UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137-5927

August 13, 1993

Docket No. 030-16055
License No. 34-19089-01

Advanced Medical Systems, Inc.
ATTN: Ms. Sherry Stein
Director of Regulatory Affairs
121 North Eagle Street
Geneva, Ohio 44041

Dear Ms. Stein:

SUBJECT: VIOLATION OF LICENSE CONDITION; FAILURE TO COMPLETE INVENTORY OF NRC LICENSED MATERIALS

This letter refers to Condition No. 14.C of NRC Byproduct Material License No. 34-19089-01, issued to Advanced Medical Systems, Inc. (AMS) and the requirement that an inventory of all radioactive materials possessed under that license be completed by June 1, 1993. It is our understanding from your letters dated May 17 and May 27, 1993, that the majority of the inventory was completed prior to June 1, 1993. However, an inventory of material in the front well of the "hot cell" has not been performed because the cell plug cannot be moved. Due to the concerns regarding complete accountability of all radioactive materials possessed under your license, the uncertainties about the quantity of radioactive materials contained in that well, and because of the long delay in quantifying that material, we believe there is a need for an immediate and accurate inventory of all radioactive materials in the possession of AMS.

While the NRC understands that an immovable plug impeded your efforts to meet the June 1, 1993, deadline, we remain concerned that your efforts to remove it were not aggressive. In a previous inspection conducted at AMS January 23-26, 1990, we identified that inventories had not been conducted since at least January 1988. An enforcement conference was held on March 27, 1990, during which the physical inventory was discussed. At that time AMS presented information that an inventory was underway and would be completed by the end of calendar year 1990. The Notice of Violation associated with that enforcement conference (EA 90-051) was transmitted to you on July 26, 1990, and in the letter transmitting the Notice, the NRC noted that while we appreciated the difficulties of completing the inventory of sources, you are required to comply with NRC license conditions and regulations.

The NRC recognizes that taking an inventory as complex as the one at your facility is difficult, and we have worked with AMS by

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RETURN RECEIPT REQUESTED

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revising the inventory requirement and extending the inventory deadline. The NRC issued License Amendment No. 24 on May 8, 1992, revising the existing inventory requirement and establishing March 31, 1993, as the deadline for completing the inventory. That deadline was subsequently extended to June 1, 1993, with the issuance of License Amendment No. 27 on April 19, 1993. Even with that extension, AMS still failed to complete the inventory by June 1, 1993.

The NRC believes that AMS has not aggressively acted to complete the inventory as demonstrated by the failure to: (1) retain sufficient staff; (2) aggressively make facility changes to accommodate and complete the inventory (e.g. sufficiently decontaminate the hot cell to gain access to the front well plug); and (3) aggressively seek outside help to open the front well plug.

The failure to complete the inventory by June 1, 1993, is a violation of NRC requirements. You should be aware that Section VII.A of the "General Statement of Policy and Procedure for NRC Enforcement Actions," (Enforcement Policy), 10 CFR Part 2, Appendix C, provides that the NRC may assess civil penalties for violations of NRC requirements. Because of the extended time it has taken for AMS to complete the inventory as required by your license, the NRC will consider issuing civil penalties if the inventory is not completed within 60 days of the date of this letter. Should AMS fail to complete the inventory within that period of time, the NRC staff will consider, among other things, a penalty such that the cost of non-compliance will be greater than the cost of compliance as provided for in the Enforcement Policy.

Pursuant to Section 182.a of the Atomic Energy Act, as amended (42 U.S.C. 2232a) and 10 CFR 2.204 and 30.32(b), you are required to respond to this letter, no later than 60 days from the date of this letter, advising us of the status of your compliance with this inventory requirement and the actions you plan to take to ensure future compliance.

The response directed by this letter and the enclosed Notice are not subject to the clearance procedures of the Office of Management and Budget as required by the Paperwork Reduction Act of 1980, Public Law No. 96-511.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter will be placed in the NRC Public Document Room.

Sincerely,

JBMartin

John B. Martin
Regional Administrator

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PAO:RIII
IMS:RIII

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MEMORANDUM FOR: Carl J. Paperiello, Director, Division of Industrial and Medical Nuclear Safety, NMSS

FROM: Charles E. Norelius, Director, Division of Radiation Safety and Safeguards, Region III

SUBJECT: STATEMENT OF WORK FOR THE SAFETY ASSESSMENT OF THE ADVANCED MEDICAL SYSTEM'S FACILITY (LICENSE NO. 34-19089-01)

Reference: July 29, 1993 Memorandum; Paperiello to Norelius

Enclosed is a draft Statement Of Work (SOW) for the contractor safety assessment of the Advanced Medical System's London Road facility in Cleveland, Ohio. The SOW was drafted following the guidance and format documents provided in your referenced memorandum.

Tasks I through III of the SOW require that the contractor(s) perform a comprehensive safety assessment and hazard/risk analysis of the facility as it exists today. Task IV requires that the facility be evaluated to determine modifications necessary should manufacturing operations or long term storage be authorized.

We understand that Region III will maintain the technical lead on the SOW and the Operations Branch, IMNS, will provide coordination and guidance. We further understand that headquarters will prepare the final SOW for awarding and funding.

In view of the interest this facility has generated at the commissioner level and with the Congress and Cleveland city government staffs, the assessment project should be initiated promptly. Although the SOW outlines four tasks, we recommend that tasks I-III be considered high priority, be initiated late this fall and the contractor's site assessment for these three tasks completed by the end of this calendar year. Task IV is of lower priority and can be initiated after the licensee's long term plans for the facility are determined.

The Technical Liaisons for the SOW are John Madera and Wayne Slawinski of my staff. The regional Project Manager for this effort is Roy Caniano.

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If you have any questions regarding the SOW, please contact Mr. Caniano at (708) 790-5612.

Charles E. Norelius, Director
Division of Radiation Safety
and Safeguards, Region III

Enclosure: Statement of Work

cc w/enclosure:
J. Martin, RIII
H. Miller, RIII
J. Glenn, NMSS
J. Austin, LLWM
J. Goldberg, OGC
F. Combs, NMSS
T. Johnson, NMSS
B. J. Holt, RIII

RIII	RIII	RIII	RIII
Slawinski/jaw	Madera	Caniano	Norelius
8/23/93	8/23/93	8/23/93	8/25

STATEMENT OF WORK

Project Title: Advanced Medical Systems, Inc., Facility Hazard/Risk Assessment

Job Code:

B & R No.:

NRC Issuing Office:

NRC Project Officer's Name/Telephone No.:

Technical Monitor's Name/Telephone No.: Wayne Slawinski/(708) 790-5618

Background

Advanced Medical Systems, Inc. (AMS) is an NRC licensee currently authorized to possess large quantities of cobalt-60 and cesium-137 for storage, training of AMS personnel in the manufacture of NRC approved sealed sources, and servicing of teletherapy devices. AMS was previously authorized to possess up to 150,000 curies of cobalt-60 in solid metal form for the fabrication of sealed sources for distribution to authorized recipients for use in teletherapy units.

The AMS manufacturing and production facility located in a combination residential/industrial area in Cleveland, Ohio was previously owned and operated for similar purposes by Picker Corporation since the late 1950's. The radioactive material use facility on London Road occupies about one quarter of a large (about 8,000 ft^2) warehouse and office building. The facility occupies portions of three floors in the building. The first floor houses a hot cell used for cobalt-60 bulk storage, source handling and sealed source fabrication; a large laboratory and hot cell support area (a.k.a. isotope shop) that includes a in-floor storage pit for long term sealed source storage; warehouse areas and two dry waste storage rooms. The second floor houses a mechanical equipment (boiler) room and a room containing the ventilation system for the hot cell. A liquid waste handling and storage area and another dry waste storage area are located in the basement.

The hot cell is highly contaminated and its storage wells contain several thousand curies of cobalt-60 bulk sealed and unsealed sources. Radiation levels measured inside the cell in 1992 ranged from about 150-1000 rem/hour and smearable contamination levels from 5-115 million dpm/100 cm^2. The form of the cobalt used by the licensee is a metallic oxide which readily oxidizes when exposed to air.

A liquid waste collection area (a.k.a. WHUT room) in the basement of the facility directly below the hot cell houses a 500 and a 100-gallon stainless steel holdup tank, previously used to collect liquid wastes generated from hot cell operations and facility decontamination activities. The tanks are likely filled near capacity and contain an estimated 200-300 curies of cobalt-60 in the form of contaminated liquid and sediment. The poured concrete floor of the WHUT room is expected to be highly contaminated with cobalt-60 sediment and residue, as a result of several overflows of the tanks over the years.

Radiation levels in the WHUT room are expected to range up to about 500 rem/hour. In 1988, the NRC authorized AMS to seal and monitor this room until radiation levels decayed to levels low enough to permit safe remediation.

A 1985 Oak Ridge Associated University (ORAU) fire protection and operational radiation safety assessment of the facility resulted in a recommendation that extensive facility decontamination be completed. In accordance with a 1987 NRC Order, the licensee remediated the site, with the exception of the liquid waste holdup area, to contamination levels suitable for continuing operations. The decontamination activities were completed in mid-1989. During the next license renewal due in late 1994, the NRC will determine whether remediation activities should commence in the liquid waste holdup tank room. In late 1988, ORAU conducted followup radiological surveys of the facility and reviewed the implementation status of the recommendations from its 1985 assessment.

In 1990, the NRC re-evaluated the fire protection program at the facility and issued a Fire Protection Safety Evaluation Report. Several upgrades to the facility were determined to be necessary to improve its fire protection capabilities.

In 1992, the NRC, with assistance from the Oak Ridge Institute for Science and Education (ORISE) and Battelle Labs reviewed concerns related to the hot cell's radiological condition and integrity of the cell's window. The review disclosed several problems related to the design of the cell and its use over the years.

In 1992 and early 1993, the ventilation/filtration system for the hot cell was redesigned and a new system installed and tested. Enhanced fire protection features were included in the redesign.

Attached to this Statement Of Work are several facility inspection and assessment reports which provide additional background information to aid the contractor. The specific attachments are listed later in this document.

The facility was built in the 1950's and has been in use for approximately 35 years without significant modifications to its equipment or structure, other than redesign of its hot cell ventilation system and improvements to certain facility fire protection features. AMS plans to continue operations and has no immediate plans to decommission the entire facility. Although no immediate threat to the public health and safety exists, a comprehensive hazard/risk assessment of the facility is necessary to determine the: (1) overall structural integrity of the facility; (2) ability of existing equipment to function as designed and as necessary for safe operations; (3) effect of previous operations on equipment and the environment beneath the facility (ground water contamination); (4) facility vulnerabilities from internal and external hazards; and (5) facility and equipment modifications necessary to alleviate or minimize risks and allow continued facility operations or long term status quo material storage.

Objectives and Scope of Work

The purpose of this project is to conduct a comprehensive hazard/risk analysis of the current AMS facility, and assess its vulnerabilities to internal and external hazards which could lead to significant releases of radioactivity to the environment. A fire protection assessment was completed by an NRC contractor in 1985 and re-assessed by the NRC in 1990. Consequently, further fire protection assessments may not be required. However, the contractor shall consider the necessity for a reassessment based on review of the previous assessment reports and modifications made by the licensee to the facility fire protection program since 1990.

This hazard/risk analysis is intended to provide valuable information on the overall adequacy of the current facility and its equipment to protect health and minimize danger to life, property and the environment, as required by 10 CFR 30.33. The results of the analysis will be used by the NRC during the facility license renewal process to support decisions regarding: (1) whether the facility can continue to be licensed for manufacturing operations; (2) license possession and use restrictions and/or limitations; (3) WHUT room remediation; and (4) facility and equipment modifications which may be necessary to control and monitor for radiological hazards and ensure the required degree of safety.

Specific tasks defined for the project are as follows:

Task I

Perform a safety assessment of the facility to evaluate its current structural integrity. The key areas of the facility which shall be included in the assessment are outlined below.

A. Liquid Waste Collection (WHUT room) and Processing (Back Basement) Areas

- Integrity of WHUT room and its two storage tanks

B. Hot Cell

- Integrity of hot cell and its viewing window

C. Hot Cell Ventilation System and Room

- Integrity of ventilation and filtration system
- Integrity of room housing the system

D. Isotope Shop

- Integrity of room and its in-floor source storage garden

Task II

Perform a hazard/risk analysis to determine the potential radiological consequences of internal and external hazards, including hazards created by natural and man-made causes. The key areas of the facility which shall be included in the analysis are outlined below.

A. WHUT Room and Back Basement

- Determine the consequences of flooding caused by natural phenomena, water line rupture and excessive leakage or rupture of the WHUT room tanks.

B. Hot Cell

- Determine the probability and consequences of excessive quantities of water entering the cell from both external and internal sources
- Determine the consequences of an internally or externally generated projectile striking the cell window

C. Hot Cell Ventilation System

- Determine the consequences of external hazards, from natural and man-made causes, significantly effecting system operability (e.g., degradation from explosion, tornado, water, etc.)
- Determine the potential for emergency generator gas line leakage or rupture and its consequences
- Determine the probability and consequences of flooding in the ventilation system room

D. Isotope Shop

- Determine the consequences of source storage garden flooding
- Determine the consequences of leaking sources in the storage garden

Task III

Perform a safety assessment to determine the effect of previous operations on safety related equipment and evaluate the radiological environment in certain areas within and beneath the facility. The key areas which shall be included in the assessment are outlined below.

A. WHUT Room and Back Basement

- Determine the extent of, if any, cobalt-60 migration into the building's foundation and floor areas beneath the WHUT room. Also, determine if cobalt-60 has migrated into the grounds beneath the WHUT room and adjacent basement areas.

- Assess the radiological environment in the WHUT room and determine its source term

B. Hot Cell

- Assess the radiological conditions in the hot cell

- Assess the physical condition of electrical and mechanical support equipment used in the hot cell

Task IV

Perform an evaluation to determine if the facility and its equipment meet, or can be modified to meet, current safety standards necessary to ensure safe operations. What facility or equipment modifications are required to alleviate or minimize both immediate and long term risks. Evaluate the need for an environmental monitoring program to detect changing radiological conditions. The areas which shall be included in the evaluation are outlined below.

A. Waste Collection and Processing

- Modifications to improve liquid waste collection, storage, monitoring and processing capabilities

- Modifications to improve solid waste collection, storage and processing

B. Hot Cell

- Modifications to improve remote manipulator reach limitations.

- Modifications to improve cell lighting problems

- Preventative maintenance needs for cell equipment

- Modifications of cell support and monitoring equipment

- Adequacy of cell air flow patterns both with and without an operable ventilation system

- Modifications to improve limitations associated with insertion and removal of materials from the cell

- Procedural development to improve cell operations

C. Other Areas

- Adequacy of hot cell ventilation and filtration system

- Adequacy of emergency generator system

- Modifications to improve change-out of ventilation system HEPA filters

- Adequacy of isotope shop's source storage garden for long term storage of sources

- Necessity for an environmental monitoring program to detect potential migration of contaminants in areas outside and beneath the facility.

Technical and Other Special Qualifications Required

Contractor(s) must possess considerable applied health physics and radiological engineering experience, including hot cell operational and decontamination expertise, and the ability to work in and evaluate hazardous radiological environments. Contractor must also possess the necessary expertise to assess the structural integrity of facilities and evaluate geologic conditions. Fire protection assessment and engineering expertise may also be required if a fire protection evaluation is deemed necessary.

Level of Effort

The level of effort for Task I is approximately one to two staff week for a civil/structural engineer. The level of effort for a 2-4 person team of health physicists, radiological engineers and technicians for all tasks is approximately one month.

Periods of Performance

The period of performance at the Cleveland, Ohio site is approximately one month and shall commence during the fall of 1993.

Meetings and Travel

NRC and contractor(s) representatives shall meet at the licensee's facility approximately one month prior to initiation of site work to discuss the project scope, milestones and degree of licensee assistance required.

The NRC will establish the meeting date and inform concerned parties at least two weeks in advance of the meeting.

NRC - Furnished Materials

Attached to this SOW are reports of previous assessments, inspections and license documents describing the licensee's facility and operations. Other necessary historical and background information will be provided to the contractor upon request.

The documents attached to this SOW are listed below:

(1) "Evaluation of the Operational Radiation Safety and Fire Protection Programs of the Advanced Medical Systems, Inc. London Road Facility, Cleveland, Ohio" Oak Ridge Associated University, December 1985

(2) Letter with attachment from Advanced Medical Systems to NRC, February 8, 1988, RE: Isolation of WHUT Room

(3) "Radiological Survey of the Advanced Medical Systems, Inc. London Road Facility, Cleveland, Ohio" Oak Ridge Associated University, February 1989

(4) NRC Inspection Report No. 030-16055/90001(DRSS), March 13, 1990. (Describes AMS facility and its equipment)

(5) "Fire Protection Safety Evaluation Report For Advanced Medical Systems, Inc. London Road Facility" NRC, June 11, 1990

(6) NRC Inspection Report No. 030-16055/91002(DRSS), August 27, 1991. (Describes hot cell ventilation system problems)

(7) Various Correspondence RE: Redesign of Hot Cell Ventilation System

- Letter with attachments from AMS to NRC, April 16, 1992
- Letter with attachments from Franck and Fric, Inc. to AMS, May 6, 1992
- Letter from AMS to NRC, June 15, 1992

(8) NRC Inspection Report No. 030-16055/92002(DRSS), November 12, 1992. (Evaluation of hot cell)

(9) NRC Inspections Report No. 030-16055/93002(DRSS), August 2, 1993. (Describes effluent release mechanisms and WHUT room isolation)

DOE - Acquired Material

The NRC Project Officer must be notified in writing when acquisition of any capitol or project related equipment is purchased or leased.

Deliverables/Schedules and/or Milestones

Brief oral reports to the Project Officer, or if unavailable, the Technical Monitor, highlighting progress for the previous week, are due by noon each Monday.

Contractor shall submit a detailed work outline for the project including a milestone chart detailing the sequence for completing various phases of the work.

Within 90-days of project conclusion, the contractor shall submit a draft report to the NRC, detailing the specific findings, conclusions and recommendations for each of the four tasks. A final report shall be issued to the NRC, as determined after NRC review of the draft report. NRC will be provided with five copies of the published deliverables.

ATTAchmenT I

Prepared by
Oak Ridge Associated Universities

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

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

EVALUATION OF THE OPERATIONAL RADIATION SAFETY AND FIRE PROTECTION PROGRAMS OF THE ADVANCED MEDICAL SYSTEMS, INC. LONDON ROAD FACILITY CLEVELAND, OHIO

G.L. MURPHY

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

FINAL REPORT
DECEMBER 1985

EVALUATION OF THE OPERATIONAL RADIATION SAFETY AND FIRE PROTECTION PROGRAMS OF THE ADVANCED MEDICAL SYSTEMS, INC. LONDON ROAD FACILITY CLEVELAND, OHIO

Prepared by

G.L. Murphy

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Prepared for

Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Region III Office

FINAL REPORT

December 1985

This report is based on work performed under Interagency Agreement DOE No. 40-816-83 NRC Fin. No. A-9076 between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Associated Universities performs complementary work under contract number DE-AC05-76OR00033 with the U.S. Department of Energy.

