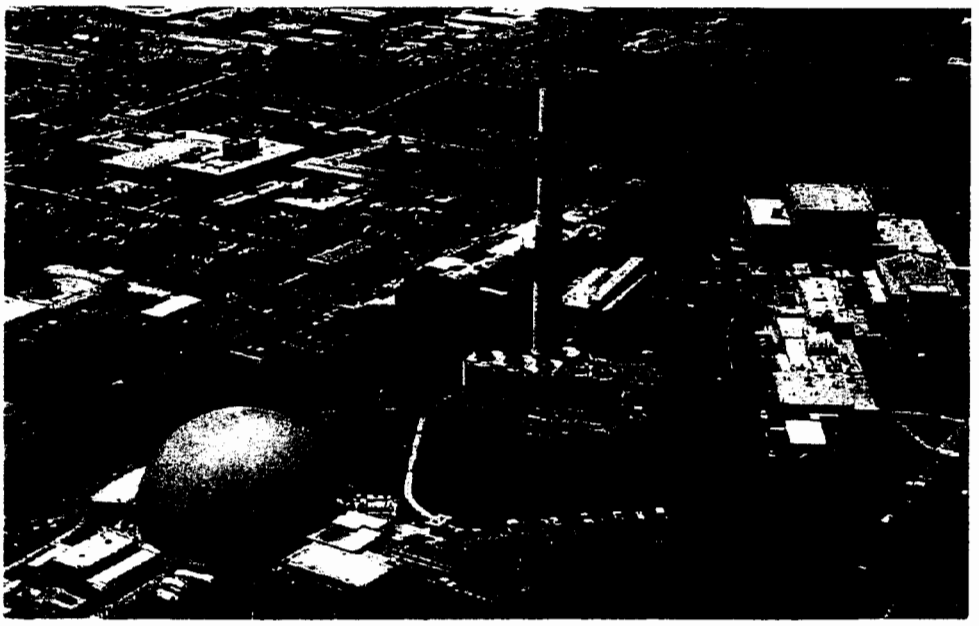
BROOKHAVEN NATIONAL LABORATORY

HIGH FLUX BEAM REACTOR



FINAL CHARACTERIZATION REPORT

SEPTEMBER 2001

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BROOKHAVEN
NATIONAL LABORATORY

HFBR FINAL CHARACTERIZATION REPORT

September 2001

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1.0 EXECUTIVE SUMMARY

The Brookhaven National Laboratory (BNL) High Flux Beam Reactor (HFBR) has permanently ceased operations. In support of ongoing decommissioning activities at the HFBR, a characterization study of the HFBR facility has been completed. This report provides characterization information for the HFBR facility and ancillary buildings, documenting the radiological and hazardous material conditions as of September 2001.

Since work is continuing at the HFBR, and future remediation work is planned, it is possible that some redistribution of contamination may occur. This characterization was therefore designed to be a "snapshot" of contamination conditions at the HFBR and is subject to change as further decommissioning activities are performed. However, this baseline information is vital for effective decommissioning planning toward the ultimate goal of "greenfield" status, meaning that the facilities and land may be released for unconditional public use.

The characterization approach for the HFBR was selected to address the fact that funding for full decommissioning is not expected for several years. The limited funding now available is being used to obtain current information using experienced HFBR personnel.

Highlights of the HFBR Characterization effort are:

- 166 Survey Units within the HFBR complex were analyzed for radiological and hazardous materials conditions.
- Generation of "snapshot" characterization reports for each survey unit (see Appendices B-H) that include the following information:
    - Survey unit description
    - Survey classification information (for future Final Status Survey use)
    - Current and previous uses
    - Summary of radiological and hazardous survey data
    - Recommendations for future decommissioning activities
    - Photographs of the survey unit.
- Classification of all Survey units into one or more of the following four categories:
    - Radiologically contaminated.
    - Hazardous material contaminated.
    - Radioactive material storage area.
    - Hazardous material storage area.
- Identification of survey units on elevation level drawings of the HFBR complete with color-coded classification information for easy contamination recognition.
- Estimation of gross waste volumes for relevant systems and components for industrial use (see Appendices I and J).

