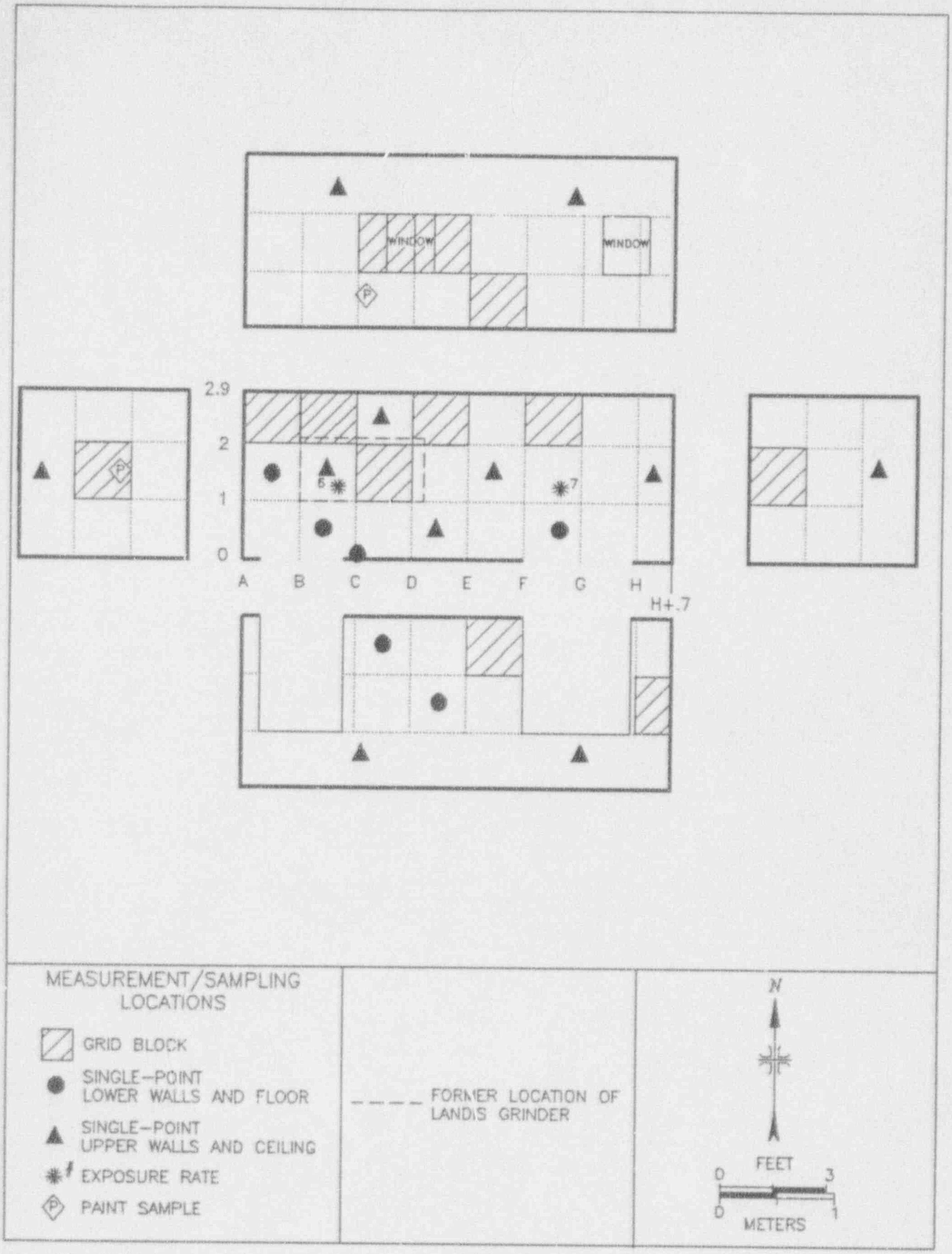


FIGURE 7: Landis Grinder Room — Measurement and Sampling Locations

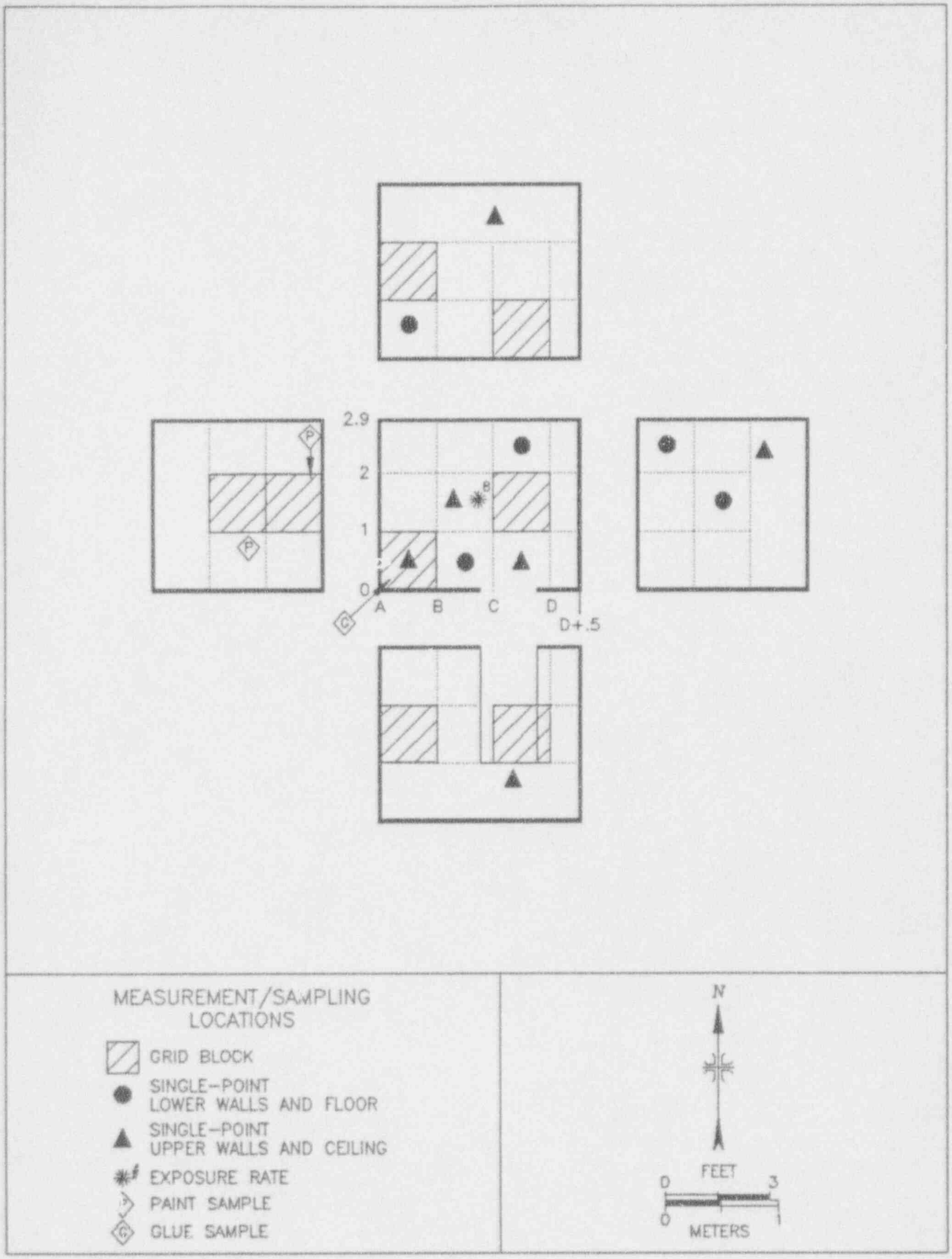


FIGURE 8: Glass Saw Room – Measurement and Sampling Locations

