ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION
ENERGY/ENVIRONMENT SYSTEMS DIVISION

January 27, 1994

Mr. Timothy Johnson
Division of Low-Level Waste Management
and Decommissioning
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: FINAL REPORT—CONFIRMATORY SURVEY OF BUILDING 65, ROOF, LOWER ROOF, VENTILATION AND DRAINAGE SYSTEMS—CLEVELAND WORKS FACILITY—THE ALUMINUM COMPANY OF AMERICA—CLEVELAND, OHIO
DOCKET NO. 040-00501

Dear Mr. Johnson:

Enclosed are five copies of the subject report. If you have any questions or need additional information, please contact me at (615) 576-3355 or Michele Landis at (615) 576-2908.

Sincerely,

Armin J. Ansari
Project Leader
Environmental Survey and
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CONFIRMATORY SURVEY OF BUILDING 65, ROOF, LOWER ROOF, VENTILATION AND DRAINAGE SYSTEMS CLEVELAND WORKS FACILITY THE ALUMINUM COMPANY OF AMERICA CLEVELAND, OHIO

[DOCKET 040-00501]

A. J. ANSARI

Prepared for the
Division of Industrial and Medical Nuclear Safety
U.S. Nuclear Regulatory Commission

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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.

CONFIRMATORY SURVEY OF BUILDING 65, ROOF, LOWER ROOF, VENTILATION AND DRAINAGE SYSTEMS CLEVELAND WORKS FACILITY THE ALUMINUM COMPANY OF AMERICA CLEVELAND, OHIO

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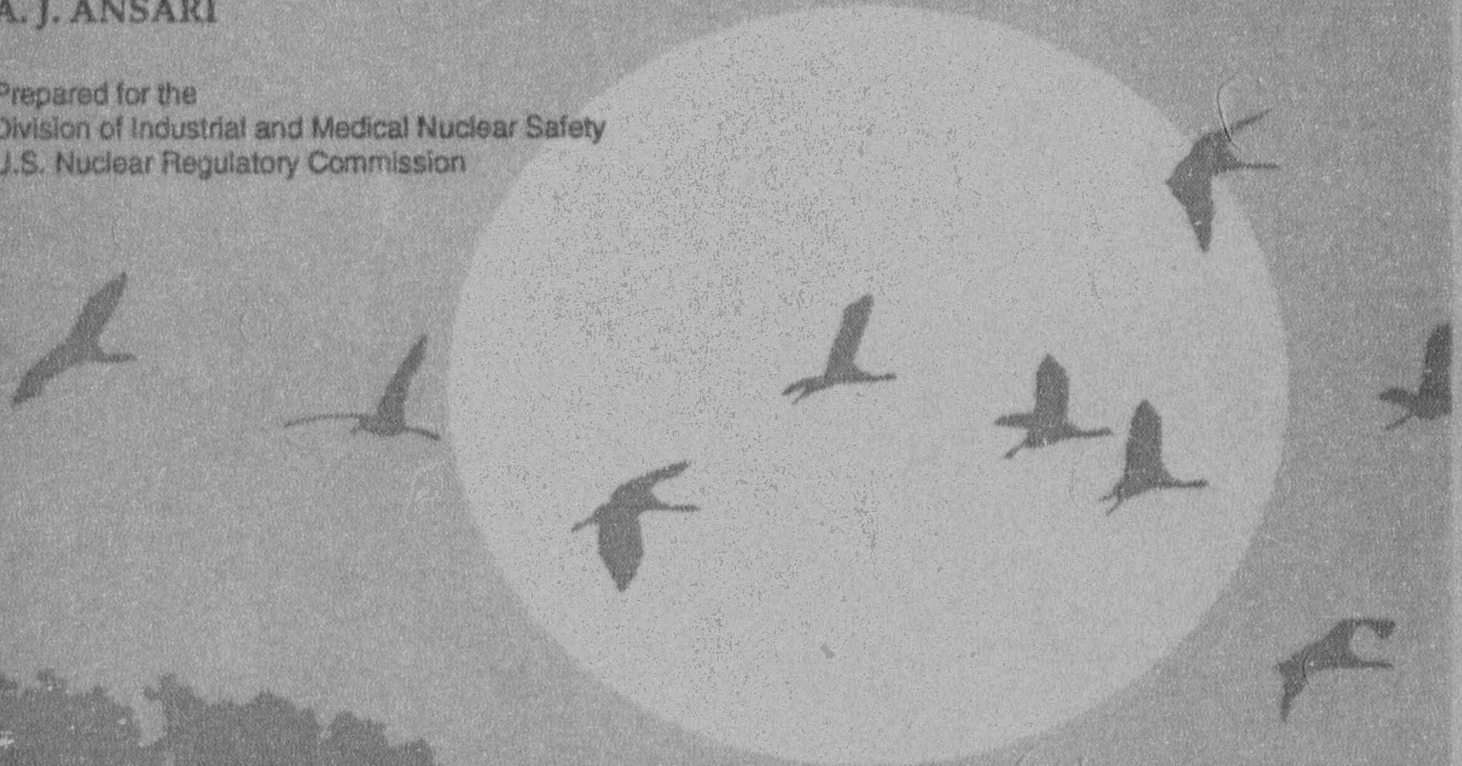

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Prepared for the

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FINAL REPORT

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CONFIRMATORY SURVEY OF
BUILDING 65, ROOF, LOWER ROOF, VENTILATION AND
DRAINAGE SYSTEMS
CLEVELAND WORKS FACILITY
THE ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

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ABBREVIATIONS AND ACRONYMS

AEC	Atomic Energy Commission
ALCOA	Aluminum Company of America
AMC	American Magnesium Company
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
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
kg	kilogram
km	kilometer
m	meter
m^2	square meter
MDA	Minimum Detectable Activity
NaI	Sodium Iodide
NES	Nuclear Energy Services
NES/IES	NES, Inc./Integrated Environmental Services
NIST	National Institute for Standards and Technology
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
PIC	Pressurized Ionization Chamber
pCi/g	picocuries per gram
μR/h	microroentgen per hour
ZnS	zinc sulfide

CONFIRMATORY SURVEY OF BUILDING 65, ROOF, LOWER ROOF, VENTILATION AND DRAINAGE SYSTEMS CLEVELAND WORKS FACILITY THE ALUMINUM COMPANY OF AMERICA CLEVELAND, OHIO

INTRODUCTION AND SITE HISTORY

The Cleveland Works facility, owned by the Aluminum Company of America (ALCOA), is a large multi-function aluminum refining, casting, and finishing facility, located in Cleveland, Ohio. Operations began at the plant in the early 1900's, at which time portions of the site were operated by the American Magnesium Company (AMC), a wholly owned subsidiary of the Aluminum Company of America (ALCOA). AMC was dissolved in 1954 and ALCOA was granted an AEC license authorizing the possession and use of 1,600 pounds of refined thorium, in both powder and pellet forms, for experimental purposes and the production of magnesium-thorium alloys at the Cleveland Works facility. Prior to the expiration of the license, excess thorium was returned to DOW Chemical Company, the supplier. AEC licensing records indicate that ALCOA was authorized to dispose of thorium wastes at the site in accordance with 10 CFR 20.304. In addition to the licensed activities, ALCOA personnel have indicated that thorium was used at the Cleveland Works facility since the early 1900s by AMC. Information on the quantities and forms of thorium used at this site prior to 1954 is not available.

Limited radiological surveys were performed at the site by Oak Ridge Associated Universities (ORAU), now known as the Oak Ridge Institute for Science and Education (ORISE), in 1985, 1991, and 1992; by NUS Corporation (NUS) in 1989, and by Nuclear Energy Services (NES) in 1990. Survey results have confirmed the presence of natural thorium and depleted uranium contamination at several locations in the facility. Because ALCOA records do not indicate that the facility possessed depleted uranium, the depleted uranium is believed to have resulted from off-site migration from another facility. In addition, during decommissioning activities of the ALCOA-Cleveland Works facility east property, thorium contamination was identified in the soil. The contamination was traced to a 30 m x 12 m (100 ft x 40 ft) area located behind Building 71. REMCOR Inc., completed the decommissioning activities to remove thorium

contamination from this location. The confirmatory survey of this area was performed by ORISE in November 1991.[1]

In November 1991, ORISE also performed a limited radiological survey of buildings where site history indicated that thorium was used or potentially disposed. The surveyed areas included Buildings 65, 71, 107, 111, 119, and 120 and the landfill.[1] A scoping survey of buildings 21, 22, 24, 25, 26, 29, 70, and 72, referred to as the Permanent Mold Facility, was performed by ORISE in August 1992.[2] During that survey, residual contamination was identified in the mezzanine area of Building 25. That area was remediated by the licensee and the follow-up confirmatory survey was performed by the Nuclear Regulatory Commission (NRC).[3] The Permanent Mold Facility has since been demolished.

The ORISE 1991 survey had identified residual contamination in the air handling system of Building 65. NES, Inc./Integrated Environmental Services (NES/IES) recently completed the decontamination and final survey of Building 65 ventilation and drainage systems. In the licensee's final survey of the facility, the remainder of Building 65 was classified as unaffected, according to NUREG/CR 5849. The licensee's future plans for this building include demolition.

The Nuclear Regulatory Commission (NRC) has requested that the Environmental Survey and Site Assessment Program (ESSAP) of ORISE perform an independent confirmatory survey of Building 65, roof, lower roof, ventilation and drainage systems. This report summarizes the procedures and results of that survey.

SITE DESCRIPTION

ALCOA-Cleveland Works facility is located on Harvard Avenue in the villages of Newburgh Heights and Cuyahoga Heights, suburbs of Cleveland, Ohio (Figure 1). The facility is located in a mixed industrial and residential area approximately 5 km (3 miles) south of downtown Cleveland. The site occupies approximately 37 hectares (92 acres) with approximately 14 hectares (35 acres) under roof; it is fenced to prevent unauthorized access. The facility is comprised of many production buildings which contain open bays for manufacturing. Several

other buildings contain office and administration space (Figure 2). The property is bounded to the east by the McGean-Rohco Chemical Company, formerly Chemetron Corporation, to the south by Newburgh and South Shore Railroad, and to the west and north by other portions of the Cleveland Works facility.

Building 65 is a two level building with a basement shelter. Construction is of concrete, brick and steel foundation and frame; concrete and brick floors; and concrete block, brick, or tile walls. The building is in poor condition and much of the floor space is inaccessible to survey. This building was used as a research and development laboratory and was last occupied in the early 1970's.

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 status report, relative to established guidelines.

DOCUMENT REVIEW

As part of the confirmatory activities, ESSAP reviewed the licensee's final radiological survey data.[4,5] Procedures and methods used by the licensee were reviewed for adequacy and appropriateness. The data were reviewed for accuracy, completeness, and compliance with guidelines and comments were provided to the NRC.

PROCEDURES

During the period September 21-23, 1993, ESSAP performed a confirmatory survey of Building 65. The survey was conducted in accordance with a survey plan which was submitted to and approved by the NRC with slight modifications.[6] Modifications to the proposed survey plan were documented by ESSAP in the site log book.

REFERENCE GRID

The licensee established a 1 m × 1 m alphanumeric reference grid system on the roof. All 6ESSAP measurement and sampling locations on the roof were referenced to that grid. The licensee also established an alphanumeric identification system to reference various segments of the ventilation system. ESSAP used the same identification system to reference measurement and sampling locations for the ventilation system. For drains, ESSAP used the licensee's numbering system. The floor and the walls were not gridded. All ESSAP measurement and sampling locations were referenced to prominent building features and/or recorded on appropriate drawings.

SURFACE SCANS

On the roof, approximately 10% of the grid blocks were randomly selected for survey. The entire surface of each grid block was scanned for alpha and beta activity. Surface scans for gamma activity were performed on 50% of the roof area. The surface scans were performed using large area gas proportional and NaI detectors, coupled to ratemeter-scalers and ratemeters with audible indicators.

For the ventilation duct work, survey locations were selected either randomly or based on the licensee's survey results. At each surveyed location, a 1 m^2 area was scanned for alpha, beta, and gamma radiation. The surface scans were performed using ZnS scintillation and GM detectors coupled to ratemeter-scalers with audible indicators.

Only limited cursory scans were performed on the floors of the building because they were designated as unaffected areas and, in addition, much of the floor space was inaccessible to survey.

SURFACE ACTIVITY MEASUREMENTS

Direct measurements to determine total alpha and total beta surface activity were performed at 306 locations throughout the surveyed area. On the roof and for the ventilation ducts, the measurement in each grid block was made at a location corresponding to the highest scan results. If the scan results were uniform across the surface, the measurement was made at the center of the grid block.