*Radiation Safety Officer, OSH/ORAU
**Professional Loss Control, Inc., Oak Ridge, TN

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1.0 EXECUTIVE SUMMARY

At the request of Nuclear Materials Safety and Safeguards, Nuclear Regulatory Commission (NRC) Region III, Glen Ellyn, IL, the Radiological Site Assessment Program (RSAP) of Oak Ridge Associated Universities (ORAU) performed a comprehensive evaluation of the fire protection and operational radiation safety programs at the Advanced Medical Systems Inc., (AMS) facility on London Road, in Cleveland, Ohio. The evaluation addressed policies, procedures and radiological conditions related to: organization, training, ALARA program, emergency planning, fire protection, security, facilities, equipment, waste management, material accountability, and hot cell entry/accessibility.

This section summarizes findings and recommendations as they relate to specific program areas. It should be noted that certain of the recommendations provide only one suggested approach and that there may be alternative approaches which would be acceptable. The short and long term recommendations serve only to emphasize specific concerns, and should not be considered a comprehensive listing of all recommendations.

The AMS staff was very cooperative, and demonstrated a receptive attitude for the recommendations discussed during the audit.

SHORT TERM RECOMMENDATIONS

(to be accomplished within approximately six months)

Policies and Procedures

Implement the use of a Radiation Work Permit (RWP) system which will require the Radiation Safety Officer (RSO) to authorize the work request and be present to monitor the work activity.

Implement a respiratory protection program consistant with NRC guidelines.

Staffing/Training

Improve the professional health physics capabilities by augmenting the staff or providing in-depth training.

Provide formal Radiation Protection Trairing for all employees.

Facilities

Perform a complete decontamination of the hot cell and duct system. This may best be performed by a professional decontamination firm.

Increase the single HEPA filter on the hot cell to a two stage series HEPA filter system.

Provide improved illumination in the hot cell.

Upgrade ventilation system pre-filters and holders.

Plug the basement floor drain to minimize the discharge of radionuclides to the sanitary sewer system.

Equipment

Supplement the high range measurement capabilities with an additional instrument.

Install a new frisker system in the change room.

Redesign and install a new exhaust stack sampling system.

Fire Protection

Develop and implement a fire pre-plan with the Cleveland Fire Department.

Provide automatic fire suppression systems throughout the facility (hot cell excluded).

Emergency Planning

Review and upgrade ISP-1, Emergency Action Procedures.

Initiate preliminary emergency action plans for all agencies listed in Section 1.4 of ISP-1.

Waste Management

Package and dispose of the current inventory of dry waste.

Decontaminate the dry waste storage area.

Decontaminate the liquid waste area, the batch tank, the holding tank, and associated piping. This may best be performed by a professional decontamination firm.

LONG TERM RECOMMENDATIONS

Policies and Procedures

Implement the specific recommendations contained in Section 2.4, Policies and Procedures.

Facilities

Redesign the illumination system in the hot cell to facilitate remote bulb change.

Upgrade the remote manipulators to provide access to all areas of the hot cell.

Equipment

Calibrate all portable survey instruments semi-annually; repair or dispose of non-repairable instrumentation.

Calibrate all rotameters semi-annually.

Material Accountability

Develop a new program or modify the existing material accountability program to include radioactive waste as an inventory item.

Emergency Planning

Establish written procedures for handling a potential radiation emergency.

Waste Management

Redesign the holding tank to add a level guage.

Develop contingency plans for liquid releases to the sanitary sewer system.

2.0 INTRODUCTION

2.1 Purpose and Scope

At the request of Nuclear Materials Safety and Safeguards, Nuclear Regulatory Commission (NRC) Region III, Glen Ellyn, IL, the Radiological Site Assessment Program (RSAP) of Oak Ridge Associated Universities (ORAU) performed an evaluation of the fire protection and operational radiation safety programs at the Advanced Medical Systems Inc., (AMS) facility on London Road, in Cleveland, Ohio. This evaluation was performed October 21-24, 1985 by an audit team (see Appendix A) composed of:

J.D. Berger - Certified Health Physicist, Program Manager, RSAP/ORAU

E.B. Darden - Radiation Safety Officer, OSH/ORAU

E.J. Deming - Health Physics Team Leader, RSAP/ORAU

H.E. Goranson - Sr. Fire Protection Engineer, Professional Loss Control Inc.

G.L. Murphy - Health Physicist, Assistant Program Manager, RSAP/ORAU

The NRC was represented at the evaluation by Mr. William Axelson, Chief, Nuclear Materials Safety and Safeguards and Mr. Robert Burgin, Senior Radiation Specialist.

Appendix B contains the scope of work issued by NRC for this assessment. The evaluation addressed policies, procedures, and radiological conditions related to: organization, training, ALARA program, emergency planning, fire protection, security, facilities, equipment, waste management, material accountability, and hot cell entry/access. Confirmatory measurements, onsite and offsite sampling were performed to determine the radiological status of the site and the immediate environment. The scope of work did not include evaluation for compliance with federal, state and/or local requirements.

The ORAU review incorporated appraisal methods utilized by the NRC (NUREG-0855 dated 12/81), Department of the Navy (NAVENENVSAINST 5100.1 dated 5/83), and internal health physics audit procedures developed by ORAU. The review utilized analytical "risk trees" with related questions to guide the evaluation team.

AMS personnel contacted during the review included:

S.S. Stein, Ph.D; General Manager
H.R. Irwin; Corporate Compliance Manager (Radiation Safety Officer)
D. Murray; Consultant
W. Turbett; Technician
M. Baruffa; Electronics Technician

Items of concern noted during the review were brought to the immediate attention of the facility personnel. A brief close-out presentation was made by Mr. Murphy on the afternoon of October 24, identifying those areas where major deficiencies or potential problems were felt to exist.

2.2 Site Description

Advanced Medical Systems, Inc., at 1020 London Road (Figure 2-1), is located in an industrial/residential area of Cleveland, Ohio, and occupies the former Picker Cobalt Teletherapy facility.

AMS occupies three floors on the southeastern end of a large warehouse/manufacturing building (Figure 2-2). The main floor includes an office area, an isotope shop area, a hot cell, a shielded work room, a storage area and miscellaneous unoccupied areas. The basement includes dry and liquid waste storage facilities, air sampling equipment and other unoccupied space. The second floor includes additional office space (unoccupied), exhaust ventilation equipment room, and a mechanical equipment room. AMS occupies approximately 25% (21,000 ft^2) of the total building space (approximately 85,000 ft^2).

AMS is licensed by the NRC to possess up to 300 kCi of Co-60, 40 kCi of Cs-137 and 9,000 pounds of depleted uranium. License number 34-19089-01 authorizes AMS to perform research, development, and processing of sealed sources for distribution to authorized recipients; to install, dismantle, service and maintain Picker Corporation and AMS teletherapy units, and Picker radiography units; to remove, install or exchange sources in Picker Corporation, AMS Inc., and Keleket Barnes teletherapy equipment; to develop and demonstrate equipment containing sealed sources; and to leak test sealed sources installed in Picker Corporation and AMS, Inc. devices.

2.3 Administration and Organization

Management of the AMS London Road facility is under the direction of S.S. Stein, Ph.D, General Manager (Figure 2-3). Mr. H.R. Irwin is the Corporate Compliance Manager (Radiation Safety Officer), and reports directly to the General Manager. Other full-time employees are B. Turbett, technician and J. Powell, secretary. Other AMS - Geneva, Ohio, employees may visit the London Road facility as necessary. (Reference to the AMS facility in this report will refer to the London Road site, unless specifically noted otherwise.)

2.4 Policies and Procedures

Policies and procedures are documented in the AMS Operating Procedures Manual (OPM) (Rev: 8/1/85). Many of these procedures have been adopted from Picker, Inc., the facility predecessor. Chapter 1, Emergency Action Procedures, of AMS OPM is reviewed in section 9.0, Emergency Planning, of this report. Chapter 2, Description of the Isotope Facility, is reviewed in section 4.0, Facilities, of this report. Chapters 3 through 8 and Appendix A are reviewed in this section on an individual item basis.

Recommendations

Chapter 3 - "Safety and Health"

- Items 3.1.1.a (restricted working air sample), c. (hot cell air sample), d. (shipping container wet smear), and e. (personal body contamination check) do not refer to the specific procedure for performing tests, surveys, or checks. These should reference specific procedures, i.e. ISP 2, ISP 15, etc., in the operating procedures manual.

- 3.1.2.a Personal dosimeters should be read at numerous intervals throughout the day, to minimize the possibility of an off-scale reading.

- 3.1.5.d The wrist badge should be replaced with a finger ring, and the ring should be worn continuously within the plant.

- 3.1.7.a All survey instruments should be calibrated at intervals not to exceed six months.

- 3.2.3 Bioassy - Whole body counting for internal exposure should be related to actual work time and air concentrations in correlation with radiation protection guides. The frequency can be formulated and presented to the NRC for concurrence. There is no obvious correlation between whole body exposure and need for whole body counting.

- 3.2.5 Air Sampling Instrumentation - Redesign the entire air sampling system per the recommendation from section 5.0, Equipment.

Chapter 4 - "Procedures for Handling Radioisotopes"

- 4.2.2.b <u>Entering the liquid waste storage room</u> - Use a calibrated high range ion chamber for surveying (minimum 20 R/h recommended).

- 4.3.2.a <u>Cell and Decontamination Room</u> - Complete anti-contamination dressout (disposable jump-suit, gloves, boots, and head gear) should be required. All open seams or junctions (glove/sleeve) should be taped off. Full-face respirators should be utilized.

- 4.3.2.b <u>Liquid Waste Storage & Processing Room</u> - Complete anti-contamination dressout (disposable jump-suit, gloves, boots, and head gear) should be required. All open seams or junctions (glove/sleeve) should be taped off. Full-face respirators should be utilized.

Chapter 5 - "Storage of Isotopes"

- No recommendations.

Chapter 6 - "Transportation of Isotopes"

- No recommendations.

Chapter 7 - "Monitoring"

- Personnel monitoring is provided by whole body film badge changed weekly, and wrist film badges changed monthly.

- 7.2.b Change the wrist badge to a finger ring and require it to be worn at all times within the facility.

- 7.2.c Implement the use of an RWP system, which will require the RSO to authorize the work request and provide health physics surveillance. The RSO should not engage in the work activity, but should monitor/manage the work. The RWP would require complete pre-planning of the operation, pre-operation monitoring of 1) dose rates, 2) contamination levels, and 3) air concentrations, time estimation for work, projected dose to individuals, a review of the operation to reduce the dose, and a review of the completed operation and dose records to determine if ALARA conditions were met.

Chapter 8 - "Contamination Control & Waste Disposal"

- 8.1.1 <u>Action in the event of a spill</u> - This should be amended to require that a leak or spill be confined if possible.

- 8.1.3.a <u>Area Decontamination - Non-Expendable Equipment</u> - Redefine the wipe area to be the "standard" 100 cm^2 (approximately 15.5 $in.^2$), and adjust the action level to the appropriate value.

ISP-2 Revision A - "Meter Survey Procedure"

- ISP-2A Should be revised to include the action level for each area listed (occupied vs. non-occupied). The reverse side of the form could be used to note any corrective action taken, and the survey results of the action.

ISP-3 Revision A - "Wipe Survey Procedures"

- 5.1.2 The wipe area should be 100 cm^2 (approximately 15.5 $in.^2$) instead of 1 $ft.^2$

- 5.2.1 Action limits should be set in terms of disintegrations per minute (DPM) and referenced to specific criteria. For example, 50,000 cpm on 1 $ft.^2$ corresponds to 5,555 cpm on 100 cm^2. Using the efficiency and background of the isotope shop area (ISA) well counter this would correspond to approximately 100,000 dpm, which is considered excessive by the audit team for any area in the ISA.

- 5.2.2 <u>Uncontrolled Areas</u> - Same general principle as above. The action limits should be re-evaluated and submitted to NRC for approval.

ISP-4 Revision A - "Well Counting Procedures"

- 5.4 and 5.6 Determine the minimum detectable activity (MDA) needed to ensure that the guidelines or criteria have been met, then select the appropriate counting time for the sample.

- 5.7 The activity calculation should also include, as a minimum, the associated error based on counting statistics.

ISP-5 Revision A - "Daily Check List"

- No recommendations.

ISP-6 Revision A - "Semi-Monthly Checklist"

- No recommendations.

ISP-7 Revision B - "Monthly Checklist"

- No recommendations.

ISP-8 Revision A - "Air Monitor System Check"

- 5.6.2 Use the new flow rate as prescribed by the new stack sampling system.

- Calculate the MDA for the system based on the counting time needed to meet the NRC air concentration release limits. Calculate the associated error based on counting statistics. Report either MDA, or the calculated concentration and its associated error based on counting statistics.

ISP-9 Revision A - "Air Monitor Calibration"

- No recommendations.

ISP-10 Revision A - "Hot Cell Air Samples"

- The same calculation recommendations in ISP-8 apply.

ISP-11 Revision B - "ISP Air Samples"

- 5.2 Based on a one month sample period, the background and efficiency from the ISA well counter (10/22/85), the sample would have to be counted for 71.8 minutes to determine if the net activity exceeded 9×10^{-9} μCi/cc of air. This counter should be used to screen the sample, then forward it to the well counter in the unrestricted area for final analysis.

- 5.3 This section refers to "discharged air". This procedure calculates the air concentration for the ISA over a given period of time and does not directly reflect the concentrations of the "discharged air".

ISP-12 Revision A - "Release of Liquid Waste into the Sanitary Sewage System"

- 5.3 Modify this section to require continual agitation of the water during the disposal process, otherwise settling may occur and Co-60 may buildup in the batch tank.

ISP-13 Revision B - "Emergency Generator Battery Check"

- No recommendations.

ISP-14 Revision B - "Entering the Hot Cell"

- No recommendations.

ISP-16 Revision C - "Radioisotope Container Receiving Procedure"

- Change ISP-6A to reflect the contamination check area as the "standard" 100 cm^2 instead of 1 sq. ft.

ISP-17 - "ALARA Program Revision"

- Item 5.d. suggests that when necessary, a new higher action level II can be enacted. This is not in accordance with good ALARA practice. Action levels should be realistically determined for general situations, and should not be allowed to fluctuate based on the need to expose an individual. This item should be eliminated from the ALARA Program.

- A functional ALARA Program should work to reduce high radiation areas, excessive surface and airborne contamination, and potential for release of radionuclides to the environment. Several practical steps could be taken (reduce solid and liquid waste volume, reduce HEPA filter contamination, decontaminate the hot cell and decontamination room, etc.) to establish a sound functional ALARA Program.

ISP-18 Revision 0 - "Radiation Exposure Level Evaluation"

- 3.0 Change wrist badge to finger ring, because the fingers are often exposed to higher radiation levels than the wrist.

- 4.1 Air samples should also be taken separately as the work is performed.

ISP-19 Revision A - "Cobalt 60 Encapsulation"

- 5.1.1 The worksheet identified as "attached" should be given an ISP-19 Number.

ISP-20 Revision A - "Preparation of Used Sources for Resale"

- No recommendations.

ISP-21 thru 27 - Not defined in Appendix A.

ISP-28 Revision B - "Packaging & Labeling Depleted Uranium"

- No recommendations.

ISP-29 thru 1001 - Not defined in Appendix A.

ISP-1002 Revision A - "Leak Test for Sources Installed in Teletherapy and Industrial Radiography Systems"

- 5.3 ISP-1 does not specifically address leaking sealed sources. This specific item (Leak Testing of Sealed Sources) should be added as part of Chapter 1 under a separate heading.

ISP-1003 Revision A - "Packaging & Labeling Depleted Uranium"

- All sections of this ISP are identical to ISP-28 Revision B, dated 10/23/84, except items 5.5.1 and 5.5.2. Either ISP-1003 Rev. A or ISP-28 Rev. B. should be deleted from the manual.

The following ISP procedures were reviewed as a part of the November 1984 license renewal application; they were not provided as a part of the OPM.

ISP-26 Revision A - "Depleted Uranium Handling Procedure" (Attachment 10.4 of 1984 license renewal application)

- No recommendations.

ISP-27 Revision A - "Emergency Procedures for Depleted Uranium"

- This procedure should be modified to note that Uranium metal is pyrophoric and can be extinguished only with type D fire extinguisher or equivalent equipment.

ISP-30 Revision 0 - "Instructions to Drivers When Transporting Radioactive Materials"

- No recommendations.

ISP-31 Revision D - "Calibrating Radiation Detection Instruments"

- 7.1 The instructions for selecting appropriate distances for using the TECH/OPS calibrator should be incorporated into this section of ISP-31.

- 8.0 Procedures for the use of the commercially available personal dosimeter calibrator should be incorporated into this section of ISP-31.

Miscellaneous Findings

- Several procedures refer to the use of respirators (half-face dual cartridge were available) as required equipment. AMS does not have an approved respirator use program in effect, nor is there a written policy statement on respiratory usage.

- A respirator hanging in the ISA was found to be contaminated. The two type H cartridges were returned to the RSAP lab for analysis. Although significant surface contamination was present, the filter media was also contaminated. (See Results in section 11.0, Site Survey).

Recommendations

AMS should establish a respiratory protection program consistant with NRC guidelines. USNRC Regulatory Guide 8.15 (October 1976) (or ANSI Standard Z88.2-1980) outlines acceptable programs for respiratory protection (see Appendix E). The program should address, as a minimum, the following elements:

1. A strong management committment to respirator usage;

2. Identification of the individual responsible for the program;

3. A method for evaluating program effectiveness;

4. A program to ensure proper respiratory equipment fitting;

5. Preparation of procedures covering equipment, issuance, maintenance, use, training, and qualification; and

6. A maintenance program for inspection, testing, repair, decontamination, and disinfection of respirators.

2.5 Environmental Surveillance Program

Findings

- No environmental surveillance program is in operation.

- Air and liquid effluent releases are routinely monitored at the point of discharge.

- Environmental exposure-rates are not routinely measured.

- Environmental exposure-rates were measured at several locations around the facility. (See Section 11.0, Site Survey for results).

Recommendations

Quarterly exposure-rate measurements on the roof and inside the fence line should be performed.

No environmental surveillence program is recommended at this time.

3.0 STAFFING/TRAINING

Findings

- The AMS facility had only two full-time personnel on staff at the time of the audit. The secretary had no background or training in radiation protection or industrial safety; the technician (employed less than two months) has a mechanical background and an eight weeks electronics course. The technician had no formal training or experience in radiation protection or industrial safety.

- AMS utilizes the services of a consultant on an as-needed basis for hot cell and other related work requirements. The consultant, a previous Picker employee at this facility, has at least 15 years experience in hot cell work, sealed source fabrication, source exchange and other radiation related projects. The consultant has some formalized training in radiation protection from previous employment.

- AMS provides a radiation protection training session as a part of the field engineer training course.

- The RSO is located in Pittsburgh, PA and visits the AMS London Road facility weekly. The RSO has a B.S. in Chemistry from Carnegie Mellon Institute (Pittsburgh, PA), but has no formal training and minimal experience in radiation protection.

- Other personnel from the AMS Geneva facility have been utilized on an as-needed basis for hot cell entries, decontamination work, high radiation area entry, waste handling, etc. These personnel have attended in-house training sessions on radiation protection, and have passed written exams.

  Example: Sr. Electronics Technician - Two year Associate degree in electronics. Approximately two days formal in-house training in radiation safety procedures, instrumentation, and ALARA practices.

- There is currently no employee of AMS qualified to perform radiation protection training.

- The RSO appears to have an open, receptive attitude, and an eagerness to increase basic knowledge and improve health physics practices where appropriate.