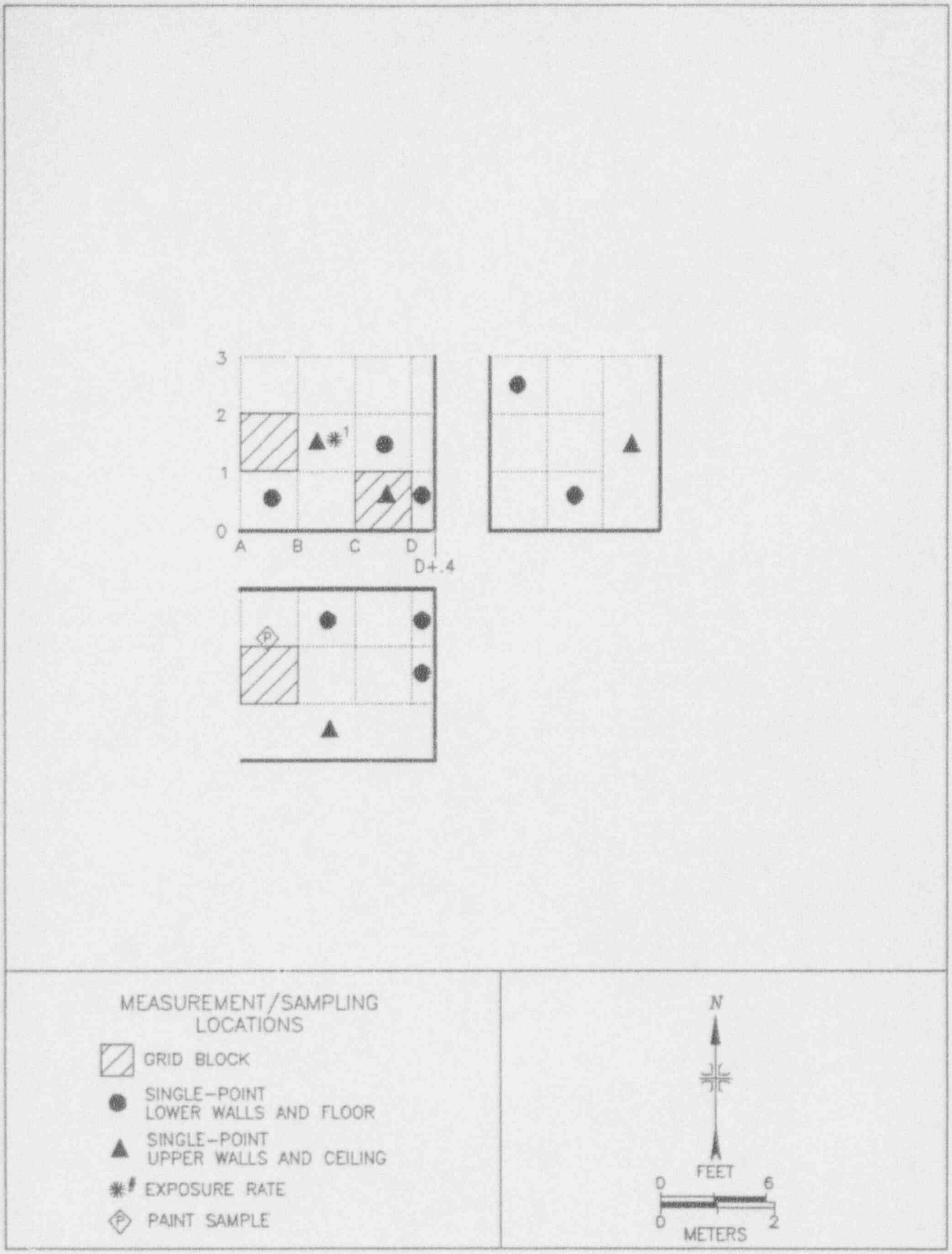


FIGURE 9: Single-Draw Tower Room – Measurement and Sampling Locations

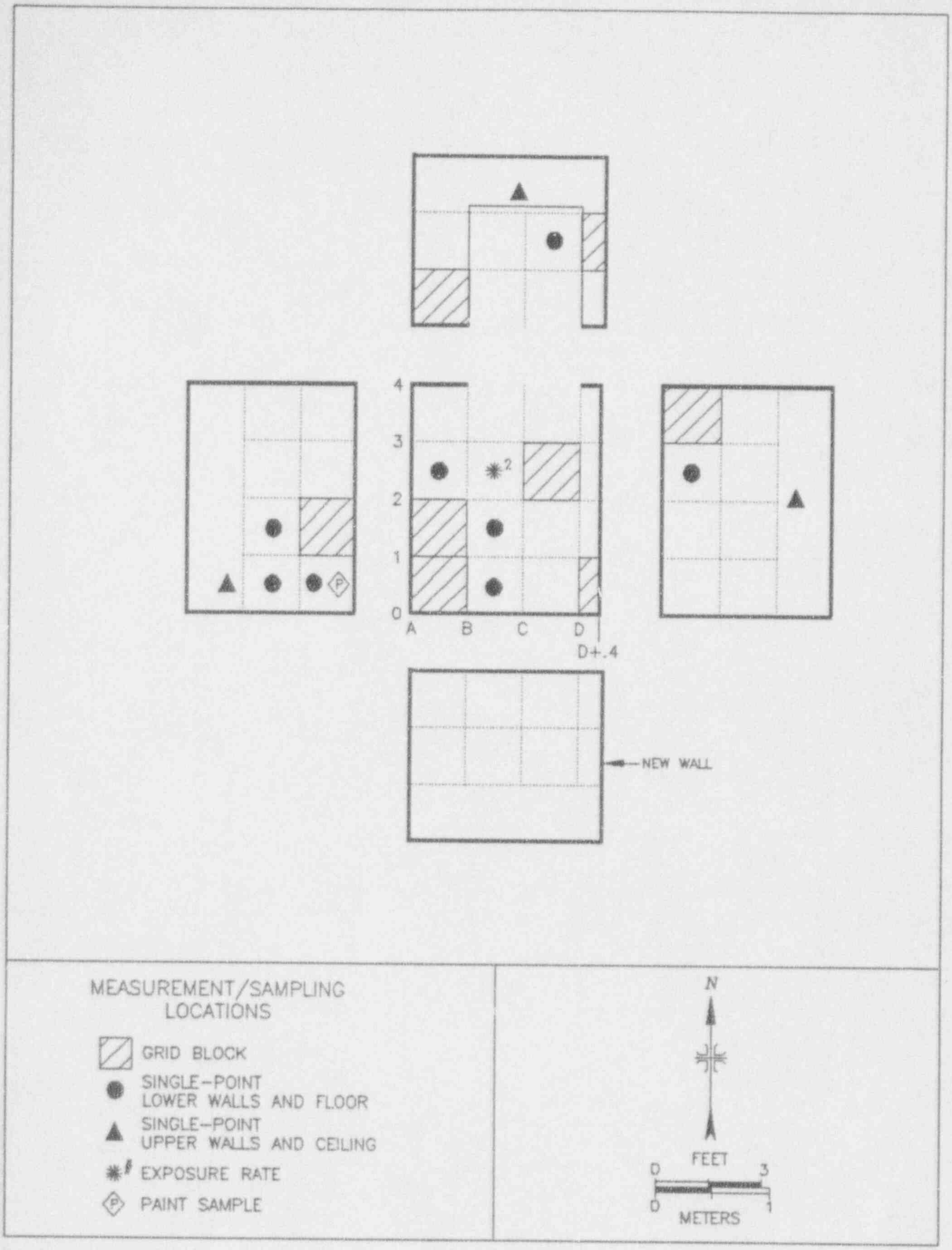


FIGURE 10: Multi-Draw Tower Room, North - Measurement and Sampling Locations