This HFBR Characterization Project does not address internal reactor components or surrounding soils. Both of which will be addressed by separate project tasks.

2.0 INTRODUCTION

This report documents results of the radiological and hazardous material characterization effort for the High Flux Beam Reactor (HFBR) at the Brookhaven National Laboratory (BNL). The HFBR has permanently ceased operations and has undergone this stage of facility characterization. The HFBR facility includes the Reactor Building (750) and ancillary support buildings.

The purpose of the HFBR Characterization Project is to assess the current status of radiological and hazardous material conditions for each survey unit. This information is essential for effective decommissioning planning and consideration of appropriate decommissioning alternatives in the future. The characterization approach was defined in the HFBR Characterization Project Plan, which outlined overall scope of work, estimated costs, and schedule to identify radiological and hazardous material constituents that are present in the HFBR complex. The goal of the plan is to return the HFBR complex to "greenfield" status, meaning that the facilities and land may be released for unconditional public use.

The following list provides the anticipated uses of this HFBR characterization data:

- Decommissioning planning and engineering
- Determining remedial work scope
- Developing waste disposal strategies
- Determining decommissioning cost estimates and schedules
- Determining the extent of neutron activation
- Providing data to assess the impact of decommissioning on worker and general public health and safety
- Providing input for development or modification of health physics, safety, radioactive waste handling, and environmental monitoring procedures specific to a planned decommissioning program
- Providing input for the development of a final survey program, which will be used to demonstrate compliance with end-state criteria.
- Providing an indication of the current state of contamination in the facility.

This report provides characterization information for the HFBR facility and ancillary buildings, documenting the radiological and hazardous contamination conditions of the facility as of September 2001. Since there is work continuing at the HFBR, and future remediation work is planned, some redistribution of contamination may occur. This characterization was therefore designed to be a "snapshot" of contamination conditions at the HFBR and is subject to change as further decommissioning activities are performed. However, this baseline information is vital for effective decommissioning planning toward the ultimate goal of "greenfield" status for the facility.

The characterization approach for the HFBR complex was selected to address the fact that funding for full decommissioning is not expected for several years. Based on the fact that experienced HFBR personnel are retiring or will not be on site when full decommissioning takes place, performing the characterization at this time takes advantage of their historical knowledge of the facility.

2.1 HFBR FACILITY DESCRIPTION AND HISTORY

2.1.1 Historical Overview

The concept for the HFBR used a new approach in reactor design that was optimized to provide intense

external beams of neutrons, primarily for neutron scattering experiments. The mission of the HFBR was to provide a source of neutrons for multidisciplinary scientific studies in chemistry, biology, and physics. Following a construction period of four years and one month, the HFBR achieved criticality on October 31, 1965. The reactor was originally designed for operation at a power level of 40 megawatts (MW). In addition to its external beams of neutrons, the HFBR provided seven sample irradiation thimbles for neutron activation experiments. An equipment upgrade in 1982 allowed operations at 60 MW, providing a peak thermal flux of 1.05E+15 neutons/cm^2-sec. (BNL 1992) In 1989, the reactor was shut down to reanalyze the safety impact of a hypothetical loss-of-coolant accident. The reactor was restarted in 1991 at 30 MW. The HFBR was shut down in December 1996 for routine maintenance and refueling, when it was discovered that a leak in the spent fuel pool had released tritium-contaminated water to the ground. The reactor remained shut down for almost three years for safety and environmental reviews. By January 1998, all of the spent fuel was removed and shipped off-site. The shipment of the spent fuel and the disposal of miscellaneous reactor components from the canal was necessary to facilitate the canal draining and insertion of a double-walled stainless steel liner for restart. The Secretary of Energy, however, decided to permanently shut down the HFBR in November 1999.