Recommendations

All full-time employees and occasional or consultant labor should participate in a formalized Radiation Protection Training Course. The training should be documented and re-training should be provided on an annual basis. The training program should be implemented as soon as possible. A list of possible training courses is provided in Appendix C.

Improve the professional health physics capabilities by augmenting the existing staff, or providing in-depth training for the RSO (basic and advanced course).

The RSO should be required to be present at the site to monitor any activity requiring an RWP:

a. entry into a "high radiation area";
b. hot cell entry;
c. HEPA filter change out;
d. radioactive waste packaging;
e. radioactive waste shipment.

4.0 FACILITIES

Findings (Figures 4-1 through 4-3)

- The licensee has designated restricted/unrestricted areas; however, the NRC designates the entire facility as a restricted area, since all access is limited 24 hours a day by lock and key. The restricted areas in the facility are adequately marked and secured to prevent unauthorized entry.

- Exposure-rate levels in the licensee designated areas were generally less than 1.0 mR/h, with a maximum of 220 mR/h (see Section 11.0 Site Survey for results). Twenty-nine of 41 areas were less than 1.0 mR/h, 6 areas were between 1.0 and 2.0 mR/h, and 6 areas exceeded 2.0 mR/h.

- Traffic patterns are designed to minimize entry into the restricted areas.

- Entry into the airlock is controlled by key and door lock out system. If the ISA doors are open, the warehouse or hallway doors cannot be opened or vice versa. This isdesigned to minimize introducing potentially contaminated air into the unrestricted areas.

- The ISA is maintained under negative pressure with respect to the unrestricted areas, by supplying more air to the unrestricted areas, than is removed.

- The hot cell is maintained under negative pressure with respect to the ISA and the unrestricted areas, and measured 0.11 inches of water on the manometer.

- All drains within the restricted area (with the expection of the toilets and basement floor drain) are piped into the liquid waste collection system.

- The hot cell is 6 feet square inside with a height of approximately 10 feet, and has 5 1/2 feet thick concrete walls and 4 feet thick concrete floors and ceiling. The floor pan is stainless steel and the walls are lined with 1/4" steel plate to a height of 11 feet. The cell is accessed at the rear through a 42 ton hinged door. Cell observation is provided by a 5 foot glass and zinc bromide solution window. Remote operations are possible using a pair of Model 8 manipulators and a two-ton overhead crane. Normal cell operations do not require entry into the hot cell.

- The Model 8 manipulators can reach most of the cell area, but not the cell floor.

- The cell is illuminated by 3, glass-enclosed, mercury vapor lamps. Two bulbs are burned out, and the other is very dim, significantly reducing the illumination level.

- Portable spotlights are presently being used in the cell, but are susceptible to breakage.

- Access to the hot cell from the ISA is via two straight-thru ports in the cell wall. The only other access is through the 42 ton hinged door which serves as the rear (west) wall of the cell. The limited size of the access ports do not permit the exchange of equipment, filters, waste, etc.; this restriction requires opening the cell door to exchange any object over 4" in diameter.

- The cell door is interlocked by a switch located at the door, and a second switch located at the cell controls. Release of either switch stops the door movement. The dual switch system limits single person entry into the hot cell, and requires an individual in the cell control area to assist in cell door opening.

- Storage facilities within the cell are provided by two lead containers inserted in steel sleeves in the floor.

- Radiation levels in the hot cell due to unsealed sources (contamination and loose pellets) are high, resulting in excessive personnel exposure during cell entry.

- Two exhaust ducts in the hot cell are connected to a HEPA filter system. One duct was pre-filtered using a regular furnace-type filter, the other duct did not contain a pre-filter.

- The hot cell pre-filter is held in place by screws which require cell entry for change-out.

- The ISA and the hot cell have once through airflow directed to a HEPA filter system. The air flow pattern is from the unrestricted areas through the ISA to the HEPA system, and through the decontamination room through the hot cell to the HEPA system.

- The doors to the decontamination room are interlocked such that, opening the doors increases the hot cell fan speed, and diverts the the decontamination room supply air to the ISA.

- The blowers and HEPA filter system are located on the second floor directly above the hot cell.

- The hot cell is exhausted through a single HEPA filter into a common exhaust stack. The ISA exhausts through a "2 x 2 array" of HEPA filters into a common exhaust stack.

- The exposure-rate outside the restricted area exhaust ventilation room exceeds 80 mR/h in some areas, due to contamination on the HEPA filter. During the audit the exposure-rate at the hot cell filter was 3.0 R/h. These exposure-rates are excessive, and severely limit the time accessibility to this room for routine maintenance (generator, battery checks, etc.).

- The exhaust stack for restricted areas of the facility extends approximately 15 feet above the roof line, directly above the exhaust ventilation room.

- The radiation level on the roof, in the vicinity of the stack ranges from approximately 30 mR/h at waist height to a maximum of 300 mR/h directly over the small HEPA filter.

- The radiation levels in the vicinity of the exhaust maintenance room increase as the contamination on the HEPA filter increases.

- The rooftop exhaust stack area is placarded as a "High Radiation Area" but the physical boundaries are not clearly defined.

Recommendations

Changing the pre-filters used in the ISA and hot cell to a dry and spun-glass filter, will reduce the contamination of the HEPA systems. These pre-filters will remove a larger percentage of smaller diameter particulate material. Changing these filters more frequently will reduce personnel exposure, and should increase the useful lifetime of the HEPA system.

Redesigning the pre-filter holders in the hot cell to permit manipulator replacement of the pre-filters will reduce personnel exposure during filter change.

Install a pre-filter over the open duct in the hot cell, until the filter holder design can be changed. This will reduce contamination of the hot cell HEPA filter, increase its useful lifetime, and reduce personnel exposures during filter system maintenance, emergency battery test, or other activities in the surrounding area.

Improve hot cell illumination by replacing the burned-out bulbs. Also, change the bulb assembly design to permit remote changing of bulbs.

Upgrade the remote manipulators to provide access to all areas of the cell.

Perform a complete decontamination of the hot cell and duct work, to reduce the exposure levels as low as reasonably achievable for future hot cell entry. This work may best be performed by a professional decontamination firm.

Changing the single HEPA filter on the hot cell to a two-stage, series HEPA filter system will reduce the risk of off-site releases in the event of filter rupture.

On an annual basis, perform a smoke-test throughout the facility to verify proper air flow patterns are in effect.

5.0 EQUIPMENT

5.1 Portable Monitoring Instrumentation

Findings

- The following portable monitoring/surveying/detecting instrumentation was operational and calibrated on the dates of the audit:

  5-Victoreen model 491 w/30 mg/cm^2 GM detectors (range 100 mR/h) (Serial #1851 - had low battery indication)

  1-Eberline Radtad (Chirper)

  1-Victoreen Digital Chirper

  1-Eberline PIC 6A Ion Chamber (range 1000 R/h)

  1-Nuclear Associates Mini-monitor II (range 1 R/h)

- The following portable monitoring/surveying/detecting instrumentation was operational but out of calibration:

  2-Nuclear Associates Mini-monitor II (range 1 R/h)

- The following portable monitoring/surveying/detecting instrumentation was non-operational:

  5-Victoreen model 491 with or without detectors

  2-Victoreen Thyac II

  4-Victoreen Model 592-B

  2-Victoreen Thyac I

3-DCA digital alarming dosimeters model 1888 (range 10 R)

1-Eberline E-510G (internal GM tube) (range 1 R/h)

1-Nuclear Associates Mini-monitor II (range 1 R/h)

1-Eberline Radtad (chirper)

- Several portable instruments were in field use at the time of the audit. Their operational state and calibration accuracy were not verified by the audit team.

- Instrument calibration for GM survey meters and ion chambers are performed at six month intervals, or prior to use if the calibration date has been exceeded.

- GM meters are calibrated with a 2 mg Ra-226 source. Ion chambers are calibrated using a Tech/OPS Co-60 calibrated reference source.

  Ra-226 2.02 mg U.S. Radium Corporation
  Co-60 15 mCi 7/31/78 Tech/OPS
  Ra-226 approximately 2.0 mg Picker Model 540

- The instrument calibration room has storage areas set aside for calibrated instruments, non-calibrated instruments, functional and non-functional instruments. This appears to be an effective system to monitor instrument status.

- Several instrument calibration stickers had inaccurate calibration due dates. These were noted and corrected immediately.

- The instrument calibration sheets were reviewed. All current sheets appear complete, and were signed and dated.

Recommendations

Change the instrument calibration requirement to semi-annual regardless of use history. If the instrument is operational, it should be calibrated. This will prevent an individual from "grabbing" a functional instrument which may not be calibrated.

Repair all non-functioning instrumentation or dispose of non-repairable items.

Calibrate all portable instrumentation with the Tech/OPS Co-60 source.

Add a second Eberline PIC 6A or other high range ionization instrument for backup when the current unit is out for calibration or down for repair.

5.2 Personal Dosimeters

Findings

- The following dosimeter chargers operated properly:

  7-Victoreen model 561-A

  2-DCA chargers

- The following pocket dosimeters were operating properly and within calibration:

  3-Victoreen 5R Chambers
  5-Victoreen 1R Chambers
  4-Victoreen 200 mR Chambers

- A DCA dosimeter calibrator was stored in a cabinet in the cell control area. This unit contains a nominal 10 μCi Cs-137 source calibrated 2/26/85.

- ISP 31-C section 8.0, in the Operating Procedures Manual, gives three acceptable methods for pocket dosimeter calibration. Item 1 references outside vendor; item 2 references commercial dosimeter calibrator; and item 3 utilizes procedure 8.1 through 8.5.

Recommendations

Expand section 8.0, ISP 31-C to include procedures for use of the commercial dosimeter calibrator.

5.3 Fixed Instrumentation

Findings

- The ISA uses a Picker Spectroscaler IIIA with a NaI(Tl) well detector for smear and other sample analysis. The scaler is located in the cell control area but is visible from the ISA, while the well detector is located in the ISA. The start count function can be operated from the ISA. The detector is shielded on the bottom and sides by 4" lead. Functional tests performed during the audit:

  HV - 1100 volts
  Background - 7352 counts/5 min = 1470 cpm
  Co-60 standard - 9902 cpm
  Co-60 activity - 2.54 E5 γ/min
  Efficiency - 3.31%

- A Picker Spectroscaler 4 with a NaI(Tl) well detector is used to count smears and other samples in the unrestricted area of the facility.

  Functional tests performed during the audit:

  HV - 1200 volts
  Background - 77 cts/5 min = 15.4 cpm
  Co-60 standard - 3261 cpm

Co-60 activity - 2.32 E5 γ's/min

Efficiency - 1.40%

- A Picker 600049 Labmeter with a 30 mg/cm^2 GM tube is used as a frisker for exiting the ISA.

- A Victoreen model 500 electrometer with a 0.33 cm^3 chamber is used for monitoring hot cell operations. The range of this instrument is 0-2000 R/min. The instrument was operational and calibrated at the time of the audit.

- A Victoreen model 500 electrometer with a 3.33 cm^3 dosimeter calibrated for Co-60 was used by the audit team to survey the hot cell and evaluate the calibration of the AMS unit. The cross check data indicated the AMS unit was within 4% of the ORAU unit. This is considered satisfactory.

- Tech/OPS model 492 Gamma Alarms are used as area radiation monitors. The units in the second floor equipment room and the cell control area are set to alarm if the exposure rate exceeds 2 mR/h. The units in the ISA and the shielded work room are set to alarm if the esposure rate exceeds 5 mR/h. The Tech/OPS area radiation monitor in the shielded work room was turned off at the time of the audit, because the exposure rate in this room exceeded 5 mR/h. The room is temporarily being used as a waste storage area. The alarm set points an each unit are checked monthly using a Ra-226 source. The records were checked for the current calendar year, and appear to be complete.

- The exhaust stack air sampling station, located in the basement uses a Picker 600049 Labmeter with GM detector to monitor the air filter.

Recommendations

The ISA well counter should be used as a screening device only. The high backgrounds in the ISA give a minimum detectable activity of 5444 dpm using the counting procedures described in ISP-3 (i.e. a 1 minute count).

Replace the Picker frisker used in the change room, with an audible alarming, AC operated, battery back-up ratemeter, with a thin window, pancake style GM detector. New models available provide more dependable operation, and the thin window GM tube will improve sensitivity. A backup scaler and detector should also be purchased.

Make arrangements with Victoreen to provide secondary instrument support for the model 500 electrometer during re-calibration or down time for repair, in the event cell operations are ongoing.

5.4 Air Monitoring

Findings

- Two fixed, general area, air sampling stations are located in the ISA (Figure 5-1). The vacuum for these stations is supplied by a common pump shared with the exhaust stack air sampling station in the basement.

- Each station flow rate is individually monitored by a rotameter. The prescribed rotameter settings are 10 lpm. Both rotameters were within 0.5 lpm of the prescribbed setting.

- The rotameters are not being calibrated on a regular schedule. There are no records from recent history to denote any rotameter calibrations.

- An open-end filter holder has been mounted on a semi-flexible copper tube for remote air sampling of the cell, decontamination room, or other areas as needed.

- The stack sampling system (Figure 5-2) is composed of a stack probe, sample line, flow meter, filter system and pump.

- The existing drawings indicate at least 70' of sample line from the probe on the roof to the filter paper in the basement. The sample line changes from 1" to 3/4" pipe during the piping run; the sample line contains a minimum of 8 right-angle bends between the probe and the filter. The flow meter is placed in the line between the probe and the filter. The flow meter is measuring the flow from the fixed air stations in the ISA as well as the stack sample flow.

- The stack probe design is not compatible with ANSI stack sampling recommendations, and the air is not isokinetically sampled from the stack.

- The prescribed stack sample flow rate was 5 cfm and the indicated flow rate was 6 cfm at the time of the audit; however, this includes the flow rate from the two ISA fixed stations.

- The stack is sampled continuously, with a monthly filter change. The filter loading has been assumed to be negligible.

- Air samples were collected from the stack, hot cell, decon room and ISA; the results are reported in Section 11.0, Site Survey.

Recommendations

Calibrate all air sampling flow meters semi-annually.

The stack sampling system and procedure should be redesigned to incorporate the following:

1. Design and install an isokinetic sampling probe. Refer to the ANSI Stack Sampling Guide for proper sample probe selection and installation.

2. Mount the filter paper holder as close to the stack as possible.

3. Mount the rotameter as close to the filter holder as possible.

4. Install separate vacuum pumps and flow meter set-ups for the ISA stations and the stack sampling system.

5. Change the filter paper sample media to 0.8 μm millipore paper. Monitor the filter loading by change in rotameter flow.

6. Record beginning and ending flow rate to document filter loading and change out frequency.

6.0 MATERIAL ACCOUNTABILITY

Findings

- Radioactive material inventory is maintained on a time-share computer.

- Whenever an inventory request is made, the printout reflects the activity on hand corrected for decay to the current date.

- The radioactive material on hand is in the form of solid metal Co-60 (pellet form), or manufactured Co-60 sealed sources (wafer, customer owned, competitor owned, or pellet form), cesium-137 sealed sources, and depleted uranium.

- The radioactive material inventory does not include waste materials.

- Inventory as of 10/01/85:

	On Hand	License Limits
Co-60	175414 Ci	300000 Ci
Cs-137	6403 Ci	40000 Ci
Depleted Uranium	3682 #	9000 #

Recommendations

Modify the computer program to include radioactive waste in all forms (liquid, solid, contamination, packaged (ready for shipment), etc.), or develop a separate program to track radioactive waste inventories.

7.0 SECURITY

Findings

- Building security is provided by ADT Security Systems, Cleveland, Ohio.

- Inspection of the active security system was difficult, because outdated wiring and detection devices are still in place.

- Monitoring of unauthorized building entry is provided by security tape on glass, magnetic door sensors, ultrasonic motion monitors, and infra-red photoelectric beam systems. Tripping any of the above devices results in an alarm at ADT Security Services, as well as visual and audible alarms on the control panel in the cell operations area.

- An alarm at ADT Security Services initiates the following action:

  1. Notify police of alarm and probable cause (unauthorized entry, fire, etc.)

  2. Dispatch an ADT security team to the site.

  3. Notify AMS personnel on the Emergency Call list.

- ADT Security Services have been instructed not to enter the AMS facility unless accompanied by AMS personnel.

- Six safety/monitoring devices, installed by ADT, are connected to the cell operations master alarm panel. These devices, which provide redundancy, are:

  1. Cell temperature alarm - if temperature in cell drops below 42°F or rises above 85°F.

2. Cell exhaust fan alarm - fan shut down; sudden pressure drop across HEPA filter (filter rupture); improper filter pressure (broken belt, clogged filter, etc.); excessive radiation detected in stack air filter.

3. ISA exhaust fan alarm - fan shutdown; sudden pressure drop across HEPA filter (rupture); improper filter pressure (broken belts, clogged filter); excessive radiation detected in stack air filter.

4. Stack filter monitor alarm - excessive radiation on filter paper or monitoring equipment inoperative.

5. Supply air fan alarm - a thermostat in the air intake will trigger an alarm if the duct temperature sensed <u>after</u> the heaters, drops below 50°F.

6. Emergency generator alarm - signal given on power failure.

° At a maximum of three years, or at the request of AMS, ADT Security Services performs a comprehensive facility review and recommends appropriate modifications to the existing security plan. The last ADT review was approximately July 1984.

° ADT inspects the burglar alarm system every one to two years.

° AMS personnel are not familiar with the type of burglar alarm system currently in operation.

Recommendations

None

8.0 FIRE PROTECTION

Findings

- The review of the AMS Fire Protection program was conducted by Harvey Goranson, P.E., with Professional Loss Control, Inc., Oak Ridge, TN. The evaluation is presented in Appendix F.

- The Cleveland Fire Department lacks basic knowledge of the operations of the AMS facility, and the potential risks associated with responding to an incident.

- The hot cell contains no form of fire suppression system.

- Several areas of the facility are not covered by fire detection devices.

- Other areas of deviation from NFPA standards and good fire protection practices are documented in the attached report.

Recommendations

AMS should develop a fire pre-plan with the Cleveland Fire Department.

Automatic fire suppression should be provided throughout the facility (hot cell excluded). Acceptable suppression systems would include:

1. Wet pipe sprinkler system;

2. Preaction sprinkler system with heat detector activation;

3. Wet pipe system utilizing "on-off" sprinklers which will stop the flow of water below a prescribed temperature;

4. Total flooding Halon 1301 extinguishing system.

Hot cell fire suppression can be provided through a hose line from the cell faucet, or an open can of dry chemical. Either system could be manipulated using the remote manipulator arms.

Separate the presently occupied areas of the facility from unoccupied areas by three hour rated barriers.

Require ADT Security Systems to inspect, repair, and replace loose or painted heat detectors or loose pneumatic tubing; and, extend the heat detection system to second floor offices and mechanical equipment room.

Removal all oil spillage from the basement floor. Relocate and/or redesign the vacuum pump system in the basement. An oil collection pan with absorbant should be used to trap pump exhaust.

Relocate the natural gas line to the second floor emergency generator to the outside of the building, and the natural gas line through the airlock to the warehouse.

Upgrade the safety features on the mechanical room boiler to NFPA '85A standards. (Actual specifics addressed in Appendix F.)

Provide Halon or type B/C portable extinguishers in the ISA and the first floor office area.

The recommendations for the balance of the plant areas are addressed in section 5.0 of Appendix F.

