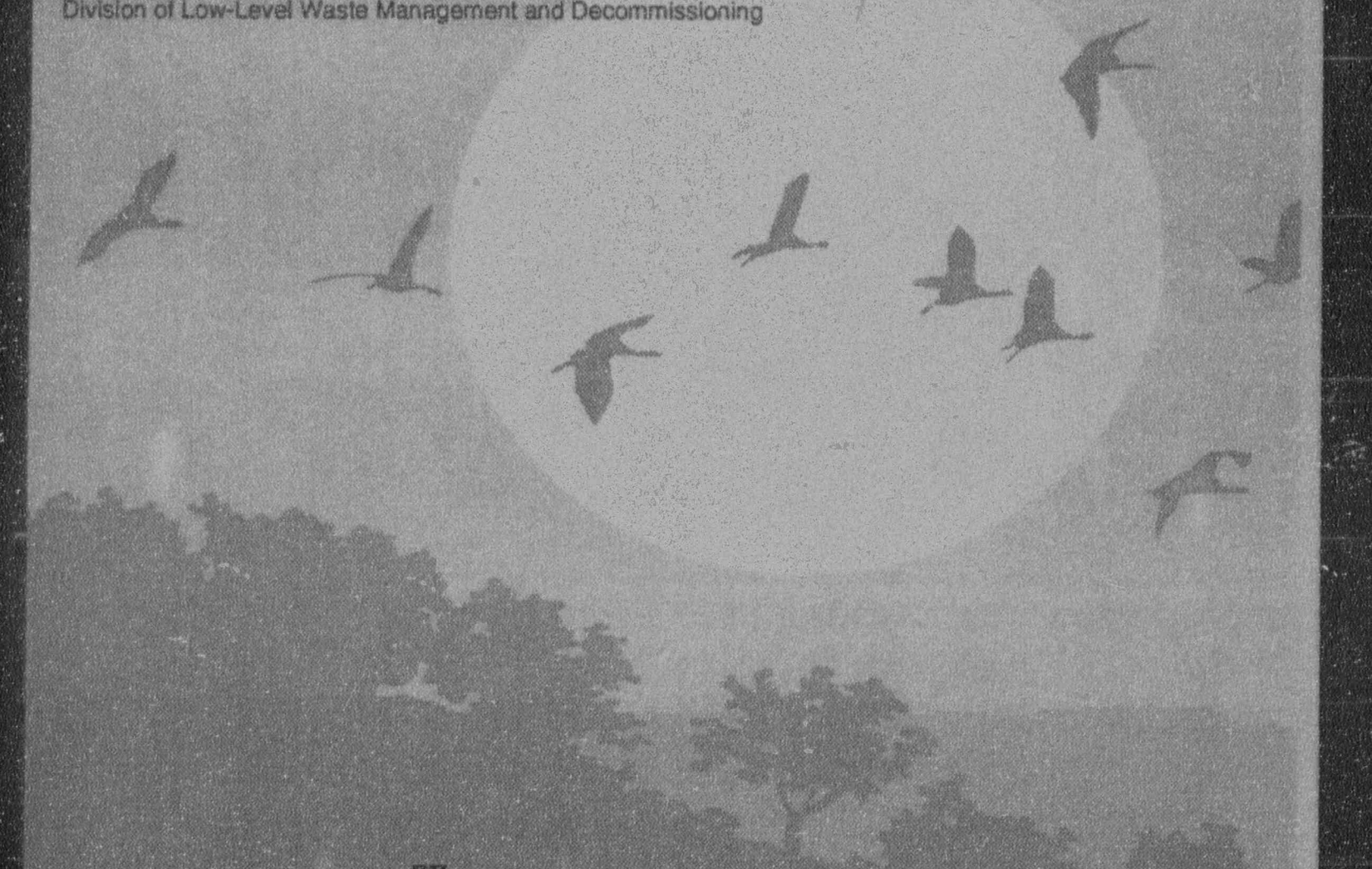
ORISE 93/L-70

CONFIRMATORY SURVEY OF THE UNAFFECTED INDOOR AREAS AND THE ELECTRODE GRIND ROOM UNC NAVAL PRODUCTS MONTVILLE, CONNECTICUT

[DOCKET 70-371]

A. J. ANSARI AND M. A. HENKE

Prepared for the
U.S. Nuclear Regulatory Commission
Division of Low-Level Waste Management and Decommissioning



ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Environmental Survey and Site Assessment Program
Energy/Environment Systems Division

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Prepared for

U.S. Nuclear Regulatory Commission
Division of Low-Level Waste Management and Decommissioning

December 1993

FINAL REPORT

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CONFIRMATORY SURVEY OF
THE UNAFFECTED INDOOR AREAS AND THE ELECTRODE GRIND ROOM
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

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ACKNOWLEDGEMENTS

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ABBREVIATIONS

ASME	American Society of Mechanical Engineers
cm^2	square centimeter
cpm	counts per minute
dpm/100 cm^2	disintegrations per minute/100 square centimeters
EPA	Environmental Protection Agency
EML	Environmental Measurement Laboratory
ESSAP	Environmental Survey and Site Assessment Program
ft	foot
GM	Geiger-Mueller
m	meter
m^2	square meter
MDA	minimum detectable activity
NIST	National Institute for Standards Technology
NRC	Nuclear Regulatory Commission
NaI	Sodium Iodide
ORISE	Oak Ridge Institute for Science and Education
PIC	Pressurized Ionization Chamber
μR/h	microroentgen per hour
UNC	United Nuclear Corporation
ZnS	Zinc Sulfide

CONFIRMATORY SURVEY OF THE UNAFFECTED INDOOR AREAS AND THE ELECTRODE GRIND ROOM UNC NAVAL PRODUCTS MONTVILLE, CONNECTICUT

INTRODUCTION AND SITE HISTORY

United Nuclear Corporation (UNC) Naval Products fabricated reactor fuel elements for the Naval Reactors Program at the Montville, Connecticut facility under U.S. Nuclear Regulatory Commission (NRC) License SNM-368. The license authorized the fabrication and inspection of unclad fuel components, encapsulation of the fuel into corrosion-resistant materials, assemblage of these into larger components or into reactor cores, and laboratory activities necessary to support these operations. The radioactive materials utilized were fully enriched unirradiated uranium and uranium source materials. In March of 1990, UNC was notified by the U.S. Government that certain contracts were being terminated. As a result of that action, UNC decided to initiate decontamination and decommissioning efforts at the UNC facility in the summer of 1990, while concurrently completing work on existing contracts.

The licensee's decontamination activities and final radiological surveys in support of the license termination have been performed in multiple phases. At the request of the U.S. Nuclear Regulatory Commission (NRC), Region I Office, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) has performed independent confirmatory surveys at this facility. During the period of April 1991 through November 1992, the confirmatory activities for Unit 1, Unit 2, Unit 3 Vault, Pack Assembly, Septic Fields 1 and 2, and Incinerator Pad were completed and the results of those surveys were provided in a separate report.[1]

In December 1992, the results of the licensee's final survey for the indoor unaffected areas were provided to the NRC. These areas included the manufacturing areas (Buildings B North, A, M, and East Plant), office areas, mezzanines, Building L, and support buildings. The support

buildings consist of D, R, S, T, H Buildings, Carpentry Building, Compressor Building, West Pump House, Security Towers, and Security Gate House. In these areas, designated as unaffected, unencapsulated fuel had never been used or stored. There is no record of any major incidents or fires involving release of radioactive materials in these areas. However, there had been incidents of machine misoperations involving encapsulated fuel in the manufacturing area. In every case, the contamination, if any, was confined to the machine and/or component. Four such "incident" areas have been identified. These are the Hot Roll room in Building B North, Warm Roll room, Vapor Grit Blast room, and the Welding area in Building A.

At the request of the U.S. Nuclear Regulatory Commission, ESSAP performed a confirmatory radiological survey of the indoor unaffected areas at the UNC facility during the period of February 8 through 11, 1993. The procedures and results of that survey are included in this report. During the same period, the Electrode Grind room in Building A, designated as an affected area, was surveyed. The procedures and results of that survey are also provided in this report.

SITE DESCRIPTION

The 251 acre UNC site is located in the northeast corner of the town of Montville, New London County, Connecticut (Figure 1). Only a small portion of the site is occupied by the UNC facility. The Central Vermont Railroad has a right-of-way along the Thames River at the eastern edge of the UNC site. The plant is served by a spur from the railroad and has car and truck access from State Highway 32. The site is bounded on the north by the Thames River, on the east by the railroad and the Thames River, and on the south and west by private property (Figure 2).

The Montville facility was built in 1957-59, with small additions in 1961 and 1966 (Figure 3). A major expansion, Building M (4,700 m^2) was completed in 1969. All operations in this building were limited to clad fuel. Following authorization by the Atomic Energy Commission (predecessor to NRC) in 1972, UNC constructed four additional buildings. Building A

(7,000 m^2) was completed in early 1973. Operations in Building A were also limited to clad fuel. Building B (6,000 m^2) was completed in September of 1973 and was used for the initial forming and encapsulation of uranium-bearing material. Building C (4,700 m^2) was completed in May 1973 and contained the main office and clerical support functions. Construction of Building L (4,200 m^2) was completed in 1990, however, installation of uranium processing equipment was never completed.

There are a number of support buildings in this facility. Building D was used for inspection of non-uranium materials, bulk storage or other non-uranium materials and recovery of silver. Buildings S, R, T, and H were used for receiving, inspection, and storage of non-uranium materials.

The plant buildings are set in the side of the valley with the roof line nearly level with the parking lot. Exterior walls of all buildings are a combination of concrete block and insulated metal siding. A security fence surrounds the building complex.

OBJECTIVES

The objectives of the confirmatory process are to provide independent document reviews and radiological data, for use by the NRC in evaluating the adequacy and accuracy of the licensee's radiological survey data, relative to established guidelines.

DOCUMENT REVIEW

As part of the confirmatory activities, ESSAP reviewed the licensee's radiological status report.[2] 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 February 8 through 11, 1993, ESSAP performed a confirmatory radiological survey of the indoor unaffected areas at the UNC Naval Products facility. The survey was in accordance with a survey plan which was submitted to and approved by the NRC Region I Office.[3] This report summarizes the procedures and results of that survey. During the same period, the Electrode Grind room in Building A, designated as an affected area, was surveyed.

SURVEY PROCEDURES

Reference Grid

The reference grid systems established by the licensee were utilized. Individual grid blocks were identified by their northwest (floor grids) or top-left (lower wall grids) coordinates. In all of the unaffected areas except the Incident Areas, 7 m x 7 m and 2 m x 25 m grids were used for the floor and lower walls (up to 2 m), respectively. In the Incident Areas 3 m x 3 m and 2 m x 3 m grids were used for the floor and lower walls (up to 2 m), respectively. In the Electrode Grind room a 1 m x 1 m grid was used for both the floor and lower walls. Measurement locations on ungridded surfaces were referenced to prominent building features or the existing grid.

Surface Scans

Surface scans for alpha, beta, and gamma activity were performed using large-area gas proportional and NaI scintillation detectors, coupled to ratemeters or ratemeter-scalers with audible indicators. In the Manufacturing Area, approximately 10% of the floor surfaces were scanned for gamma and alpha radiation. In the four identified Incident Areas, in addition to gamma and alpha floor scans, beta scans were performed on approximately 10% of the floor surfaces. In the offices, mezzanines, and support buildings, only gamma scans were performed. Particular attention was given to scanning doorways and passageways in and between the

buildings. Locations of elevated direct radiation, identified by surface scans, were marked for further investigation.

In the Electrode Grind room, located in Building A, 100% of the floor and lower (up to 2 m) wall surfaces were scanned for alpha, beta, and gamma radiation.