For the floor of the building, four rooms with accessible floor space were selected and direct measurements were performed at a minimum of 15 locations in each room. Thirty-five measurements were performed at randomly selected locations throughout the rest of the floor space.

Surface activity measurements were performed using either gas proportional detectors (roof, floor) or ZnS scintillation and GM detectors (ventilation ducts, drains). Detectors were coupled to ratemeter-scalers. A smear sample for determining removable activity was obtained from each direct measurement location. If a five-point measurement was performed, a smear sample was obtained from a location corresponding to the highest total activity. Measurement and sampling locations for total and removable activity are illustrated in Figures 3-15.

EXPOSURE RATE MEASUREMENTS

Background exposure rate measurements, performed during the previous ESSAP survey at this facility, were used for comparison.[1,2]

Exposure rate measurements were performed at 1 m above surface at 11 locations on the roof and at 42 locations in the building, using a pressurized ionization chamber (PIC). Measurement locations are illustrated in Figures 15-18.

MISCELLANEOUS SAMPLING

Four brick and three tile samples were collected from first floor of the building for laboratory analysis.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and survey data were returned to the ESSAP Oak Ridge laboratory for analyses and interpretation. Smears were analyzed 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), and exposure rate measurements were reported in microroentegens per hour (μR/h). Brick and tile samples were analyzed by gamma spectrometry. Spectra were reviewed for K-40, U-235, U-238, Th-232, Th-228, and any other identifiable photopeaks. Brick and tile sample results were reported in units of picocuries per gram (pCi/g). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to 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.[7] In ESSAP's opinion, the licensee's documents provide an adequate description of the radiological condition of the facility relative to the NRC guidelines for release to unrestricted use.

SURFACE SCANS

Surface scans for alpha, beta, and gamma activity did not identify any locations of elevated direct radiation. In close proximity to tile and brick walls, the gamma activity was slightly

higher than background levels. This elevated activity was present uniformly near wall surfaces. Representative tile and brick samples were collected for laboratory analysis.

SURFACE ACTIVITY LEVELS

Results of total and removable surface activity levels are summarized in Tables 1-7. On the roof, total surface activity levels were <83 dpm/100 cm^2 for alpha and $<1,200$ dpm/100 cm^2 for beta (Table 1). Total surface activity levels for the ventilation ducts in the building interior and for exterior wall vents were <73 dpm/100 cm^2 for alpha and ranged from $<1,500$ to 3,300 dpm/100 cm^2 for beta (Table 2). Total surface activity levels for the roof ventilation system were <83 dpm/100 cm^2 for alpha and ranged from $<1,200$ to 3,300 dpm/100 cm^2 for beta (Table 3). Total surface activity levels for floor and lower walls surfaces on the basement, first, and second floors of the building ranged from <73 to 150 dpm/100 cm^2 for alpha and from $<1,200$ to 2,800 dpm/100 cm^2 for beta (Tables 4-6). Total surface activity levels for the drains surveyed ranged from <83 to 98 dpm/100 cm^2 for alpha and from $<1,200$ to 3,800 dpm/100 cm^2 for beta (Table 7). All removable activity levels were <12 dpm/100 cm^2 for alpha and <16 dpm/100 cm^2 for beta (Table 1-7).

EXPOSURE RATES

The background exposure rates, previously measured at this site, ranged from 7 to 12 μR/h (averaged 9 μR/h) for building interiors and ranged from 6 to 11 μR/h (averaged 9 μR/h) for exterior locations.[1,2]

Exposure rate measurements at 42 locations on the first and second floor of Building 65 ranged from 8 to 14 μR/h. Exposure rate measurements at 11 locations on the roof of the building ranged from 7 to 10 μR/h (Table 8).

MISCELLANEOUS SAMPLES

The analysis of the tile and brick samples indicated that the activity is due to K-40, and natural thorium. These samples were not crushed and homogenized for laboratory analysis, thereby allowing the front and back side of each sample to be analyzed individually. No systematic differences between the activity on the front and the back side of the samples were noted. For the tile samples, the K-40 and Th-232 concentrations averaged approximately 17 and 2 pCi/g, respectively. For the brick samples, the K-40 and Th-232 concentrations averaged approximately 42 and 2 pCi/g, respectively. This analysis should be considered semiquantitative due to irregular sample geometry. Nevertheless, these values are consistent with naturally occurring concentrations, typically found in similar building construction materials.

COMPARISON OF RESULTS WITH GUIDELINES

Initially, thorium guidelines were applied to the remediation and decommissioning activities of the Building 65 roof and ventilation systems. However, following additional sampling by NES/IES and reevaluation of previous data by REMCOR, Inc., the contaminant of concern was determined, by the licensee, to be depleted uranium. Therefore, approval was granted by the NRC to apply the uranium guidelines for remediaton of Building 65.[4,5] The NRC guidelines for surface contamination, established for license termination or release of a facility for unrestricted use, are presented in Appendix C.[8]

The surface contamination guidelines for uranium are:

Total Activity

5,000 dpm/100 cm^2, averaged over a 1 m^2 area

15,000 dpm/100 cm^2 α/100 cm^2, maximum in a 100 cm^2 area

Removable Activity

1000 dpm/100 cm^2

The uranium guidelines specify alpha activity. However, depleted uranium in equilibrium with its short half-life daughter radionuclides emits both alpha and beta radiations. Because rough, dirty, or damp surface may selectively attenuate alpha radiation, beta activity levels were also measured and used for comparison to guidelines. Ratios ranging from 1:1.4 to 1:1.6 are typically used to estimate beta activity levels for depleted uranium. Based on an approximate decay ratio of 1:1.5, beta surface contamination levels of 7,500 dpm/100 cm^2 and 22,500 dpm/100 cm^2 correspond to the respective average and maximum uranium guideline levels. All surface activity measurements for total and removable activity were well within these guidelines.

The NRC guideline for exposure rate at 1 m above the surface is 5 μR/h above background.[9] All exposure rates were within this guideline.

SUMMARY

At the request of the Nuclear Regulatory Commission, the Environmental Survey and Site Assessment Program of the Oak Ridge Institute for Science and Education performed an independent confirmatory survey of Building 65, roof, lower roof, ventilation and drainage systems at the Aluminum Company of America Facility in Cleveland, Ohio. The survey was performed between September 21 and 23, 1993. Survey activities included surface scans, surface activity measurements, exposure rate measurements, and miscellaneous material sampling.

The results of total and removable surface activity measurements were all below the NRC guidelines for release for unrestricted use. Exposure rate measurements were all within the 5 μR/h above background criterion. In ESSAP's opinion, the licensee's documents provide an adequate description of the radiological condition of the facility.