9.0 EMERGENCY PLANNING

Findings

- The organization chart (Figure 2-3) does not designate personnel to be notified in case of emergency. However, ISP-1, Chapter 1 addresses emergency action procedures and personnel notification.

- Radiation hazards are addressed to:

  Howard Irwin, Radiation Safety Officer
  Seymour Stein, General Manager

- ISP-1 also addresses general fire or explosion precautions and actions.

- The emergency action plans do not give adequate guidance for contacting the appropriate agency or institution in the event of:

  1. Fire
  2. Explosion
  3. Burglary
  4. Personnel contamination with or without injury.
  5. Possible ingestion or inhalation of radioactive materials.

- The following agencies, listed in section 1.4 of ISP-1 were contacted to determine the status of emergency action plans:

Agency/Institution	Individual Contacted	Status
Cleveland Police Dept.	Patrolman Healy (Badge #593) (216) 623-5005 11/12/85	Plan in effect for Police/Fire/Utilities Emergency Medical Services. Contents of plan & issue date were classified, and were not released.

Agency/Institution	Individual Contacted	Status
Cleveland Police Dept.	Sgt. Regete (Local London Road District) 11/12/85	No knowledge of any plan.
Cleveland Fire Dept.	Cpt. J. Esper 10/22/85	No knowledge of any plan.
Hillcrest Hospital	Gail Bassick Director of Legal Affairs 11/12/85	No knowledge of any plan.
Huron Rd. Hospital	Jeff Moebius Assistant Vice President 11/12/85	No knowledge of any plan.

- The phone number for the Huron Road Hospital is incorrectly listed:

  as reads: 761-6111
  should read: 761-3300

- The emergency action procedures do not clearly outline steps to evaluate contamination nor dose rates arising from emergency situations.

- There is no established check point where radiation survey equipment can be readily accessed in the event a fire or explosion renders the AMS building inaccessible.

Recommendations

Review and upgrade ISP-1 to present explicit instructions on who to contact in the event of an emergency, what action to take, what equipment should be accessible, etc. Emergency planning information can be obtained from:

Robert C. Ricks, Program Director
Radiation Emergency Assistance Center/Training Site (REACTS)
ORAU/MHSD
150 E. Vance Road
Oak Ridge, TN 37830
(615) 576-3130

Department of Emergency Preparedness
Perry Nuclear Plant
Cleveland Electric Illuminating
10 Center Road
North Perry, Ohio 44081

Initiate preliminary contacts/arrangements with all agencies listed in ISP-1, section 1.4, to advise them of the potential hazards associated with the AMS facility, general procedures for responding to an emergency at the facility, and who to contact at AMS if they are asked to respond to an emergency at the facility.

Establish definitive procedures for handling a potential radiation emergency. For example:

1. Take immediate action to protect life and property.

2. Report the emergency to:

   Name Phone # Home Phone

3. Contact appropriate outside emergency group:

Agency	Person to Contact	Telephone #
Fire	________	________
Police	________	________
Emergency Medical Services	________	________
Hospital Name	________	________

4. Contact outside consultant if available.

The individual making the call should be able to clearly and concisely define the scope of the emergency:

1. Location;

2. Type of emergency (Fire, Explosion, etc.);

3. Radiation levels;

4. Contamination present;

5. Contaminated victims present (internal, external, potential hazard to medical personnel, etc.);

6. Possibility of airborne contamination;

7. Monitoring instrumentation is/is not available at the site, etc.

Establish a set of monitoring equipment available at a nearby, but remote location, to assist in monitoring the site or personnel, in the event access to the equipment located in the building is limited or impossible.

10.0 WASTE MANAGEMENT

Findings

- The responsibility for waste management is assigned to Howard Irwin, Radiation Safety Officer.

- The waste management program has been neglected for a period of time, allowing dry waste to accumulate to excessive volumes with associated high radiation levels.

- Low level dry waste, generated in the ISA is compacted using a home-type trash compactor.

- Radioactive waste is stored in the basement beneath the ISA/hot cell area. The waste is not stored in proper packaging or clean tight containers. HEPA filters from past changeouts are still stored in the basement area.

- AMS is packaging the dry waste for shipment to Chem-Nuclear Systems, Barnwell, SC. Two shipments were planned; November 1985 and at a later date.

- The dry waste storage area contains high levels of removable contamination.

- Liquid waste from the hot cell, decontamination room, ISA, laundry, change room (showers, sinks, etc.) are all piped into a 600 gallon stainless steel holding tank, located in a shielded maze in the basement.

- Floor drains in the basement are connected to the sanitary sewer system.

- Some drains to the holding tank have screens in place to prevent solids 1 mm or larger from passing to the tank. (The drain in the hot cell could not be examined. The sink in the ISA did not have an obvious filter in place.)

- The liquid waste room has a 9 to 12 inch curbed berm to act as spill basin for the holding tank. The curbed floor area has a stated capacity of 2400 gallons.

- The floor area could not be inspected for cracks or fissures due to standing water and high exposure rates.

- Disposal of liquid waste to the sanitary sewer system is by batch process. Water is drawn off the top of the holding tank, gross filtered and transferred to a 55 gallon drum. The batch tank is agitated by electric motor for 5 minutes. A sample is drawn off and counted in the well counter and the release quantity (number of gallons) is calculated. The batch is released if the total activity does not exceed the limits of 10CFR20.303. Records maintained are:

  Date of discharge
  cpm standard
  cpm sample
  Gallons discharged
  μCi/ml of standard
  μCi discharged
  Total μCi discharged to date.

- No procedure has been developed to handle disposition of the batch liquid if the limits of 10CFR20.303 are exceeded.

- No procedures have been developed for decontaminating the liquid waste storage area, the batch tank, the holding tank or the associated plumbing.

- No provisions are available for controlling discharges to the sanitary sewer system in situations such as:

  1. Pipe breakage which flood the basement;

  2. Fire which triggers sprinkler system, or where large quantities of water are used to extinguish a fire.

  Either of these situations could lead to discharges to the sanitary sewer system well in excess of the limits specified in 10CFR20.303.

Recommendations

Continue to package and remove the current inventory of dry waste. Make future periodic shipments to prevent a buildup of waste.

Decontaminate the dry waste storage area. A suggested method would be the application of a strippable coating, such as Imperial Coatings #1146 ALARA Decon Yellow, to remove the majority of the contamination. This area should be maintained to as great a degree possible as a non-contaminated zone.

Decontaminate the liquid waste area, the batch tank, the holding tank, and associated piping. This may best be performed by a professional decontamination firm. Appendix D contains a partial list of decontamination firms. Check the cleaned floor for cracks or fissures, and seal.

Redesign the holding tank to add a level gauge. Monitor the liquid level and make batch sewer disposals or commercial disposals when the tank reaches a pre-set level.

Develop procedures to address disposition of batch liquids which exceed the disposal limits of 10CFR20.303. (For example - contract for commercial filtration, ion exchange resin or other method, which results in final commercial disposal and sanitary sewer release.)

Develop contingency plans for controlling liquid releases to the sanitary sewer system through basement drains in the event of a major spill into the basement. (AMS could monitor discharges to the sanitary sewer system and place a servo-controlled valve in the basement floor drains to shut-off flow to the sanitary sewer if a prescribed radiation level is exceeded; or, temporarily seal the floor drains, so that releases to the sanitary sewer can be monitored and controlled.)

11.0 SITE SURVEY

During the audit, random facility and environmental (on and off site) samples were collected and returned to the ORAU laboratory for analysis. The facility survey consisted of exposure-rate measurements, smears, air, miscellaneous samples, liquid (floor of holding tank area), and miscellaneous samples. The environmental samples consisted of soil, vegetation, standing liquid (storm drains, roof, etc), sediment (sewer and storm drains), sewer discharge, and other miscellaneous samples. Direct radiation measurements were also performed.

The analytical procedures and equipment used are listed in Appendix G.

Findings

- <u>Facilities</u>

  <u>Hot Cell</u> - Exposure-rate measurements were made in the hot cell at the table level and three foot above the table. A few Co-60 pellets were placed in a known position at the rear of the cell (Figure 11-1). Table 11-1 presents the survey results. Although there were no obviously visible pellets in the vicinity of areas 5 and 6, a substantial source of activity was present. The maximum reading at the table level was 35 R/m (2100 R/h), and at the three foot level was 1.7 R/m (102 R/h).

  The average exposure-rate in the cell at the table level was 6.5 R/m (390 R/h) and at the three foot level was 1.4 R/m (84 R/h). This indicates considerable cell contamination, with a probability of loose pellets under the table.

  NOTE: The licensee has designated restricted/unrestricted areas based on contamination or radiation levels. The NRC views the entire facility as a restricted area per 10CFR20, since the facility is operated as 24 hour controlled access by lock and key. The following references to re .ricted/unrestricted areas are based on licensee designation, not NRC designation.

2nd Floor - The second floor exposure-rate measurements are summarized in Table 11-2. It should be noted that radiation levels in several unrestricted areas exceeded the action levels specified in ISP-2.

First Floor - The first floor exposure-rate measurements are summarized in Table 11-3. Several locations in the unrestricted areas exceed the action levels in ISP-2.

Basement - The basement exposure-rate measurements are summarized in Table 11-4. The present effort to reduce the dry waste volume will reduce the high exposure rates in this area. Several locations, in the unrestricted areas exceed the action levels in ISP-2.

Smear Survey Measurements - Tables 11-5 thru 11-7 present the smear survey results from the second, first and basement floors. The results are within acceptable limits for the individual area designation, except the floor of the isodose-curve storage room and the miscellaneous storage room (basement).

Air Samples - Three facility air samples were collected in the hot cell, decontamination room, and the ISA. During each sampling period, no activities were conducted in the area which would resuspend particulate materials. The air concentrations were:

Hot Cell	1.24 ± 0.01 E-08	μCi/ml
Decontamination Room	3.35 ± 0.01 E-09	μCi/ml
ISA	1.42 ± 0.01 E-09	μCi/ml

The cobalt-60 insoluble air concentration for occupationally exposed individuals is 9×10^{-9} μCi/ml. Note: These results are based on no activities which will resuspend particulate matter; the air concentrations during work operations would undoubtably be higher. This data, dependent upon stay time, could support the establishment of a respiratory protection program, consistant with NRC guidelines.

A single stack air sample was collected over a period of 48 hours. The stack air concentration was 1.64 $\pm$ 0.03 E-13 µCi/ml which is considerably less than 3 E-10 µCi/ml, from Table II, Appendix B, 10CFR20.

<u>Miscellaneous Samples</u> - Several miscellaneous samples were analyzed for radionuclide concentration or total radionuclide content. The data is presented in table 11-8. Cobalt-60 contamination in a roof gravel sample (#3519) indicates previous stack releases have occurred. The sampling direction chosen (North of the stack) correlated to the actual wind direction on that date; for a definitive study, the sampling locations should be chosen based on site micro-meteorology. The sediment from the loading dock drain (#3516) contains a low but detectable amount of Co-60. A water sample from the liquid waste room floor contained 1.75 E05 pCi/l of Co-60. This water needs to be disposed of as soon as possible; and, the entire waste storage area should be decontaminated.

During the audit, an exposure rate of 20 mR/h was measured on a half-face respirator which was available for use in the ISA. The cartridges were returned to ORAU and analyzed by gamma spectroscopy to determine if the contamination was from handling the cartridge, or Co-60 on the filter media. Table 11-9 presents the cartridge data. There is considerable surface contamination on the cartridge, but there also is significant Co-60 on the filter media itself. This also supports the need for a respiratory protection program, consistant with NRC guidelines.

° Environment

Table 11-10 thru 11-14 presents the radionuclide concentrations in sediment, soil, vegetation, and water. No detectable offsite cobalt-60 concentrations were found; however a few sediment, soil, and vegetation samples displayed detectable significant Co-60 concentrations in the south to southeast regions of the plant property. This data suggests that contamination is being released through the stack, or being transferred outside the building from the restricted areas. Sediment collected from storm drains at the loading dock and east of the building contain low, but detectable, Co-60. Standing liquid collected from the roof, storm drains, and sewer outfall contained no detectable Co-60. The Co-60 concentrations detected pose no hazard to the public or environment.

Figure 11-10 depicts three locations where radiation leakage occurs from the building. Area 1 measured 0.6 mR/h and is located opposite the access ports from the hot cell. Area 2 occurs in a narrowly defined beam approximately six feet off the ground, and measured 0.5 mR/h at the fence line. This beam originates from the cell exhaust HEPA filter room on the second floor. Area 3 occurs in a wide flat beam streaming along the top edge of the Hot Cell door. This beam is only detectable on the roof and measured 6 mR/h at the location indicated.

° Areas 1 and 3 will vary in intensity depending on the activity present in the hot cell. Area 2 will increase as the HEPA filter contamination increases with time.

Recommendations

Quarterly exposure-rate measurements on the roof and inside the fence should be performed. These measurements may indicate areas where additional shielding can reduce external exposure rates. (i.e. The Area 2 exposure rate could be reduced by adding a solid concrete block wall on the southwest corner of the facility where the second floor access door is located. Also, action to improve the pre-filter media, and reduce the contamination on the HEPA filters, will reduce the direct radiation levels.)

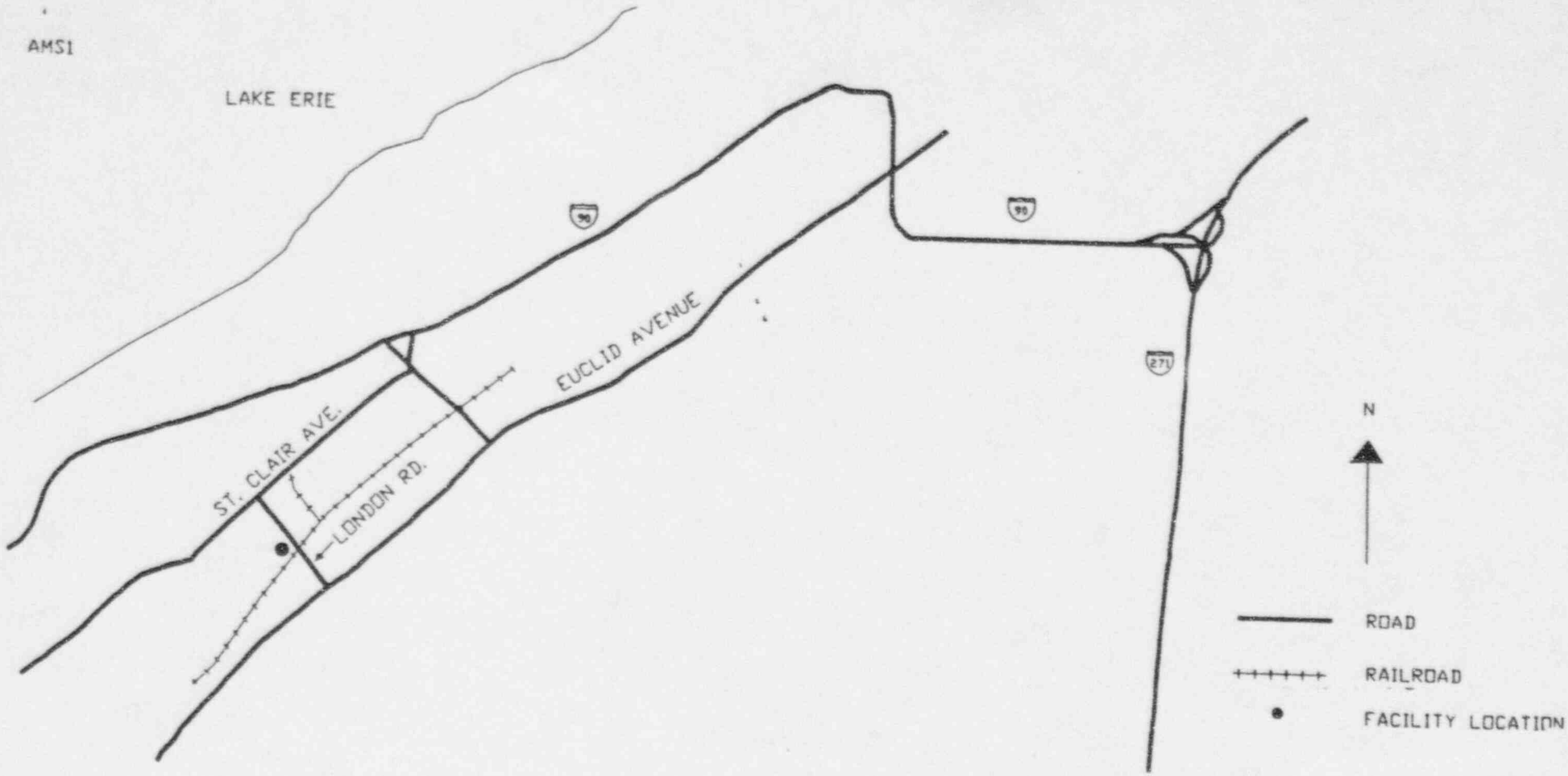


FIGURE 2-1: CLEVELAND, OHIO, AREA INDICATING THE LOCATION OF THE AMS FACILITY

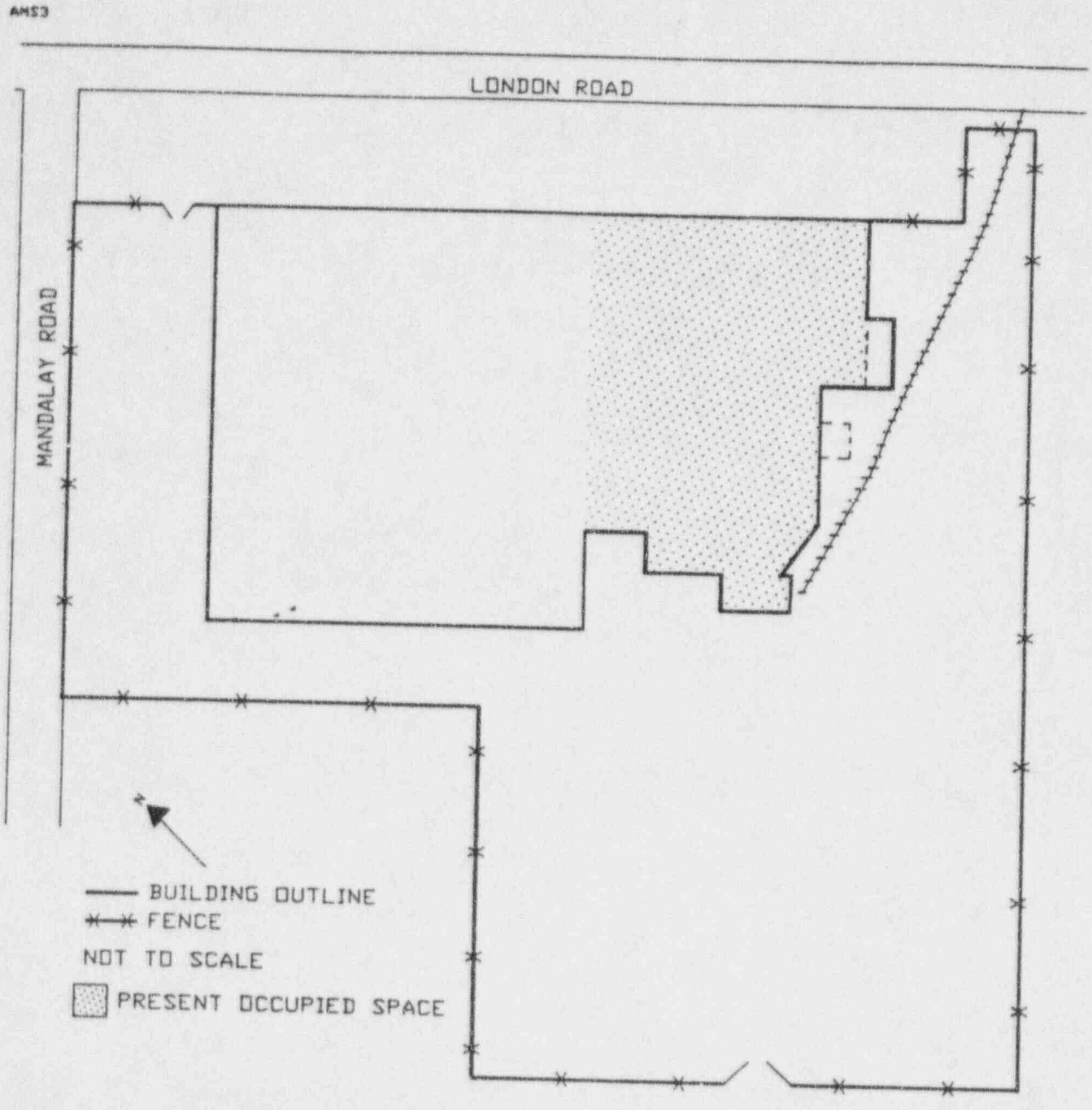


FIGURE 2-2: General Layout of AMS Property

ADVANCED MEDICAL SYSTEMS, INC. - ORGANIZATION CHART

TREASURER - B.R. KRIEGER
CONTROLLER - FRANK DODAH
PUBLIC RELATIONS - LUCILLE RICHMAN

GENERAL MANAGER - DR. S.S. STEIN

ADMINISTRATIVE ASSISTANT - DONNA ELY
SAFETY/REGULATORY AFFAIRS - HOWARD IRWIN
TECHNICAL SUPPORT - WILLIAM EVANS
PERSONNEL - MARILYN ZUBAL