Surface Activity Measurements

Direct measurements for total alpha activity were performed at 315 locations in the unaffected areas. Because rough, dirty or damp surfaces may selectively attenuate alpha radiation, beta activity was also measured at every location. In the gridded areas the measurements were made at the center of randomly selected grid blocks on floors and lower walls. The number of these measurements in each room or building varied between 10-25% of that provided in the licensee's final status survey report.[2] Direct measurements were also performed at locations of elevated activity identified by surface scans. In addition, in the manufacturing areas, direct measurements for total alpha and total beta activity were made at several locations on upper walls and overhead structures. These measurements were performed using ZnS scintillation and thin-window GM detectors, coupled to ratemeter-scalers. A smear sample for determining removable activity was obtained from each direct measurement location. The measurement and sampling locations for total and removable activity in the unaffected areas are illustrated in Figures 4 through 33.

In the Electrode Grind room, one set of five direct measurements for total alpha and total beta activity was obtained from each randomly selected grid block. These measurements were obtained at the center and at four points equidistant from the center and grid block corners. Removable activity levels were determined by taking a smear for each set of five direct measurements, corresponding to the location of the highest alpha activity. The measurement and sampling locations for total and removable activity in the Electrode Grind room are illustrated in Figure 34.

Exposure Rate Measurements

Background exposure rates for building interiors were previously determined for this site.[1]

Exposure rate measurements were performed at 1 m (3.3 ft) above the interior building surfaces at 35 locations, using a pressurized ionization chamber (PIC). Measurement locations are shown in Figures 4, 5, 8-16, 19, 22, 24-28, 30-32 and 35.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and interpretation. Smears were analyzed for gross alpha and gross beta activity using a low background gas proportional counter, and the results were converted to units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2). Direct measurements for surface activity were converted to units of dpm/100 cm^2. Exposure rates were reported in microroentgen per hour (μR/h). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to the NRC guidelines which are provided in Appendix C.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP reviewed the licensee's radiological survey data and comments were provided to the NRC.[4] In ESSAP's opinion, the licensee's documentation provides sufficient information to assess the status of the surveyed areas and data provided satisfy the NRC guidelines for release of the facility for unrestricted use.

SURFACE SCANS

Surface scans did not identify any locations of elevated direct radiation.

SURFACE ACTIVITY LEVELS

Total surface activity levels throughout the unaffected surveyed areas ranged from <69 to 340 dpm/100 cm^2 for alpha, and from <1400 to 2900 dpm/100 cm^2 for beta. These results are summarized in Tables 1 and 2. In the Electrode Grind room, total activity levels ranged from <130 to 222 dpm/100 cm^2 for alpha and from <2200 to 2500 dpm/100 cm^2 for beta. Removable activity levels, in all areas surveyed, were <12 dpm/100 cm^2 and <17 dpm/100 cm^2 for alpha and beta, respectively.

Exposure Rate Measurements

The background exposure rates, previously determined by ESSAP, averaged 12 μR/h.[1] Exposure rate measurements are summarized in Table 3. The measurements ranged from 8 to 15 μR/h.

COMPARISON OF RESULTS WITH GUIDELINES

The guidelines for acceptable surface contamination levels, used by the NRC to determine whether a licensed facility may be released to unrestricted use, are summarized in Appendix C.[5]

The following surface contamination guidelines for uranium apply to all areas:

Total Activity

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

Removable Activity

1,000 α dpm/100 cm^2

The surface activity levels in the surveyed areas were within the guideline levels.

The exposure rate measurements were also less than the guideline value of 5 μR/h above background.[6]

SUMMARY

During the period of February 8 through 11, 1993, at the request of the U.S. Nuclear Regulatory Commission, the Oak Ridge Institute for Science and Education's Environmental Survey and Site Assessment Program conducted a confirmatory radiological survey of the indoor unaffected areas and the Electrode Grind room at the UNC Naval Products facility in Montville, Connecticut. Confirmatory activities included document reviews, surface scans, surface activity measurements, and exposure rate measurements.

The review of UNC documentation did not identify any significant deficiencies. All independent measurements by ESSAP were within the applicable NRC guidelines and support the results of the licensee's final radiological survey. Based on the confirmatory activities, it is ESSAP's opinion that the licensee's results accurately describe the radiological status of the surveyed areas and that this status is adequately and accurately documented in the UNC final survey report.

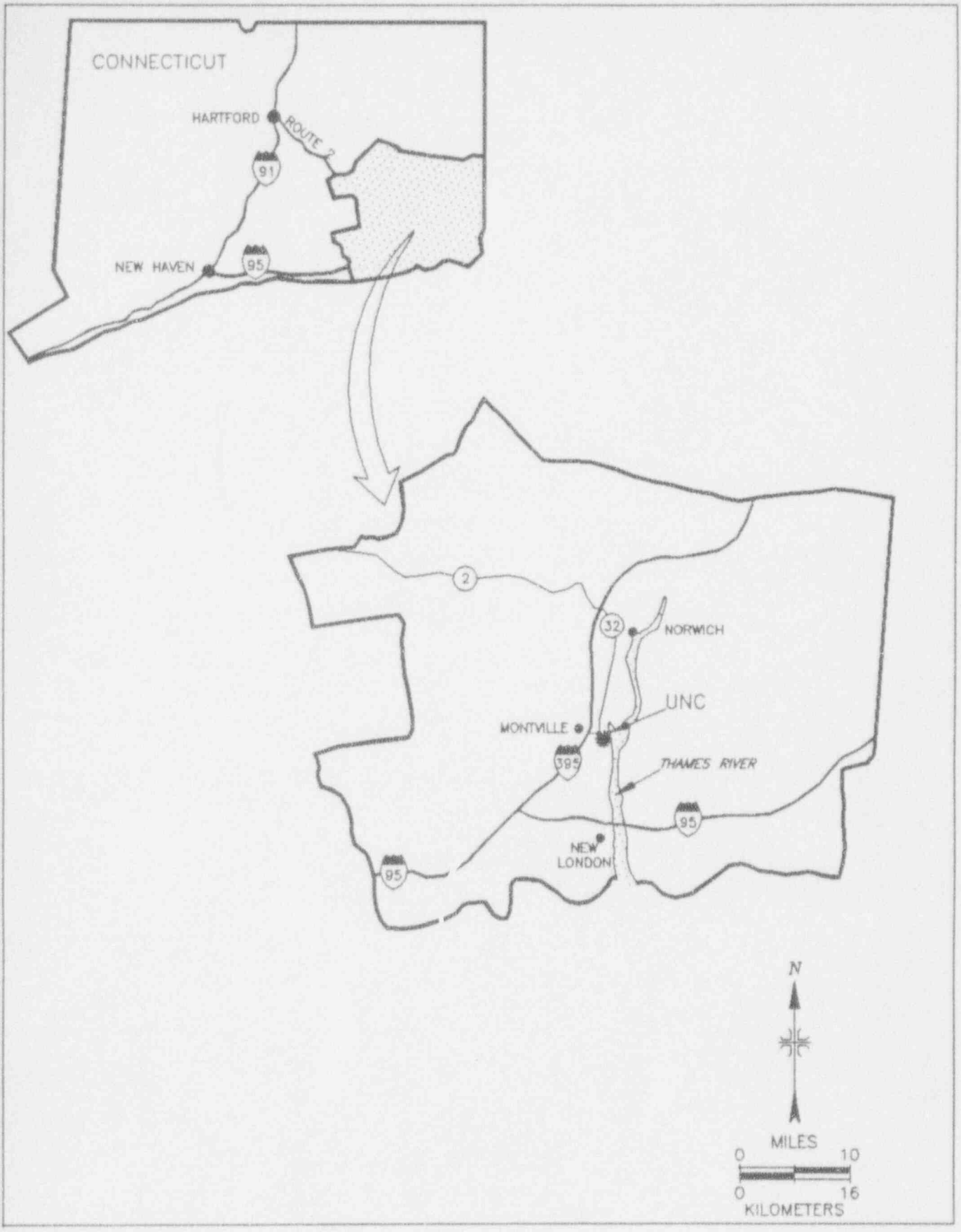


FIGURE 1: Map of New London County, Connecticut, Showing Location of UNC Naval Products Facility