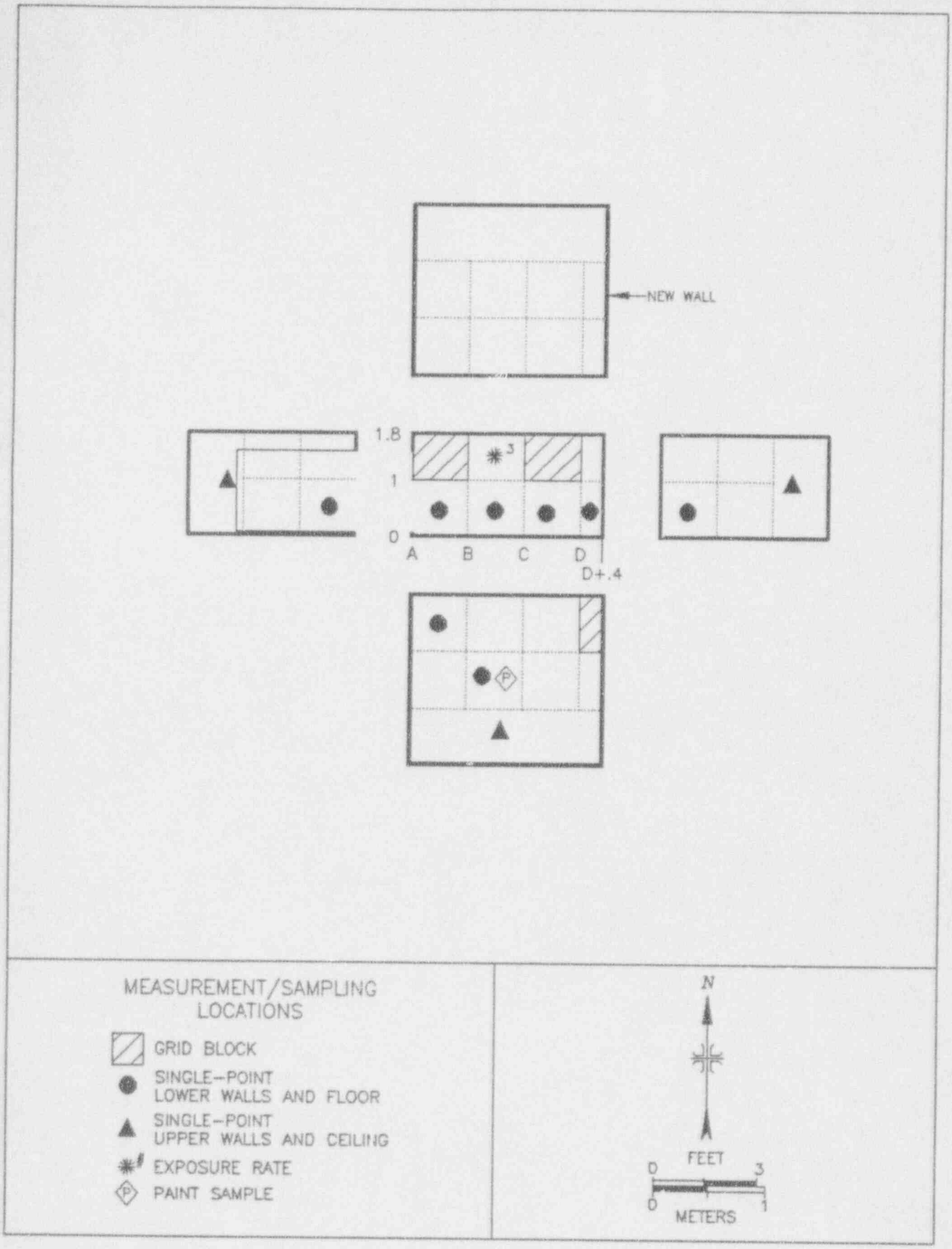


FIGURE 11: Multi-Draw Tower Room, South – Measurement and Sampling Locations

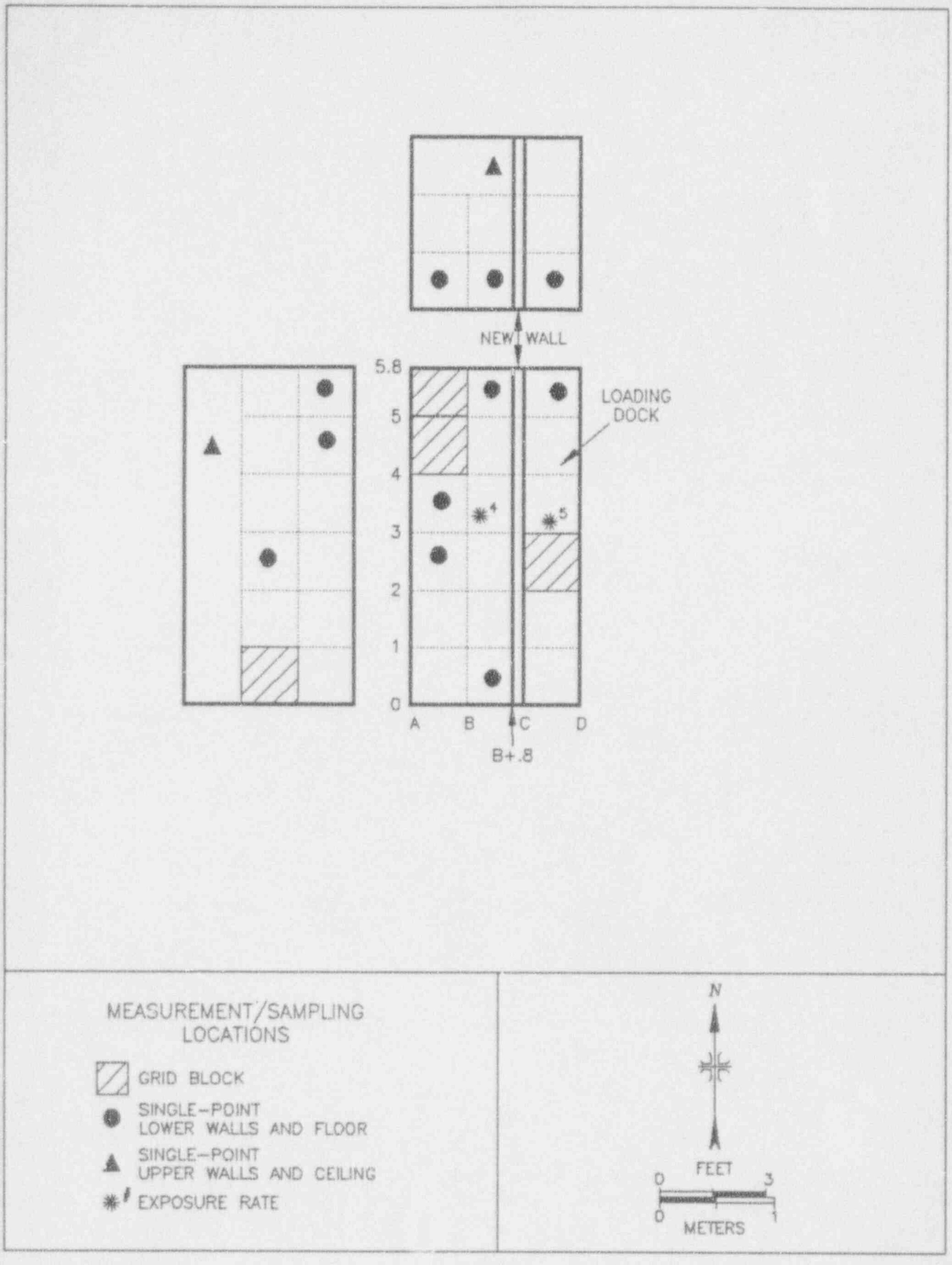


FIGURE 12: M.C.P. Waste Holding Area — Measurement and Sampling Locations