2.1.2 Operational History

A review of historical records shows that there were several D_2O leaks during HFBR operation. D_2O has drained into the FA101 sump and pit, cells, equipment level floor and the CO_2 cavity (from V14 "vertical thimble" instrument line). In July of 1995, about 150 gallons of D_2O spilled onto the "A" cell floor and onto the west side of the equipment level, outside of B cell. The concentration of tritium in the water that leaked was approximately 2.2 Curies/liter. The integrity of the floor seams in A cell and on the equipment level was questionable. D_2O has also inadvertently been released into the D waste system.

On March 31, 1994 a fire occurred at the TRISTAN (Terrific Reactor Isotope Separator To Analyze Nuclides) experiment at beam line H-2. The target consisted of 5 grams of ^{235}U, which, when interacted with the neutron beam induced a fission reaction. The fission fragments were ionized and extracted as a radioactive ion beam. The resulting smoke spread contamination throughout the building. Contamination was found in many areas of the building, with the highest levels at the H-2 beam area. The air particulate monitor on the experimental level indicated full scale, and there were positive reading on the air particulate monitors on the operations and equipment levels. The release to the environment was 18 milliCuries of noble gases and 0.054 milliCurie radioiodines.

2.1.3 Physical Descriptions

The majority of the HFBR facility is housed within the reactor confinement building (750). Support buildings and structures within the HFBR complex include the Stack (705), the Stack Shack (715), the Annex (750A), the Fanhouse (704), the Pumphouse (707), the Water Treatment House (707B), the Cooling Towers, and the Cold Neutron Facility (751) and the Guard Shack (753). Several of these facilities also supported the Brookhaven Graphite Research Reactor (BGRR).