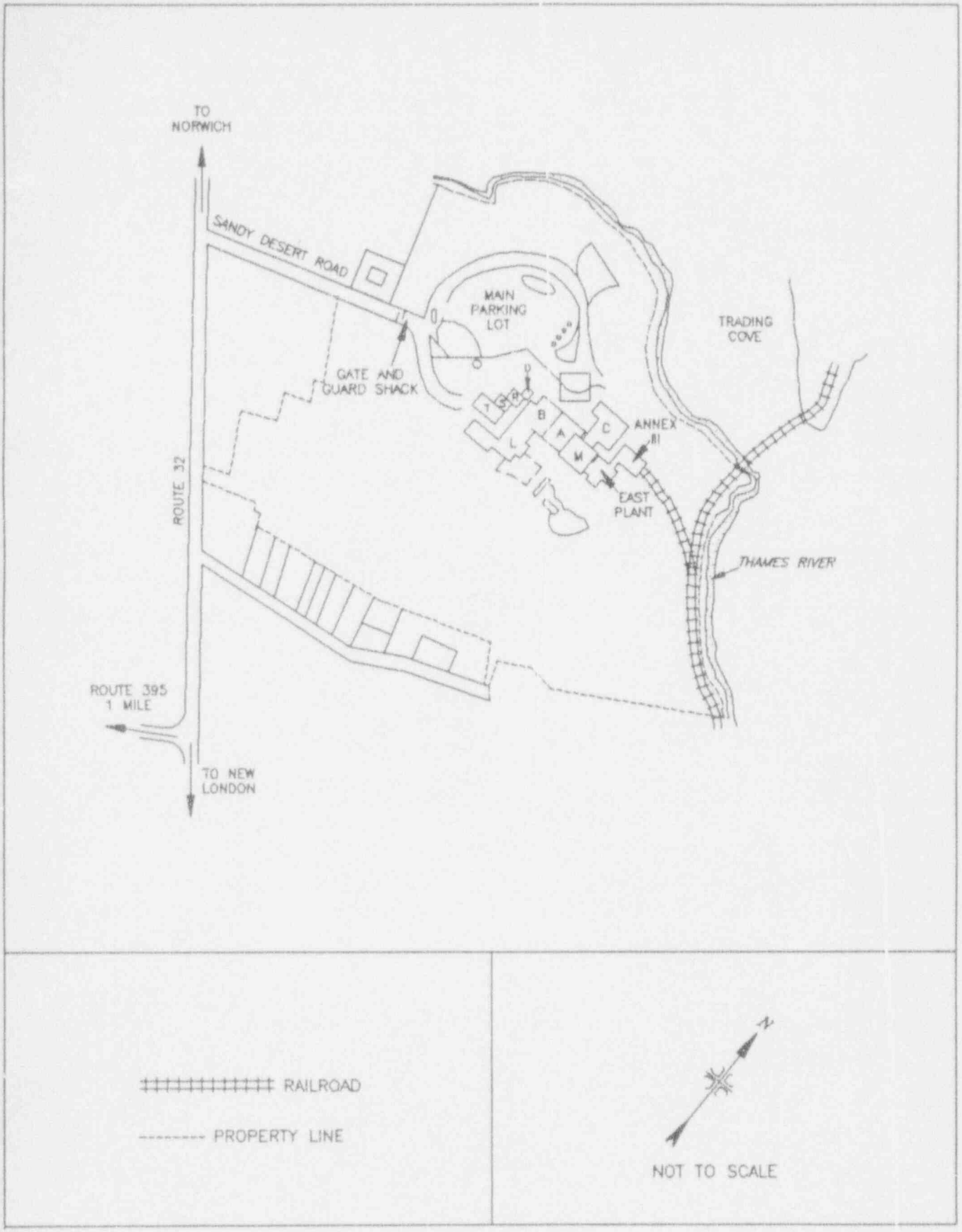


FIGURE 2: Layout of the UNC Naval Products Property

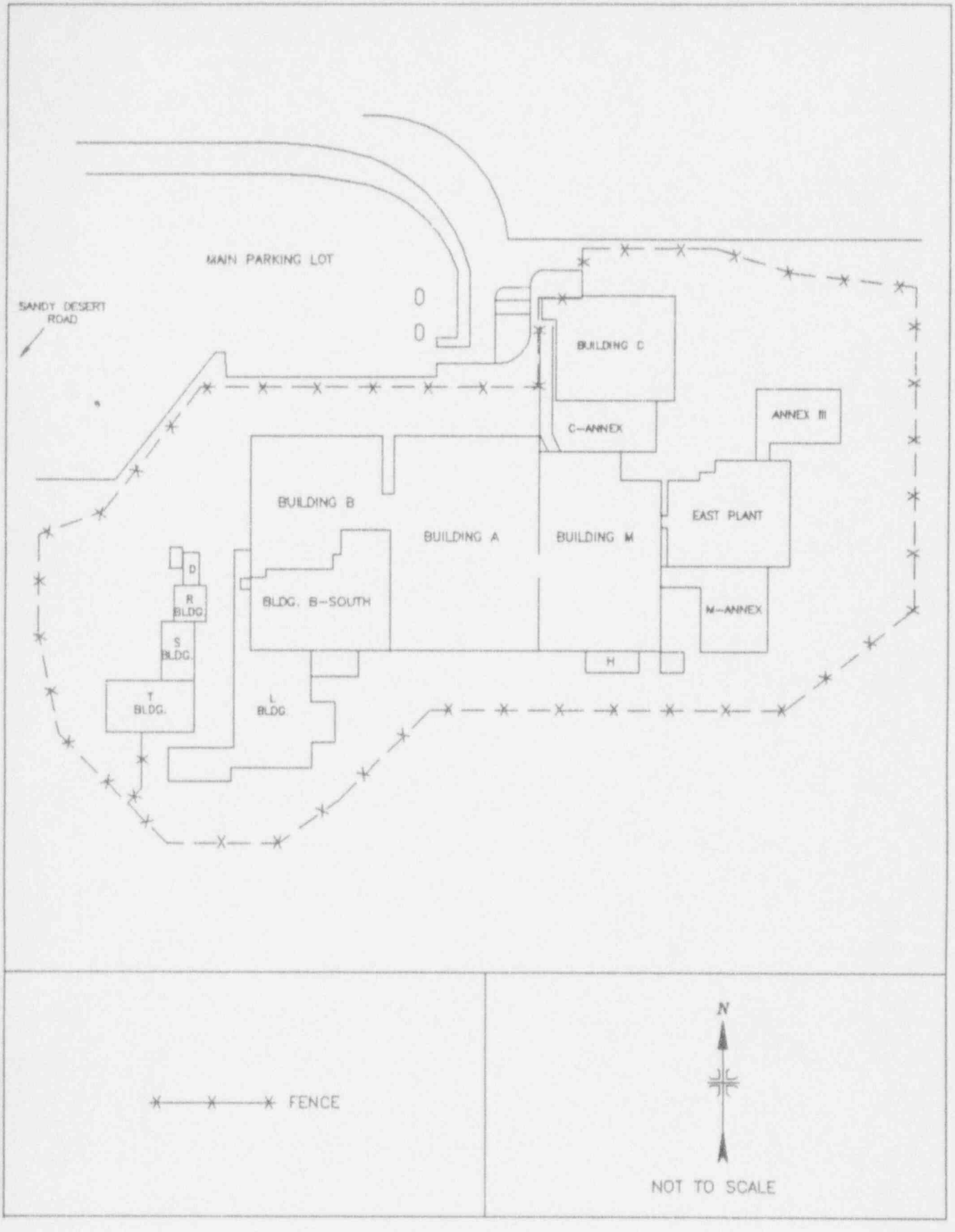
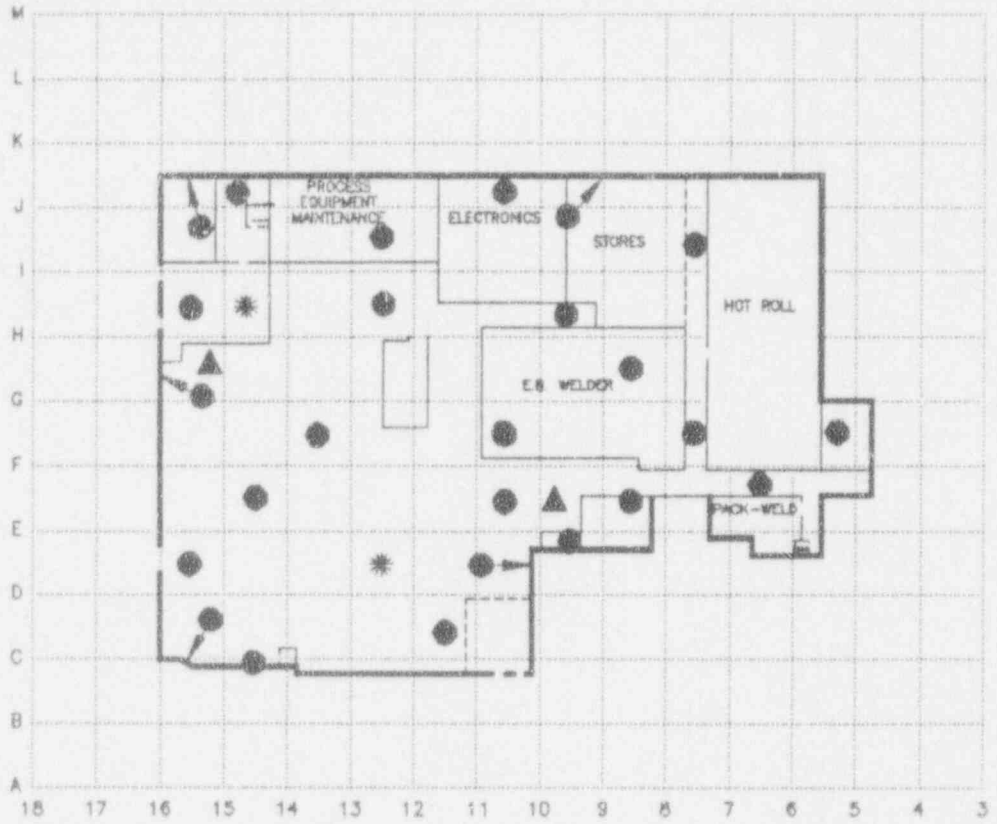


FIGURE 3: Layout of UNC Naval Products Facility



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- SINGLE-POINT UPPER WALLS AND STRUCTURES
- EXPOSURE RATE

FIGURE 4: Building B North, Main Floor – Measurement and Sampling Locations

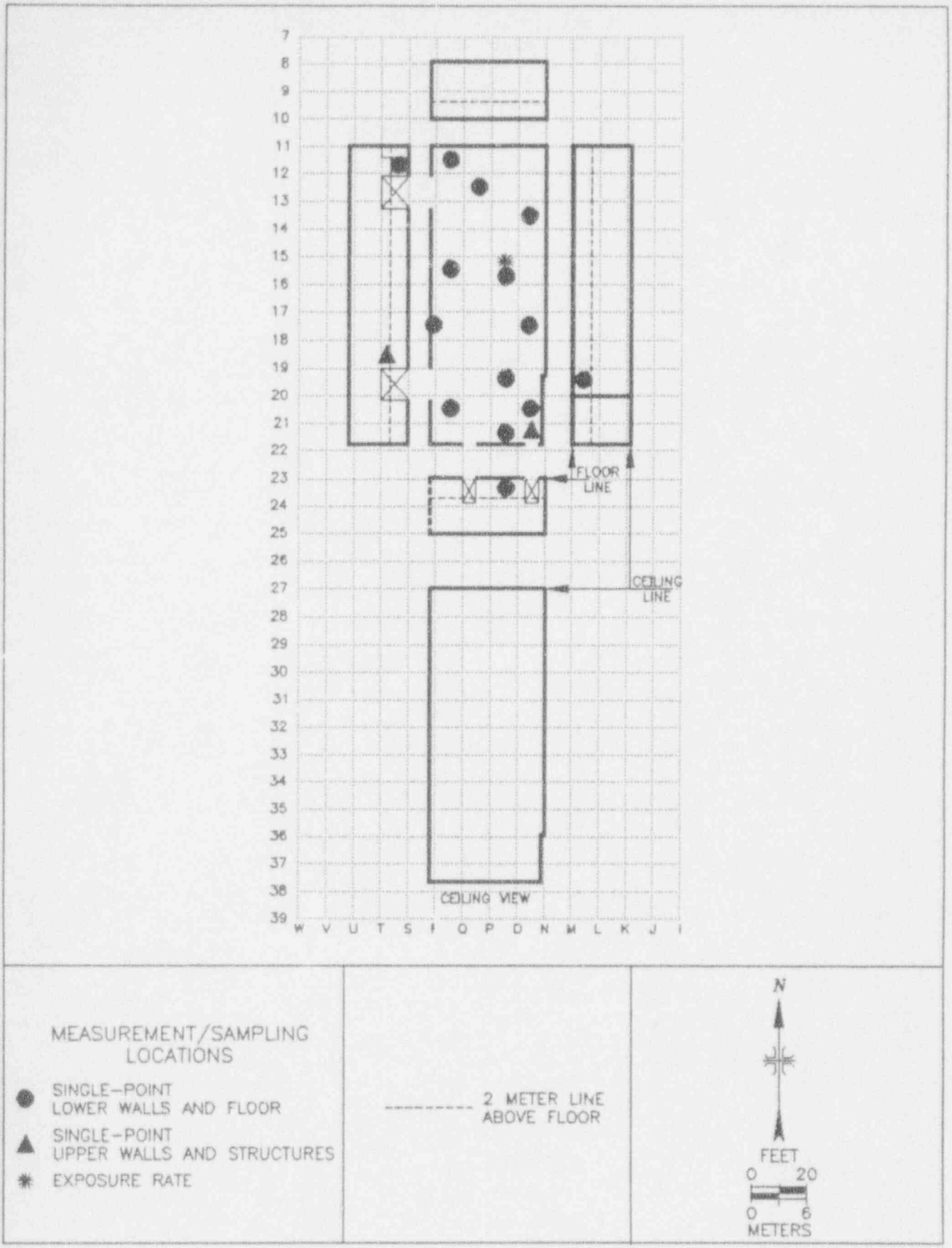
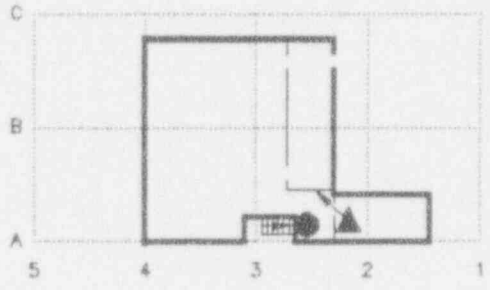


FIGURE 5: Building B North, Hot Roll – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

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- SINGLE-POINT UPPER WALLS AND STRUCTURES

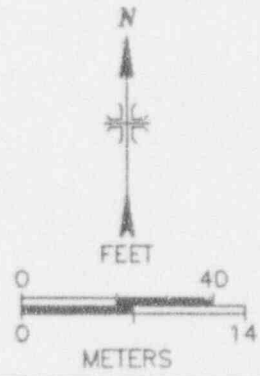
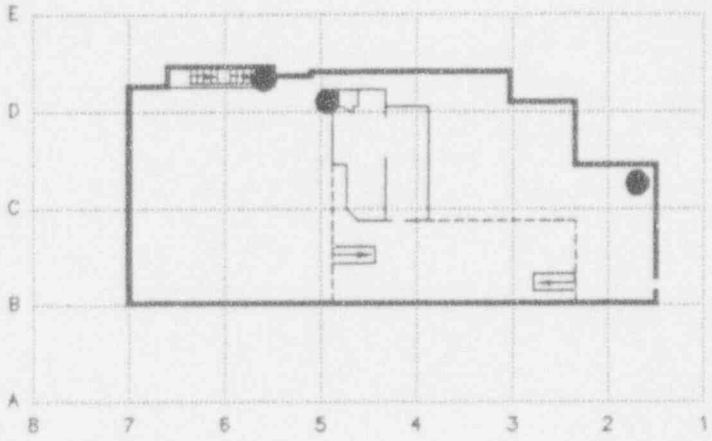


FIGURE 6: Building B North, Maintenance Mezzanine – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