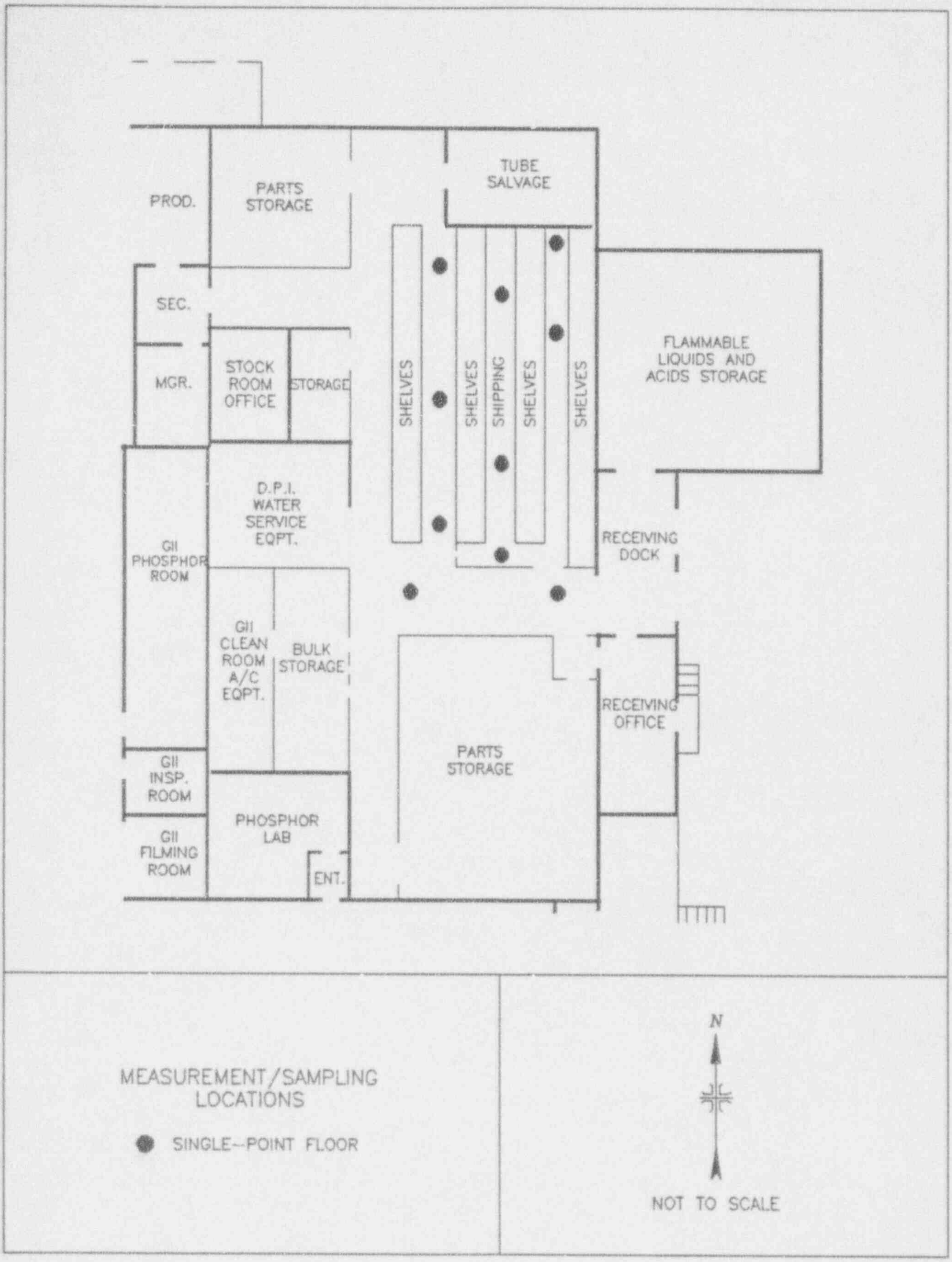


FIGURE 13: Shipping and Receiving Area – Measurement and Sampling Locations

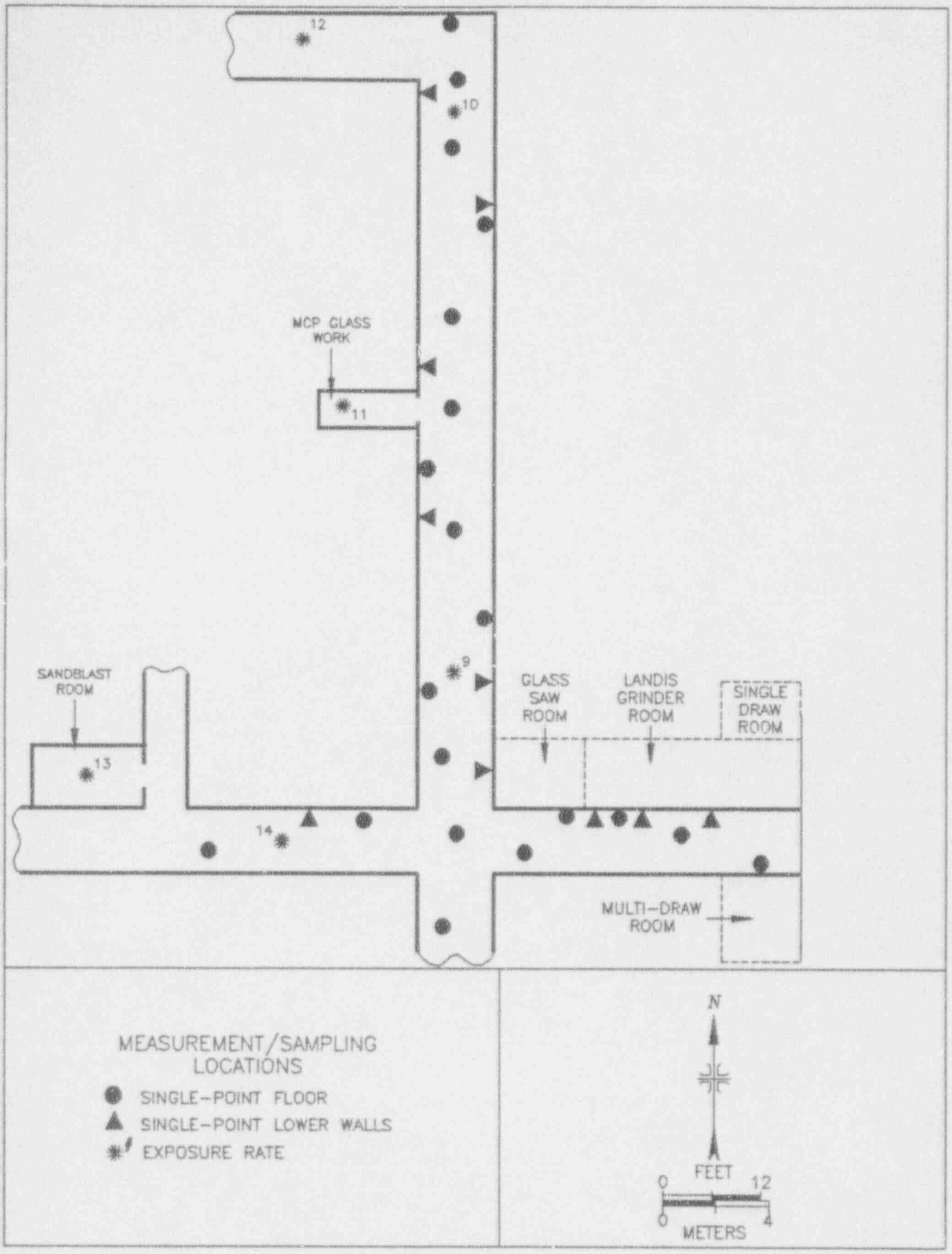
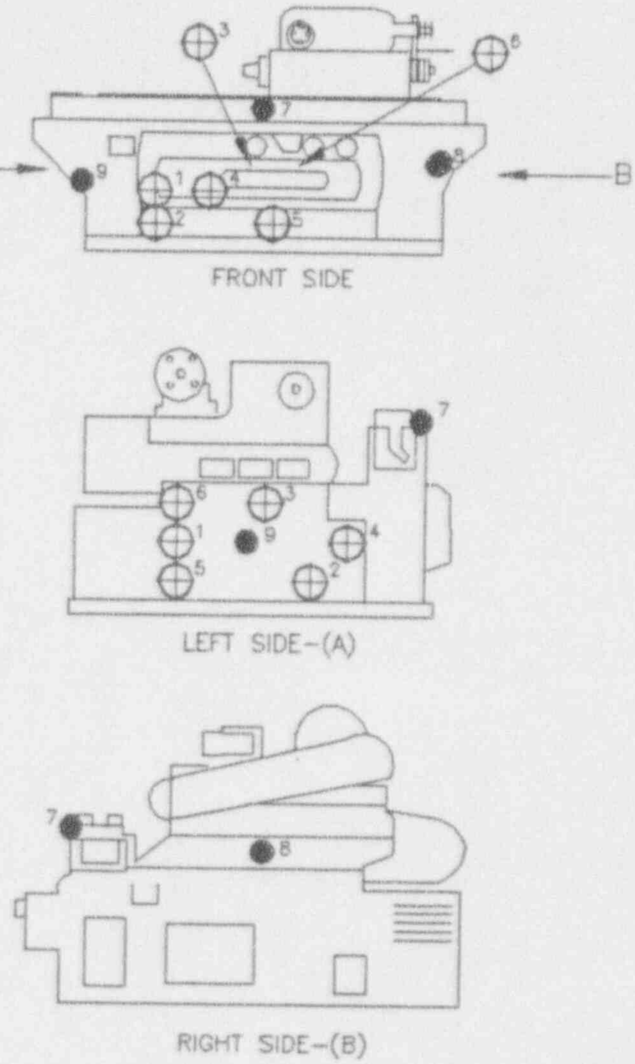