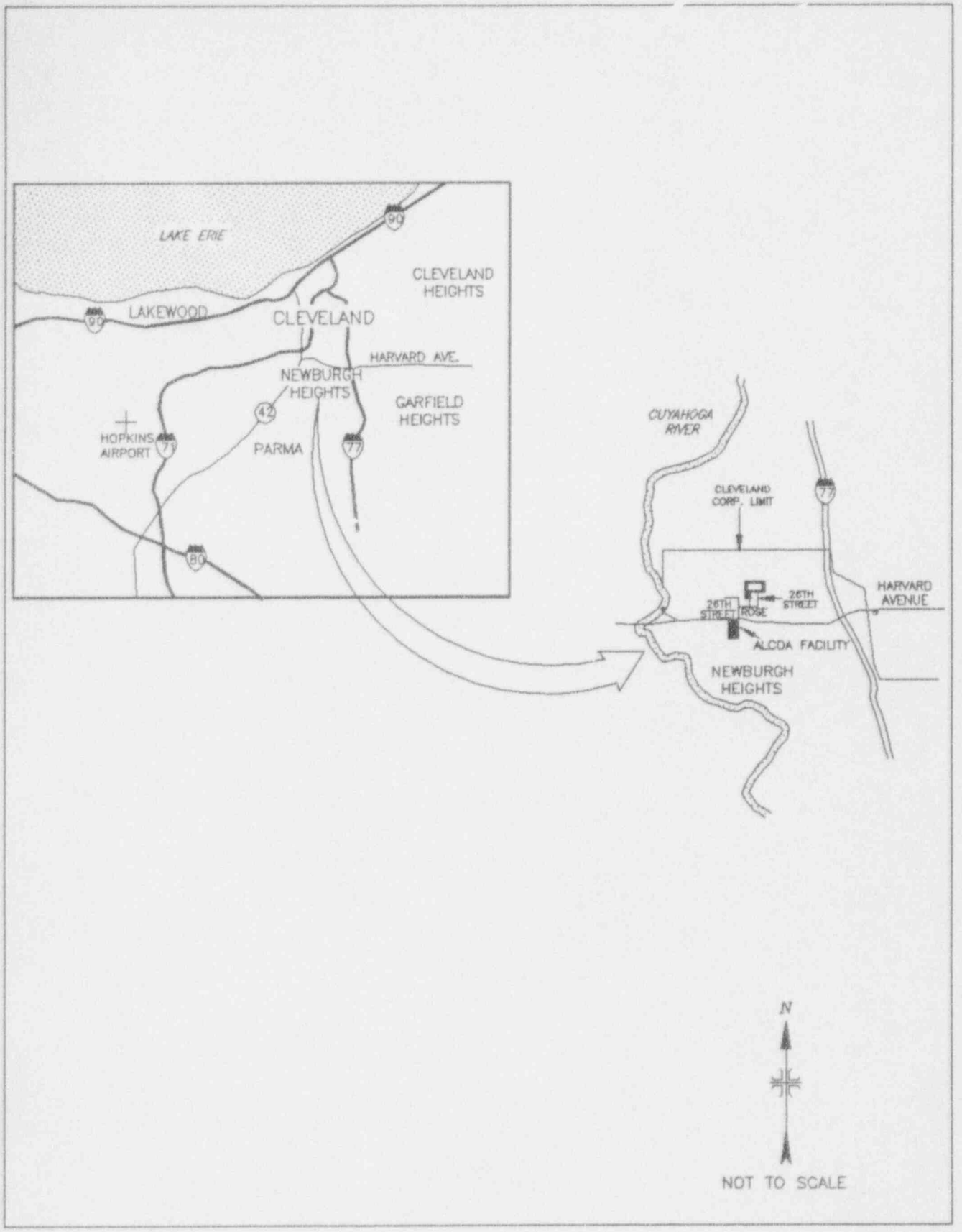


FIGURE 1: Location of ALCOA–Cleveland Works, Cleveland, Ohio

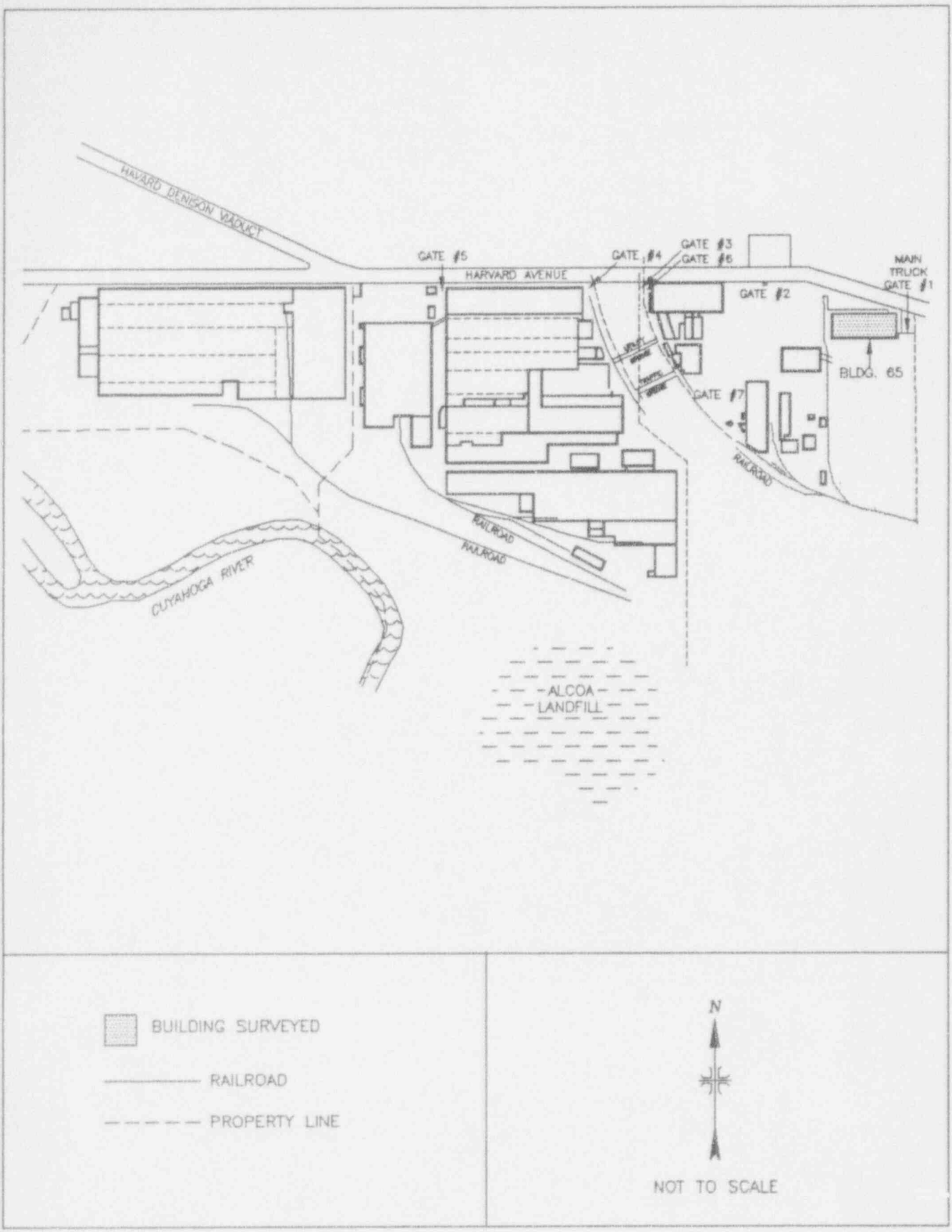


FIGURE 2: Plot Plan for ALCOA–Cleveland Works

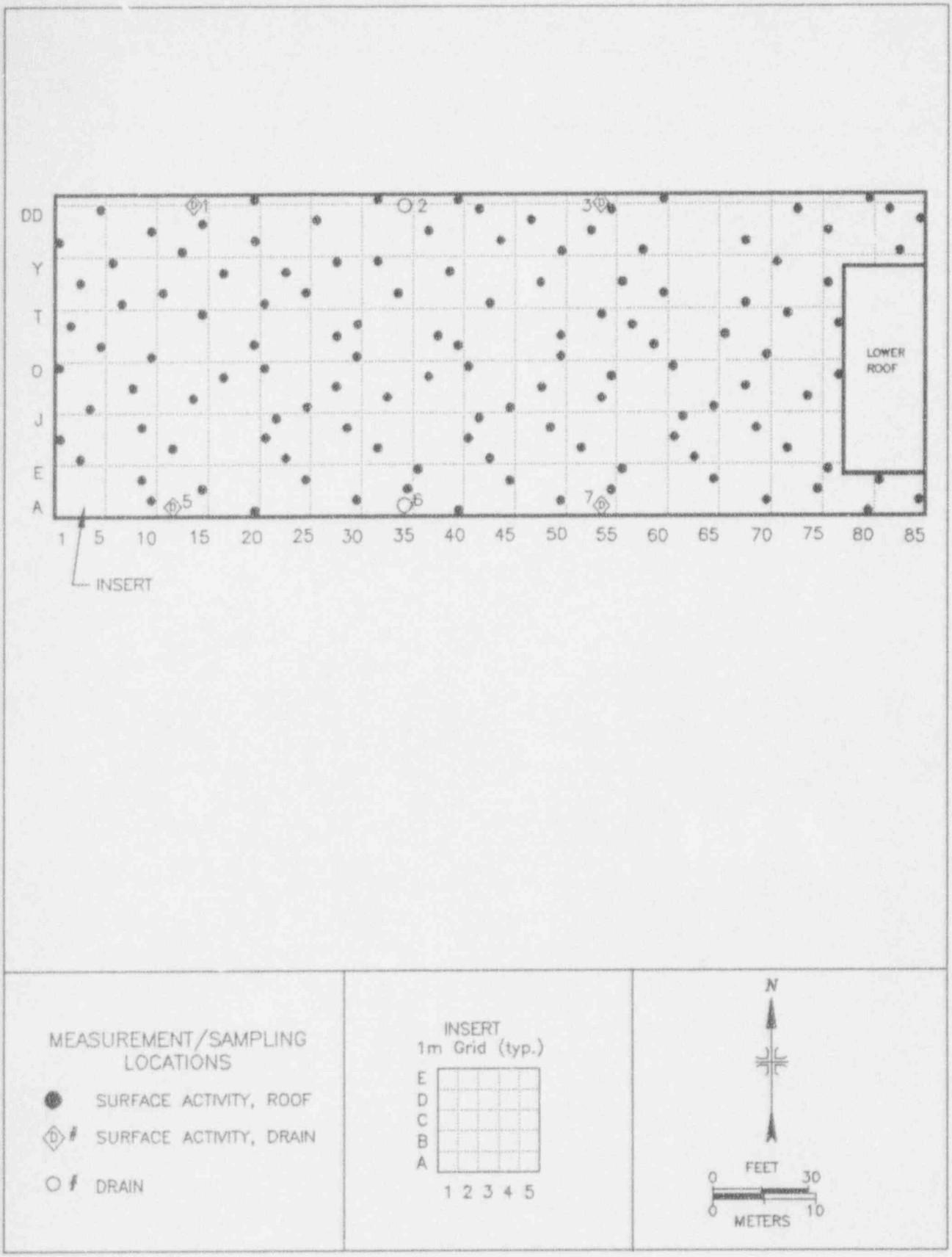


FIGURE 3: Building 65, Roof – Measurement and Sampling Locations

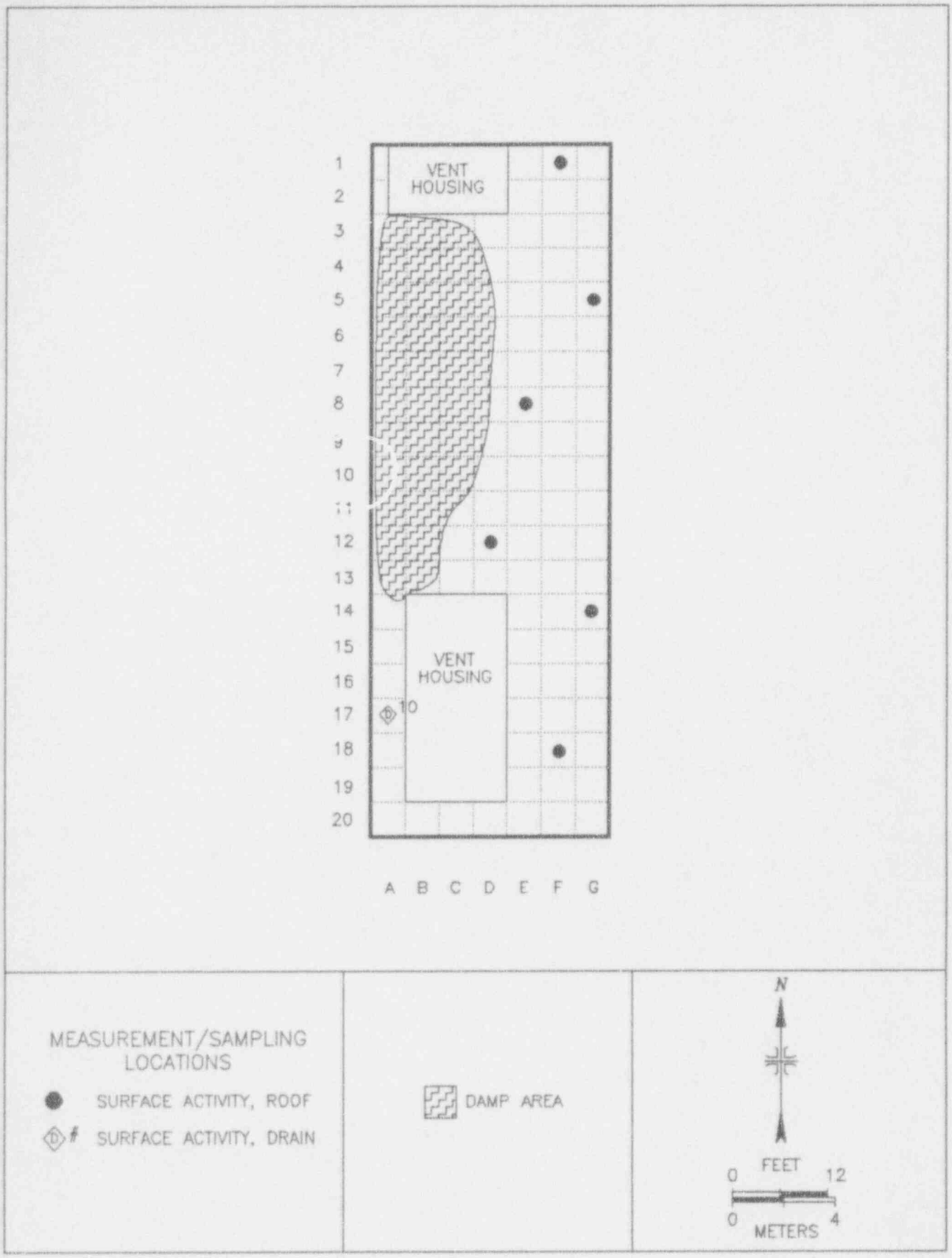
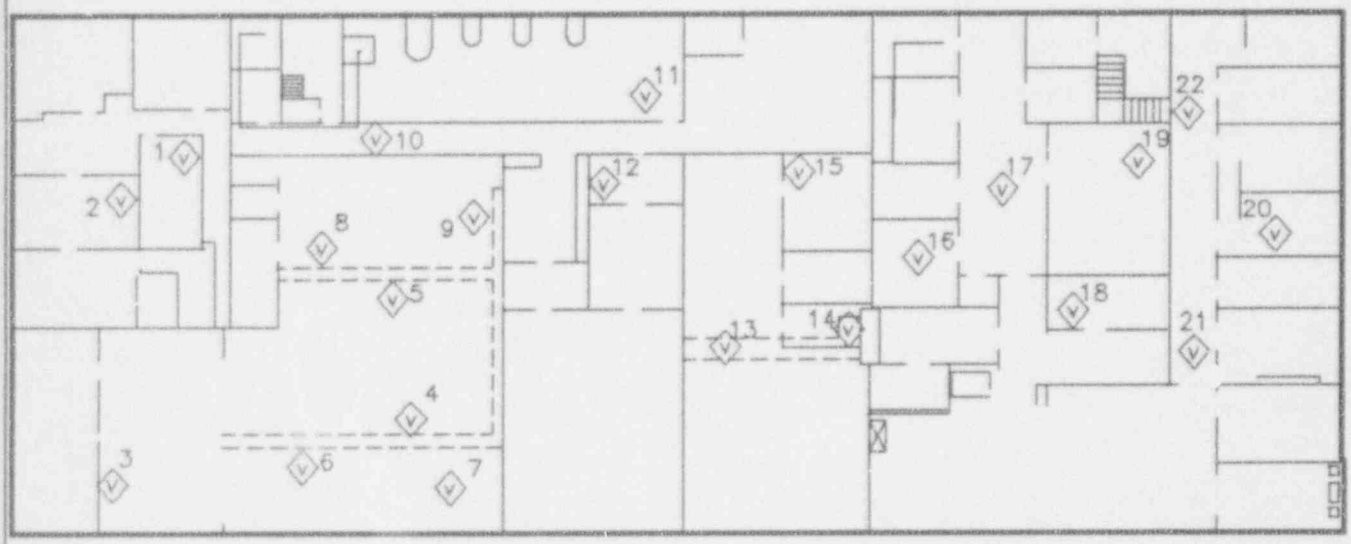


FIGURE 4: Building 65, Lower Roof – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

SURFACE ACTIVITY, VENT

DUCTWORK

N

FEET 0 40

METERS 0 10

FIGURE 5: Building 65, First Floor Ventilation System
Measurement and Sampling Locations