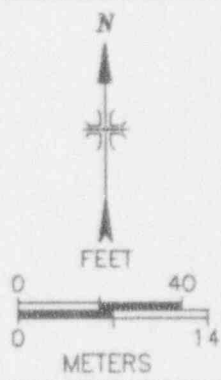
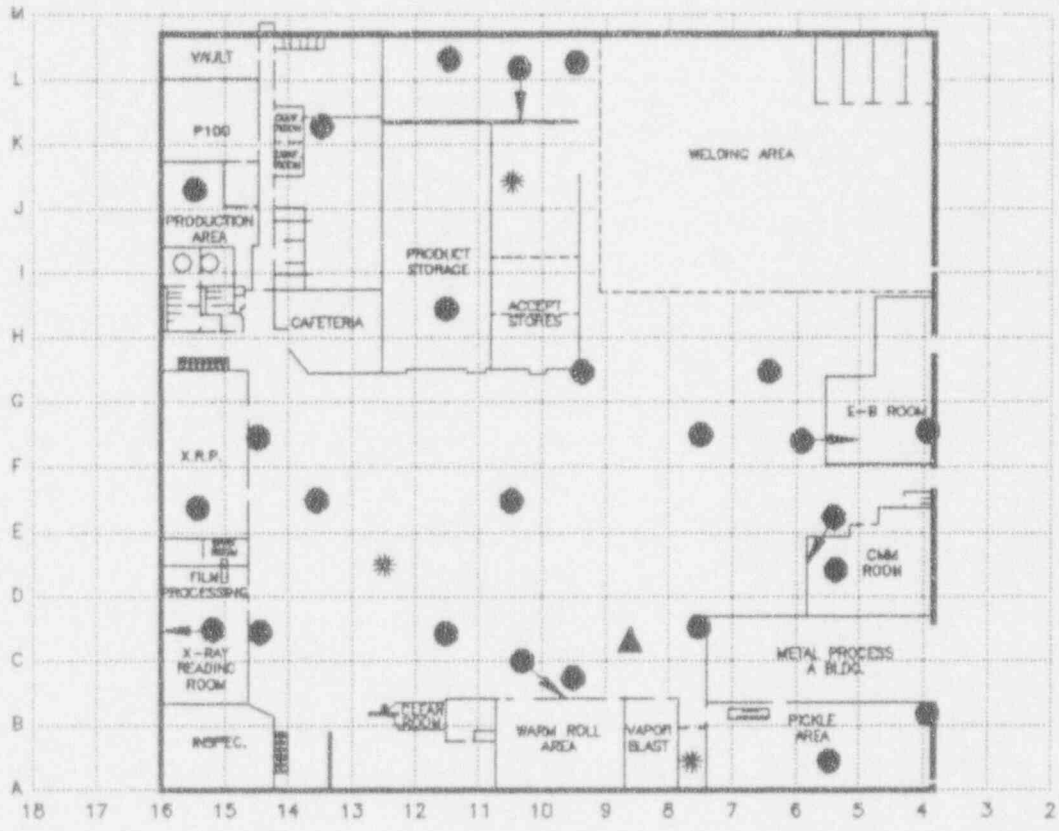


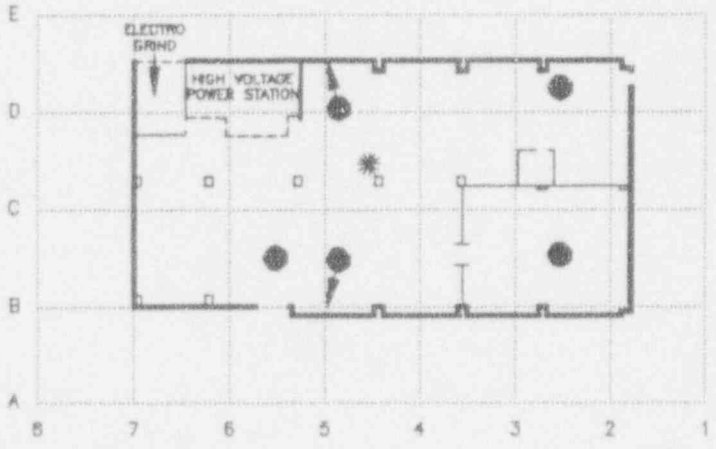
FIGURE 7: Building B North, Stores Mezzanine – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- SINGLE-POINT UPPER WALLS AND STRUCTURES
- EXPOSURE RATE

FIGURE 8: Building A, Main Floor – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

✱ EXPOSURE RATE

FIGURE 9: Building A, Basement – Measurement and Sampling Locations

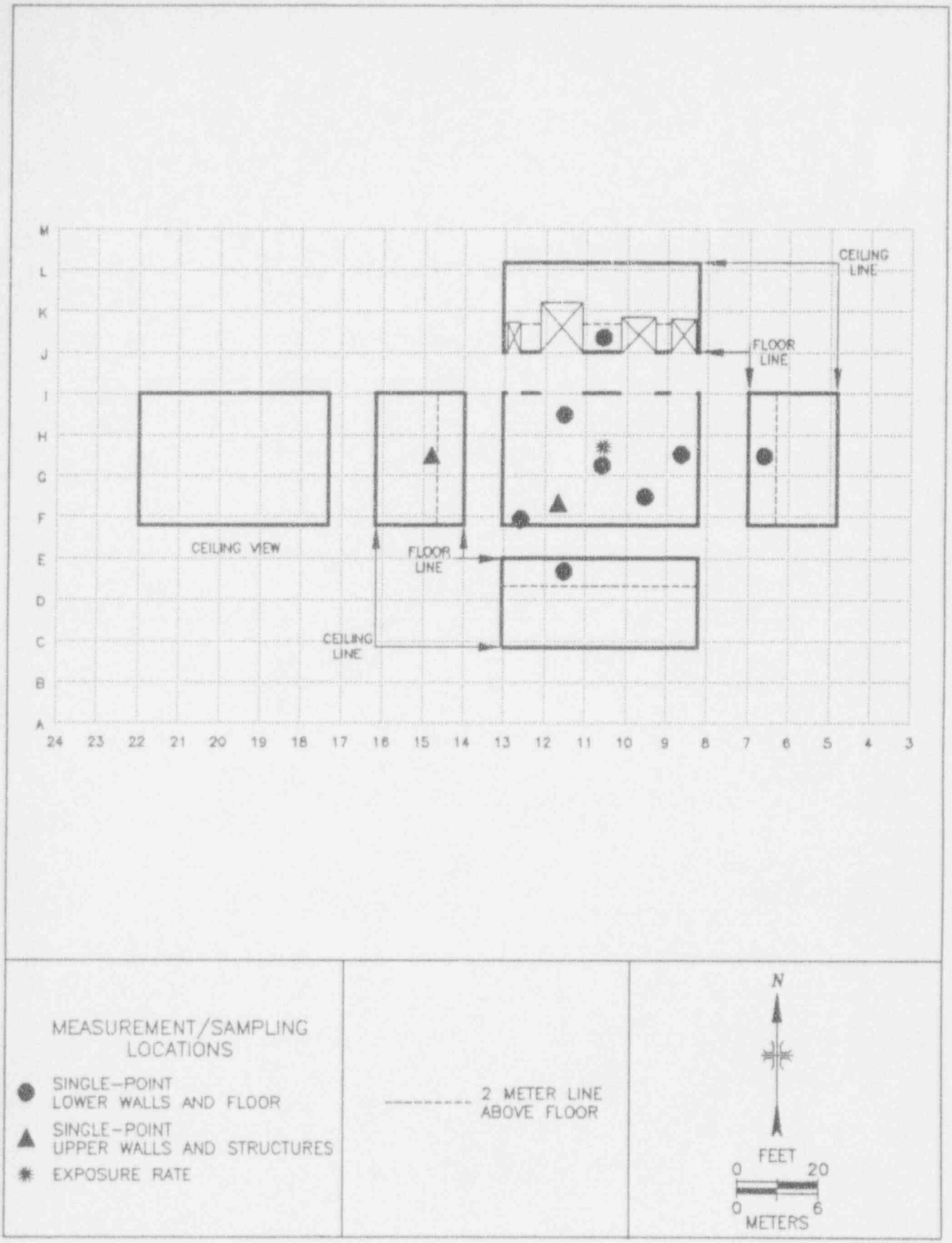
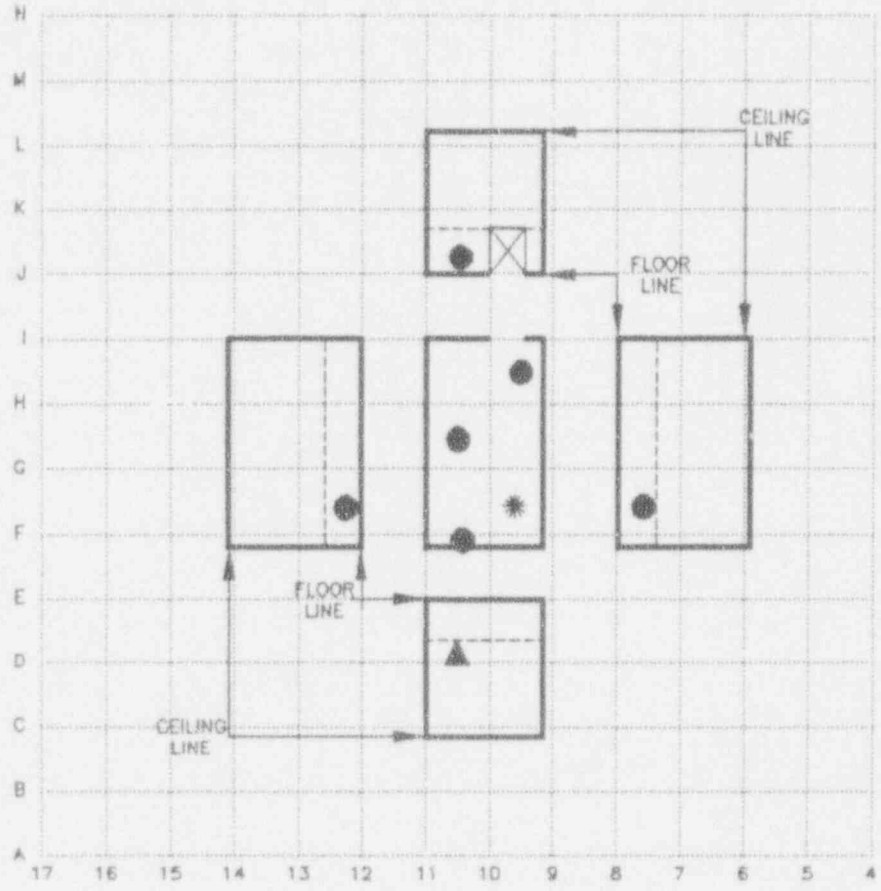


FIGURE 10: Building A, Warm Roll – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- SINGLE-POINT UPPER WALLS AND STRUCTURES
- EXPOSURE RATE