ENGINEERING

MANAGER/M.E.
-E. SVIGEL

ELECT. TECH.
-M. BARUFFA

DRAFTSMEN
-K. CHAFFEE
-G. CURTIS

TECH. WRITER
-Y. CARPENTER

SECRETARY
-B. TEACHOUT

COMPUTER SYSTEMS:

SUPERVISOR /PROGRAMMER
-J. HARVEY

HARDWARE TECHS.
-E. RUBY
-D. BURKE

MARKETING

SALES MANAGER
-D. ABRAHAM

MIDWEST REGION SALES MANAGER
-J. SMITH

DOMESTIC ASSISTANT
-C. CORLETT

DOMESTIC SALES COORDINATOR
-T. FIDEL

S.E./S.W. REG. SALES MANAGER
-J. RANCONT

N.E. REGIONAL SALES REP.
-B. SUSSMAN

EXPORT ADMINISTRATOR
-M. JUDD

INTERNATIONAL ASST.
-K. HJERPE

SWITCHBOARD

OPERATOR
-L. FISH

QUALITY ASSURANCE

INSPECTORS
-Wm. REESE
-J. PANANEN

FIELD SERVICE

ACTING MANAGER - P. CARANI

ADMIN. CLERK - G. ROBINSON

SERVICE TECHS.
-M. CLIPSTON
-M. ORD
-V. SALTENIS
-K. JORDAN
-J. COCHRAN
-R. FORTIER
-J. JURAS

LONDON RD.

ISOTOPE TECHS.
-W. TURBETT
-J. POWELL

ACCOUNTING

INTERCOMPANY
-C. DeANNA

RECEIVABLES
-D. REMINDER

PAYABLES
-J. BISHOP

PURCHASING

MANAGER
-R. SCHENCK

BUYER
-L. BROWN

SECRETARY
-W. PLANK

PRODUCTION and MAT'LS CONTROL

MANAGER - P. CARANI

SECRETARY - J. HOOVER

COLLIMATOR ASSY.
-J. MILLER
-J. DOUGLAS

ELECTRICAL ASSY.
-S. McLAIN
-J. MOORE

MECHANICAL ASSY.
-G. LIGHT
-R. SPEER
-G. PAWLOWSKI
-J. JURAS
-B. HAYTCHER
-J. LESLIE

PAINT DEPAIMENT
-A. WHEELER

INV./MAT'LS.

SUPERVISOR
-J. PARKER

SHIPPING
-S. VINCENT

I/M CLERK
-B. BEST

STOCKROOM
-G. JULIANA

REVISED: OCT. 1985

FIGURE 2-3: Advanced Medical Systems, Inc. Organization Chart

AMS5

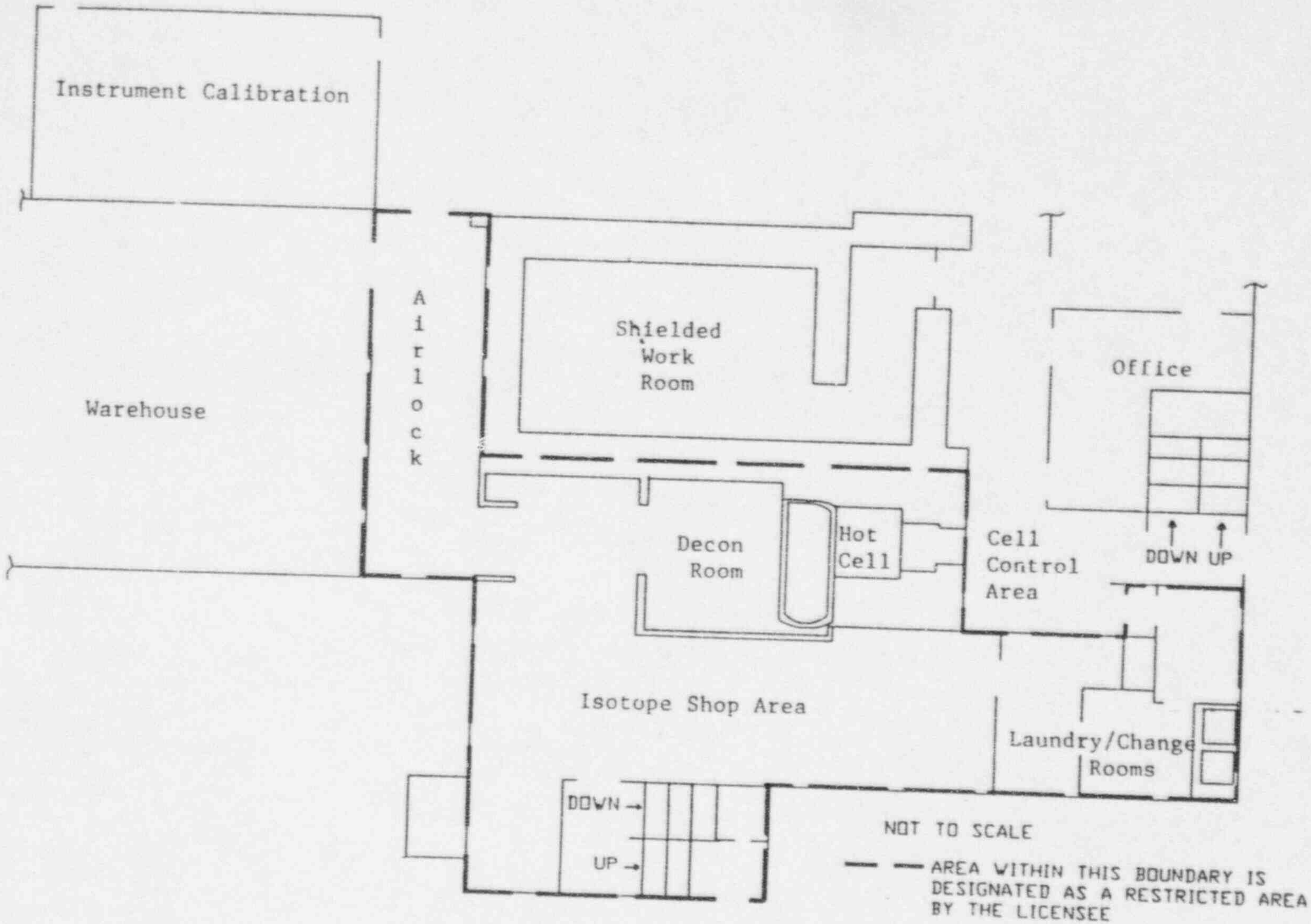
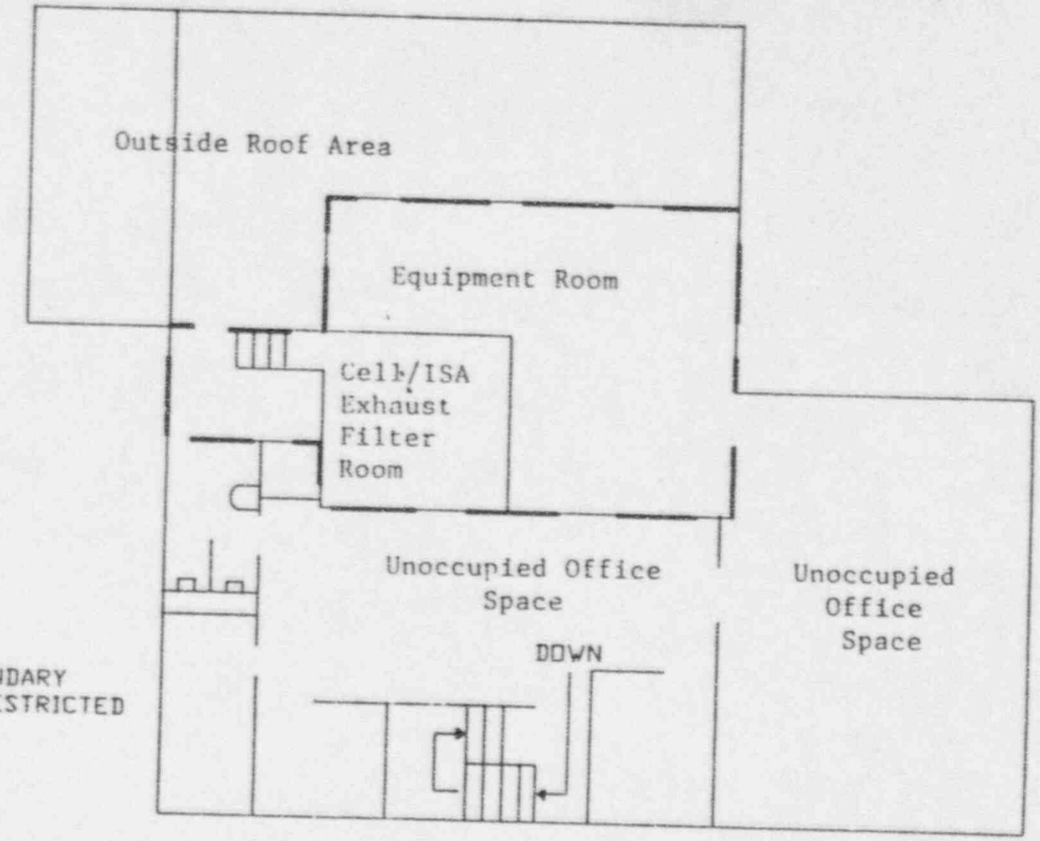


FIGURE 4-1: AMS Facility--First Floor (Partial)

AMS7



NOT TO SCALE

— — AREA WITHIN THIS BOUNDARY IS DESIGNATED AS A RESTRICTED AREA BY THE LICENSEE

FIGURE 4-2: AMS Facility--Second Floor (Partial)