FIGURE 14: Building 1 Hallways – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● # SINGLE–POINT <1000 dpm/100 cm^2

⊕ # SINGLE–POINT >1000 dpm/100 cm^2 <3000 dpm/100 cm^2

NOT TO SCALE

FIGURE 15: Landis Grinder – Measurement and Sampling Locations

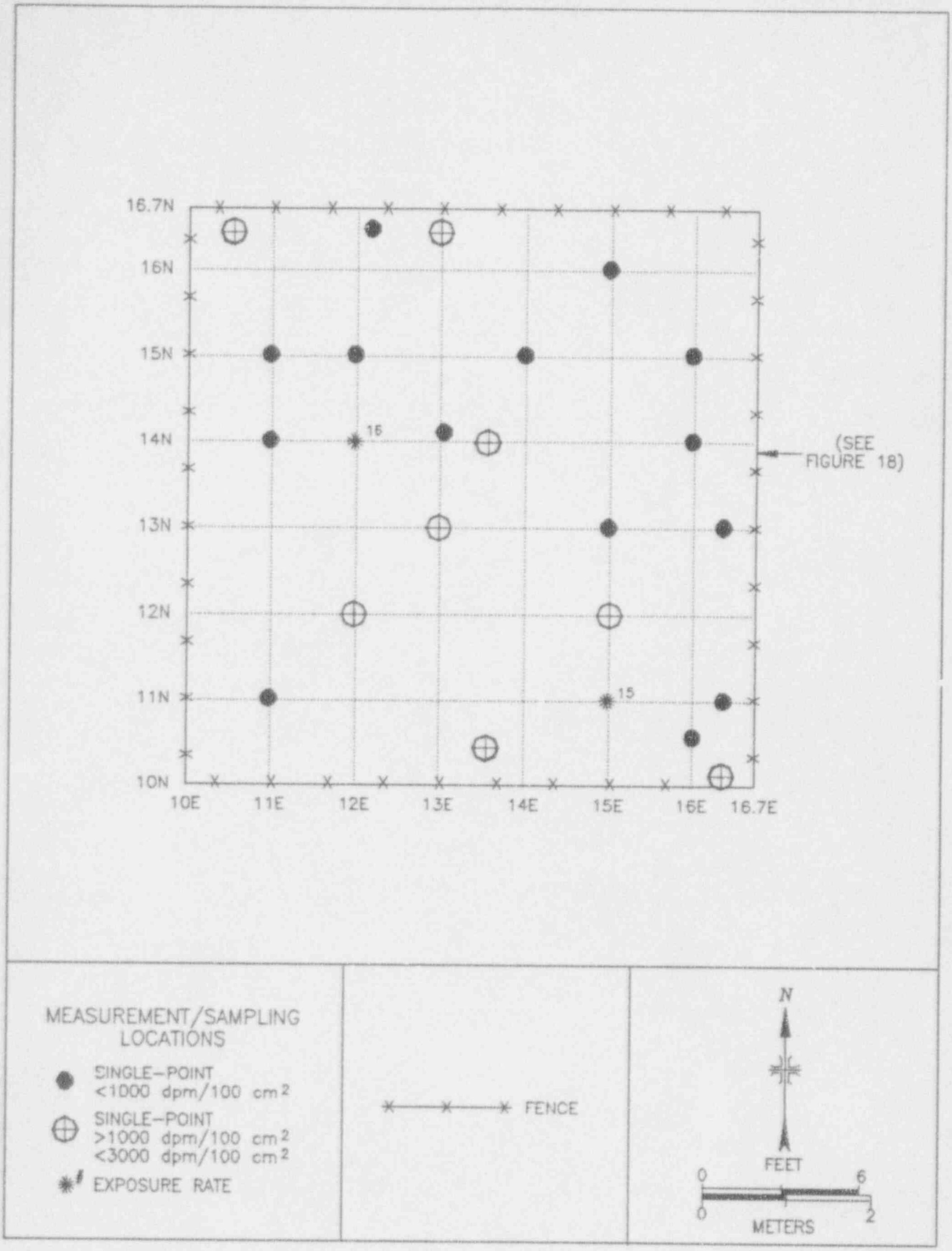


FIGURE 16: Drum Storage Pad – Measurement and Sampling Locations

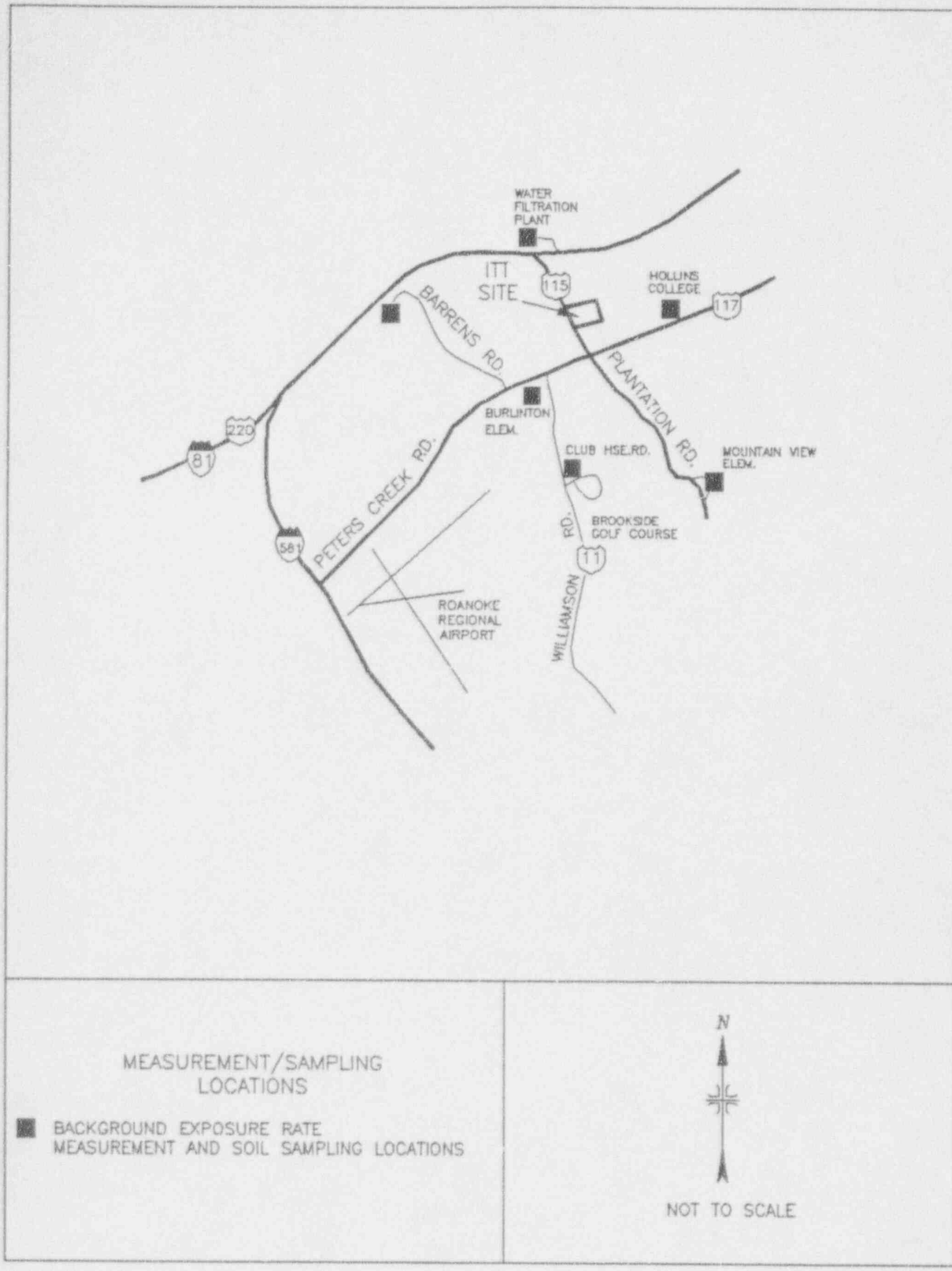


FIGURE 17: Background Exposure Rate Measurement and Soil Sampling Locations

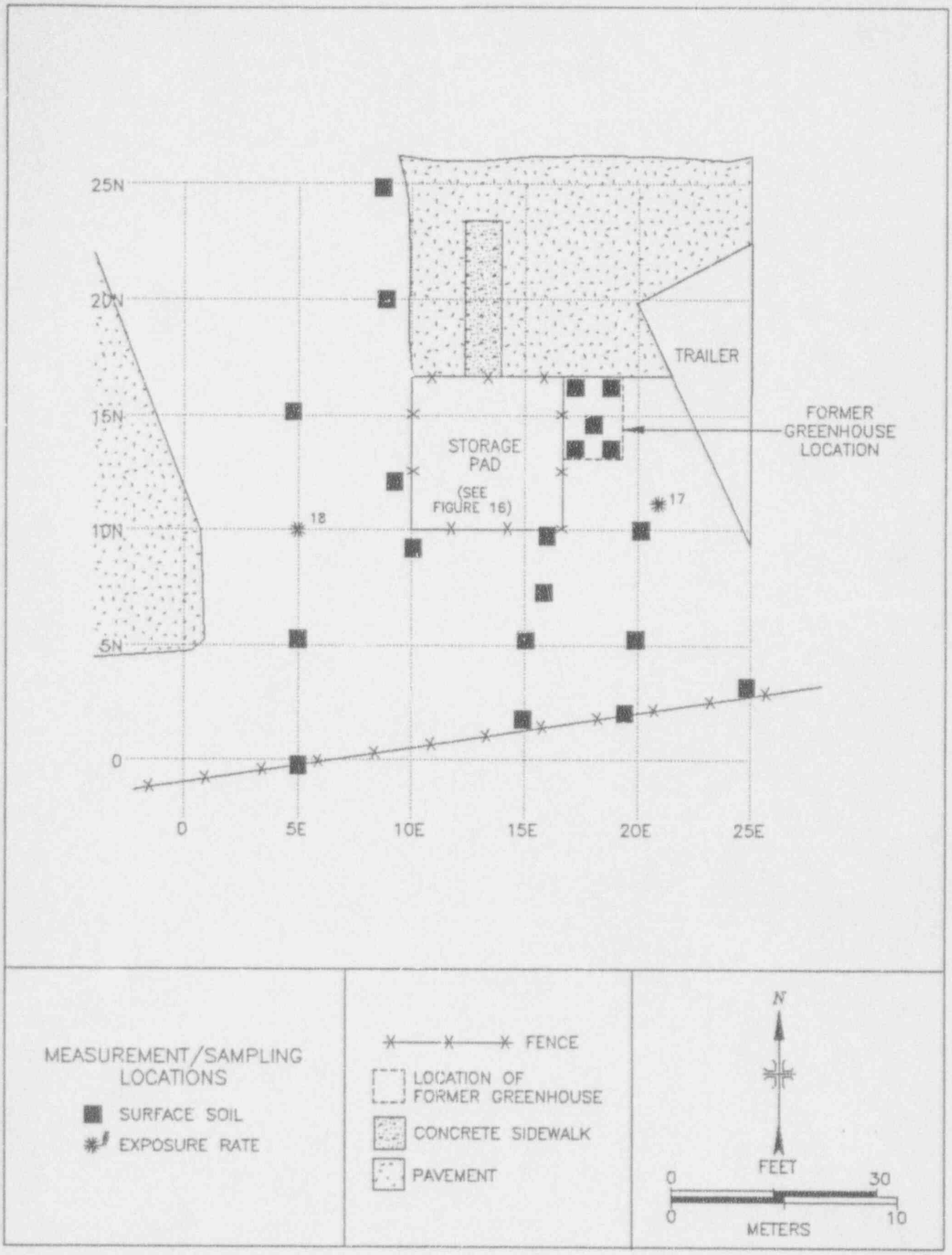


FIGURE 18: Storage Pad and Greenhouse Area – Measurement and Sampling Locations

TABLE 1

SUMMARY OF ELEVATED SURFACE ACTIVITY MEASUREMENTS
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
ROANOKE, VIRGINIA

Location[a]			Total Activity (dpm/100 cm²)				Removable Activity (dpm/100 cm²)	
			Individual Measurement		Grid Block Average			
Surface	Grid Block	Point[b]	Alpha	Beta	Alpha	Beta	Alpha	Beta
Landis Grinder Room								
Floor	B,2	pt. B	4000	4700	550	730	21	<20
	B,2	pt. C	3000	1700	550	730	22	<20
	A,2	pt. B	1800	3400	120	<320	14	<20
	N/A[c]	B + 0.5,0	1800	5500	N/A	N/A	<12	<20
Glass Saw Room								
Floor	A,0	pt. F	1200	3800	230	730	<12	<20
Lower Wall	B,0,0	pt. G	930	3000	400	1700	<12	<20
	N/A	A,1.5,0	ND[d]	5200	ND	ND	ND	ND
	A,0,1	pt. D	1300	2900	450	1100	<12	<20
	A,0,0	pt. A	1700	3700	830	1700	<12	<20
	B,0,1	pt. C	900	3900	280	860	ND	ND
	B,0,1	pt. F	1200	4900	280	860	<12	<20
	B,0,1	pt. G	1300	4200	280	860	ND	ND

[a]Refer to Figures 5-6.
[b]Refer to Figure 4 for grid block measurement locations.
[c]Not Applicable.
[d]Not Determined.

TABLE 2

SUMMARY OF SINGLE-POINT SURFACE ACTIVITY MEASUREMENTS