--------- 2 METER LINE ABOVE FLOOR

N

FEET
0 20
0 6
METERS

FIGURE 11: Building A, Vapor Grit Blast – Measurement and Sampling Locations

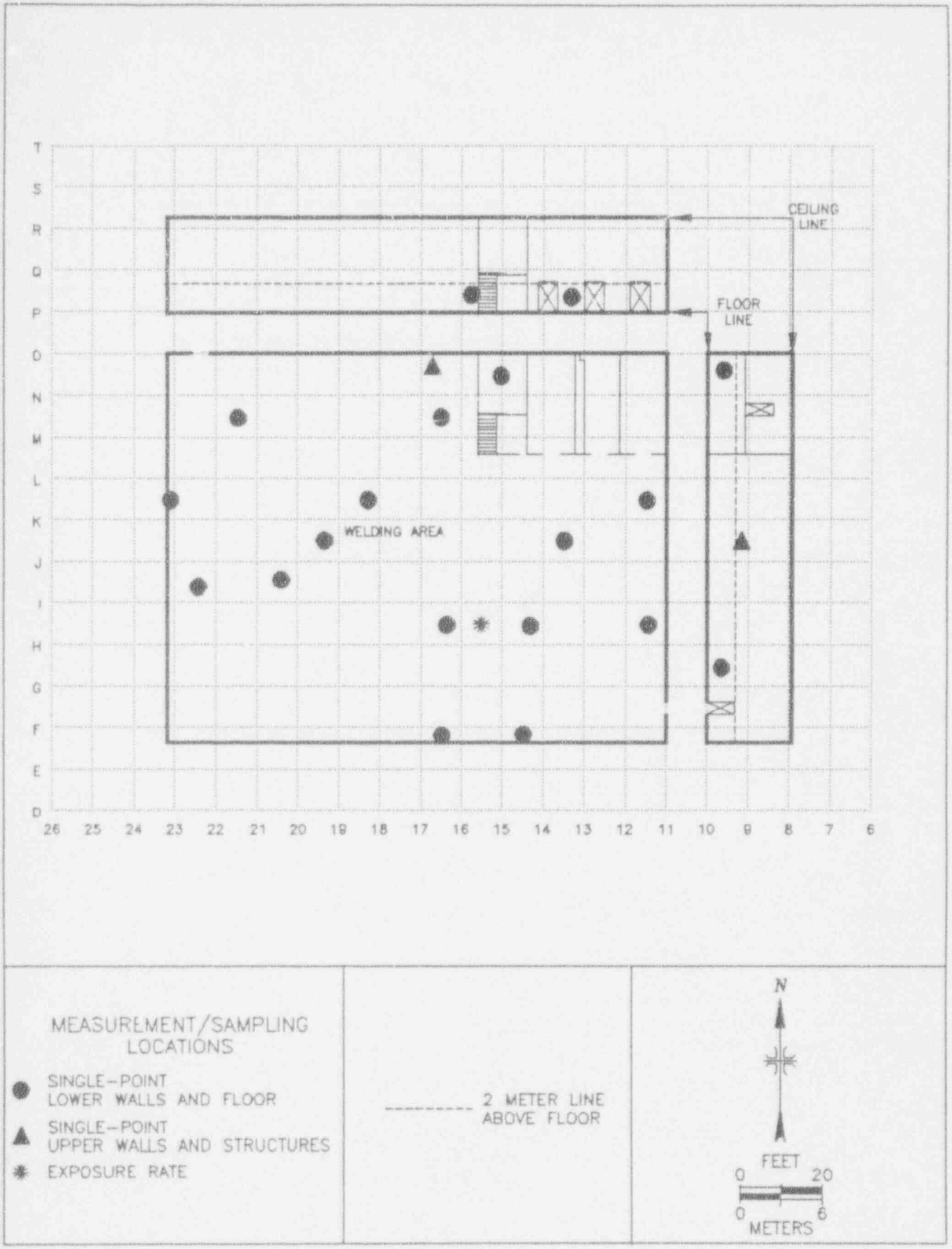
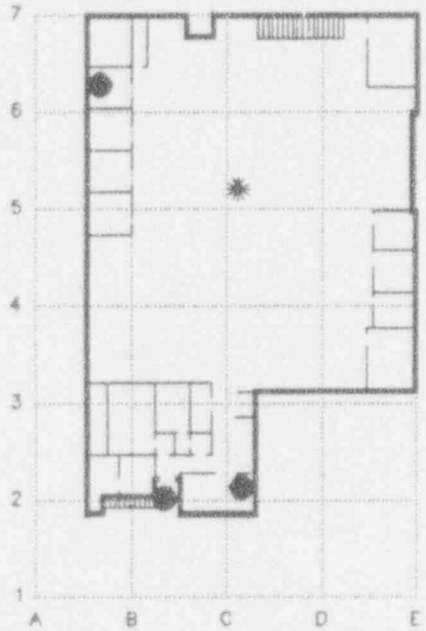


FIGURE 12: Building A, Welding Area – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

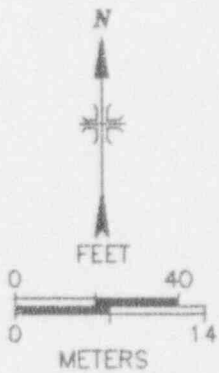
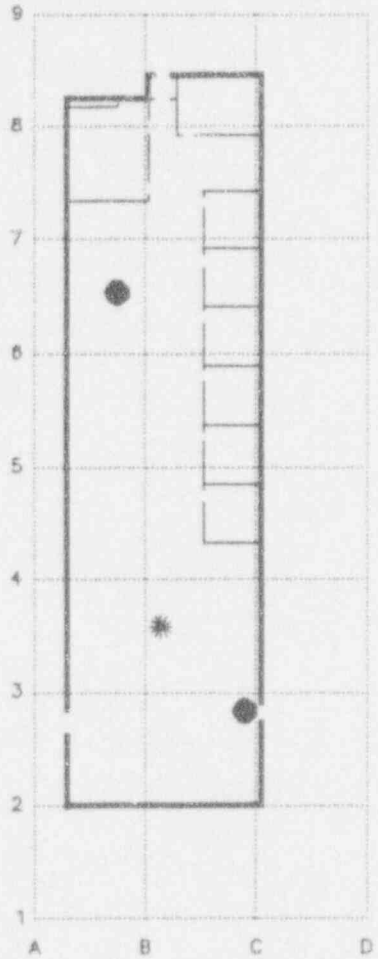


FIGURE 13: Building A, North Mezzanine – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

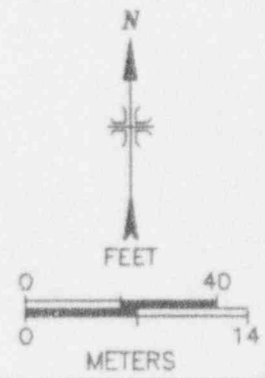
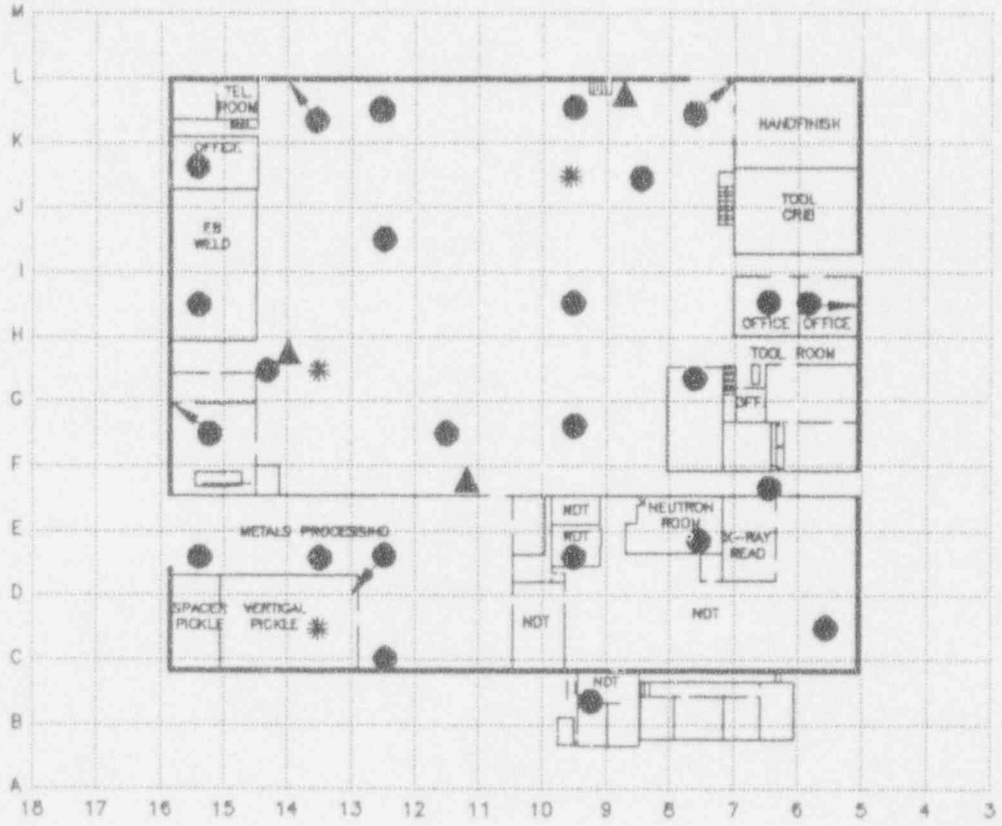


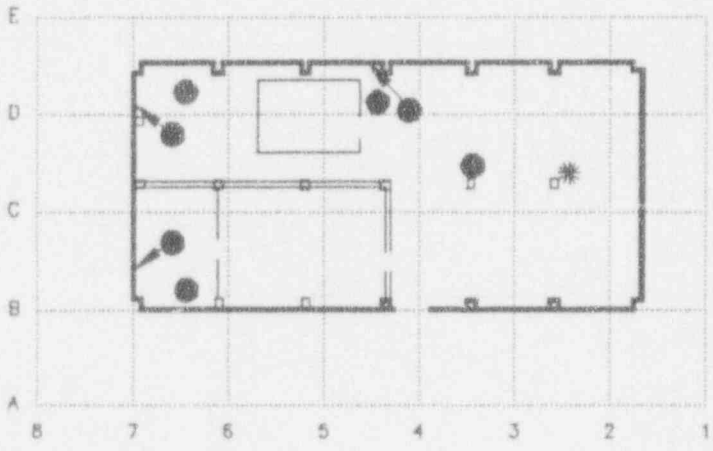
FIGURE 14: Building A, South Mezzanine – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- SINGLE-POINT UPPER WALLS AND STRUCTURES
- EXPOSURE RATE

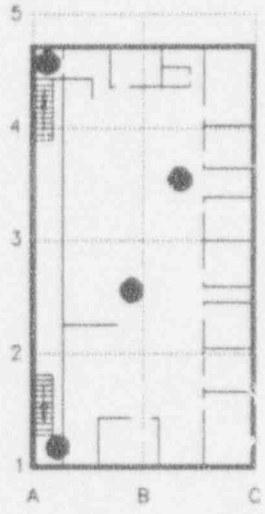
FIGURE 15: Building M, Main Floor – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

FIGURE 16: Building M, Basement – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

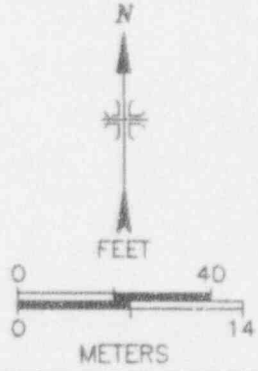
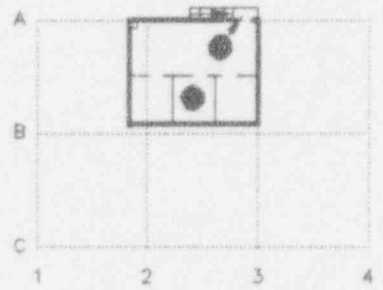


FIGURE 17: Building M, East Mezzanine – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