AMS8

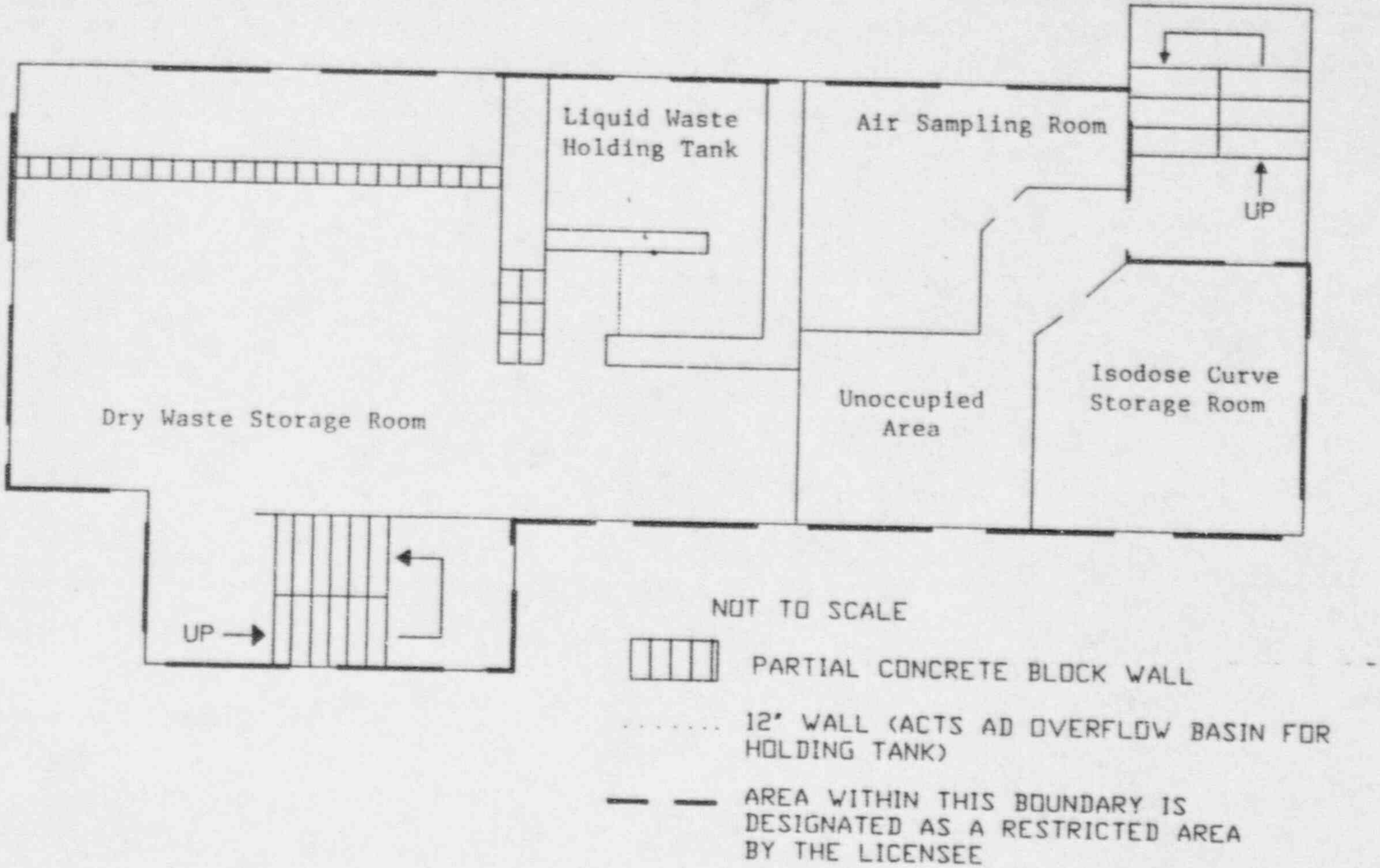


FIGURE 4-3: AMS Facility--Basement

AMS4

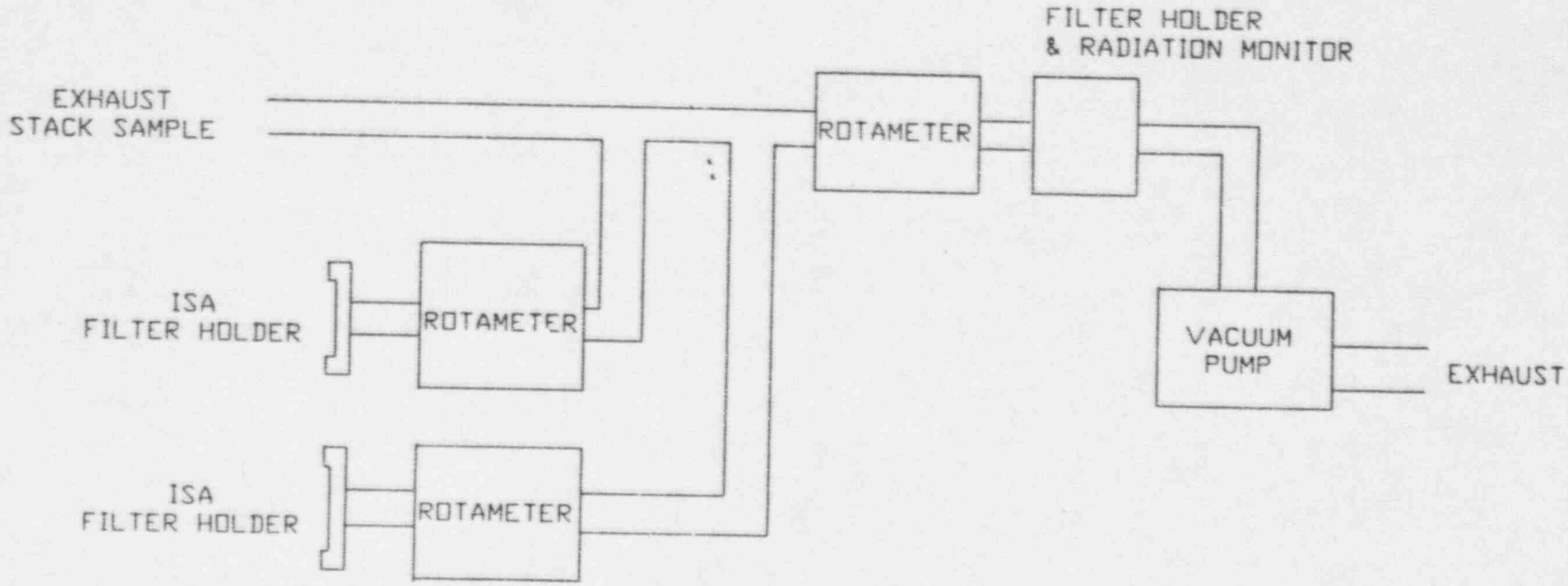


FIGURE 5-1: Air Sampling Station: Schematic Diagram

AMS11

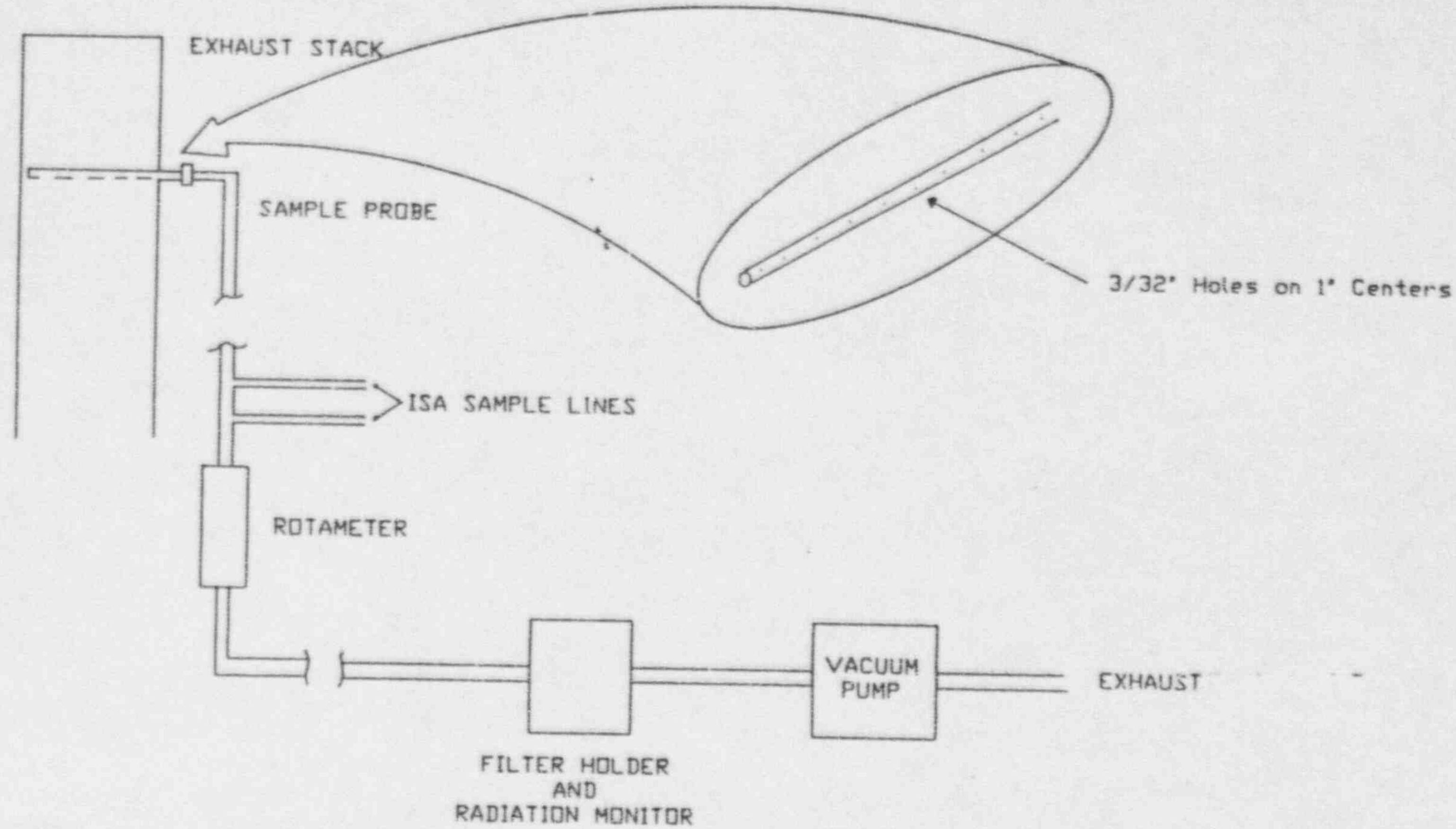
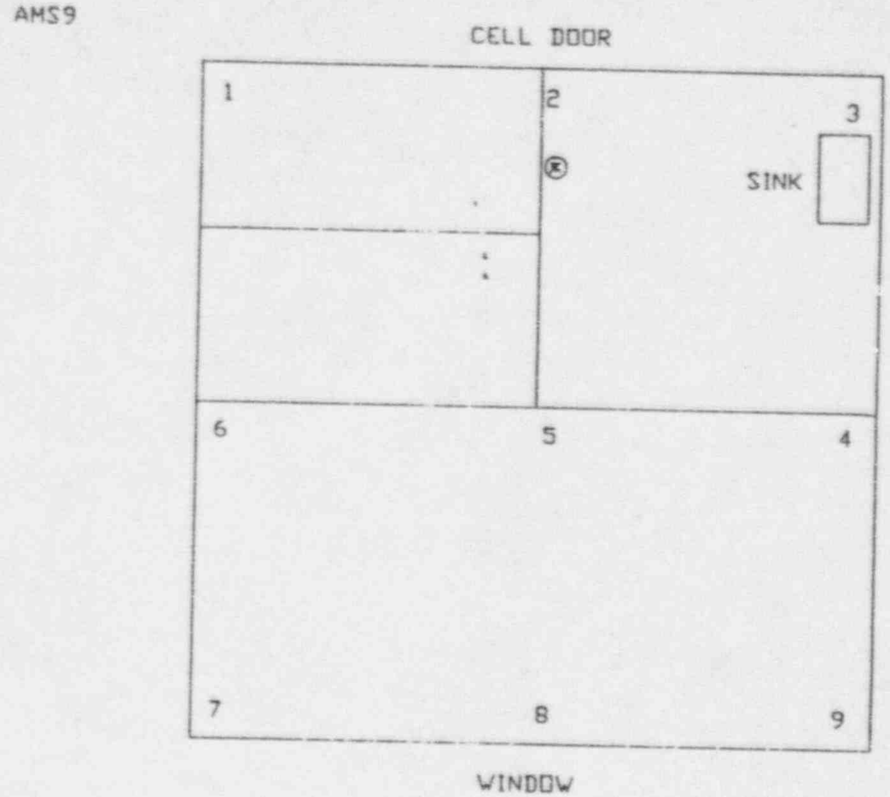


FIGURE 5-2: Stack Air Sampling System Schematic Diagram



⊗ Location of pellets in stainless steel dish.

FIGURE 11-1: Hot Cell Exposure-Rate Survey Locations.
Refer to Table 11-1.

AMS6

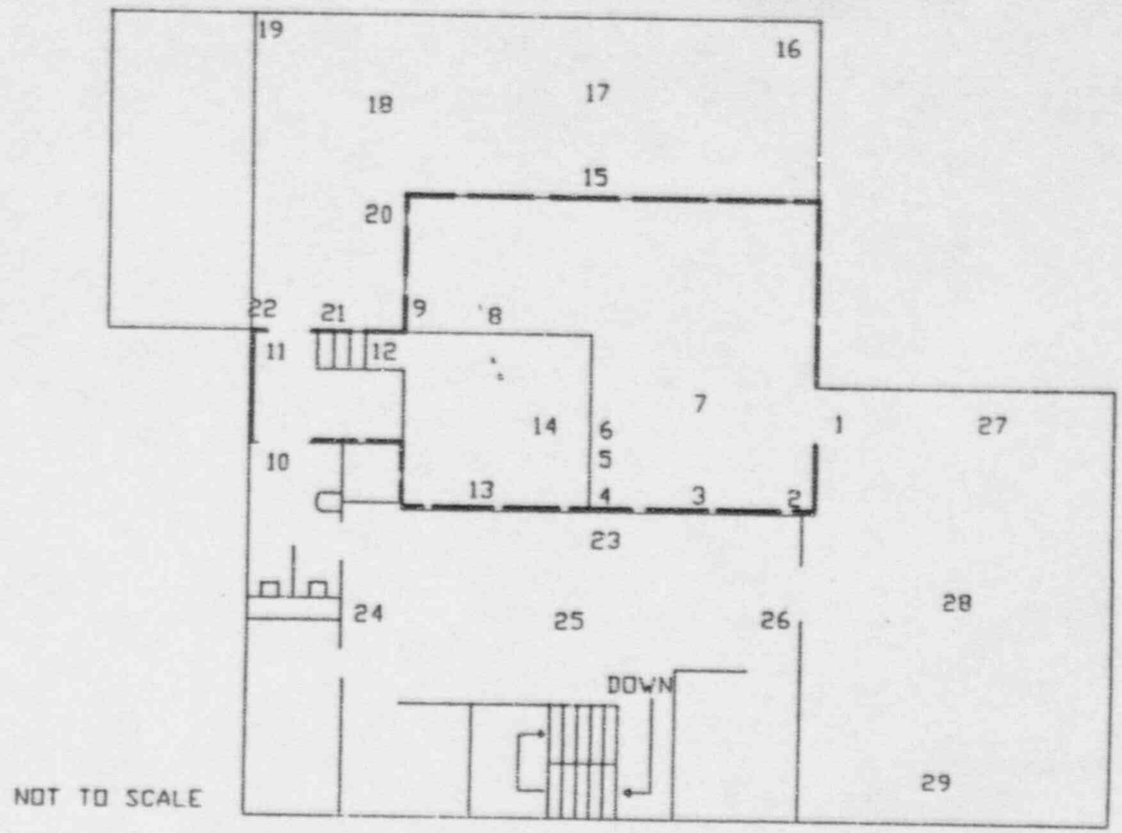


FIGURE 11-2: Second Floor Exposure-Rate Survey Locations.
Refer to Table 11-2.

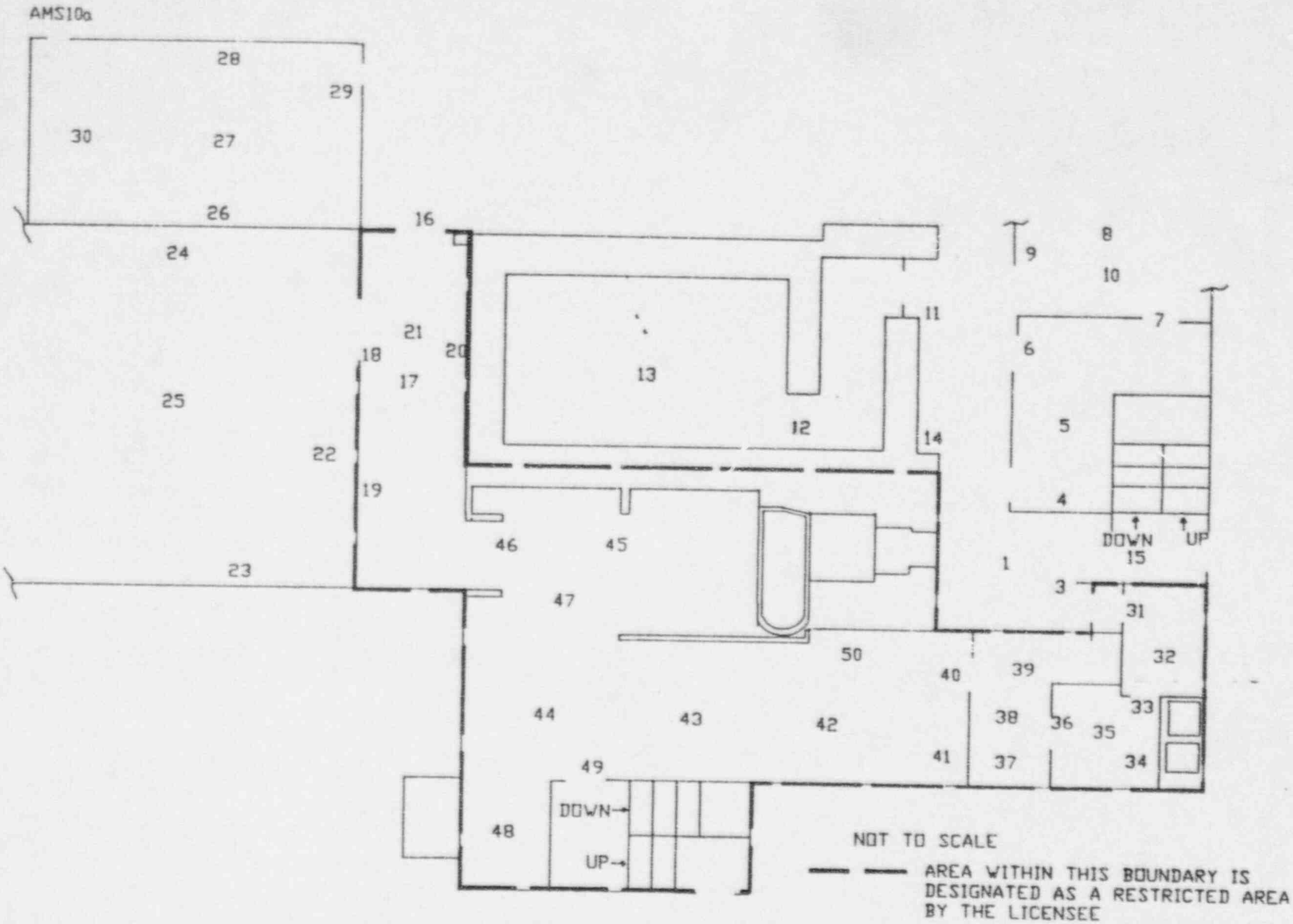
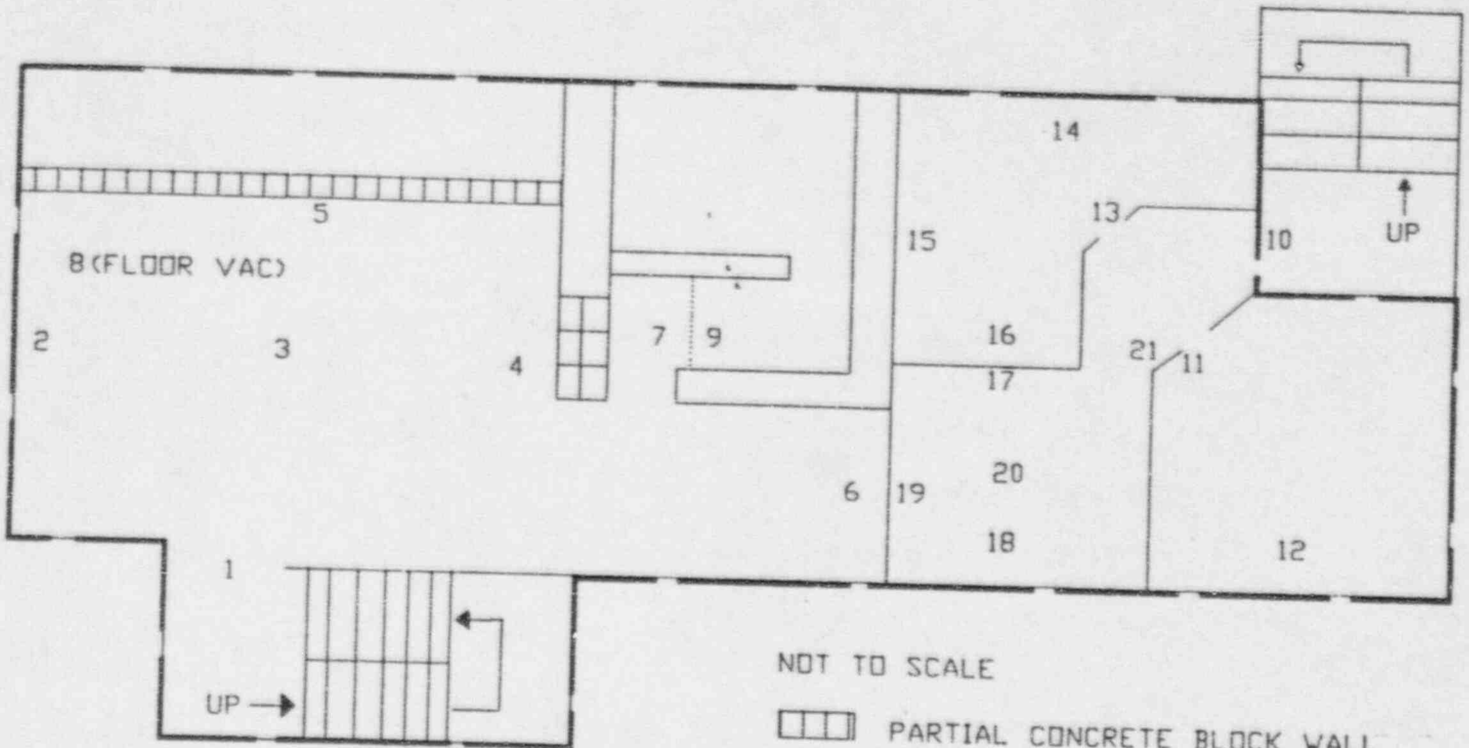


FIGURE 11-3: First Floor Exposure-Rate Survey Locations.
Refer to Table 11-3.

AMS2



NOT TO SCALE

PARTIAL CONCRETE BLOCK WALL

12" WALL (SERVES AS OVERFLOW BASIN FOR HOLDING TANK)

AREA WITHIN THIS BOUNDARY IS DESIGNATED AS A RESTRICTED AREA BY THE LICENSEE

FIGURE 11-4: Basement Exposure-Rate Survey Locations
Refer to Table 11-4.

AMS6a

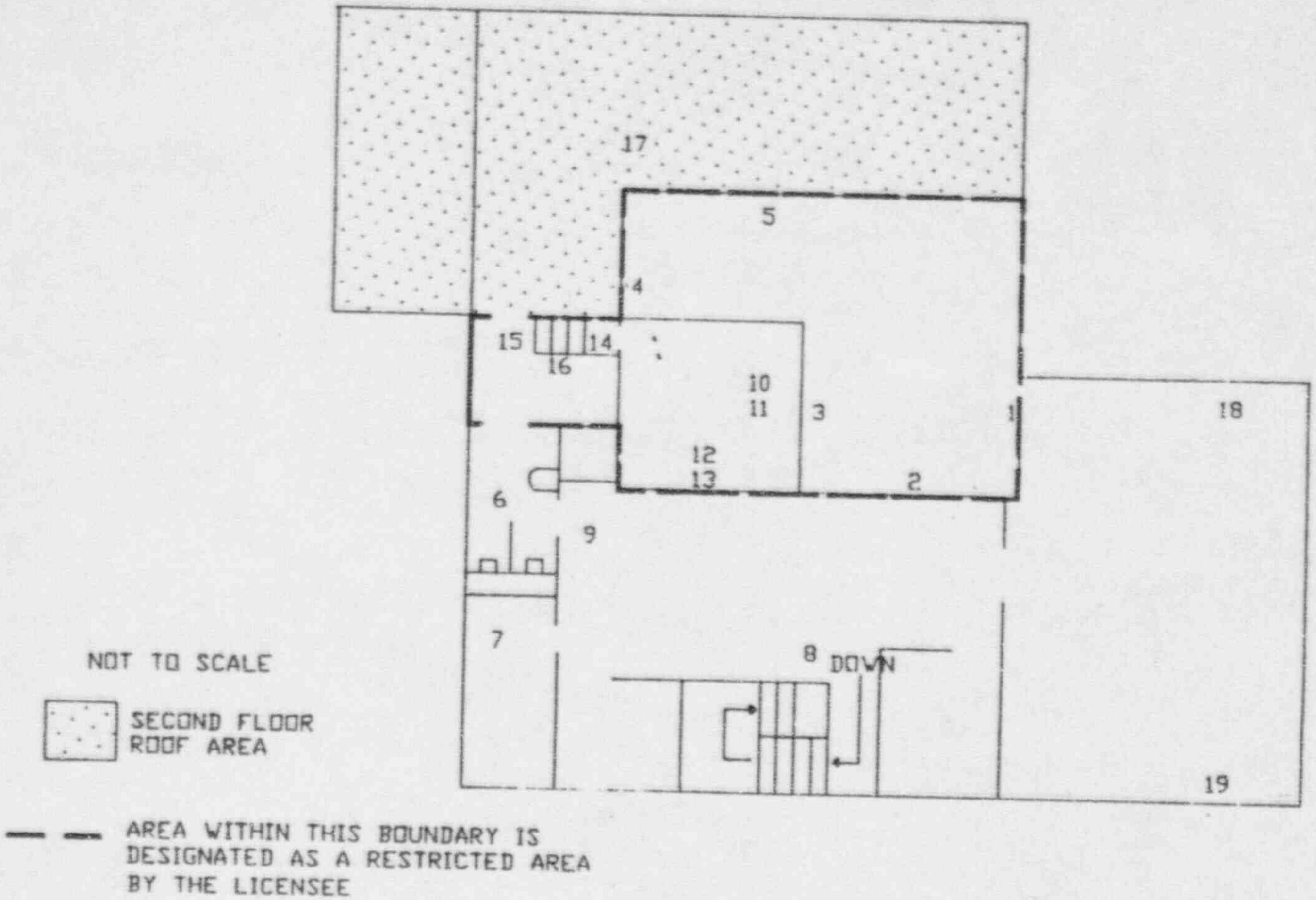


FIGURE 11-5: Second Floor Smear Locations.
Refer to Table 11-5.