2.1.4 HFBR Confinement Building (Building 750)

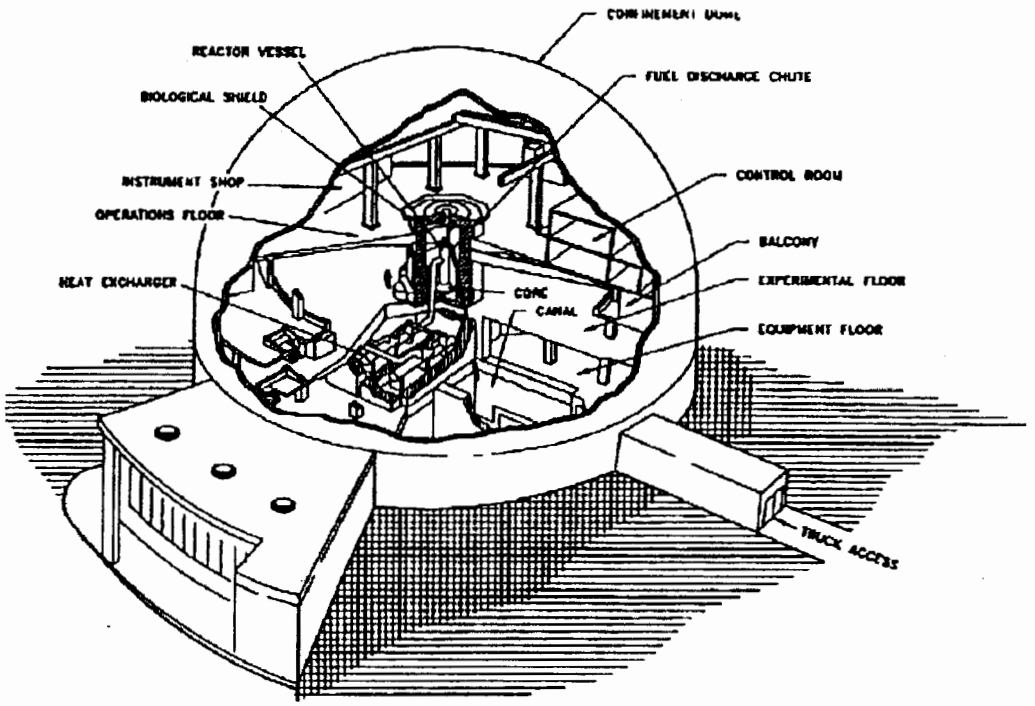

Figure 1. Cutaway View of the HFBR, Building 750

The most recognizable feature of the High Flux Beam Reactor is its steel dome structure in the shape of a hemisphere resting on a cylindrical base. This structure is formed of welded steel plates supported upon an integral I-beam framework. The inside diameter of the hemisphere at its base is 176 ft-8 in. The cylindrical base (22 ft-4 in. high) rests upon a bedplate that is bolted to the reinforced concrete foundation ring. The hemispherical portion of the dome is insulated on the outside, and the insulation is covered with aluminum sheets. The steel plates in the hemispherical section are 0.250 in. thick, and those in the cylindrical base are 0.375 in. thick. The foundation of the reactor building is a reinforced concrete mat bearing on the soil beneath the building. The confinement building consists of four levels: the Equipment Level, Experimental Level, Balcony Level, and Operations Level.

The HFBR core was formed of 28 fuel elements in a close-packed array. The fuel material was fully enriched (93%) uranium oxide-aluminum, clad with aluminum and shaped into curved plates. Heavy water (D_2O) served as the moderator/reflector and primary water coolant. The reactor vessel is fabricated from a 6061-T6 aluminum alloy and contained the active core, reflector and control rods and provided space and access for 16 experimental facilities, which utilized the high neutron flux in the core region. The vessel consists of an 82-in inside diameter spherical section welded via a transition piece to a 46-inch inside

diameter cylinder. Including the closure flange, the over-all height of the vessel assembly is 24.75 ft. The nine horizontal beam reentry tubes are integral (welded) parts of the vessel's spherical section.

There are 16 control rod blades, separated into main and auxiliary rod groups, each containing 8 rods. The control rods operated in the reflector region, just outside the core. The control rod blades are angle-shaped in cross-section, and are made of europium oxide (Eu_2O_3) and dysprosium oxide (Dy_2O_3) in stainless steel, all clad in stainless steel.

The Equipment Level, located at an elevation of 93 ft-0 in. above sea level, contains most of the reactor support and building systems equipment, such as pumps, heat exchangers, filters, wastewater storage tanks, HVAC, and piping networks. Shielded cells for the primary cooling water system pumps and heat exchangers are located in the center of the floor. The spent fuel storage canal (also referred to as the spent fuel pool), located to the east of the shielded cells, is 8 ft wide, 43 ft long and 20 ft deep for most of its length. A 30-foot deep section, 8-ft-6 in long resides under the fuel discharge chute at the west end. A small bay, 8 ft wide, 10 ft long and 20 ft deep, located on the north side of the canal, was used primarily for spent fuel cutting operations. The heavy water purification system and one of two storage tanks are installed in pits sunken into the floor in the northeast quadrant of the Equipment Level. Three rooms along the south wall are partitioned from the rest of the level by a containment wall. These are the transformer room, the blower room, and the generator room. Each of these rooms has access from outside the building.

The Experimental Level, located at an elevation of 113 ft-6 in., was dedicated to the scientific users. The reactor biological shield occupies the central portion of this level, with open floor space surrounding it for the external beam experiments. Laboratories and offices are located along the perimeter wall of the level. A 20-ton capacity radial traveling beam crane services this level.

The Balcony Level, located at an elevation of 128 ft-6 in., is approximately 21 ft. wide, with its outer circumference at the confinement shell. Offices, locker rooms, toilets, and HVAC equipment are contained on this level.

The Operations Level is the top floor of the building located at an elevation of 141 ft-6 in. The reactor shielding structure rises 7.5 ft. above the floor at the center of the building. The southwest quadrant of the level contains an enclosed process area (the Greenhouse), which houses pumps, a heat exchanger and piping associated with the experimental facilities cooling water system. The second of the two heavy water storage tanks is located in this area. A series of offices and workrooms are located on the east side of the Level, with the reactor control room occupying the second story above these offices. A two-story cinderblock structure containing the instrument shop and offices is located on the west side of this Level.