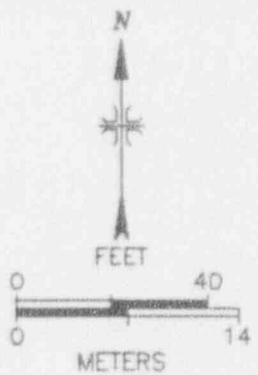


FIGURE 18: Building M, West Mezzanine – Measurement and Sampling Locations

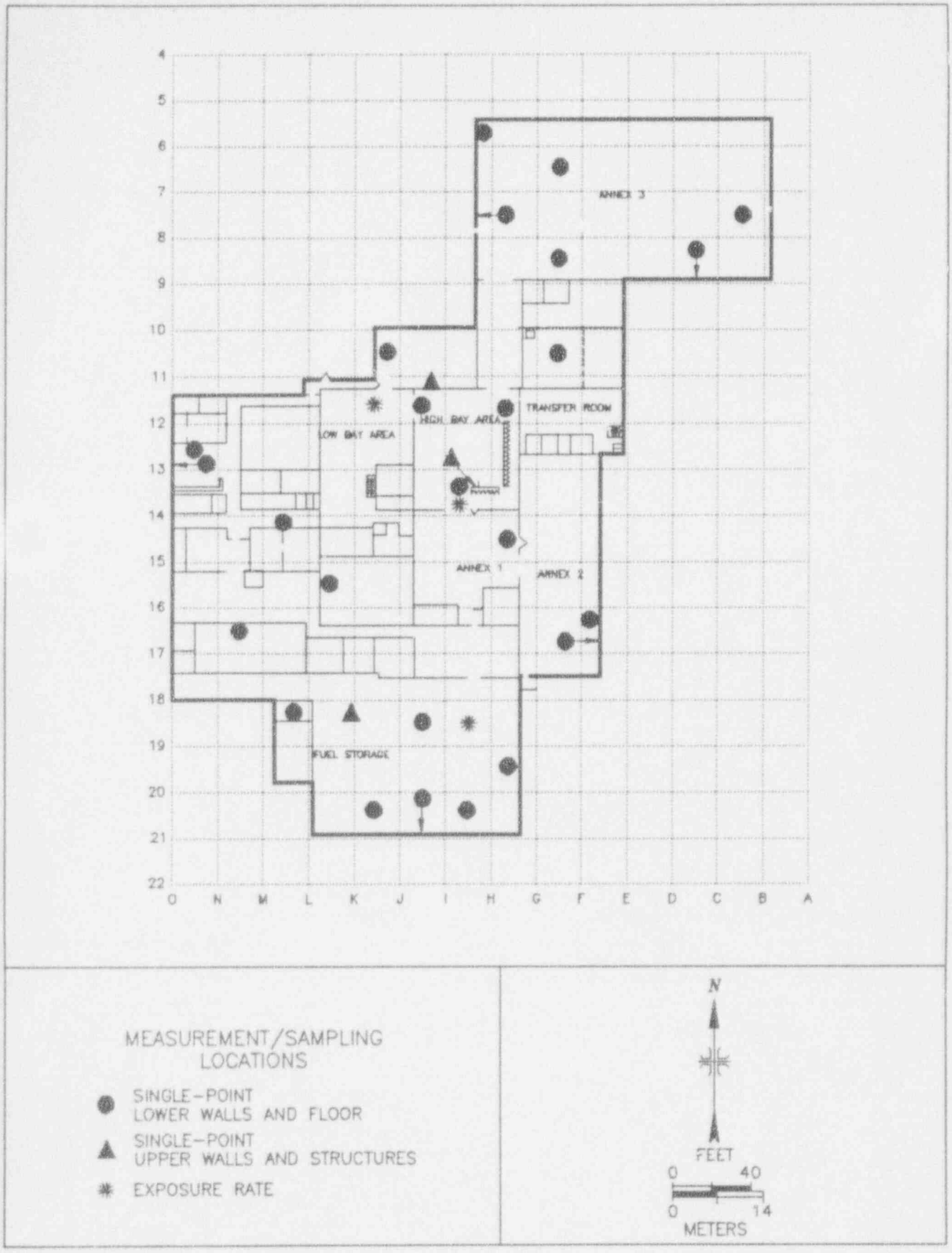
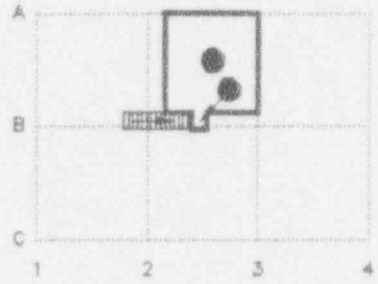


FIGURE 19: East Plant, Main Floor – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

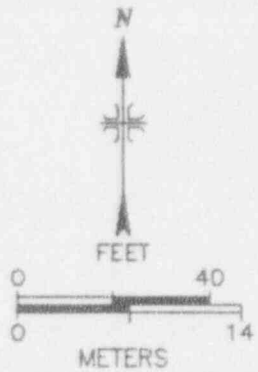
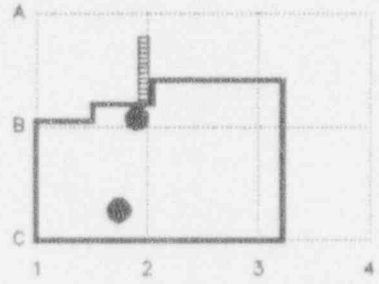


FIGURE 20: East Plant, Low Bay Mezzanine (Upper) – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

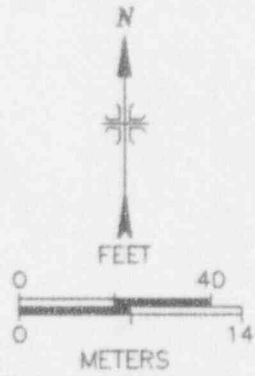


FIGURE 21: East Plant, Low Bay Mezzanine (Lower) – Measurement and Sampling Locations

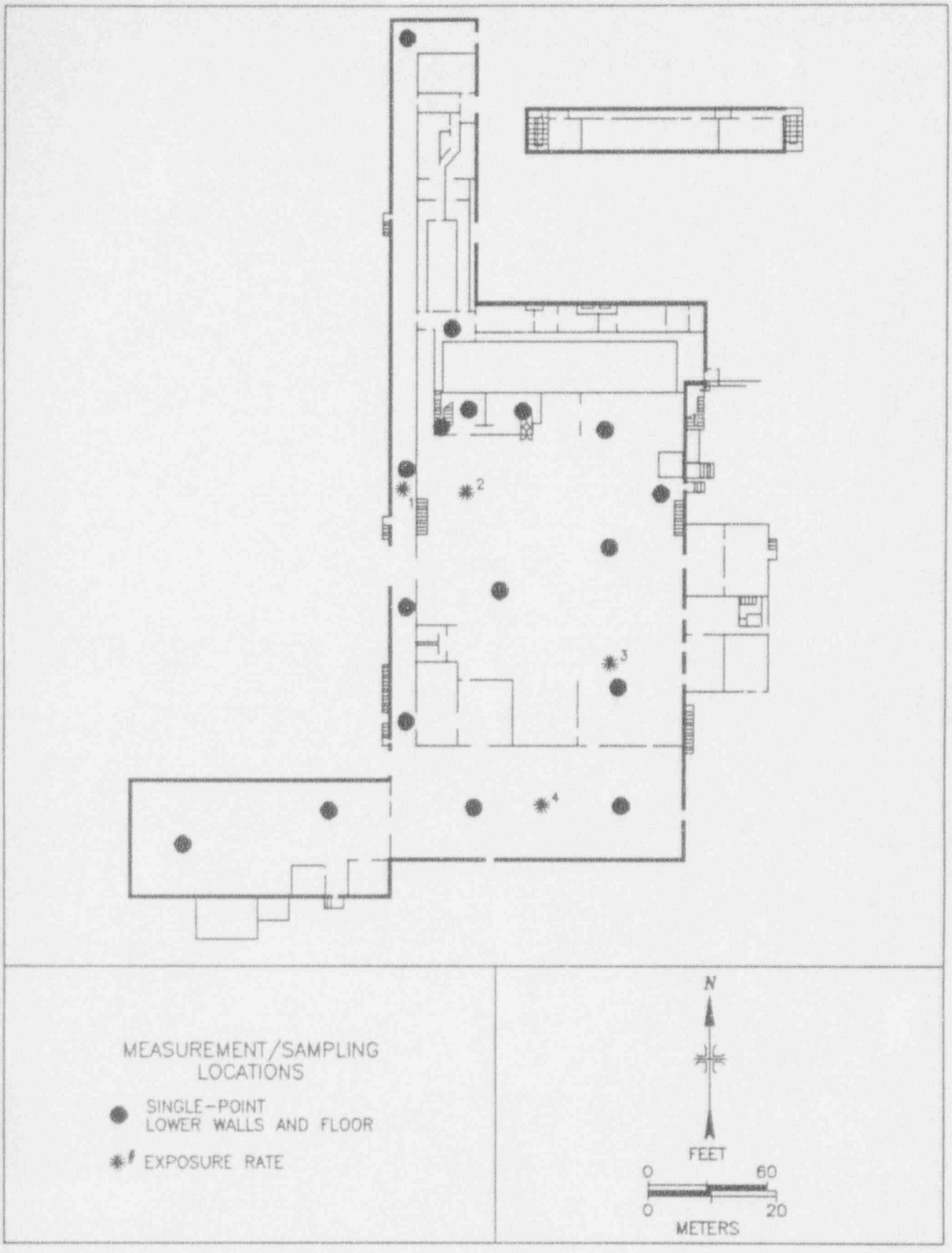
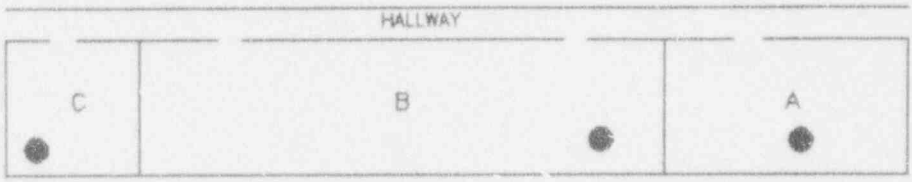


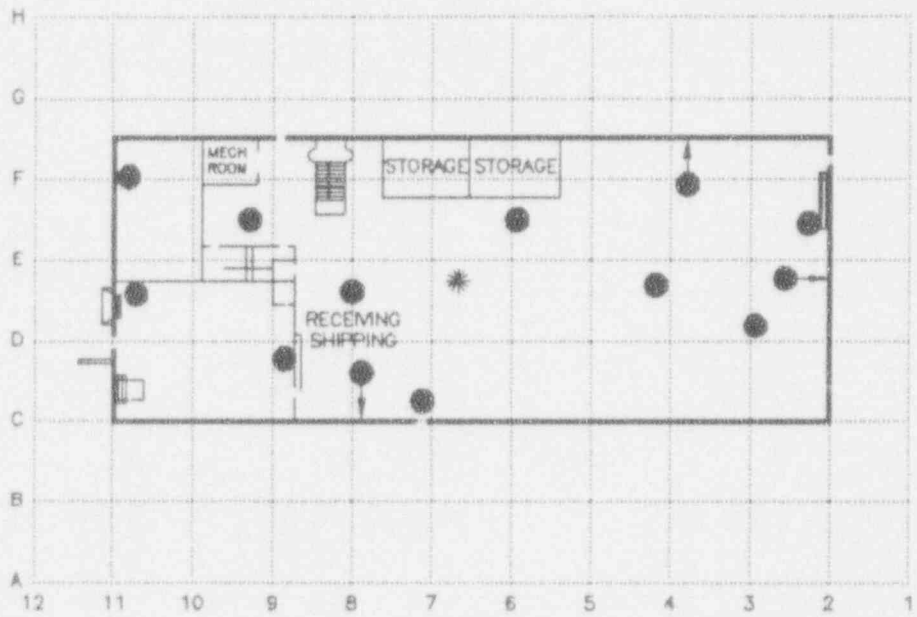
FIGURE 22: Building L, Main Floor – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

FIGURE 23: Building L, Mezzanine – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

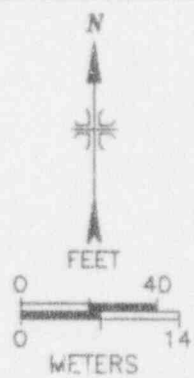
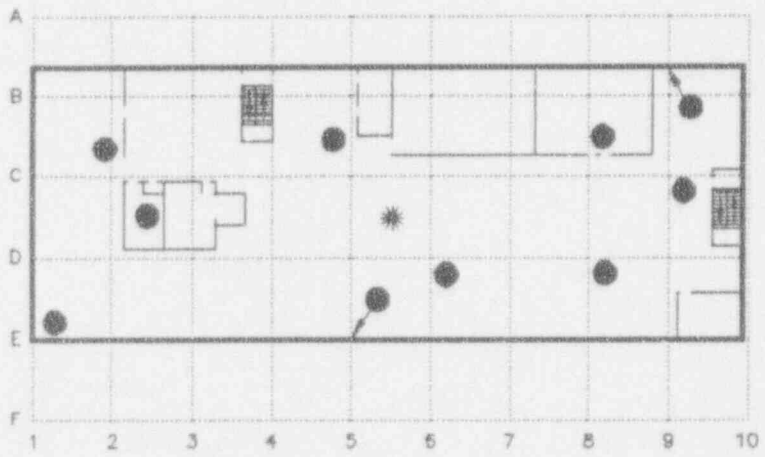