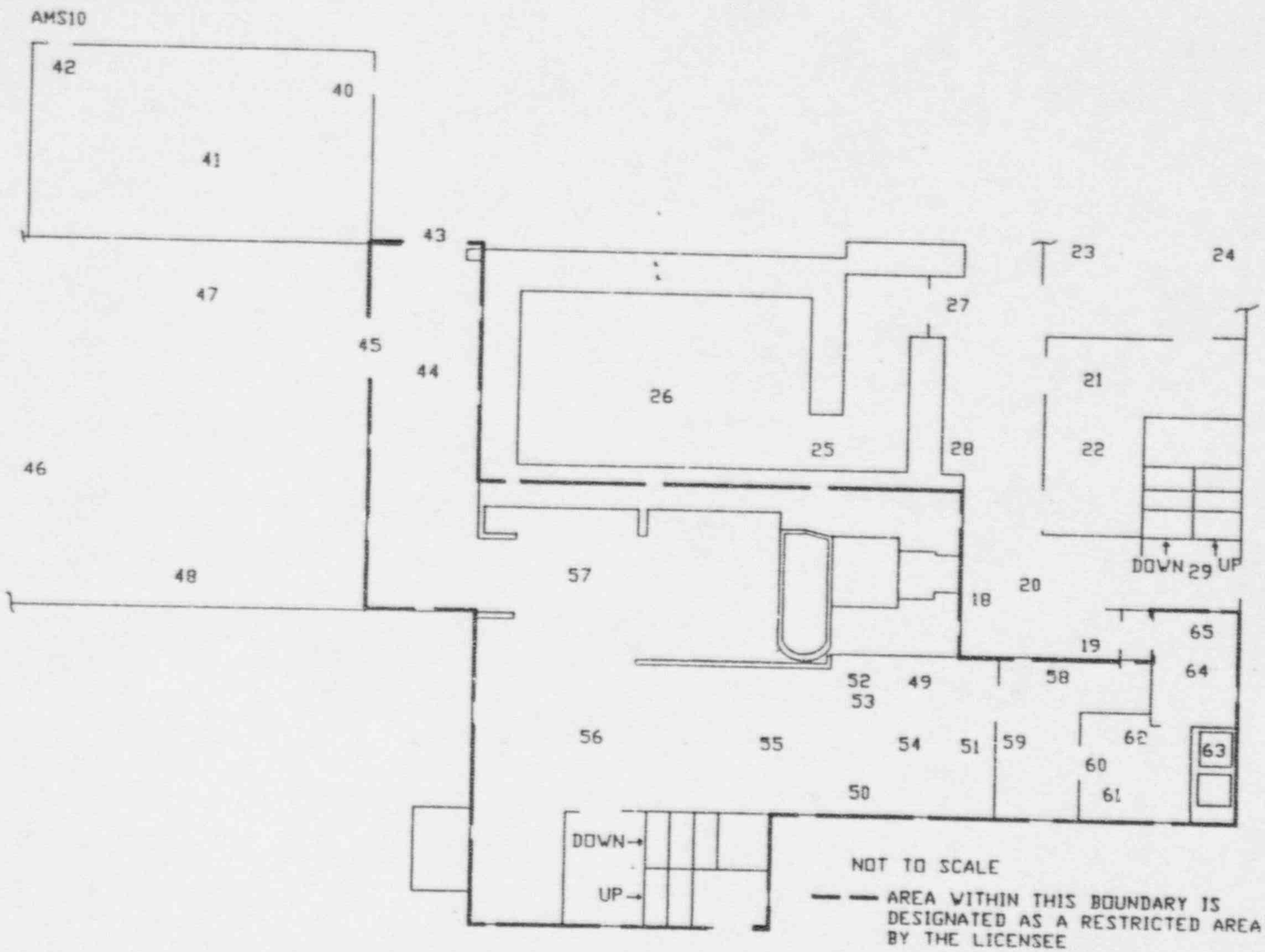


FIGURE 11-6: First Floor Smear Locations.

Refer to Table 11-6.

AMS2a

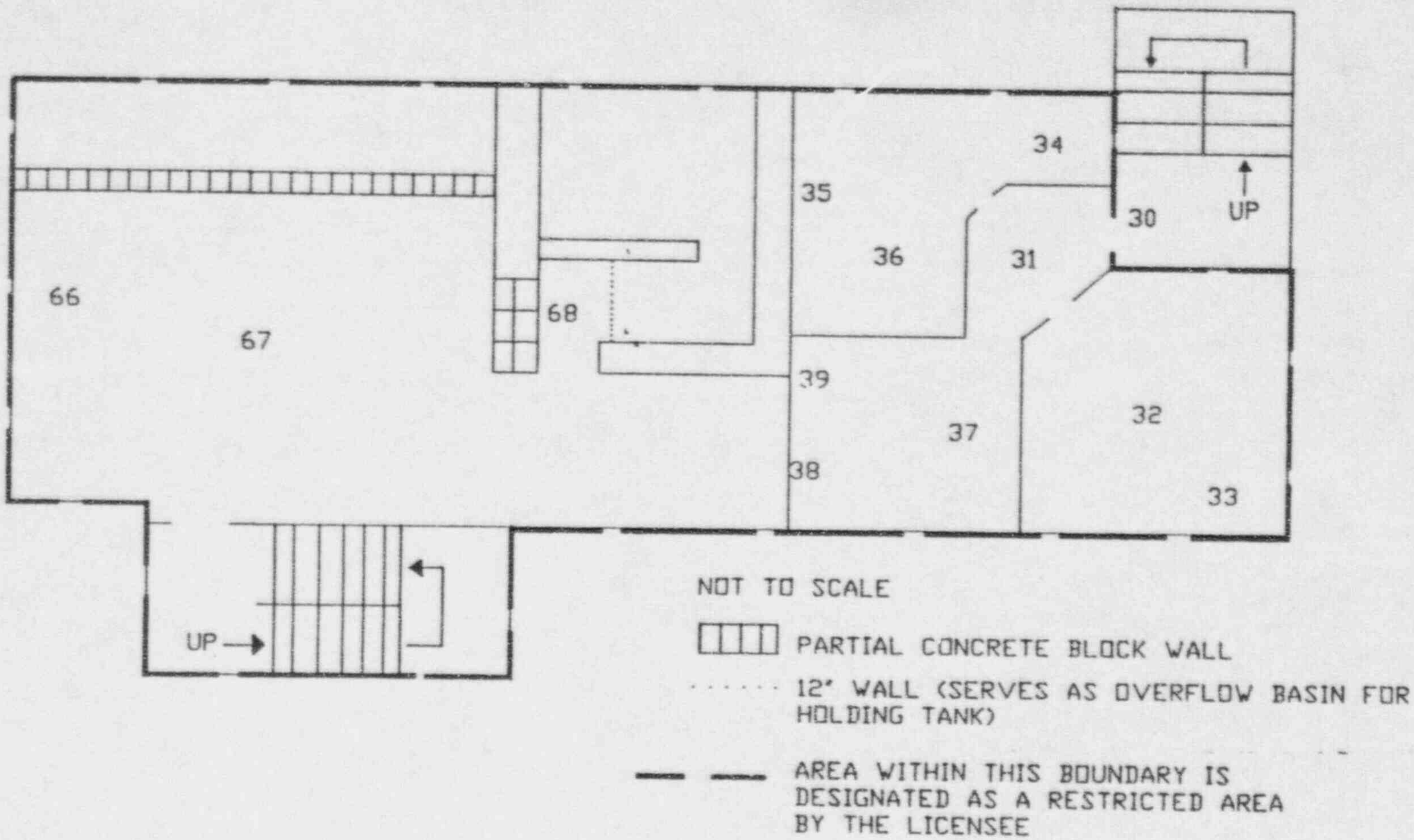


FIGURE 11-7: Basement Smear Locations
Refer to Table 11-7.

AMS12b

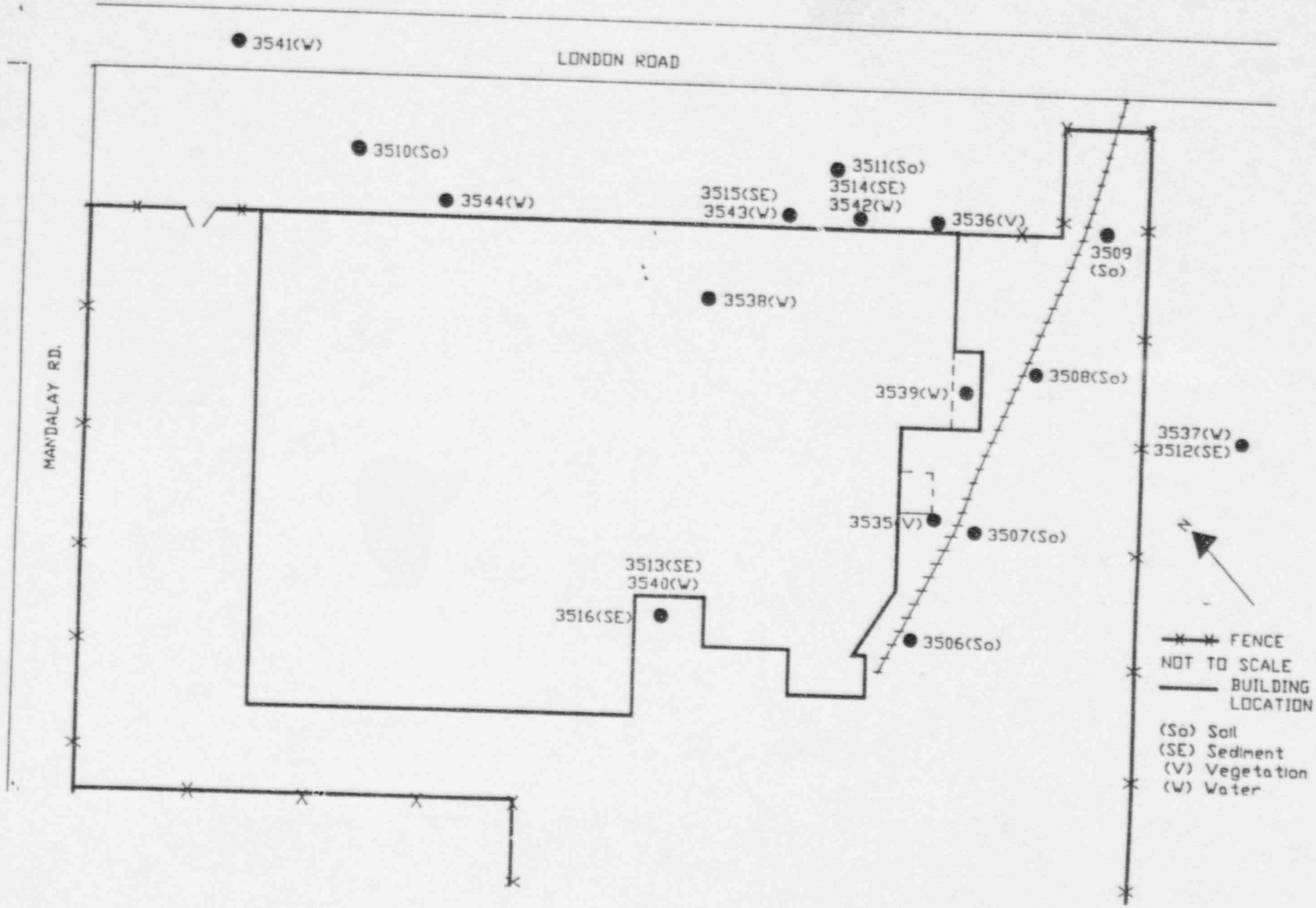


FIGURE 11-8: AMS Environmental Sample Locations.

AMS13

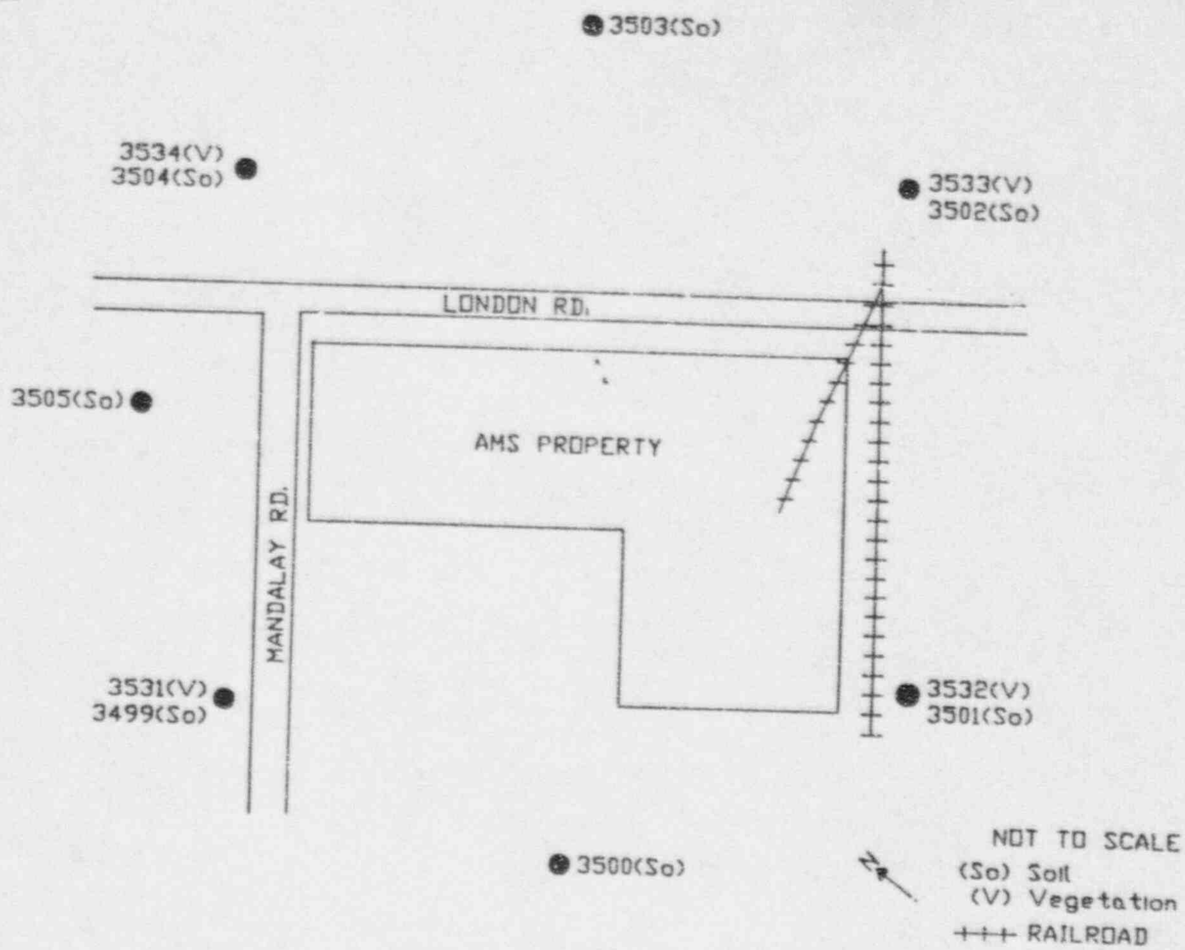


FIGURE 11-9: AMS Offsite Sample Locations

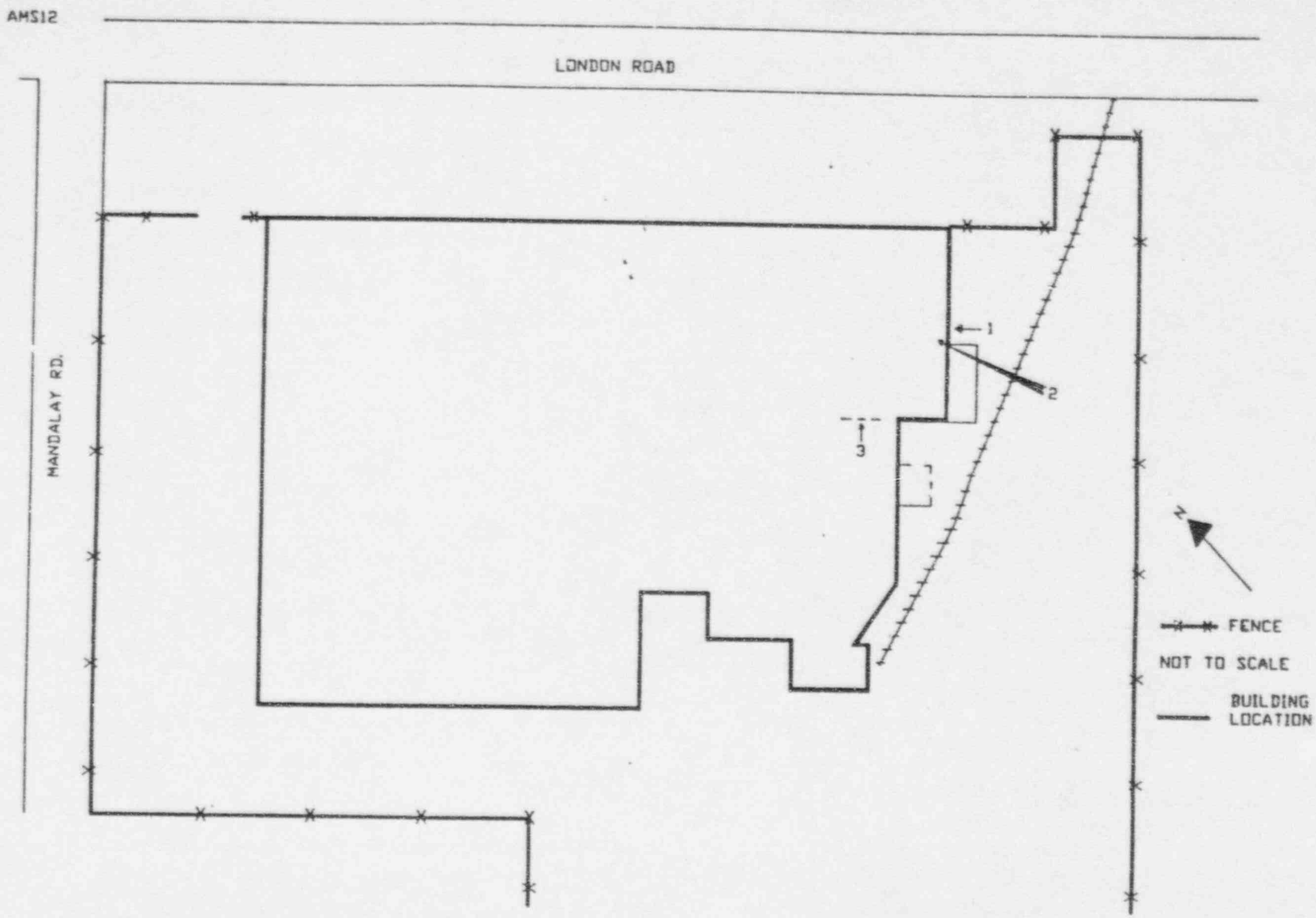


FIGURE 11-10: Facility Radiation Leakage Locations
(For additional description of this figure, see Section 11-0, Site Survey.)