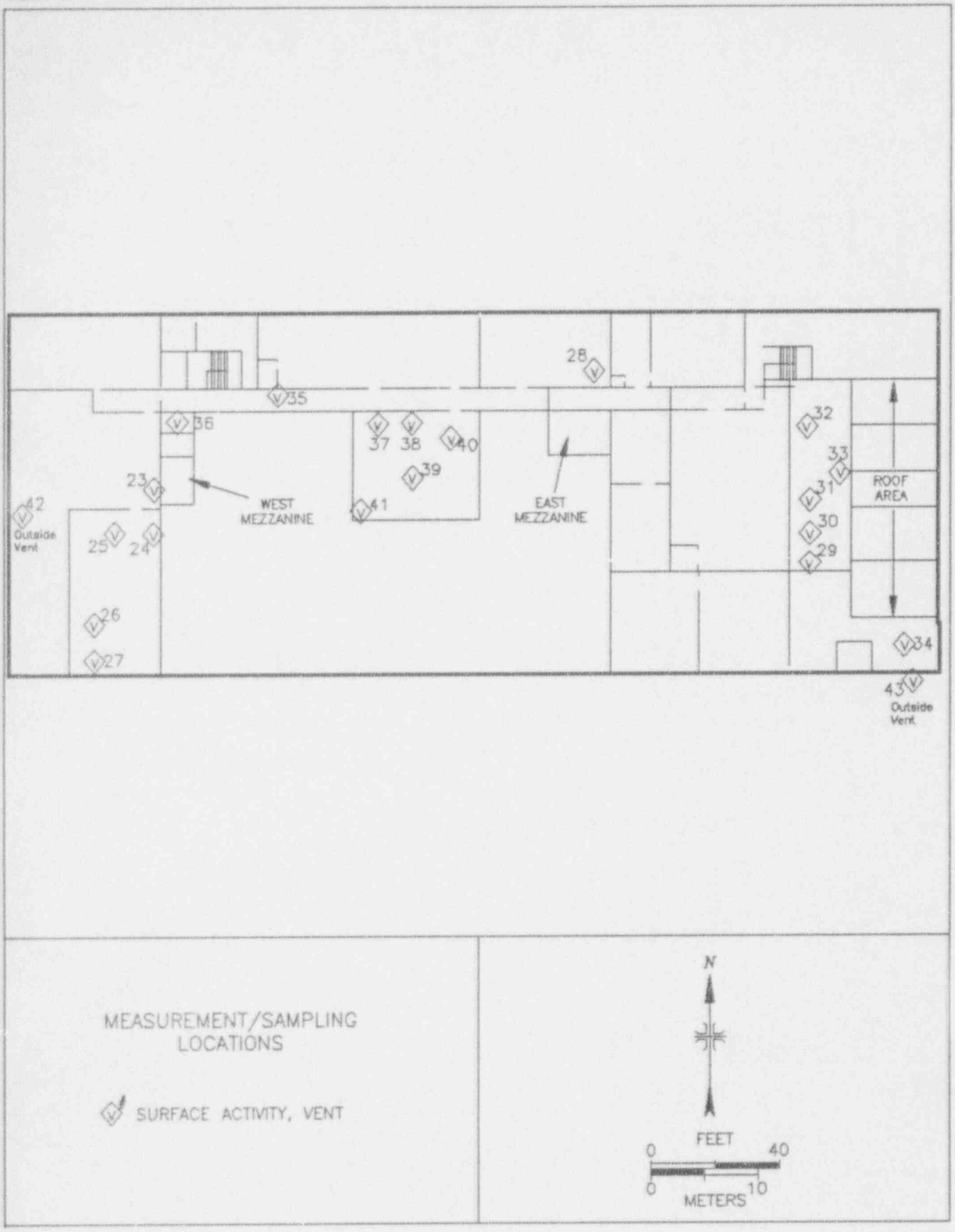


FIGURE 6: Building 65, Second Floor Ventilation System Measurement and Sampling Locations

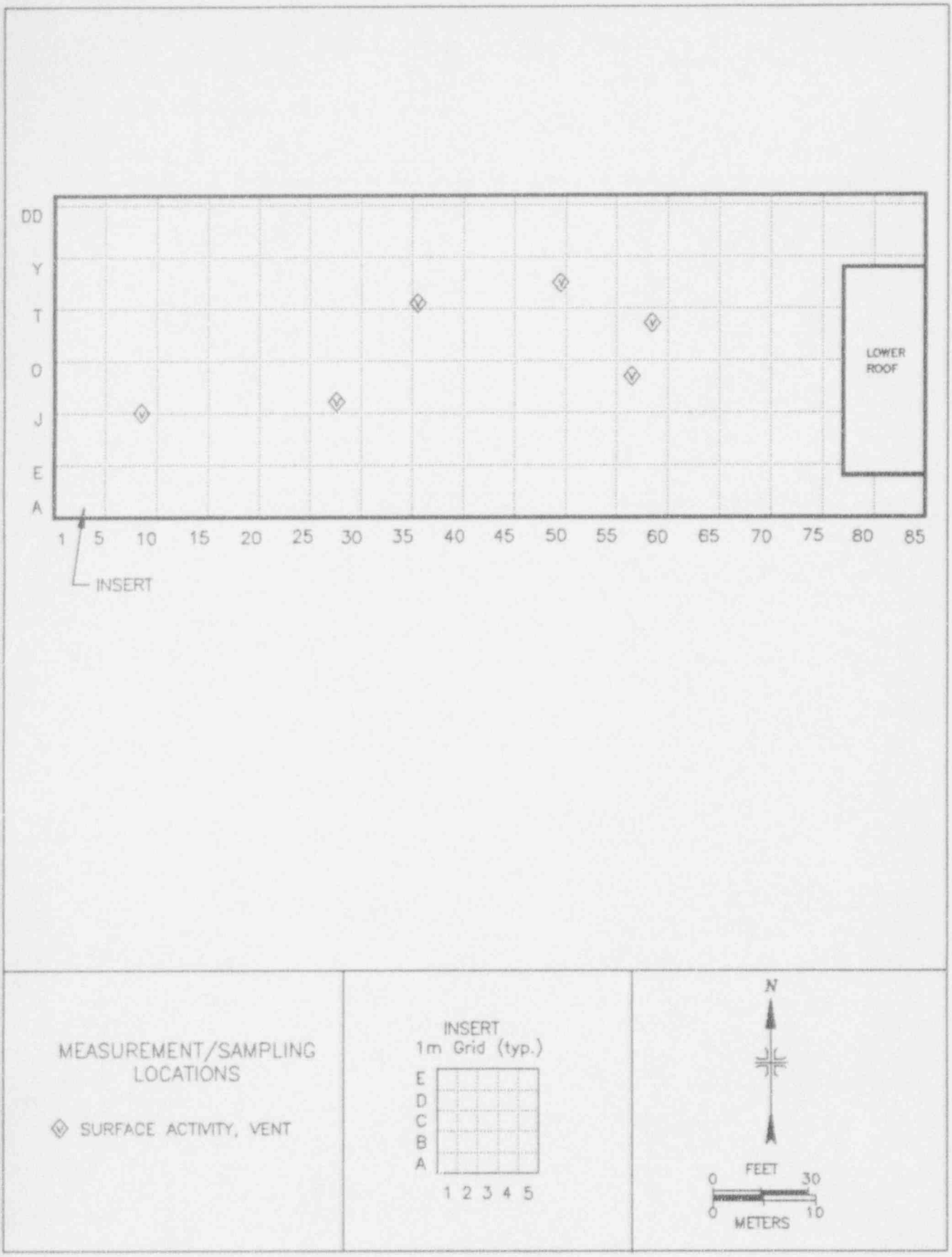
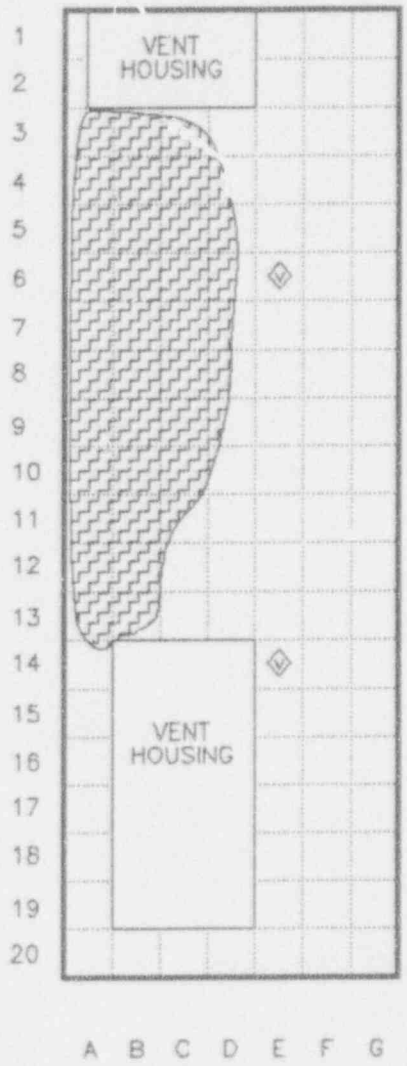


FIGURE 7: Building 65, Roof Ventilation System
Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

SURFACE ACTIVITY, VENT

DAMP AREA

N

FEET 0 12

METERS 0 4

FIGURE 8: Building 65, Lower Roof Ventilation System Measurement and Sampling Locations