FIGURE 24: Building T, Main Floor – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

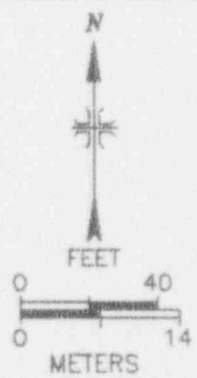
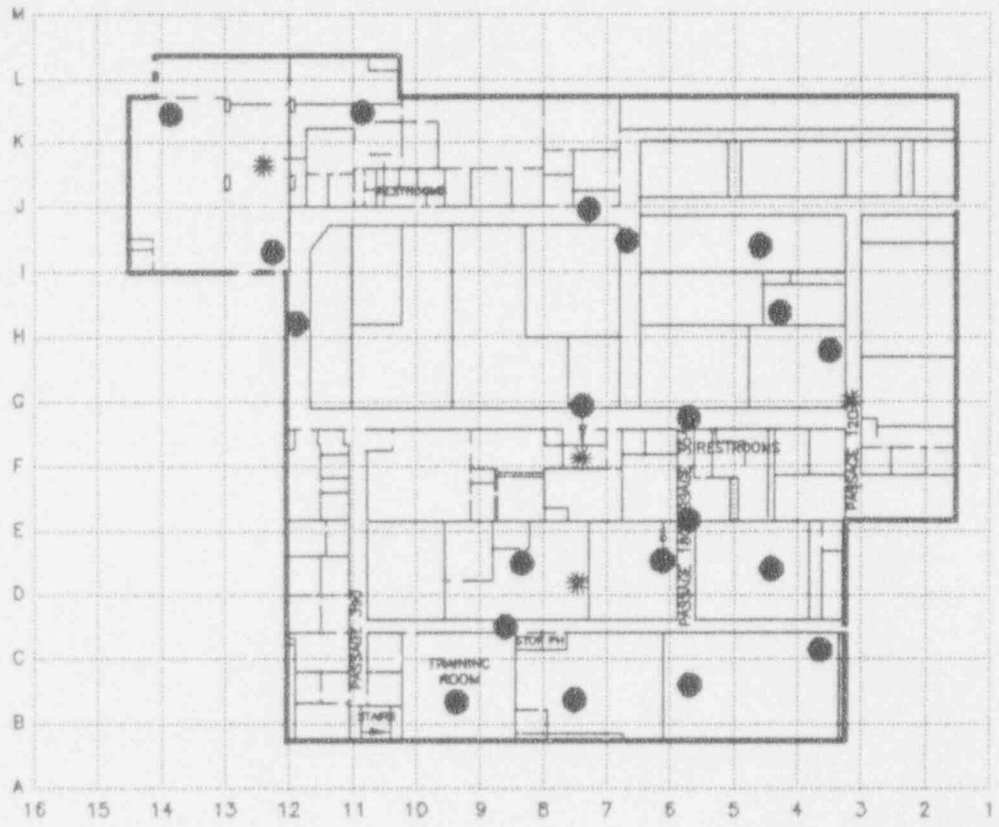


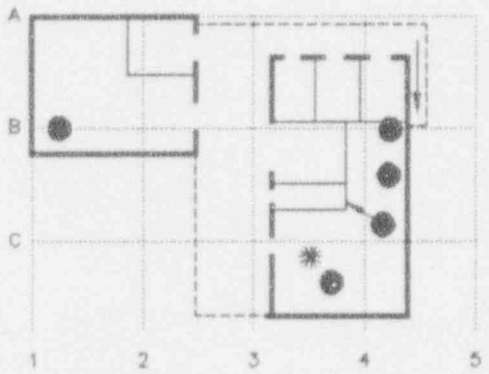
FIGURE 25:Building T, Mezzanine – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

FIGURE 26: Building C, Main Floor and Annex – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE–POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

---------- CONCRETE DOCK

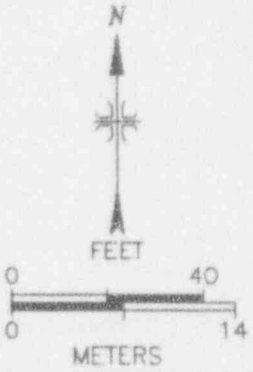
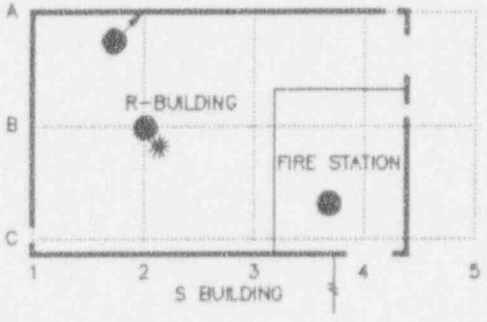


FIGURE 27: Building D – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

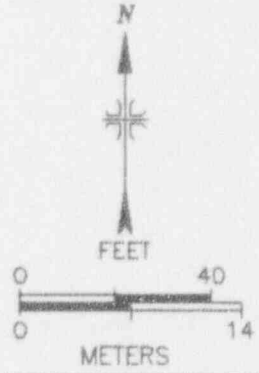
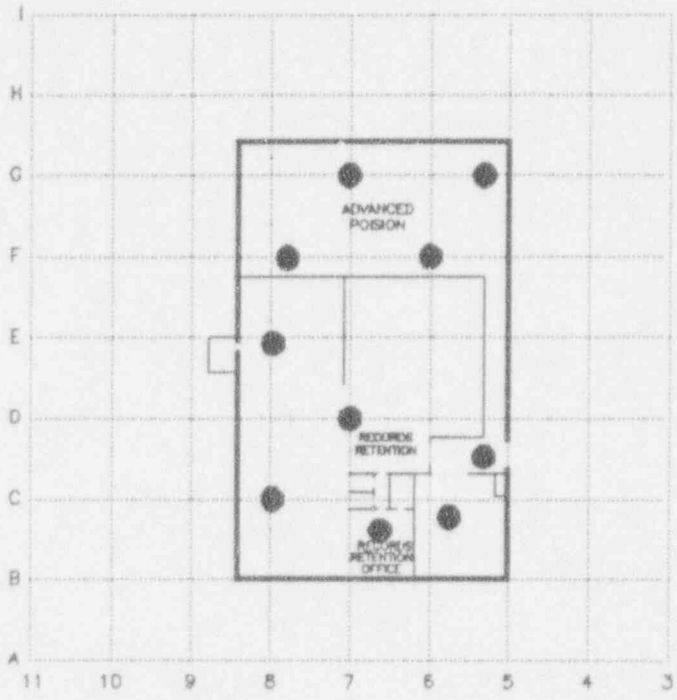


FIGURE 28: Building R – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

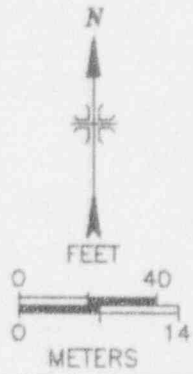
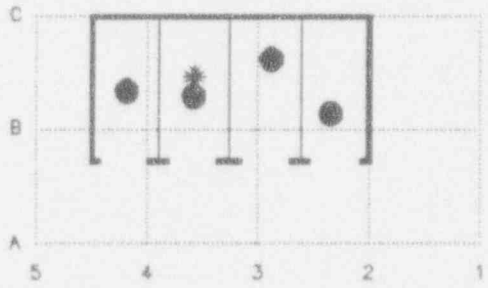


FIGURE 29: Building S – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

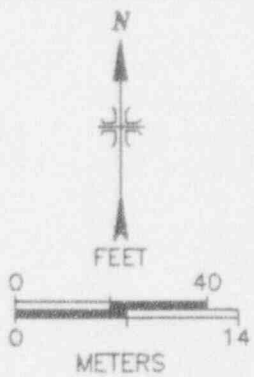
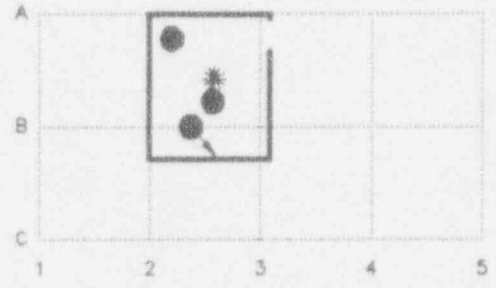


FIGURE 30: Building H – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

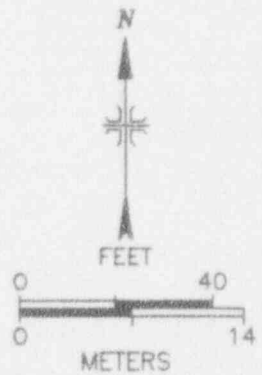
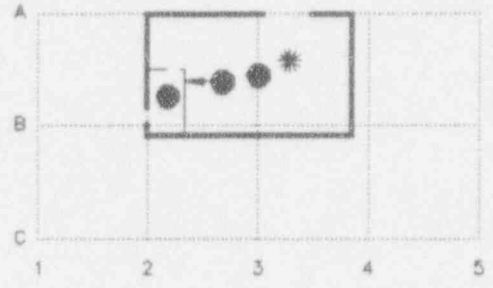


FIGURE 31: Compressor Building – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- SINGLE-POINT LOWER WALLS AND FLOOR
- EXPOSURE RATE

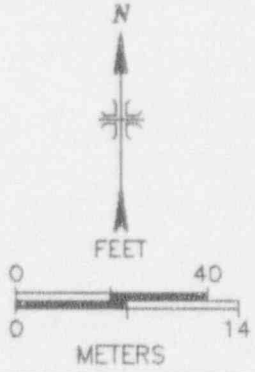
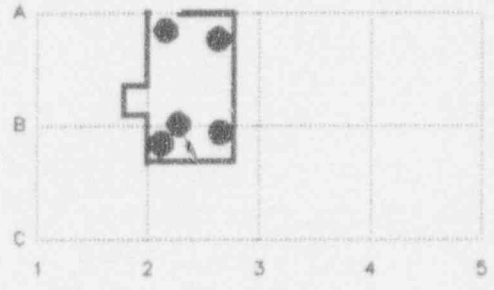


FIGURE 32: Carpentry Shop – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SINGLE-POINT LOWER WALLS AND FLOOR