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
ROANOKE, VIRGINIA

Location[a]	Number of Individual Measurements	Range of Total Activity (dpm/100 cm^2)		Range of Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
Landis Grinder Room					
Lower Walls and Floor	5	<39	<320 - 370	<12	<20
Lower Walls and Floor	1[b]	1200	2600	<12	<20
Upper Walls and Ceiling	11	<39 - 47	<310 - 640	<12	<20
Glass Saw Room					
Lower Walls and Floor	5	<39 - 58	<310 - 550	<12	<20
Upper Walls and Ceiling	6	<39	<310 - 580	<12	<20
Single-Draw Tower Room					
Lower Walls and Floor	8	<39	<320 - 350	<12	<20
Upper Walls and Ceiling	4	<39	<310 - 880	<12	<20
Multi-Draw Tower Room, North					
Lower Walls and Floor	8	<39	<290	<12	<20
Upper Walls and Ceiling	3	<39	<290	<12	<20
Multi-Draw Tower Room, South					
Lower Walls and Floor	8	<39	<290	<12	<20
Upper Walls and ceiling	3	<39	<230	<12	<20

TABLE 2 (Continued)

SUMMARY OF SINGLE-POINT SURFACE ACTIVITY MEASUREMENTS
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
ROANOKE, VIRGINIA

Location[a]	Number of Individual Measurements	Range of Total Activity (dpm/100 cm^2)		Range of Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
MCP Waste Holding Area					
Lower Walls and Floor	11	<79	<310 - 310	<12	<20
Upper Walls and Ceiling	2	<39	<310	<12	<20
Shipping and Receiving					
Lower Walls and Floor	10	<39	<290	<12	<20
Hallways					
Lower Walls and Floor	30	<39	<320	<12	<20
Drum Storage Pad					
Lower Walls and Floor	14	<79 - 850	<290 - 840	<12	<20
Lower Walls and Floor	8[c]	84-1100	1100-2300	<12	<20

[a]Refer to Figures 7 through 14 and 16.
[b]Area <300 cm^2.
[c]Surface scans indicate residual activity remains on the Drum Storage Pad.