Two air intake ports are located on the Balcony Level. Access into the confinement building is provided by four airlocks: a personnel-size airlock (3 ft.-3 in. x 7 ft. x 9 ft.) located between the Equipment and Experimental Levels on the south side of the building, a forklift size (6 ft. x 8 ft.-9 in. x 18 ft.) located on the north side of the Experimental Level and two tractor trailer size (12 ft. x 14 ft. x 65 ft.), one entering on the north side of the Experimental Level and the other on the east side of the Equipment Level.

2.1.5 HFBR Support Facilities

The Pump House (Building 707) is a one-story building with structural steel support covered by brick walls and a flat built-up tar roofing system over concrete. The foundation consists of poured concrete, with a 49,700-gallon capacity sump connected to the cooling tower basin. The pump house contains three of the five secondary cooling water pumps, water tank FA309, and the associated electrical switchgear in an adjacent room designated Building 707A.

Water Treatment House (Building 707B) – The water treatment house is a one-story building with structural steel supports covered by brick walls and a flat built-up tar roofing system over concrete. The foundation consists of poured concrete. The water treatment house was used to store chemicals and contained associated injection, monitoring, and control systems. Cooling water lines, connecting the water treatment house with the secondary water system piping and basin, enabled the chemicals to be injected into the system

The Fanhouse (Building 704) is a one-story, above-grade structure approximately 150 ft long by 60 ft wide. Concrete block and brick walls and a flat built-up roof cover structural steel supports. This building has been associated with the operation of both the BGRR and HFBR. Most of the equipment associated with the BGRR, such as the exhaust fans, motors and above-grade air ducting, has been removed as part of the BGRR decommissioning project. The fan discharge ducts below the building, which exhausted BGRR air into the base of the stack, remain. The south side of the fanhouse contains the electrical switchgear currently associated with the HFBR facility.

The Stack (Building 705) was also associated with operation of both the BGRR and HFBR and is included among the BGRR complex buildings. The stack was designed to convey fan discharge radioactive air sufficiently high above the ground (320feet) to permit adequate mixing and dilution with atmospheric air. (AEC 1962) Exhaust air, discharged from HFBR building 750 exhaust fans, passes through underground ductwork to a bank of particulate and charcoal filters, before entering the base of the stack.

The Stack Shack (Building 715) housed instrumentation used to monitor stack effluents.

The HFBR Annex (Building 750A) consists of supplemental office space.

The Guard Shack (Building 753) was used by Security personnel on watch.

The Cold Neutron Facility (CNF) became operable in 1980, and was developed to provide researchers with a source of very low energy neutrons.The slowing of the neutrons was accomplished by passing the neutron beam through liquid hydrogen in a moderator chamber located at the tip of the beam tube. CNF support equipment, such as the helium refrigerator, was housed in a separate building (Building 751) on the southeast side of Building 750. A CNF monitoring and control panel was located on the south side of the Experimental Level.

2.2 DECOMMISSIONING PLANS AND END-STATE SELECTION

This Characterization Final Report is intended to support a "greenfield" decommissioning end-state, meaning that the facilities and land may be released for unconditional public use. As such, the radiological and hazardous material data are reported against established or anticipated criteria that will determine if systems, equipment and structures within the HFBR are "contaminated" or "non-contaminated". However, all data collected and reported will be supportive of other decommissioning end state alternatives, if the desired end state were to change in the future. Understanding that a particular component or structure is contaminated or non-contaminated will provide valuable input to project variables such as cost and schedule, for all decommissioning alternatives.

3.0 DATA QUALITY OBJECTIVES

3.1 STATE THE PROBLEM

The objective of this characterization study is to determine what parts of the HFBR and support facilities are contaminated in order to provide information for future decommissioning efforts.

3.2 IDENTIFY THE DECISION

- Determine if existing data adequately defines the contamination in the facility.
- Determine the location, type, and extent of contamination.
- Determine if the structure and installed components exceed the Table 1 criteria.