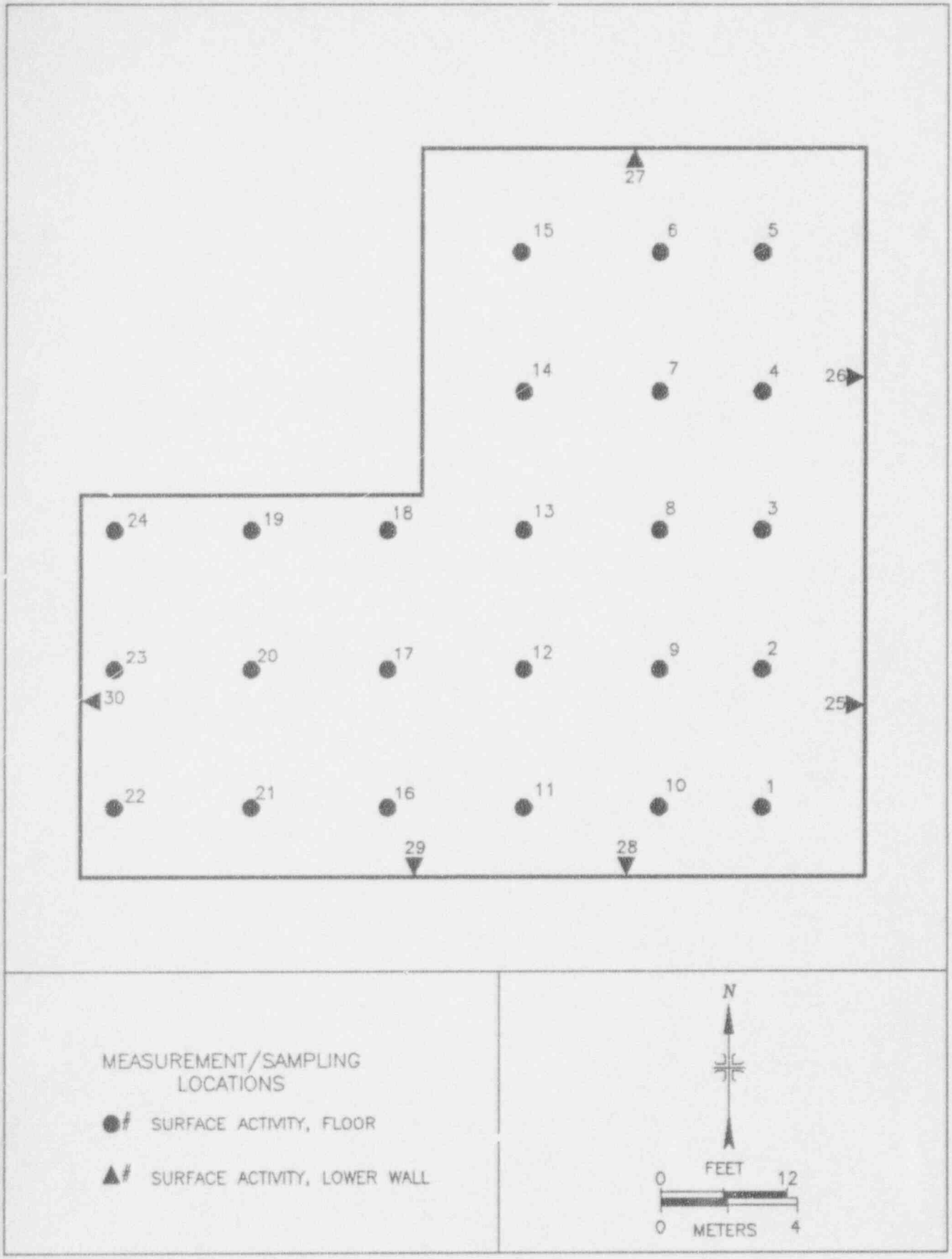


FIGURE 9: Building 65, Room 110 – Measurement and Sampling Locations

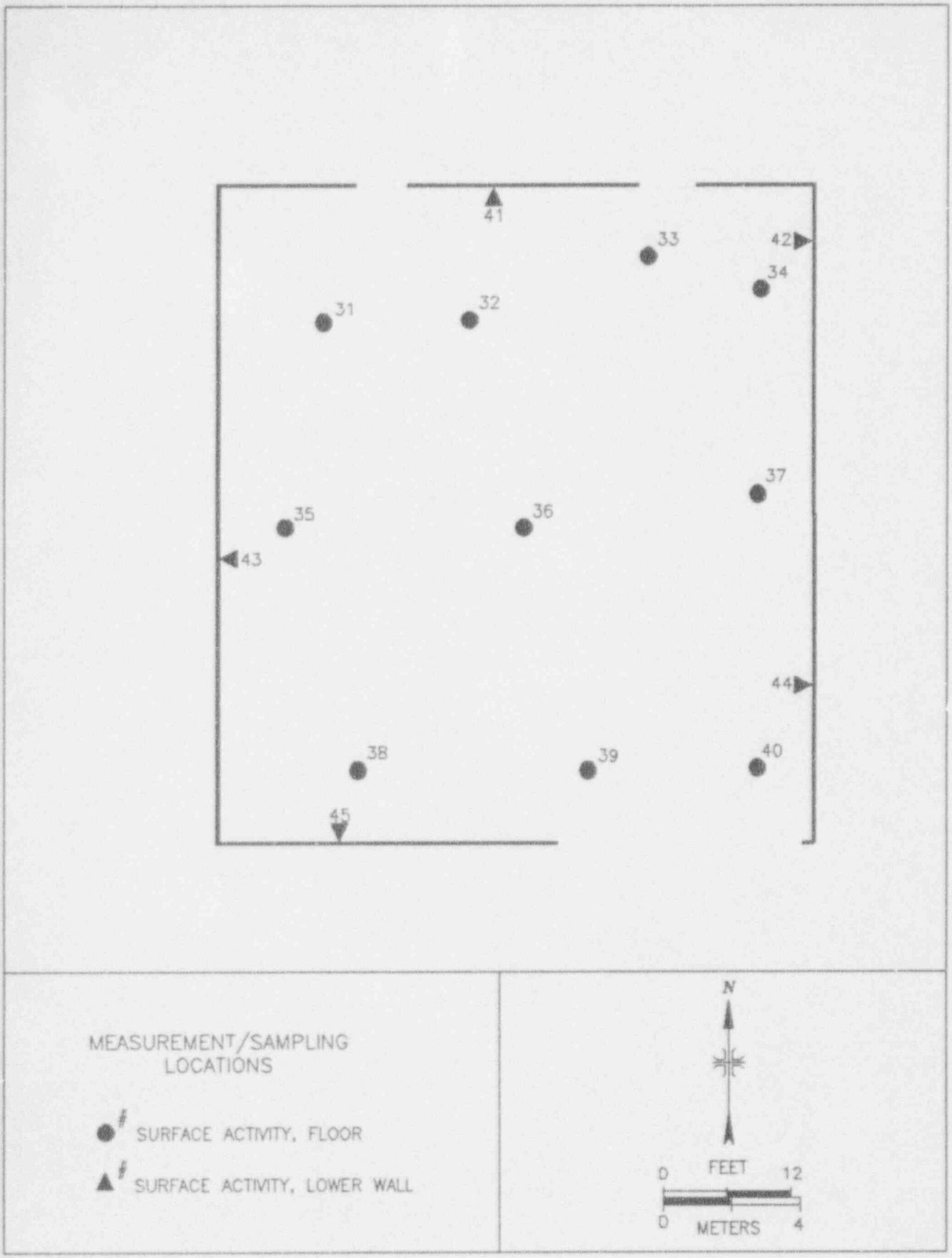
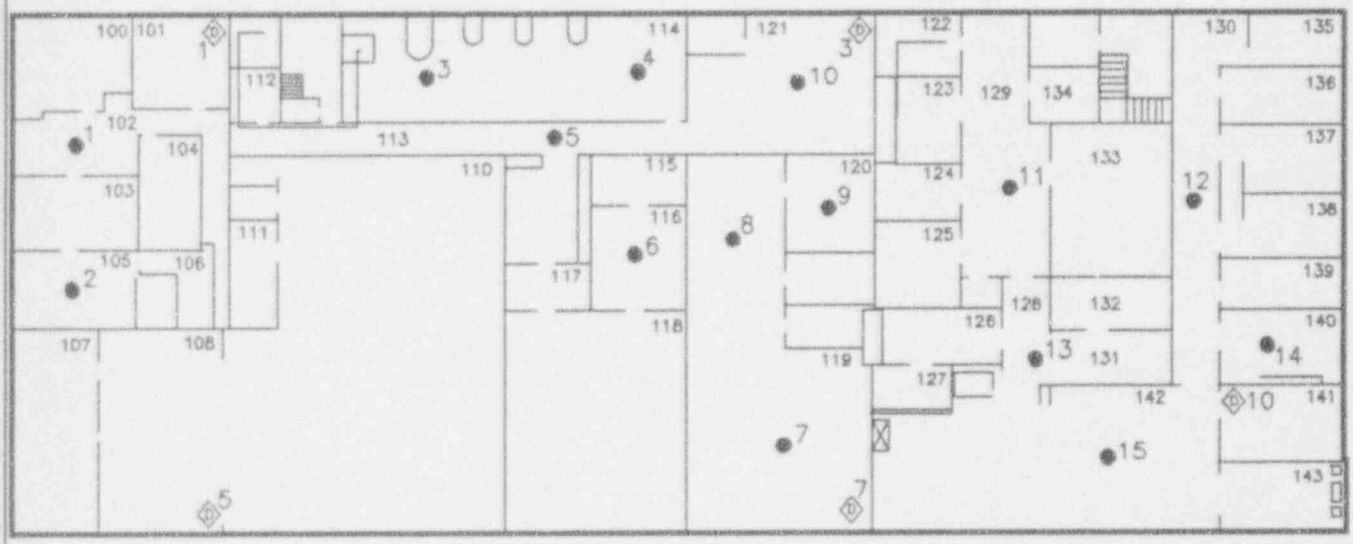


FIGURE 10: Building 65, Room 118 – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

● SURFACE ACTIVITY, FLOOR

◈ SURFACE ACTIVITY, DRAIN

N

FEET 0 40

METERS 0 10

FIGURE 11: Building 65, First Floor – Measurement and Sampling Locations

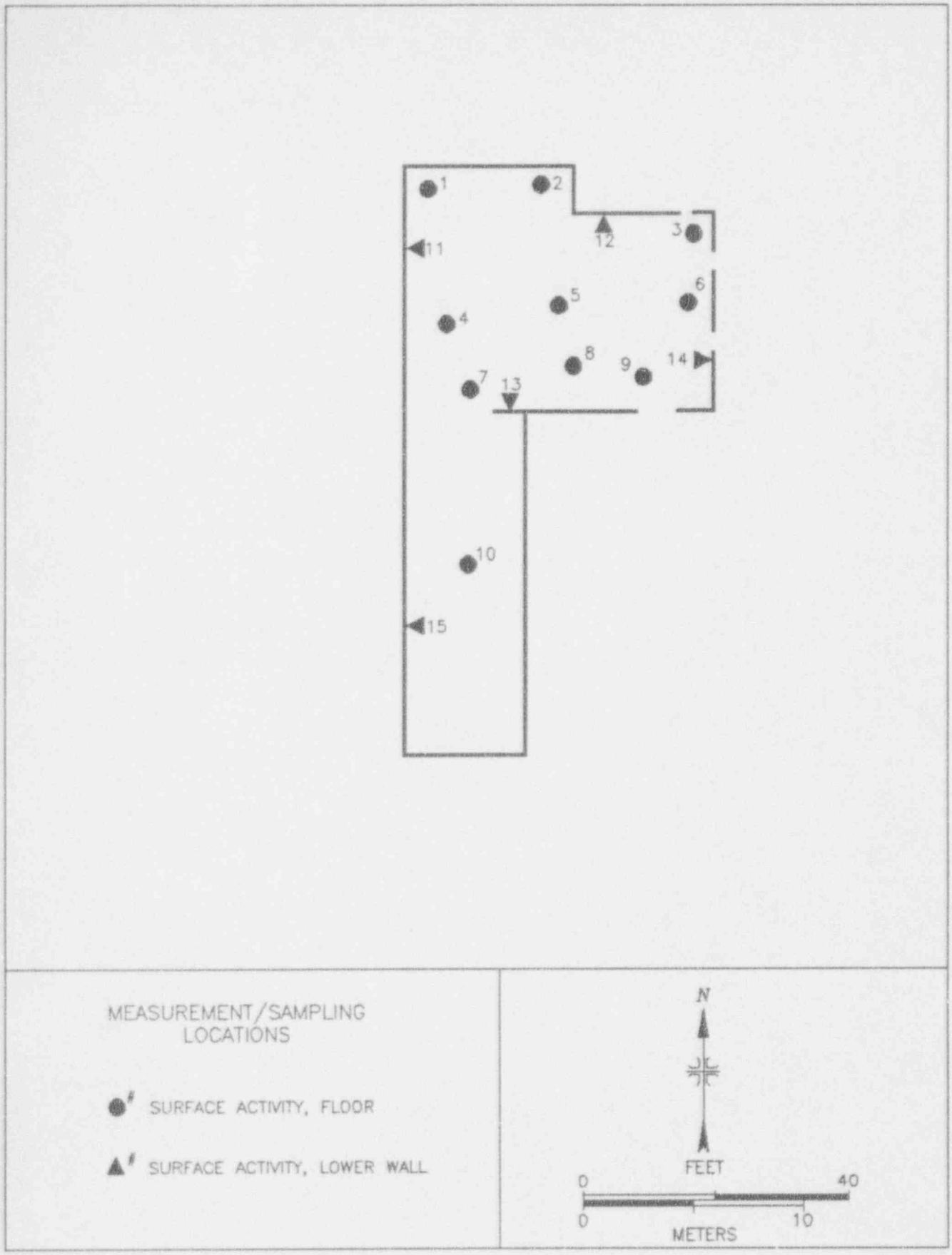
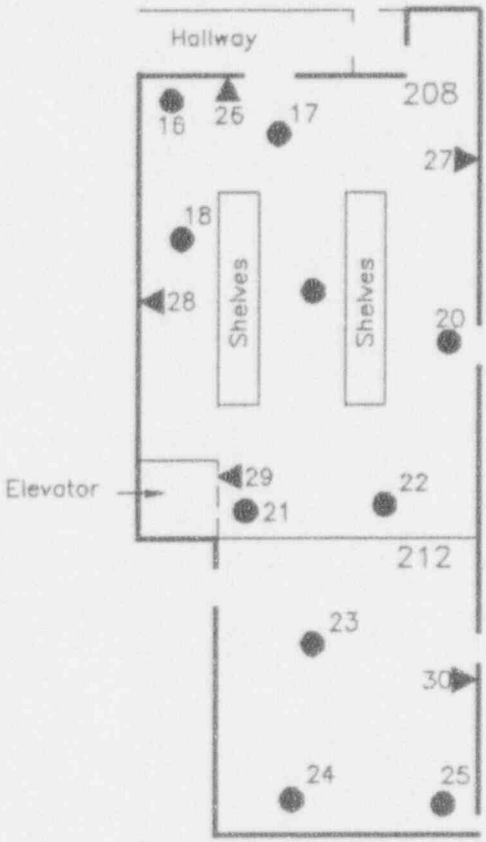


FIGURE 12: Building 65, Room 201 – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