TABLE 3

SUMMARY OF GRID BLOCK SURFACE ACTIVITY MEASUREMENTS
ITT ELCTRO-OPTICAL PRODUCTS DIVISION
ROANOKE, VIRGINIA

Location[a]	Number of Grid Block Measurements	Range of Total Activity (dpm/100 cm²)				Range of Removable Activity (dpm/100 cm²)	
		Individual Measurements		Grid Block Average			
		Alpha	Beta	Alpha	Beta	Alpha	Beta
Landis Grinder Room							
Lower Walls and Floor	12	<39 - 58	<320 - 410	<39	<320	<12	<20
Glass Saw Room							
Lower Walls and Floor	7	<39 - 870	<310 - 920	<39 - 230	<310 - 730	<12	<20
Lower Walls and Floor	1[b]	640	2800	350	940	<12	<20
Single-Draw Tower Room							
Lower Walls and Floor	3	<39	<320	<39	<320	<12	<20
Multi-Draw Tower Room, North							
Lower Walls and Floor	8	<39	<290 - 360	<39	<290	<12	<20
Multi-Draw Tower Room, South							
Lower Walls and Floor	3	<39	<290	<39	<290	<12	<20
MCP Waste Holding Area							
Lower Walls and Floor	2	<79	<290	<79	<290	<12	<20
Lower Walls and Floor	2[c]	<79-480	<290-1100	<79-84	<290-450	<12	<20

[a]Refer to Figures 7-12.
[b]Area <200 cm².
[c]Area <100 cm².

TABLE 4

SUMMARY OF SURFACE ACTIVITY
LANDIS GRINDER
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
ROANOKE, VIRGINIA

Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Beta	Alpha	Beta
Inside Surface of Landis Grinder Bowl				
1	2100	3900	<12	<20
2	1300	3700	<12	<20
3	5100	7000	<12	<20
4	1700	6000	<12	<20
5	920	5700	<12	<20
6	3000	580	<12	<20
Outside Surface of Landis Grinder				
7	120	<290	<12	<20
8	<39	<290	<12	<20
9	260	<290	<12	<20

[a]Refer to Figure 15.

TABLE 5

EXPOSURE RATE MEASUREMENTS
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
ROANOKE, VIRGINIA

Location		Exposure Rate at 1 m Above Surface (μR/h)
Surveyed Areas[a]		
1	Single-Draw Tower Room, B1	7
2	Multi-Draw Tower Room, North, B2	7
3	Multi-Draw Tower Room, South, B1	7
4	MCP Waste Holding Area, B3	7
5	MCP Waste Holding Area, Loading Dock, C3	7
6	Landis Grinder Room, B1	9
7	Landis Grinder Room, F1	8
8	Glass Saw Room, B1	9
Background Measurements[b]		
9	North/South Hallway at Gen. Maint.	9
10	North/South Hallway	12
11	North/South Hallway	7
12	East/West Hallway	8
13	Sand Blast Room	10
14	East/West Hallway at Semi-cond. Research	8
Drum Storage Pad[c]		
15	N 11, E 15	7
16	N 14, E 12	7
17	N 12, E 21	10
18	N 10, E 5	10

[a]Refer to Figures 7-12.
[b]Refer to Figure 14.
[c]Refer to Figures 16-18.

TABLE 6

THORIUM ACTIVITY IN MISCELLANEOUS SAMPLES
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
ROANOKE, VIRGINIA

Location[a]	Sample Type	Total Activity[b] (dpm/100 cm ^{2})				Sample Activity (dpm/100 cm^2)
		Pre-Sampling		Post-Sampling		Total Thorium[c]
		Alpha	Beta	Alpha	Beta	
Landis Grinder Room C,2.9, 0.5	paint	160	<310	42	<310	320
Landis Grinder Room A,1.5, 1	paint	<39	<310	<39	<310	<120
Glass Saw Room - A, 0.6,1	paint	2700	3300	740	1200	1600
Glass Saw Room - A,2,0	paint	930	2100	360	1200	650
Single-Draw Tower Room A ± 0.5,0,1	paint	<39	<310	<39	<310	<120
Multi-Draw Tower Room, South B ± 0.5,0,1.5	paint	<39	<310	<39	<310	<120
Multi-Draw Tower Room, North A,0,0	paint	<39	<260	<39	<260	<120
Glass Saw Room A ± 0.2,0	glue	2000	2200	1200	2600	930

[a]Refer to Figures 7-11.
[b]Direct measurements before and after sample was collected.
[c]Calculated by adding Th-232 and Th-228 activity levels.

TABLE 7

BACKGROUND EXPOSURE RATE MEASUREMENTS
AND THORIUM CONCENTRATION IN SOIL
ITT ELECTRO-OPTICAL PRODUCTS DIVISION
ROANOKE, VIRGINIA

Location[a]	Exposure Rate at 1 m Above Surface(μR/h)	Thorium Concentration (pCi/g)		
		Th-232	Th-228	Total Thorium[b]
Water Filtration Plant	10	0.7 ± 0.2[c]	0.6 ± 0.1	1.3
Burlington Elementary School	8	1.4 ± 0.4	0.7 ± 0.6	2.1
Barrens Road	8	0.6 ± 0.3	0.5 ± 0.1	1.1
Brookside Golf Course	10	0.7 ± 0.2	1.1 ± 0.1	1.8
Mountain View Elementary	8	0.4 ± 0.2	0.6 ± 0.1	1.0
Hollins College	9	1.2 ± 0.4	1.3 ± 0.1	2.5

[a]Refer to Figure 17.
[b]Calculated by adding Th-232 and Th-228 concentrations.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 8

THORIUM CONCENTRATIONS IN SOIL SAMPLES FROM THE DRUM STORAGE PAD AREA ITT ELECTRO-OPTICAL PRODUCTS DIVISION ROANOKE, VIRGINIA

Location[a]	Thorium Concentrations (pCi/g)		
	Th-232	Th-228	Total Thorium[b]
Soil			
N 16, E 19	2.5 ± 0.4[c]	2.0 ± 0.2	4.5
N 16, E 16	1.7 ± 0.4	1.2 ± 0.1	2.9
N 14.5, E 16.5	3.0 ± 0.5	2.6 ± 0.2	5.6
N 13, E 19	0.7 ± 0.2	0.8 ± 0.1	1.5
N 13, E 16	1.8 ± 0.3	1.3 ± 0.8	3.1
N 10, E 20	1.8 ± 0.4	1.1 ± 0.2	2.9
N 10, E 16	2.5 ± 0.4	2.0 ± 0.2	4.5
N 7, E 16	1.6 ± 0.4	1.4 ± 0.1	3.0
N 9, E 10	1.4 ± 0.4	1.0 ± 0.1	2.4
N 15, E 5	1.0 ± 0.4	1.0 ± 0.1	2.0
N 20, E 9	1.0 ± 0.3	0.9 ± 0.1	1.9
N 25, E 9	0.8 ± 0.3	0.5 ± 1.0	1.3
N 12, E 10	0.2 ± 0.1	0.2 ± 0.1	0.4
N 5, E 5	1.2 ± 0.5	1.1 ± 0.2	2.3
N 0, E 5	0.7 ± 0.2	0.9 ± 0.1	1.6
N 5, E 15	1.5 ± 0.4	1.4 ± 0.2	2.9
N 5, E 20	0.8 ± 0.5	0.8 ± 0.1	1.6
N 2, E 17	1.4 ± 0.4	1.4 ± 0.2	2.8
N 2, E 20	1.2 ± 0.4	1.4 ± 0.2	2.6
N 3, E 25	1.6 ± 0.4	1.3 ± 0.2	2.9

[a]Refer to Figure 18.
[b]Calculated by adding Th-232 and Th-228 activity levels.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

REFERENCES

1. "Decommissioning Plan for ITT Electro-Optical Division, 7635 Plantation Road, Roanoke, Virginia 24019," International Technology Corporation, Knoxville, TN, November 20, 1990.

2. Letter from W. Adams (Oak Ridge Associated Universities) to J. Pelchat (U.S. Nuclear Regulatory Commission, Region II), RE: "Preliminary Confirmatory Letter Report for MCP Final Etch Room, ITT Electro-Optical Projects Division, Roanoke, Virginia (Docket File No. 040-08761)," August 2, 1991.

3. Letter from D. M. Collins (U.S. Nuclear Regulatory Commission, Region II) to J.D. Berger (Oak Ridge Institute for Science and Education), RE: "Proposed Confirmatory Survey of ITT Electro-Optical Products Division, Roanoke, Virginia (Docket File No. 040-08761)," May 21, 1993.

4. Letter from S. Duce (International Technology Corporation) to R. Olmetti (ITT Corporation), RE: "Transmittal of Final Survey Data to Support Approval of Facilities Decommissioning," January 18, 1993.

5. Letter from R. Olmetti (ITT Corporation) to J. Henson (U.S. Nuclear Regulatory Commission, Region II), RE: "ITT Roanoke - Decommissioning," January 21, 1993.