3.3 IDENTIFY INPUTS TO THE DECISION

- Brookhaven National Laboratory procedures for release of radioactive materials (shown in Section 4.1).
- New York State Department of Environmental Conservation (NYSDEC) Technical Action Guidance Memoranda (TAGM).
- 40 CFR 261, EPA Regulations, Hazardous Waste

3.4 DEFINE THE STUDY BOUNDARIES

- This study includes Building 750 and support facilities as described in Section 2.1.5.
- Soils external to the buildings are not included.
- The information from the survey units are a combination of historical information, and surveys taken from March to September 2001. Changes to the facility after September 2001 are not part of this study.
- There are constraints on data collection in that parts of the facility are being used for office space. In addition, there are non-permanent materials, tools, and supplies remaining on all elevations.

3.5 DEVELOP A DECISION RULE

- Survey units are deemed contaminated or non-contaminated based on historical information, biased sampling, and professional judgment.
- If radioactive materials were detected above the criteria in Section 4.1, then the area was considered contaminated for the purposes of this characterization. Specific cleanup levels will be developed at a later time.
- If hazardous materials were detected above the required detection levels in Section 4.2, then the area is considered contaminated for the purposes of this characterization. Specific cleanup levels will be developed at a later time.

3.6 SPECIFY LIMITS ON DECISION ERRORS

Constraints on decision error are not needed, because a statistical sampling plan is not required for this project.

3.7 OPTIMIZE THE DESIGN FOR OBTAINING DATA

- Use historical information; including surveys, incident reports, and interviews with HFBR experienced personnel.
- Survey using a combination of scans, smears, and samples of material to characterize survey units where historical information is not adequate to define an area.
- "Release" of a survey unit will not be accomplished, as additional activities may occur between the time of the survey and the time of remediation and final release.

4.0 OVERVIEW OF CHARACTERIZATION PLAN AND METHODS

4.1 RADIOLOGICAL CHARACTERIZATION CRITERIA

The HFBR building surfaces, structures, and systems were divided into 166 survey units, subdivided by reactor elevation (e.g. Experimental Level) or general area (e.g. "Lobby"). A master list of all survey units is provided in Appendix A.

Survey units were characterized using historical HFBR survey data, "new" survey data obtained during the characterization efforts, and laboratory analysis results of samples and facility components for hazardous materials. Each survey unit was investigated using the "Survey Unit Checklist", as shown in Appendix E of the HFBR Characterization Project Plan (April 2001). Each checklist contained questions regarding the past and present use of each survey unit from a radiological and hazardous perspective to ensure that all aspects of an area are considered.

The results of each Survey Unit Checklist were placed in a master survey file. Each Survey Unit Report serves as a "snapshot" of the current state of the area and includes the following detailed information:

- Survey unit description
- Survey classification information (for future Final Status Survey use),
- Current and previous uses,
- Summary of radiological and hazardous survey data collected,
- Recommendations for future decommissioning activities, and
- Photographs of the survey unit taken during this characterization effort.

4.1.1 Radionuclides of Concern

The HFBR operated as a heavy water cooled research reactor. Typical radionuclide contaminants include those of mixed fission and activation products (MFAP), transuranics (TRU), and tritium (HT or ^{3}H).

- Mixed Fission and Activation Products (MFAP)
  MFAP includes beta and gamma (β/γ) emitting radionuclides. Gross contamination is generally detected with conventional portable field instrumentation such as GM probe coupled with a scaler/ratemeter or gas flow proportional detector. Difficult-to-detect-radionuclides, such are iron-55 and nickel-63, are generally estimated through compared ratios of standard HFBR mixes of contamination. After three years since reactor shutdown, the predominant MFAP of concern is cobalt-60 (^{60}Co).
- Transuranics (TRU)
  TRU contamination is conventionally identified as alpha (α) contamination. Alpha contamination is generally detected through removable wipe tests and is only anticipated in specific areas such as the special nuclear material (SNM) vaults, and hutch area.
- Tritium (HT or H3)
  Heavy water was used to cool and moderate the HFBR core. Heavy water is rich in deuterium, i.e., a hydrogen atom with and additional neutron. Deuterium readily transforms to tritium when subject to high neutron flux. Tritium contamination is detected through liquid scintillation analysis.