SURFACE ACTIVITY, FLOOR

SURFACE ACTIVITY, LOWER WALL

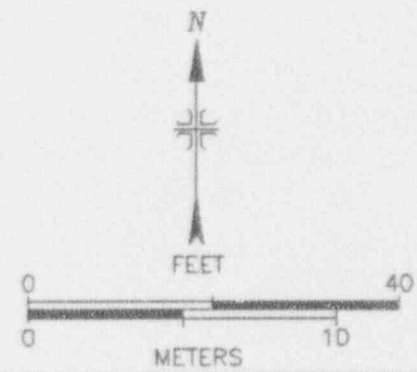
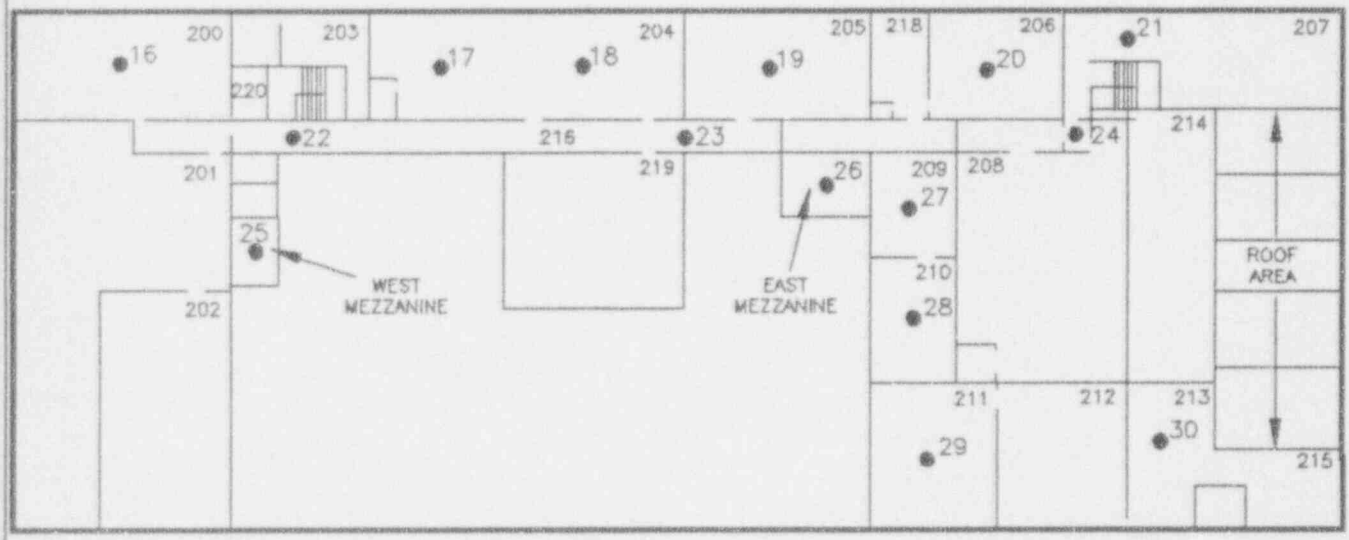


FIGURE 13: Building 65, Rooms 208 and 212 – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

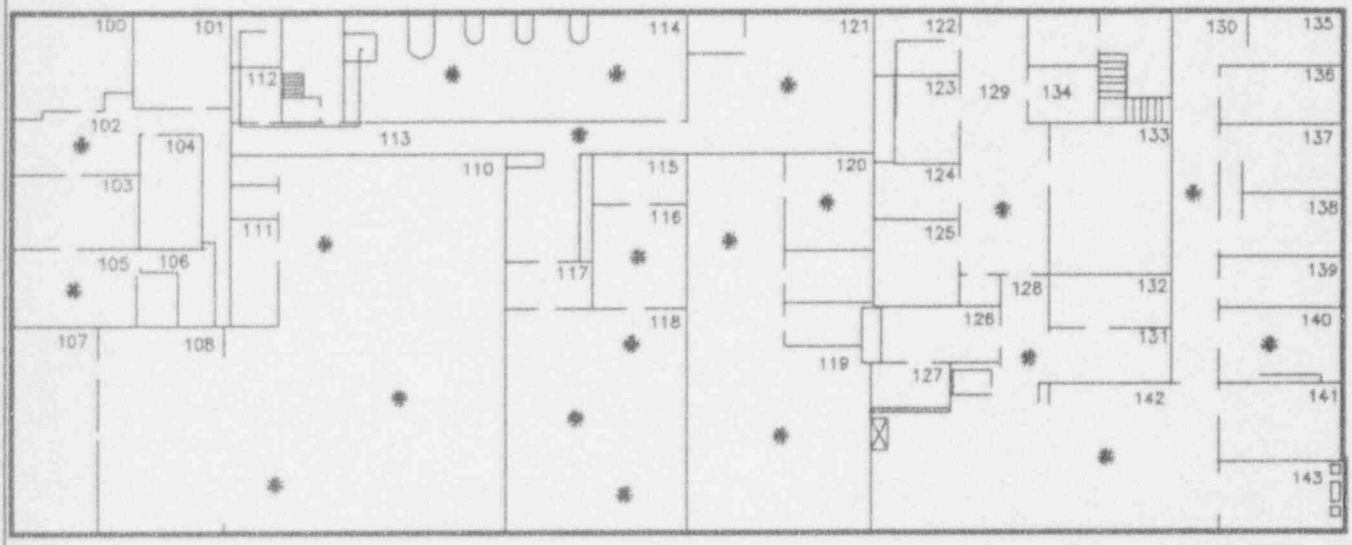
SURFACE ACTIVITY, FLOOR

N

FEET
0 40

METERS
0 10

FIGURE 14: Building 65, Second Floor – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

✱ EXPOSURE RATE

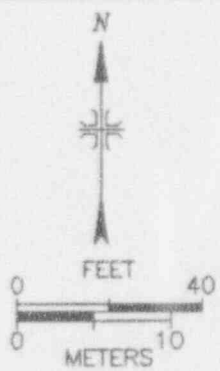
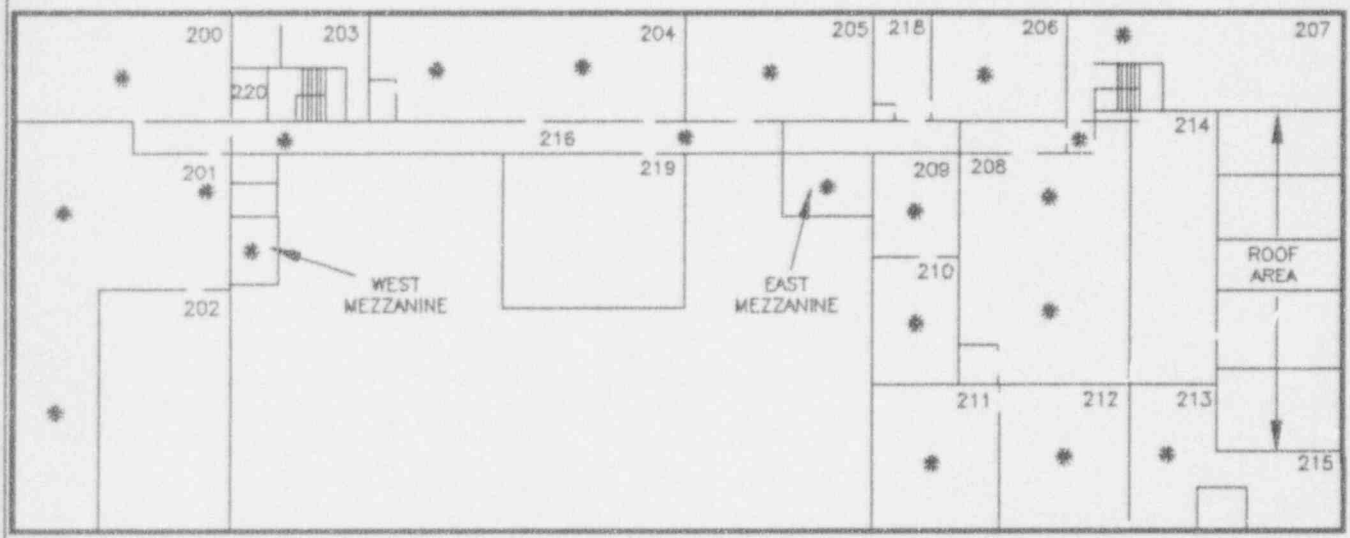


FIGURE 15: Building 65, First Floor – Exposure Rate Measurement Locations



MEASUREMENT/SAMPLING
LOCATIONS

✱ EXPOSURE RATE

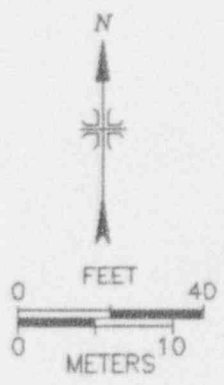


FIGURE 16: Building 65, Second Floor – Exposure Rate Measurement Locations

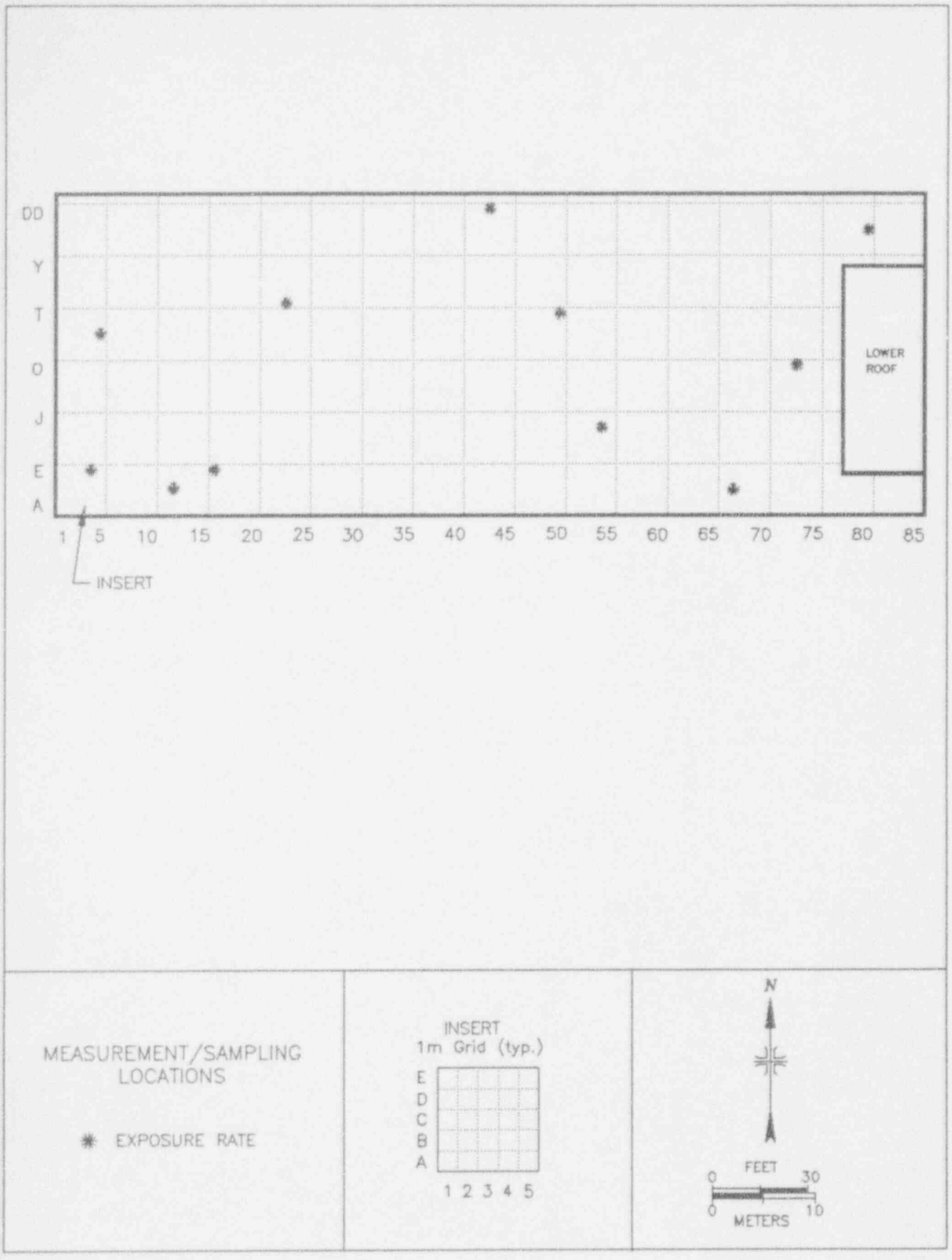
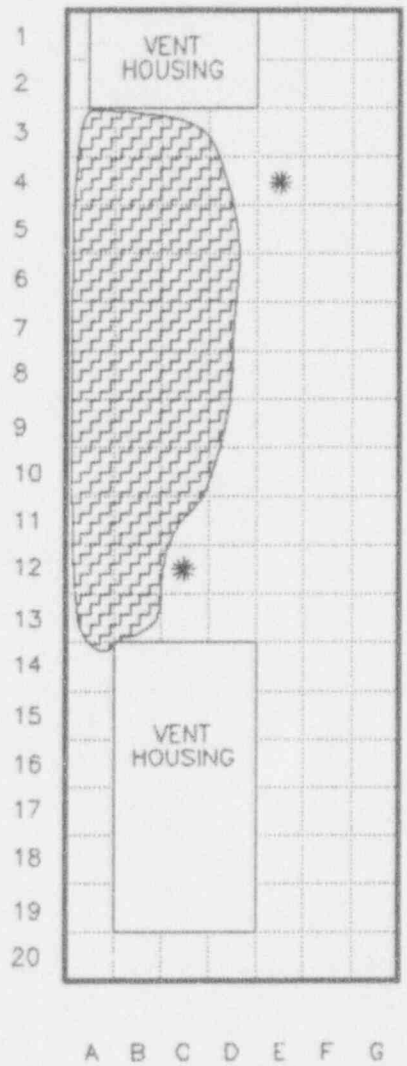