6. Oak Ridge Institute for Science and Education, "Proposed Radiological Survey Plan, ITT Electro-Optical Products Division, Plantation Road Facility, Roanoke, Virginia," June 9, 1993.

7. Letter from W. Adams (Oak Ridge Associated Universities) to J. Pelchat (U.S. Nuclear Regulatory Commission, Region II), RE: "Document Review—ITT Electro-Optical Products Division, Roanoke, Virginia (Docket File No. 040-08761)," August 23, 1991.

8. Letter from W. Adams (Oak Ridge Associated Universities) to J. Pelchat (U.S. Nuclear Regulatory Commission, Region II), RE: "Document Review—ITT Electro-Optical Products Division, Roanoke, Virginia (Docket File No. 040-08761)," January 28, 1992.

9. Letter from W. Adams (Oak Ridge Institute for Science and Education) to J. Henson (U.S. Nuclear Regulatory Commission, Region II), RE: "Document Review—Final Survey, ITT Electro-Optical Products Division, Roanoke, Virginia (Docket File No. 040-08761)," March 24, 1993.

10. 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, August 1987.

11. Memorandum from J. Hickey (U.S. Nuclear Regulatory Commission, HQ) to D. Collins (U.S. Nuclear Regulatory Commission, Region II), RE: "Interpretation of Thorium Surface Decontamination Limits," February 20, 1992.

REFERENCES (Continued)

12. "Policy and Guideline FC91-2, Standard Review Plan: Evaluating Decommissioning Plans for Licensees Under 10 CFR Parts 30, 40, and 70," U.S. Nuclear Regulatory Commission, August 1991.

APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

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

DIRECT RADIATION MEASUREMENT

Instruments

Eberline Pulse Ratemeter
Model PRM-6
(Eberline, Santa Fe, NM)

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

Ludlum Floor Monitor
Model 239-1
(Ludlum Measurements, Inc., Sweetwater, TX)

Ludlum Ratemeter-Scaler
Model 2221
(Ludlum Measurements, Inc., Sweetwater, TX)

Detectors

Eberline GM Detector
Model HP-260
Effective Area, 15.5 cm^2
(Eberline, Santa Fe, NM)

Eberline ZnS Scintillation Detector
Model AC-3-7
Effective Area, 59 cm^2
(Eberline, Santa Fe, NM)

Ludlum Gas Proportional Detector
Model 43-37
Effective Area, 550 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Ludlum Gas Proportional Detector
Model 43-68
Effective Area, 100 cm^2
(Ludlum Measurements, Inc.,
Sweetwater, TX)

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

Victoreen NaI Scintillation Detector
Model 489-55
3.2 cm x 3.8 cm Crystal
(Victoreen, Cleveland, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detectors
Model No: ERVDS30-25195
(Tennelec, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-23195-S, 23% Eff.
(EG&G ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

Low Background Gas Proportional Counter
Model LB-5100-W
(Oxford, Oak Ridge, TN)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B
SURVEY AND ANALYTICAL PROCEDURES

SURVEY 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. A large surface area, gas proportional floor monitor was used to scan the floors of the surveyed areas. Other surfaces were scanned using small area (15.5 cm^2 or 100 cm^2) hand-held detectors. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument. Combinations of detectors and instruments used for the scans were:

Alpha	—	gas proportional detector with ratemeter-scaler
Beta	—	gas proportional detector with ratemeter-scaler
Beta	—	GM detector with ratemeter-scaler
Gamma	—	NaI scintillation detector with ratemeter

Surface Activity Measurements

Measurements of total alpha and beta activity levels were primarily performed using gas proportional detectors with portable ratemeter-scalers. Alpha and beta activity measurements were performed on upper room surfaces, some equipment, and at locations of elevated direct radiation, using gas proportional, ZnS scintillation, and/or GM detectors with ratemeters-scalers.

Count rates (cpm), which were integrated over 1 minute in a static position, were converted to activity levels (dpm/100 cm^2) by dividing the net rate by the 4π efficiency and correcting for the active area of the detector. The alpha activity background countrates for the gas proportional detectors and the ZnS scintillation detectors averaged 1 cpm for each detector and 7 cpm for the gas proportional detectors used for measurements on the concrete pad. Alpha efficiency factors were 0.19 for the gas proportional detectors and 0.14 for the ZnS scintillation detectors. The beta activity background count rates for the proportional detectors and the GM detectors averaged 337 and 49 cpm, respectively. Beta efficiency factors ranged from 0.23 to 0.26 for the gas proportional detectors and 0.22 for the GM detector. The effective windows for the gas proportional, ZnS scintillation, and GM detectors were 100 cm^2, 59 cm^2, and 15.5 cm^2, respectively. Beta activity levels were calculated after subtracting the alpha contribution.

Removable Activity Measurements

Removable activity levels were determined using numbered filter paper disks, 47 mm in diameter. Moderate pressure was applied to the smear and approximately 100 cm^2 of the surface was wiped. Smears were placed in labeled envelopes with the location and other pertinent information recorded.

Exposure Rate Measurements

Measurements of gamma exposure rates were performed at 1 m above the surface using a pressurized ionization chamber (PIC).

Miscellaneous Samples

Soil Sampling

Approximately 1 kg of soil was collected at each sampling location. Collected samples were placed in plastic bags, sealed, and labeled in accordance with ESSAP survey procedures.

Paint Sampling

Approximately 100 cm^2 of paint was collected from each sample location. Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

ANALYTICAL PROCEDURES

Removable Activity

Smears were counted on a low background gas proportional system for gross alpha and gross beta activity.

Gamma Spectrometry

Samples of solid material (soil and paint), were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a 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. All photopeaks associated with the radionuclide of concern were reviewed for consistency of activity. Energy peaks used for determining the activities of radionuclides of concern were:

Th-228	0.239 MeV from Pb-212*
Th-232	0.911 MeV from Ac-228*

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

UNCERTAINTIES AND DETECTION LIMITS

The uncertainties associated with the analytical data presented in the tables of this report represent the 95% confidence level 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 2.71 + 4.66 times the statistical deviation of the background count (BKG) $[2.71+(4.66\sqrt{BKG})]$, the sample concentration was reported as less than the detection limit of the measurement procedures. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument. Additional uncertainties, associated with sampling and measurement procedures, have not been propagated into the data presented in this report.

CALIBRATION AND QUALITY ASSURANCE

Analytical and field survey activities were conducted in accordance with procedures from the following documents of the Environmental Survey and Site Assessment Program:

- Survey Procedures Manual, Revision 7 (May 1992)
- Laboratory Procedures Manual, Revision 7 (April 1992)
- Quality Assurance Manual, Revision 5 (May 1992)

The procedures contained in these manuals were developed to meet the requirements of DOE Order 5700.6C and ASME NQA-1 for Quality Assurance and contain measures to assess processes during their performance.

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST, when such standards/sources were available. In cases where they were not available, standards of an industry recognized organization was used. Calibration of pressurized ionization chambers was performed by the manufacturer.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in EPA and EML laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

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 MATERIALS

AND

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

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

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

August 1987

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 a 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 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 from 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, Medical, Academic, and Commercial Use Safety, U.S. Nuclear Regulatory Commission, 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. The 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	1,000 dpm/100 cm^2	3,000 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.	5,000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1,000 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.

Guidelines for Residual Concentrations of Thorium and Uranium Wastes in Soil

On October 23, 1981, the Nuclear Regulatory Commission published in the Federal register a notice of Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document established guidelines for concentrations of uranium and thorium in soil, that will limit maximum radiation received by the public under various conditions of future land usage. These concentrations are as follows:

Material	Maximum Concentrations (pCi/g) for various options			
	1[a]	2[b]	3[c]	4[d]
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10	50	--	500
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10	--	40	200
Depleted Uranium:				
Soluble	35	100	--	1,000
Insoluble	35	300	--	3,000
Enriched Uranium:				
Soluble	30	100	--	1,000
Insoluble	30	250	--	2,500

[a]Based on EPA cleanup standards which limit radiation to 1 mrad/yr to lung and 3 mrad/yr to bone from ingestion and inhalation and 10 μR/h above background from direct external exposure.
[b]Based on limiting individual dose to 170 mrem/yr.
[c]Based on limiting equivalent exposure to 0.02 working level or less.
[d]Based on limiting individual dose to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.