4.1.2 Contamination Criteria

Radiological characterization surveys were conducted with the survey criteria stated in Table 1, "Radiological Surface Contamination Criteria". (FS-SOP-1001)

Table 1: Radiological Surface Contamination Criteria

NUCLIDE	REMOVABLE (dpm/100 cm^2) (See Note 2,4,6)	TOTAL (FIXED + REMOVABLE) (dpm/100 cm^2) (See Note 2,3,6)
U-natural, U-235, U-238 and associated decay products	1,000 alpha	5,000 alpha
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. Includes mixed fission products containing Sr-90.[5]	1,000 beta-gamma	5,000 beta-gamma
Tritium organic compounds, surfaces contaminated by HT, HTO and metal tritide aerosols	10,000	10,000

Summary of Surface Contamination Values[1] - Allowable Total Residual Surface Contamination

Notes:

1. These values apply to radioactive contamination deposited on, but not incorporated into the interior of the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently. Volume/bulk activated materials are not included in these limits.
2. As noted, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
3. The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the activity guide G if:
   (1) From measurements of a representative number n of sections it is determined that
   $1/n \, \Sigma_n \, S_i \geq G$, where S_i is the dpm/min-100 cm^2 determined from measurement of section i; or
   (2) It is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds 3G.
4. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with any appropriate instrument of known efficiency. (Note - the use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and Ra-228, Ac-227, Th-228, Th-230, and Pa-231 alpha emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.
5. This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.
6. For surveys of small items covering less than 100 cm^2, the results shall be reported in units of dpm per area surveyed.

4.1.3 Exposure Rate Criteria

Radiological exposure rate measurements were conducted to ensure an exposure rate sensitivity of 5 micro R/hr above background in accordance with Procedure FS-SOP-1000. Exposure rate measurements were performed using approved procedures and measurements were made at established points that can be duplicated. Exposure rate measurements were made at contact at established reference points.

4.1.4 Volumetric Release Criteria

FS-SOP-1005 was used to evaluate if potentially contaminated volumetric material can be released or classified as non-contaminated.

There is currently a moratorium of release of scrap metals for recycling. This does not prevent BNL from releasing metal products using FS-SOP-1005 if the material is not going to a recycling firm. At the time of remediation, the Radiological Control Department will provide guidance on the current BNL and DOE policies on volumetric release.

4.1.5 Tritium Release Criteria

The tritium volumetric release criterion is set at 10,000 pCi/l (10 pCi/cc), which is the BNL administrative limit for release.

4.2 HAZARDOUS MATERIAL CHARACTERIZATION CRITERIA

Hazardous material surveys were performed by the collection of samples from building materials, drain and trap sediments and sludge, and direct sampling methods. The samples were submitted to a qualified laboratory for analyses. Analytical detection limits were determined by laboratory analytical techniques and standard methodologies. HFBR characterization samples submitted for laboratory analyses were subject to the detection limits in Table 2, "Hazardous Material Analytical Detection Limits" (EPA Regulations, NYSDEC 1994).

Table 2: Hazardous Material Analytical Detection Limits

Analyses	Detection Limit
Asbestos	1%
Mercury	<0.2 ppm
Elemental Lead	<5.0 ppm
PCB's	<1.0 ppm
Zinc	<100 ppm
Beryllium	<10 ppm
Cadmium	<5.0 ppm

4.3 SURVEY AREA CLASSIFICATION

Survey units were classified on their potential impact on decommissioning. The classification categories were considered using current Multi-Agency Radiological Site Survey Investigation Manual (MARSSIM) philosophy:

- **Class 1**
  Class 1 areas were classified if currently or previously contaminated. These areas or systems have received biased surveys to determine the extent of the contamination. Areas with hazardous material contamination, e.g. lead dust or asbestos tiles, are considered contaminated.
- **Class 2**
  Class 2 areas are generally adjacent to Class 1 areas with potential for contamination. These areas received both biased and unbiased (random) sampling for contamination.
- **Class 3**
  Class 3 units are unlikely to have contamination or activated materials present. These areas received unbiased surveys.