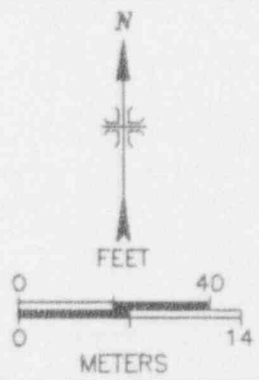


FIGURE 33: Pump House West – Measurement and Sampling Locations

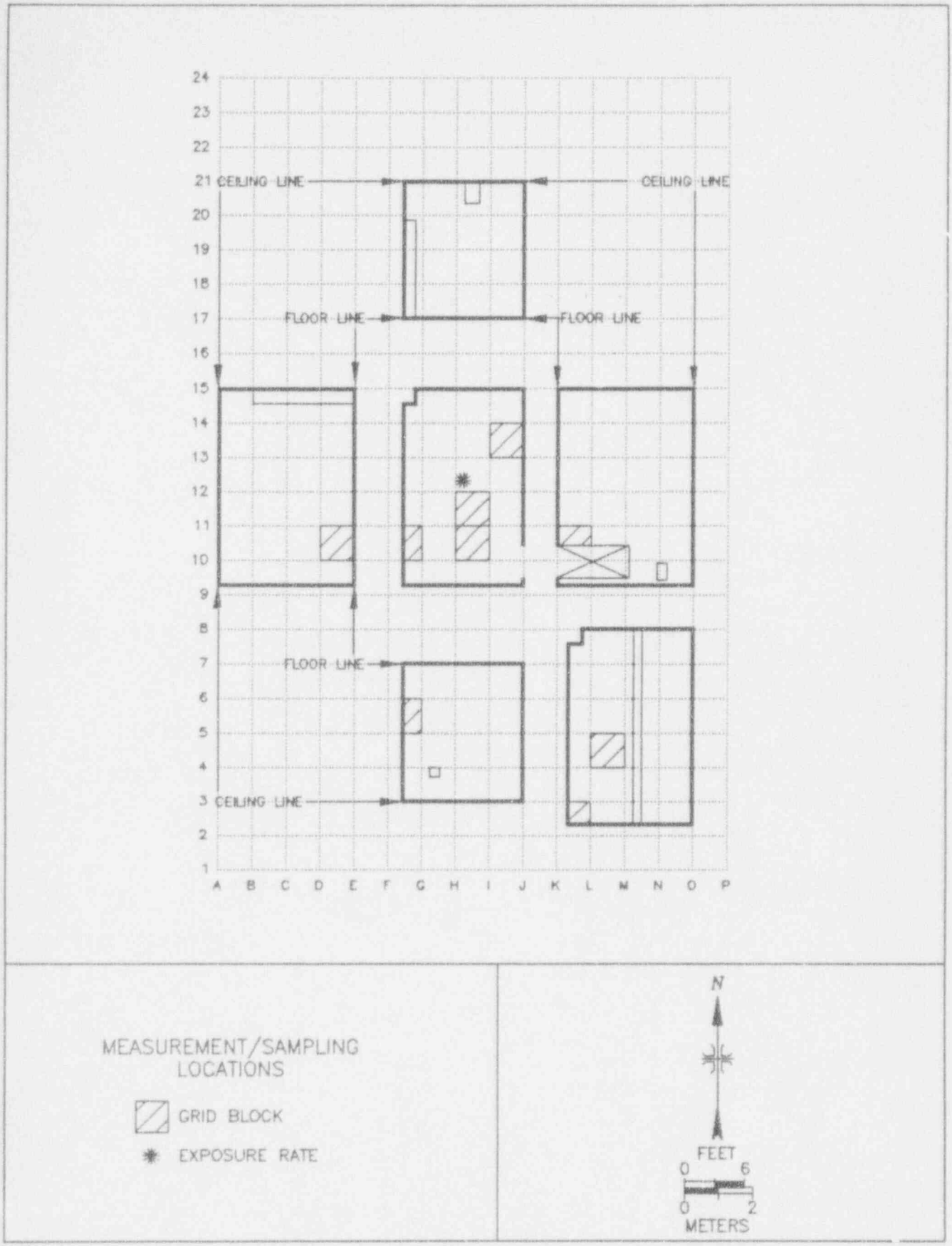


FIGURE 34: Building A, Electrode Grind Room – Measurement and Sampling Locations

TABLE 1
SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
ON FLOORS AND LOWER WALLS
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location Bldg/Area	Number of Measurements	Range of Total Activity (dpm/100 cm^2)		Range of Removable Activity (dpm/100 cm^2)	
		Single Point Measurements			
		Alpha	Beta	Alpha	Beta
Building B North					
Main Floor	25	<69	<1400 - 1600	<12	<17
Hot Roll	14	<69	<1400 - 1500	<12	<17
Maintenance Mezzanine	1	<73	<1500	<12	<17
Stores Mezzanine	3	<73	<1500	<12	<17
Building A					
Main Floor	25	<69	<1500 - 2200	<12	<17
Basement	5	<69	<1400	<12	<17
Warm Roll	8	<69	<1400	<12	<17
Vapor Grit Blast	6	<78 - 94	<1400	<12	<17
Welding Area	19	<69	<1400	<12	<17
North and South Mezzanines	5	<73	<1500	<12	<17

TABLE 1 (continued)
SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
ON FLOORS AND LOWER WALLS
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location Bldg/Area	Number of Measurements	Range of Total Activity (dpm/100 cm^2)		Range of Removable Activity (dpm/100 cm^2)	
		Single Point Measurement			
		Alpha	Beta	Alpha	Beta
Building M					
Main Floor	25	<69	<1400 - 1600	<12	<17
Basement	7	<78	<1400 - 1500	<12	<17
East and West Mezzanines	6	<73	<1500	<12	<17
East Plant					
Main Floor	25	<69	<1500 - 2900	<12	<17
Upper and Lower Mezzanines	4	<73	<1500	<12	<17
Building L					
Main Floor and Mezzanine	20	<78	<1400	<12	<17
Building T					
Main Floor and Mezzanine	23	<69	<1500	<12	<17
Building C					
Main Floor and Annex	20	<73	<1500 - 1600	<12	<17

TABLE 1 (continued)
SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
ON FLOORS AND LOWER WALLS
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location Bldg/Area	Number of Measurements	Range of Total Activity (dpm/100 cm²)		Range of Removable Activity (dpm/100 cm²)	
		Single Point Measurement			
		Alpha	Beta	Alpha	Beta
Support Buildings					
Building D	5	<69	<1500 - 2200	<12	<17
Building R	3	<69 - 75	<1500	<12	<17
Building S	10	<69	<1500	<12	<17
Building H	4	<73	<1500	<12	<17
Compressor Building	3	<73	<1500	<12	<17
Carpentry Building	3	<73	<1500	<12	<17
Pump House West	5	<69	<1500	<12	<17
South Guard Tower	5	<69	<1500	<12	<17
West Guard Tower	4	<69-75	<15000	<12	<17
East Guard Tower	4	<69-160	<1500	<12	<17

TABLE 1 (continued)
SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
ON FLOORS AND LOWER WALLS
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location Bldg/Area	Number of Measurements	Range of Total Activity (dpm/100 cm^2)		Range of Removable Activity (dpm/100 cm^2)	
		Single Point Measurement			
		Alpha	Beta	Alpha	Beta
Support Buildings					
Roof Guard Tower	4	<69	<1500	<12	<17
Gate House	3	<69	<1500	<12	<17
East Plant Shed	4	<69	<1500	<12	<17

TABLE 2
SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
ON UPPER WALLS AND STRUCTURES
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location[a] Bldg/Area	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Single Measurement			
	Alpha	Beta	Alpha	Beta
Building B North				
Heater Duct (F10)	<73	<1500	<12	<17
Heater Intake (H16)	340	<1500	<12	<17
Upper Wall-Hot Roll (T19)	<69	<1500	<12	<17
Heater Intake-Hot Roll (021)	<73	<1500	<12	<17
Exhaust Screen-Maintenance Mezzanine (B3)	<73	<1500	<12	<17
Building A				
Heater (D9)	<73	<1500	<12	<17
Upper Wall-Warm Roll (G15)	<69	<1400	<12	<17

TABLE 2 (continued)
SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
ON UPPER WALLS AND STRUCTURES
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location* Bldg/Area	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Single Measurement			
	Alpha	Beta	Alpha	Beta
Building A (continued)				
Exhaust Fan-Warm Roll (G12)	<73	<1500	<12	<17
Upper Wall-Welding Area (K10)	<69	<1400	<12	<17
Air Vent - Welding Area (O17)	<73	<1500	<12	<17
Upper Wall - Vapor Grist (C10)	<78	<1400	<12	<17
Building M				
I Beam (H14)	<73	<1500	<12	<17
Voltage Box (F12)	<73	<1500	<12	<17
Exhaust Fan (L9)	<73	<1500	<12	<17

TABLE 2 (continued)
SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
ON UPPER WALLS AND STRUCTURES
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location* Bldg/Area	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Single Measurement			
	Alpha	Beta	Alpha	Beta
East Plant				
I Beam (L18)	< 73	< 1500	< 12	< 17
Steel Beam (I13)	< 73	< 1500	< 12	< 17
Concrete Holding Bar (J11)	< 73	< 1500	< 12	< 17

*The locations of these single measurements are referenced to a floor grid indicated in parenthesis.

TABLE 3
EXPOSURE RATE MEASUREMENTS
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location		Figure	Exposure Rate at 1 m above surface (μR/h)
Building B North	(E13)[a]	4	10
	(I15)	4	11
Building B North - Hot Roll	(O15)	5	10
Building A	(E13)	8	10
	(K11)	8	11
	(B8)	8	13
Building A - Warm Roll	(H11)	10	12
Vapor Blast	(G10)	11	13
Welding Area	(I16)	12	11
South Mezzanine[b]		14	11
North Mezzanine		13	10
Basement	(D5)	9	12
Electrode Grinding Room	(H13)	34	15
Building M	(K10)	15	11
	(D14)	15	13
	(H14)	15	10
Building M - Basement	(D3)	16	14
East Plant	(K12)	19	11
	(I14)	19	10
	(I19)	19	9
Building T - 1st Floor		24	11
Building T - 2nd Floor	(C5)	25	9
Building H	(C4)	30	12

TABLE 3 (continued)
EXPOSURE RATE MEASUREMENTS
UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location		Figure	Exposure Rate at 1 m above surface (μR/h)
Building L	Measurement #1	22	10
	Measurement #2	22	8
	Measurement #3	22	9
	Measurement #4	22	10
Building C	(K13)	26	10
	(G8)	26	12
	(E8)	26	9
	(G4)	26	9
Building R		28	10
Building D		27	12
Carpentry Shop		32	9
Compressor Building	(A2)	31	11

[a] Measurements were taken at center of indicated grid block.
[b] If no grid block indicated, see appropriate Figure for measurement location.

REFERENCES

1. Oak Ridge Institute for Science and Education, "Confirmatory Survey of The B-South Area, Building L, Unit 3 Fuel Vault Area, and Affected Outdoor Areas", Final Report, December 1993.

2. UNC Naval Products, "Final Decontamination and Decommissioning Surveys, Book 4", Montville, CT, December 1992.

3. Oak Ridge Institute for Science and Education, "Confirmatory Radiological Survey Plan for UNC Naval Products, Unaffected Indoor Areas, Book 4", January 15, 1993.

4. Letter from A. Jaberaboansari (ORISE), to J. Roth (NRC Region I), Reference: "UNC Naval Products, Final Decontamination and Decommissioning Surveys Book 4, Montville, Connecticut", January 12, 1993.

5. U.S. Nuclear Regulatory Commission, "Guidelines for Decontamination of Facilities and Equipment Prior To Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials", August 1987.

6. U.S. Nuclear Regulatory Commission, Office of Nuclear Safety and Safeguards, "Review Plan: Evaluating Decommissioning Plans for Licenses Under 10 CFR Parts 30, 40, and 70" Washington, D.C., 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 employers.

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)

Reuter-Stokes Pressurized Ion 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

Low Background Gas Proportional Counter
Model LB-5110
(Tennelec, 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 59 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
	-	ZnS scintillation detector with ratemeter-scaler
Beta	-	gas proportional detector with ratemeter-scaler
	-	pancake GM detector with ratemeter-scaler
Gamma	-	NaI scintillation detector with ratemeter

Surface Activity Measurements

Measurements of total alpha and total beta activity levels were performed using ZnS scintillation, and GM detectors coupled to portable ratemeter-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 count rates for the ZnS scintillation detectors averaged approximately 1 cpm for each detector. Alpha efficiency factors ranged from 0.16 to 0.18 for the ZnS scintillation detectors. The beta activity background count rates for the GM detectors averaged 54 cpm. Beta efficiency factors ranged from 0.15 to 0.17 for the GM detectors. The effective window for the ZnS scintillation and GM detectors were 59 cm^2, and 15.5 cm^2, respectively.

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).

ANALYTICAL PROCEDURES

Removable Activity

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

DETECTION LIMITS

Detection limits, referred to as minimum detectable activity (MDA), were calculated using the following formula:

$$MDA(dpm/100\ cm^2) = \frac{2.71 + (4.66\sqrt{B})}{T \times E \times G \times \text{other modifying factors}}$$

B = background (total counts)
T = count time (min) to be used for field measurements
E = operating efficiency $\left(\frac{\text{counts}}{\text{disintegrations}} \right)$
G = geometry $\left(\frac{\text{detector area } cm^2}{100} \right)$

When the activity was determined to be less than the MDA of the measurement procedure, the result was reported as less than MDA. 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.

CALIBRATION AND QUALITY ASSURANCE

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 were used. Calibration of pressurized ionization chambers was performed by the manufacturer.

Analytical and field survey activities were conducted in accordance with procedures from the following documents:

- 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.

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

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.