FIGURE 17: Building 65, Roof – Exposure Rate Measurements



MEASUREMENT/SAMPLING LOCATIONS

✱ EXPOSURE RATE

DAMP AREA

N

FEET 0 12

METERS 0 4

FIGURE 18: Building 65, Lower Roof – Exposure Rate Measurements

TABLE 1

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOF
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Grid Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Beta	Alpha	Beta
Main Roof				
A,20	<54	<320	<12	<16
A,40	<54	<320	<12	<16
A,60	<54	<320	<12	<16
A,80	<54	<320	<12	<16
B,10	<54	<320	<12	<16
B,30	<54	<320	<12	<16
B,50	<54	<320	<12	<16
B,70	<54	<320	<12	<16
B,85	<54	<320	<12	<16
C,15	<54	<320	<12	<16
C,35	<54	<320	<12	<16
C,55	<54	380	<12	<16
C,75	<54	700	<12	<16
D,10	<54	610	<12	<16
D,25	<54	680	<12	<16
D,45	<54	520	<12	<16
D,65	<54	<320	<12	<16
D,81	<54	<320	<12	<16
E,16	<54	<320	<12	<16
E,36	<54	<320	<12	<16
E,56	<54	<320	<12	<16

TABLE 1 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOF
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Grid Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Beta	Alpha	Beta
Main Roof (Continued)				
E,76	<54	<320	<12	<16
F,3	<54	<320	<12	<16
F,23	<54	<320	<12	<16
F,43	<54	<320	<12	<16
F,63	<54	<320	<12	<16
G,12	<54	<320	<12	<16
G,32	<54	<320	<12	<16
G,52	<54	<320	<12	<16
G,72	<54	<320	<12	<16
H,1	<54	<320	<12	<16
H,21	<54	820	<12	<16
H,41	<54	600	<12	<16
H,61	<54	<320	<12	<16
I,9	<54	<320	<12	<16
I,29	<54	860	<12	<16
I,49	<54	520	<12	<16
I,69	<54	330	<12	<16
J,22	<54	<320	<12	<16
J,42	<54	<320	<12	<16
J,62	<54	<320	<12	<16
K,5	<54	<320	<12	<16

TABLE 1 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOF
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Grid Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Beta	Alpha	Beta
Main Roof (Continued)				
K,25	<54	<320	<12	<16
K,45	<54	<320	<12	<16
K,65	<54	380	<12	<16
L,14	<54	<320	<12	<16
L,34	<54	<320	<12	<16
L,54	<54	<320	<12	<16
L,74	<54	440	<12	<16
M,8	<54	<320	<12	<16
M,28	<54	<320	<12	<16
M,48	<54	680	<12	<16
M,68	<54	<320	<12	<16
N,17	<54	<320	<12	<16
N,37	<54	<320	<12	<16
N,55	<54	<320	<12	<16
N,77	<54	<320	<12	<16
0,1	<54	<320	<12	<16
0,21	<54	<320	<12	<16
0,41	<54	380	<12	<16
0,61	<67	<310	<12	<16
P,10	<67	<310	<12	<16
P,30	<67	<310	<12	<16

TABLE 1 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOF
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Grid Location[a]	Total Activity (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
	Alpha	Beta	Alpha	Beta
Main Roof (Continued)				
P,50	<67	<310	<12	<16
P,70	<67	400	<12	<16
Q,5	<67	<310	<12	<16
Q,20	<67	330	<12	<16
Q,40	<67	<310	<12	<16
Q,60	<67	<310	<12	<16
R,28	<67	<310	<12	<16
R,38	<67	<310	<12	<16
R,50	<67	<310	<12	<16
R,66	<67	410	<12	<16
S,2	<67	<310	<12	<16
S,30	<67	<310	<12	<16
S,57	<67	390	<12	<16
S,77	<67	500	<12	<16
T,15	<67	<310	<12	<16
T,54	<67	390	<12	<16
T,62	<67	490	<12	<16
T,72	<67	<310	<12	<16
U,7	<67	<310	<12	<16
U,21	<67	<310	<12	<16
U,43	<67	<310	<12	<16

TABLE 1 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOF
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Grid Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Beta	Alpha	Beta
Main Roof (Continued)				
U,68	<67	<310	<12	<16
V,11	<67	<310	<12	<16
V,25	<67	<310	<12	<16
V,35	<67	<310	<12	<16
V,60	<67	<310	<12	<16
W,3	<67	<310	<12	<16
W,48	<67	<310	<12	<16
W,56	<67	<310	<12	<16
W,76	<67	<310	<12	<16
X,17	<67	<310	<12	<16
X,23	<67	<310	<12	<16
X,39	<67	<310	<12	<16
X,64	<67	<310	<12	<16
Y,6	<67	<310	<12	<16
Y,28	<67	<310	<12	<16
Y,32	<67	<310	<12	<16
Y,71	<67	<310	<12	<16
Z,13	<67	<310	<12	<16
Z,50	<67	370	<12	<16
Z,58	<67	420	<12	<16
Z,83	<67	320	<12	<16

TABLE 1 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOF
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Grid Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Beta	Alpha	Beta
Main Roof (Continued)				
AA,1	<67	<310	<12	<16
AA,20	<67	<310	<12	<15
AA,44	<67	<310	<12	<16
AA,68	<67	540	<12	<16
BB,10	<67	<310	<12	<16
BB,37	<67	<310	<12	<16
BB,53	<67	<310	<12	<16
BB,76	<67	<310	<12	<16
CC,15	<67	<310	<12	<16
CC,26	<67	<310	<12	<16
CC,47	<67	<310	<12	<16
CC,65	<67	<310	<12	<16
CC,85	<67	<310	<12	<16
DD,5	<67	<310	<12	<16
DD,42	<67	<310	<12	<16
DD,55	<67	<310	<12	<16
DD,62	<67	450	<12	<16
DD,73	<67	600	<12	<16
DD,82	<67	<310	<12	<16
EE,20	<67	<310	<12	<16
EE,32	<67	<310	<12	<16

TABLE 1 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOF
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Grid Location[a]	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
	Alpha	Beta	Alpha	Beta
Main Roof (Continued)				
EE,40	<67	<310	<12	<16
EE,60	<67	<310	<12	<16
EE,80	<67	<310	<12	<16
Lower Roof				
D,12	<83	<1200	<12	<16
E,8	<83	<1200	<12	<16
F,1	<83	<1200	<12	<16
F,18	<83	<1200	<12	<16
G,5	<83	<1200	<12	<16
G,14	<83	<1200	<12	<16

[a]Refer to Figures 3 and 4.

TABLE 2

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, VENTILATION SYSTEM
PORTIONS OF FIRST AND SECOND FLOOR AND EXTERIOR WALL VENTS
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Measurement Number	Room Number	Duct/work Location	Total Activity (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
			Alpha	Beta	Alpha	Beta
First Floor[a]						
1	104	EX-7	<73	<1500	<12	<16
2	103	Northeast Wall	<73	<1500	<12	<16
3	108	S1-15	<73	2200	<12	<16
4	110	Internal South Vent-North Side #6	<73	<1500	<12	<16
5	110	Internal North Vent-South Side #28	<73	<1500	<12	<16
6	110	Internal South Vent-South Side #12	<73	<1500	<12	<16
7	110	SE Vent #34	<73	<1500	<12	<16
8	110	Internal North Vent-North Side #23	<73	<1500	<12	<16
9	110	Internal East Vent-North #18.4	<73	<1500	<12	<16
10	113	EX3; Hallway #3	<73	<1500	<12	<16
11	114	EX3-12	<73	<1500	<12	<16
12	1.[illegible]	EX8-3	<73	<1500	<12	<16
13	119	S2; Middle Duct #9	<73	<1500	<12	<16
14	11[illegible]	S2; East Duct #20	<73	<1500	<12	<16
15	1[illegible]	EU5; NW Corner #1	<73	<1500	<12	<16
16	125	EX4-9; Middle #18	<73	<1500	<12	<16

TABLE 2 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, VENTILATION SYSTEM
PORTIONS OF FIRST AND SECOND FLOOR AND EXTERIOR WALL VENTS
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Measurement Number	Room Number	Duct/work Location	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
			Alpha	Beta	Alpha	Beta
First Floor (Continued)						
17	129	Middle #22	<73	<1500	<12	<16
18	132	NW Corner #1	<73	<1500	<12	<16
19	133	NE Corner (Wall)	<73	<1500	<12	<16
20	138	S5-4; South Vent	<73	<1500	<12	<16
21	130 (Hallway)	S5-2	<73	<1500	<12	<16
22	130 (Hallway)	S5-5	<73	<1500	<12	<16
Second Floor[b]						
23	201	S1-17; East Wall Duct #2	<73	<1500	<12	<16
24	202	East Wall Duct #2, North Half	<73	<1500	<12	<16
25	202	EU2-2; North Wall Duct #4	<73	<1500	<12	<16
26	202	S-1; Walk-in Duct #3, pt. #9	<73	3300	<12	<16
27	202	S1-19; Walk-in Duct #1, pt. #14	<73	<1500	<12	<16
28	205	EX4-1; East Wall Vent #4	<73	<1500	<12	<16
29	214	S5-1; Walk-in Duct #1, pt. #8	<73	<1500	<12	<16

TABLE 2 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, VENTILATION SYSTEM
PORTIONS OF FIRST AND SECOND FLOOR AND EXTERIOR WALL VENTS
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Measurement Number	Room Number	Duct/work Location	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
			Alpha	Beta	Alpha	Beta
Second Floor (Continued)[b]						
30	214	S5-2; Walk-in Duct #2, pt. #11	<73	<1500	<12	<16
31	214	S5-3; Walk-in Duct #3, pt. #8	<73	<1500	<12	<16
32	214	AC2-1; Walk-in Duct #6, pt. #25	<73	<1500	<12	<16
33	214	East Wall Duct #8, South Half	<73	<1500	<12	<16
34	215	EX5; Small Fan Housing	<73	<1500	<12	<16
35	216	EX7-4; Hall Duct #4, West Half	<73	<1500	<12	<16
36	216A	S-9; Vent System, pt.#1	<73	<1500	<12	<16
37	219	S3; NW Corner Duct #2	<73	<1500	<12	<16
38	219	S-7; North Wall Duct #4	<73	<1500	<12	<16
39	219	S2; Large Fan Housing (inside) West Side	<73	<1500	<12	<16
40	219	EX9-1; NE Corner Duct #10	<73	<1500	<12	<16
41	219	EU-4; SW Corner Duct #10	<73	<1500	<12	<16

TABLE 2 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, VENTILATION SYSTEM
PORTIONS OF FIRST AND SECOND FLOOR AND EXTERIOR WALL VENTS
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Measurement Number	Room Number	Duct/work Location	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
			Alpha	Beta	Alpha	Beta
Exterior Wall Vents[c]						
42	Zone A	EU2-3; Middle of West Wall	< 73	< 1500	< 12	< 16
43	Zone C	EX6-1; South Wall, East End	< 73	< 1500	< 12	< 16

[a]Refer to Figure 5.
[b]Refer to Figure 6.
[c]Refer to Figure 6.

TABLE 3

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOF VENTILATION SYSTEM
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Vent Number[a]	Grid Number	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
1	J,9	<83	<1200	<12	<16
8	L,28	<83	<1200	<12	<16
13	U,38	<83	<1200	<12	<16
16	W,50	<83	<1200	<12	<16
20	S,59	<83	3300	<12	<16
18	N,57	<83	<1200	<12	<16
30 (Lower Roof)	E,6	<83	<1200	<12	<16
32 (Lower Roof)	E,14	<83	<1200	<12	<16

[a]Refer to Figures 7 and 8.