TABLE 11-1

HOT CELL EXPOSURE-RATE MEASUREMENTS

Location #	R/m	
	Table Level	Three Foot Above Table
1	2.1	1.2
2	5.0	1.4
3	2.0	1.1
4	2.0	1.3
5	6.7	1.6
6	35.0	1.4
7	2.2	1.6
8	1.3	1.7
9	2.0	1.4

See Figure 11-1.

TABLE 11-2

SECOND FLOOR EXPOSURE-RATE MEASUREMENTS

Location	mR/h	Comments
1 R	1.9	W
2 R	1.3	W near hot water tank
3 R	0.8	W near boiler
4 R	9.2	W
5 R	25.0	H
6 R	83.0	H near service panels
	25.0	W
7 R	3.0	H
	18.0	W
8 R	25.0	H
9 R	2.0	W
10 R	4.0	W
11 R	35.0	W
12 R	120.0	W door closed
	157.0	W door open
13 R	660.0	Large HEPA contact
14 R	3000.0	Small HEPA contact
15	1.6	W
16	0.7	W
17	1.5	H at surface
	3.0	W
18	4.6	W at surface
19	0.7	W
20	1.6	W
21	0.1	W
22	19.0	W door closed
	25.0	W door open
23	1.0	W
24	0.4	W
25	0.7	W
26	0.1	W
27	2.0	W door open
28	0.2	W
29	0.2	W

Refer to Figure 11-2.

H - Head Height

R - Restricted area as defined by the licensee; by 10CFR20 definition, the entire facility is a restricted area

W - Waist Height

TABLE 11-3

FIRST FLOOR EXPOSURE-RATE MEASUREMENTS

Location	mR/h	Comments
1	0.6	W
2	0.6	W
3	0.6	W
4	0.8	W
5	0.5	W
6	0.3	W
7	0.6	W
8	0.7	W
9	0.8	W
10	0.6	W
11	0.6	W
12	28.0	W
13	220.0	W
14	0.5	W
15	0.3	W
16	0.6	W
17 R	20.0	near old hot cell window
18 R	1.5	W
19 R	4.5	W
20 R	30.0	W
21 R	1300.0	near old hot cell window - floor
22	4.3	W
23	1.7	W
24	0.3	W
25	0.4	W
26	0.3	W
27	0.2	W
28	0.2	W
29	0.1	W
30 R	0.2	W
31 R	0.2	W
32 R	0.4	W
33 R	0.6	W
34 R	0.8	W
35 R	0.5	W
36 R	1.0	W
37 R	0.8	W
38 R	1.7	W
39 R	1.9	W
40 R	4.0	W
41 R	3.0	W
42 R	10.0	W
43 R	9.0	W
44 R	18.0	W
45 R	54.0	W

TABLE 11-3 (Continued)

FIRST FLOOR EXPOSURE-RATE MEASUREMENTS

Location	mR/h	Comments
46 R	50.0	W
47 R	440.0	Floor - dumb waiter
48 R	3.0	W
49 R	5.0	W
50 R	30.0	Square or round hot cell access port

Refer to Figure 11-3.

R - Restricted area as defined by the licensee; by 10CFR20 definition, the entire facility is a restricted area.

W - Waist Height

TABLE 11-4

BASEMENT EXPOSURE-RATE MEASUREMENTS

Location	mR/h	Comments
1 R	820	W
2 R	525	W
3 R	2600	W
4 R	1500	W
5 R	3000	W
6 R	65	W
7 R	880	W
8 R	>20000	Near floor vac/HEPA box
9 R	4000	Floor level near water surface
10	1.3	W
11 R	1.0	W
12 R	1.1	W
13 R	1.5	W
14 R	1.0	W
15 R	15.5	W
16 R	5.5	W
17 R	10.0	W
18 R	20.0	W
19 R	20.8	W
20 R	17.3	W
21 R	2.6	W

Refer to Figure 11-4.
R - Restricted area as defined by the licensee; by 10CFR20 definition, the entire facility is a restricted area.
W - Waist Height

TABLE 11-5

SECOND FLOOR SMEAR MEASUREMENTS

Location #	Room	Description	dpm/100 cm^2
1 R	Equipment	Floor	4 ± 4[a]
2 R	Equipment	Boiler	5 ± 4
3 R	Equipment	Electrical Panels	<2
4 R	Equipment	Door	<2
5 R	Equipment	Exhaust Duct	7 ± 4
6	Bathroom	Wall	<2
7	Office	Door	<2
8	Office	Floor	8 ± 5
9	Office	Floor	7 ± 4
10 R	HEPA Room	Small Filter Housing	5.67 ± 0.59 E3
11 R	HEPA Room	Floor	3.74 ± 0.16 E4
12 R	HEPA Room	Large Filter Housing	78 ± 12
13 R	HEPA Room	Floor	1.84 ± 0.11 E4
14 R	HEPA Room	Floor of Landing	52 ± 10
15 R	HEPA Room	Floor foot of Stairs	7 ± 4
16 R	HEPA Room	Stair-rail	5 ± 4
17	Roof	Drain	5 ± 4
18	Office	Floor	<2
19	Office	Floor	<2

Refer to Figure 11-5.

[a]Errors are 2σ based on counting statistics.

R - Restricted area as defined by the licensee; by 10CFR20 definition, the entire facility is a restricted area.

TABLE 11-6

FIRST FLOOR SMEAR MEASUREMENTS

Location #	Room	Description	dpm/100 cm^2
18	Cell Control Area	Manipulator Coutrols	11 ± 5[a]
19	Cell Control Area	Door Knob to Control Area	15 ± 6
20	Cell Control Area	Floor	11 ± 5
21	Office	Floor	8 ± 5
22	Office	Desk Top	3 ± 3
23	Coffee Room	Counter Top	<2
24	Coffee Room	Equipment Hood	26 ± 7
25	Shielded Work Room	Floor	9 ± 5
26	Shielded Work Room	Floor	<2
27	Shielded Work Room	Door	3 ± 3
28	Cell Control Area	Counter Top	4 ± 4
29	Cell Control Area	Entrance Door	5 ± 4
40	Calibration Room	Floor	15 ± 6
41	Calibration Room	Floor	<2
42	Calibration Room	Floor	5 ± 4
43 R	Air Lock	Door	5 ± 4
44 R	Air Lock	Floor	96 ± 13
45 R	Air Lock	Door	26 ± 7
46	Warehouse	Floor	3 ± 3
47	Warehouse	Floor	<2
48	Warehouse	Floor	<2
49 R	Isotope Shop Area	Work Bench	542 ± 30
50 R	Isotope Shop Area	Work Bench	102 ± 13
51 R	Isotope Shop Area	Fume Hood Sash	1.83 ± 0.03 E5
52 R	Isotope Shop Area	Hot Cell Square Access Port	2.05 ± 0.04 E5
53 R	Isotope Shop Area	Hot Cell Round Access Port	1.51 ± 0.02 E6
54 R	Isotope Shop Area	Floor	2.15 ± 0.12 E4
55 R	Isotope Shop Area	Floor	2.05 ± 0.11 E4
56 R	Isotope Shop Area	Floor at Air Intake Vent	1.57 ± 0.10 E4
57 R	Isotope Shop Area	Floor at Decon Room	9.61 ± 0.24 E4
58 R	Laundry Room	Washing Machine Drain	7.73 ± 0.71 E3
59 R	Laundry Room	Floor	42 ± 9
60 R	Laundry Room	Floor	48 ± 9
61 R	Shower Room	Sink	2.52 ± 0.38 E3
62 R	Shower Room	Floor	67 ± 11
63 R	Shower Room	Shower Floor	119 ± 14
64 R	Locker Room	Floor	18 ± 6
65 R	Locker Room	Door	31 ± 8

Refer to Figure 11-6.

[a]Errors are 2σ based on counting statistics.

R - Restricted area as designated by the licensee; by 10CFR20, the entire facility is a restricted area.

TABLE 11-7

BASEMENT SMEAR MEASUREMENTS

Location #	Room	Description	dpm/100 cm^2
30	Stairwell	Door	33 ± 8[a]
31 R	Isodose Curve	Floor	1.28 ± 0.28 E3
32 R	Isodose Curve	Floor	22 ± 7
33 R	Isodose Curve	Sink	27 ± 7
34 R	Air Sampling	Bench Top	<2
35 R	Air Sampling	Drain to Liquid Waste Tank	148 ± 16
36 R	Air Sampling	Floor	352 ± 24
37 R	Miscellaneous	Floor	4.02 ± 0.45 E5
38 R	Miscellaneous	Door	55 ± 10
39 R	Miscellaneous	Counter Top	55 ± 10
66 R	Waste Area	Floor	8.68 ± 0.75 E3
67 R	Waste Area	Floor	4.50 ± 0.09 E5
68 R	Waste Area	Floor	3.36 ± 0.15 E4

Refer to Figure 11-7.

[a]Errors are 2σ based on counting statistics.

R- Restricted area as designated by the licensee; by 10CFR20 definition, the entire facility is a restricted area.

TABLE 11-8

RADIONUCLIDE CONCENTRATIONS/ACTIVITY IN MISCELLANEOUS MEDIA

Sample No.	Location	Radionuclide Concentration Co-60	Cs-137
		(pCi/g)	(pCi/g)
3517	Roof Gravel - Lower Roof (Northern Corner)	<0.04	1.11 ± 0.21
3518	Roof Gravel Approximately 225 Feet Northwest of Stack	<0.03	0.74 ± 0.14
3519	Roof Gravel Approximately 12 Feet North of Stack	.08 ± .06	1.86 ± 0.23
3520	Roof Gravel Approximately 90 Feet North of Stack	<0.05	0.48 ± 0.11
		Co-60 (pCi/l)	Co-60 (μCi/ml)
3530	Water from Liquid Waste Floor	1.75 ± 0.08 E05	1.75 ± 0.08 E-04
		Radionuclide Activity Co-60 (pCi)	
3527 R	Paint Sample South Wall Isotope Shop Area	7.37 ± 0.22 E04	
3527 S	Paint Sample Floor Isotope Shop Area	2.81 ± 0.13 E04	
3528	Dryer Lint	3.31 ± 0.10 E04	

Refer to Figures 11-8 and 11-9.
[a]Errors are 2σ based on counting statistics.

TABLE 11-9

RADIONUCLIDE ACTIVITY ON TYPE H AIR FILTER CANISTER

Sample No.	Location	Radionuclide Activity (pCi) Co-60
3525	Filter & Cartridge	7.97 ± 0.44 E05[a]
3525A	Filter Media	2.18 ± 0.25 E05
3525B	Cartridge Container Only	5.68 ± 0.39 E05
3526	Filter & Cartridge	3.01 ± 0.07 E07
3526A	Filter Media	1.59 ± 0.21 E05
3526B	Cartridge Container Only	2.41 ± 0.06 E07

[a]Errors are 2σ based on counting statistics.

TABLE 11-10

RADIONUCLIDE CONCENTRATIONS IN SEDIMENT

Sample No.	Location	Radionuclide Concentration (pCi/g)[a]	
		Co-60	Cs-137
3512	Approximately 50 m South of Site	<0.05	0.12 ± 0.07
3513	Storm drain at Loading Dock	1.78 ± 0.35	1.00 ± 0.32
3514	Storm Drain Approximately 25 m Northeast Corner of Building	<0.04	0.89 ± 0.14
3515	Storm Drain Approximately 35 m Northeast Corner of Building	0.08 ± 0.02	4.06 ± 0.35
3516	Sediment in Loading Dock Basin	1.72 ± 0.36	0.48 ± 0.23

Refer to Figure 11-8.
[a]Errors are 2σ based on counting statistics.

TABLE 11-11

RADIONUCLIDE CONCENTRATIONS IN SOIL

Sample No.	Location	Radionuclide Concentration (pCi/g)[a] Co-60	Cs-137
3506	Approximately 10 m South of Paint Room	0.41 ± 0.23	1.59 ± 0.24
3507	Approximately 10 m South of H.V. Transformers	1.40 ± 0.27	0.53 ± 0.13
3508	Approximately 10 m South of Basement Stairwell	.07 ± .05	0.33 ± 0.10
3509	Approximately 15 m Southwest London Road (on RR Spur)	0.05 ± 0.04	0.25 ± 0.09
3510	Approximately 10 m Northeast AMS vs 75 m from RR Tracks on London Rd.	<0.05	0.61 ± 0.17
3511	Approximately 10 m Northeast AMS vs 30 m from RR Tracks on London Rd.	<0.09	1.34 ± 0.27
3504	200 m North	<0.07	1.51 ± 0.28
3503	200 m Northeast	<0.06	1.21 ± 0.28
3502	200 m East	<0.04	<0.04
3501	200 m South	<0.03	0.85 ± 0.22
3500	200 m Southwest (Baseball field)	<0.06	1.54 ± 0.23
3499	200 m West (Mandaley Road)	<0.04	0.27 ± 0.09
3505	200 m Northwest	<0.06	0.24 ± 0.09

Refer to Figures 11-8 and 11-9.
[a]Errors are 2σ based on counting statistics.

TABLE 11-12

RADIONUCLIDE CONCENTRATIONS IN VEGETATION

Sample No.	Location	Radionuclide Concentration (pCi/g)[a] Co-60	Cs-137
3531	200 m West of Site (Mandalay Road)	<0.24	<0.16
3532	200 m South of Site	<0.09	0.33 ± 0.19
3533	200 m East of Site	<0.20	<0.22
3534	200 m North of Site (Madison Street)	<0.29	<0.30
3535	Southeast Corner at HV Unit	0.31 ± 0.14	<0.05
3536	5 m Northeast of Building	<0.21	<0.20

Refer to Figures 11-8 and 11-9.
[a]Errors are 2σ based on counting statistics.

TABLE 11-13

RADIONUCLIDE CONCENTRATIONS IN WATER

Sample No.	Location	Radionuclide Concentration (μCi/ml) Co-60
3537	50 m South of Building	<5.67 E-09
3538	Standing Water 100' North of Stack	<8.55 E-09
3539	Roof over Basement Stairwell	<5.67 E-09
3540	Drain at Loading Dock	<5.12 E-09
3541	Sewer Outfall London Road	<4.91 E-09
3542	Storm Drain 25 m from Northeast Corner of Building	<4.70 E-09
3543	Storm Drain 35 m from Northeast Corner of Building	<5.59 E-09
3544	Storm Drain 65 m from Northeast Corner of Building	<5.40 E-09

Refer to Figure 11-8.

For comparison, the NRC criteria for Co-60 discharge to the sanitary sewer system is 1.0 E-03 μCi/ml, and the Co-60 concentration in water in an unrestricted is 3.0 E-05 μCi/ml.

Attch 1

APPENDIX A

AUDIT TEAM BIBLIOGRAPHIES

BIOGRAPHICAL SKETCH

James D. Berger
Oak Ridge Associated Universities
Oak Ridge, Tennessee

Manager, Radiological Site Assessment Program at ORAU from 1980 to present. Main duties include technical assistance to DOE and NRC in areas of radiological environmental surveys and evaluation of effluent and environmental monitoring programs. Prior positions at ORAU include Department Head, Health and Safety Office, 1975 to 1980; Radiation and Chemical Safety Officer, 1970 to 1975; and health physicist, 1967 to 1970. Also, Health Physics Team Leader for the ORAU Radiation Emergency Assistance Center from 1975 to 1985. Additional professional experience as industrial hygienist at Bettis Atomic Power Laboratory, 1963 to 1966, and instrument development physicist with the Bureau of Radiological Health, 1960 to 1963.

Education

B.S. in Physics from Bowling Green State University, 1960.

M.S. in Radiological Health from Northwestern University, 1968.

Professional Society Affiliations

Health Physics Society

American Industrial Hygiene Association

Certified by American Board of Health Physics

Publications

Author or co-author of approximately 10 published reports, guidebooks, and book chapters in various areas of health physics.

Author of numerous unpublished (internal use only) reports describing findings or results of technical assistance for DOE and NRC.

BIOGRAPHICAL SKETCH

Edgar B. Darden
Oak Ridge Associated Universities
Oak Ridge, Tennessee

Currently Radiation Safety Officer in the Office of Safety and Health. Prior work history includes Head, Radiation Safety and Dosimetry Group, Comparative Animal and Research Laboratory 1973-1981; biologist ORNL 1949-1955 and 1956-1973; Physicists Aide, Navy Department 1941.

Education

B.S. Chemistry, College of William and Mary 1941
M.S. Physics, University of North Carolina 1950
Ph.D. Zoology, University of Tennessee 1957

Professional Society Affiliations

Health Physics Society
Southeastern Section American Physical Society
Sigma Xi, The Scientific Research Society

Publications

Author or co-author of publications in radiological physics and radiobiology, including dosimetry of cyclotron and nuclear bomb radiations, radiation sterilization of insects, electrophysiological effects of radiation, and fast neutron and high energy particle mammalian radiation biology; also publications in gerontology, electron microscopy and bioelectricity in plants.

BIOGRAPHICAL SKETCH

Elizabeth J. Deming
Oak Ridge Associated Universities
Oak Ridge, Tennessee

Currently Health Physics Team Leader, Radiological Site Assessment Program at Oak Ridge Associated Universities to provide assistance to program manager for technical assistance to DOE and NRC in radiological environmental surveys and direct team of 2-10 health physics technicians in conducting these surveys at sites throughout the U.S. Prior work history including Radiological Health Specialist with the Salt Lake City County Health Department from 1980-1982 and Radiological Protection Technologist at the University of Utah from 1978 to 1980.

Education

B.S. in Medical Technology from California State University 1978
M.S. in Radiation Ecology from Colorado State University 1984

Professional Registration and Affiliations

Nationally Registered Radiation Protection Technologist - 1980
Health Physics Society

Publications

Co-author on a paper discussing the leachability of Ra-226 from soil and subsequent plant uptake currently being reviewed for publication in the Journal of Environmental Quality

BIOGRAPHICAL SKETCH

Glenn L. Murphy
Oak Ridge Associated Universities
Oak Ridge, Tennessee

Currently the Assistant Program Manager, Radiological Site Assessment Program at ORAU to provide technical assistance to DOE and NRC in the areas of radiological environmental surveys and evaluation of effluent and environmental monitoring programs. Prior work history includes Senior Health Physics Consultant with Phoenix Technology Corporation from 1983 to 1985. Research Coordinator/Health Physicist, Center for Applied Isotope Studies, University of Georgia from 1981-1985 and 1978-1980. Radiation Safety Officer, University of North Carolina at Chapel Hill and North Carolina Memorial Hospital, 1981. Radiation Safety Officer, University of Georgia 1975-1978.

Education

B.S. in Mathematics Education from Virginia Polytechnic Institute, 1971.
M.S. in Applied Nuclear Science from Georgia Institute of Technology, 1975.

Professional Society Affiliations

Health Physics Society

Publications

Author or co-author of publications on decommissioning of a luminous dial painting facility and comparative analytical methods for environmental gamma ray dose rate assessments.

Author of unpublished (internal use only) reports describing findings of results of technical assistance for DOE, NRC, and EPA.

APPENDIX B

SCOPE OF WORK

APPENDIX C

RADIATION PROTECTION TRAINING COURSES