TABLE 4

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOMS 110 AND 118
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Location	Measurement Number	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
Room 110[a]					
Floor	1	<83	1900	<12	<16
	2	<83	<1200	<12	<16
	3	<83	<1200	<12	<16
	4	<83	<1200	<12	<16
	5	<83	2700	<12	<16
	6	<83	1400	<12	<16
	7	<83	<1200	<12	<16
	8	<83	2100	<12	<16
	9	<83	<1200	<12	<16
	10	<83	2000	<12	<16
	11	<83	1900	<12	<16
	12	<83	1400	<12	<16
	13	<83	1800	<12	<16
	14	<83	2300	<12	<16
	15	<83	2200	<12	<16
	16	<83	2400	<12	<16
	17	<83	2000	<12	<16
	18	<83	1800	<12	<16
	19	<83	1600	<12	<16
	20	<83	2500	<12	<16

TABLE 4 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOMS 110 AND 118
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Location	Measurement Number	Total Activity (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
Room 110 (Continued)[a]					
	21	< 83	< 1200	< 12	< 16
	22	< 83	1900	< 12	< 16
	23	< 83	1500	< 12	< 16
	24	< 83	1800	< 12	< 16
Lower Wall	25	89	2000	< 12	< 16
	26	< 83	< 1200	< 12	< 16
	27	150	2500	< 12	< 16
	28	< 83	< 1200	< 12	< 16
	29	< 83	1900	< 12	< 16
	30	98	2800	< 12	< 16
Room 118[b]					
Floor	31	< 83	< 1200	< 12	< 16
	32	< 83	< 1200	< 12	< 16
	33	< 83	1800	< 12	< 16
	34	< 83	2000	< 12	< 16
	35	< 83	< 1200	< 12	< 16
	36	< 83	< 1200	< 12	< 16
	37	< 83	< 1200	< 12	< 16
	38	< 83	2200	< 12	< 16
	39	< 83	< 1200	< 12	< 16

TABLE 4 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOMS 110 AND 118
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Location	Measurement Number	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
Room 118 (Continued)					
	40	< 83	2300	< 12	< 16
Lower Wall	41	< 83	1400	< 12	< 16
	42	< 83	1700	< 12	< 16
	43	< 83	< 1200	< 12	< 16
	44	< 83	< 1200	< 12	< 16
	45	< 83	< 1200	< 12	< 16

[a]Refer to Figure 9.
[b]Refer to Figure 10.

TABLE 5

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOMS 201, 208, AND 212
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Location	Measurement Number	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
Room 201[a]					
Floor	1	< 83	< 1200	< 12	< 16
	2	< 83	< 1200	< 12	< 16
	3	< 83	< 1200	< 12	< 16
	4	< 83	< 1200	< 12	< 16
	5	< 83	< 1200	< 12	< 16
	6	< 83	< 1200	< 12	< 16
	7	< 83	< 1200	< 12	< 16
	8	< 83	< 1200	< 12	< 16
	9	< 83	< 1200	< 12	< 16
	10	< 83	< 1200	< 12	< 16
Lower Wall	11	< 83	< 1200	< 12	< 16
	12	< 83	< 1200	< 12	< 16
	13	< 83	< 1200	< 12	< 16
	14	< 83	< 1200	< 12	< 16
	15	< 83	< 1200	< 12	< 16
Rooms 208 and 212[b]					
Floor	16	< 83	< 1200	< 12	< 16
	17	< 83	< 1200	< 12	< 16
	18	< 83	< 1200	< 12	< 16
	19	< 83	< 1200	< 12	< 16

TABLE 5 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, ROOMS 201, 208, AND 212
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Location	Measurement Number	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
Rooms 208 and 212 (Continued)[b]					
	20	<83	<1200	<12	<16
	21	<83	<1200	<12	<16
	22	<83	<1200	<12	<16
	23	<83	<1200	<12	<16
	24	<83	<1200	<12	<16
	25	<83	1300	<12	<16
Lower Wall	26	<83	<1200	<12	<16
	27	<83	<1200	<12	<16
	28	<83	<1200	<12	<16
	29	<83	<1200	<12	<16
	30	<83	<1200	<12	<16

[a]Refer to Figure 12.
[b]Refer to Figure 13.

TABLE 6

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, PORTIONS OF THE FIRST FLOOR, SECOND FLOOR, AND BASEMENT
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Measurement Number	Room Number	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
First Floor[a]					
1	102	<73	<1500	<12	<16
2	105	<73	<1500	<12	<16
3	114	<73	2700	<12	<16
4	114	<73	2100	<12	<16
5	113	<73	2200	<12	<16
6	116	<73	<1500	<12	<16
7	119	<73	1900	<12	<16
8	119	<73	2000	<12	<16
9	120	<73	2300	<12	<16
10	121	<73	2100	<12	<16
11	129	<73	<1500	<12	<16
12	130	<73	<1500	<12	<16
13	131	<73	<1500	<12	<16
14	140	<73	<1500	<12	<16
15	142	<73	<1500	<12	<16
Second Floor[b]					
16	200	<73	<1500	<12	<16
17	204	<73	<1500	<12	<16
18	204	<73	<1500	<12	<16

TABLE 6 (Continued)

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, PORTIONS OF THE FIRST FLOOR,
SECOND FLOOR, AND BASEMENT
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Measurement Number	Room Number	Total Activity (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
Second Floor[b] (Continued)					
19	205	<73	<1500	<12	<16
20	206	<73	<1500	<12	<16
21	207	<73	<1500	<12	<16
22	216	<73	<1500	<12	<16
23	216	<73	<1500	<12	<16
24	216	<73	<1500	<12	<16
25	West Mezzanine	<73	<1500	<12	<16
26	East Mezzanine	<73	<1500	<12	<16
27	209	<73	<1500	<12	<16
28	210	<73	<1500	<12	<16
29	211	<73	<1500	<12	<16
30	213	<73	<1500	<12	<16
Basement[c]					
NA	West Room	<73	<1500	<12	<16
NA	North	<73	<1500	<12	<16
NA	Hallway-North	<73	<1500	<12	<16
NA	Hallway-South	<73	<1500	<12	<16
NA	Stairwell Landing	<73	<1500	<12	<16

[a]Refer to Figure 11.
[b]Refer to Figure 14.
[c]Not shown on a figure.

TABLE 7

SURFACE ACTIVITY MEASUREMENTS
BUILDING 65, DRAINAGE SYSTEM
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Drain Number	Location[a]	Figure	Total Activity (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
			Alpha	Beta	Alpha	Beta
1	Roof; Grid EE,14		98	<1200	<12	<16
3	Roof; Grid EE,54		<83	<1200	<12	<16
5	Roof; Grid A,12		<83	<1200	<12	<16
7	Roof; Grid A,54		<83	<1200	<12	<16
10	Lower Roof; Grid A,17		<83	1600	<12	<16
1	First Floor; Room 101		<83	3200	<12	<16
3	First Floor; Room 121		<83	2200	<12	<16
5	First Floor; Room 110		<83	2400	<12	<16
7	First Floor; Room 119		<83	1400	<12	<16
10	First Floor; Room 141		<83	3800	<12	<16

[a]Refer to Figures 3 and 4.

TABLE 8

EXPOSURE RATE MEASUREMENTS
BUILDING 65
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Location (Room)	Exposure Rate (μR/h) at 1 m above Surface
First Floor[a]	
102	11
105	9
110 (North)	13
110 (West)	11
110 (East)	13
113	12
114 (West)	11
114 (East)	12
116	14
118 (North)	13
118 (Center)	11
118 (South)	10
119 (North)	14
119 (South)	13
120	13
121	12
131	12
129	11
130	12
140	11
142	9

TABLE 8 (Continued)

EXPOSURE RATE MEASUREMENTS
BUILDING 65
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Location (Room)	Exposure Rate (μR/h) at 1 m above Surface
Second Floor[b]	
200	11
201 (Northeast)	9
201 (Northwest)	10
201 (South)	9
204 (West)	10
204 (East)	9
205	10
206	10
207	10
208 (North)	10
208 (South)	8
209	9
210	11
211	9
212	9
213	9
216 (West)	12
216 (Center)	13
216 (East)	14
West Mezzanine	10
East Mezzanine	9

TABLE 8 (Continued)

EXPOSURE RATE MEASUREMENTS
BUILDING 65
CLEVELAND WORKS FACILITY
ALUMINUM COMPANY OF AMERICA
CLEVELAND, OHIO

Location (Room)	Exposure Rate (μR/h) at 1 m above Surface
Roof[c]	
C,67	7
E,16	8
I,54	7
0,73	7
R,5	7
T,50	7
U,23	6
BB,80	7
DD,42	8
Lower Roof[d]	
C,12	9
E,4	10

[a]Refer to Figure 15.
[b]Refer to Figure 16.
[c]Refer to Figure 17.
[d]Refer to Figure 18.

REFERENCES

1. "Radiological Survey of Portions of the Cleveland Works Facility, The Aluminum Company of America," ORISE, November, 1992.

2. "Radiological Scoping Survey of Buildings 21, 22, 24, 25, 26, 29, 70, and 72, Cleveland Works Facility, The Aluminum Company of America," ORISE, October, 1992.

3. "Site Decommissioning Management Plan," NUREG-1444, U.S. Nuclear Regulatory Commission, Division of Low-Level Waste Management and Decommissioning, October 1993.

4. "Final Decommissioning Report for the Remediation of the Low Level Radioactive Contaminated Material Building 65 Ventilation System for the ALCOA Cleveland Forge Plant, Cleveland Works," NES, INC./IES, June 1993.

5. "Final Decommissioning Report for the Remediation and Release of the Building 65 Roof and Drainage System including the Characterization of Four Adjacent Roofs for the ALCOA Cleveland Forge Plant, Cleveland Works," NES, INC./IES, July 1993.

6. "Proposed Confirmatory Survey Plan of Building 65, Roof, Lower Roof, Ventilation and Drainage Systems, Cleveland Works Facility, The Aluminum Company of America," ORISE, September 14, 1993.

7. Letter from A. Ansari (ORISE) to T. Johnson (NRC), Reference: "Licensee Final Decommissioning Reports for the Remediation of Building 65 Ventilation System, Roof and Drainage System," August 17, 1993.

8. "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 and Material Safety, August 1987.

9. "Review Plan: Evaluating Decommissioning Plans for Licensees 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)

Ludlum Gas Proportional Detector
Model 43-68
Effective Area, 100 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

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)

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. Surfaces were scanned using predominantly small area (15.5 cm^2, 59 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
— 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 primarily performed using ZnS scintillation and GM detectors with ratemeters-scalers. Gas proportional detectors were used for measurements on the roof surface.

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 ZnS scintillation

and gas proportional detectors averaged 1 and 2 cpm, respectively. Alpha efficiency factors averaged 0.18 for the ZnS scintillation detectors and 0.20 for gas proportional detectors. The beta activity background count rates for the GM and gas proportional detectors averaged 51 and 390 cpm, respectively. Beta efficiency factors ranged from 0.16 - 0.19 for the GM detector and from 0.26-0.27 for the gas proportional detectors. The effective windows for the ZnS scintillation, GM, and gas proportional detectors were 59 cm^2, 15.5 cm^2, and 100 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).

Miscellaneous Samples

Brick and tile samples were collected with the front and back of each sample clearly labeled. Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

ANALYTICAL PROCEDURES

Gross Alpha/Beta

Smears were counted on a low background gas proportional system.

Gamma Spectrometry

Brick and tile samples were processed to approximate a calibrated counting geometry. Net material weights were determined and the samples counted on both sides, 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. Energy peaks used for determination of radionuclides of concern were:

K-40 1.461 MeV
Th-232 0.969 MeV from Ac-228*
U - 235 0.186 MeV
U - 238 0.063 MeV from Th-234*
*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 based only on counting statistics. Additional uncertainties associated with sampling and measurement procedures, have not been propagated into the data presented in this report.

Detection limits, referred to as minimum detectable activity (MDA), were based on 2.71 plus 4.66 times the standard deviation of the background count. 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 radionuclide 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 was 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 ESSAP documents:

- Survey Procedures Manual, Revision 7
- Laboratory Procedures Manual, Revision 8
- Quality Assurance Manual, Revision 6

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 duct work 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 duct work. 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.	aware 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.