Although the MARSSIM classification process does not directly apply to characterization surveys (it is intended for final status surveys), it was deemed valuable to perform preliminary classifications now to assist in future survey design and remediation efforts. -

5.0 RESULTS

All 166 Survey Units were characterized using the Data Quality Objectives outlined in the HFBR Characterization Project Plan (REFERENCE). Detailed characterization information for each is presented in the HFBR Survey Unit Reports found in Appendix B to Appendix H.

All survey units were classified into any single (or combination) or the following four categories:

- Radiologically contaminated (based on the Table 1 criteria);
- Radioactive material storage area;
- Hazardously contaminated (based on the Table 2 criteria);
- Hazardous material storage area.

Table 3: Summary of Characterization Results for HFBR Survey Units

HFBR Elevation / Area	Survey Units	Radiological Contamination	Radioactive Material Storage Areas	Hazardous Material Contamination	Hazardous Material Storage Areas
Operations Level	30	6	12	17	14
Balcony Level	8	-	2	2	-
Experimental Level	47	4	20	20	15
Equipment Level	29	14	6	14	6
Lobby	1	-	1	1	-
Reactor Systems	42	28	-	16	-
Support Facilities	9	3	3	3	3
Totals	***166***	***55***	***44***	***73***	***38***
% Impacted	-	33	27	44	23

5.1 GENERAL CHARACTERIZATION RESULTS

In addition to specific survey unit results, general statements or cautions can be presented for the HFBR and its support facilities based on a review of the characterization data. These general statements are applicable to both hazardous material and radioactive material.

5.1.1 Asbestos Containing Material (ACM)

ACM is found throughout the HFBR in older floor and ceiling tiles. Samples were collected from a limited number of areas. General statements caution that floor and ceiling tiles may contain ACM. Previous lobby, airlock, and building roofs areas were ACM but replaced. Residues may remain. Painted concrete floors throughout the HFBR use ACM. Throughout Building 750, floor penetrations possess ACM. Piping and valves have Garlock gaskets with ACM. Asbestos insulation is also present around many pipes. In preparation for decommissioning the HFBR, asbestos abatement technologies will be required.

5.1.2 Lead

Lead is present in many products throughout the HFBR. The most obvious is lead shielding used to reduce area radiation levels. Only some of the shielding is plastic coated to mitigate lead dust. Through area wipes analyzed for metals, lead is detected consistently. Again, a limited number of samples were taken in a limited number of areas. Appropriate precautions should be taken throughout the complex, particularly where milling and maintenance activities have taken place.

Lead paint is also apparent on many metal and concrete surfaces. The HFBR dome and crane/rail system is coated with lead based paint. Other areas have also identified lead in the paint. Building 750 Annex appears to free of lead based paints.

5.1.3 Heavy Metals

As in the survey method for lead dust, the samples were analyzed for several heavy metals. In accordance with the Characterization Plan, beryllium, cadmium, lead, and zinc were the chemicals of concern. Where surveys were performed, lead and zinc were always identified about the level in Table 2. Cadmium and beryllium were sporadically detected. All operational areas of the HFBR are suspect to heavy metals contamination.

5.1.4 PCBs

PCBs have been reported in paint chips analyzed from the HFBR. PCBs were used as an additive to paints for corrosion protection. PCB-paint (chlorinated rubber paint) was a common paint used in the period 1955-1975 for metal constructions and on pipelines. PCBs can be suspect on much of the painting throughout the facility with the exception of the Building 750 Annex, which appears to be free of PCB based paints.

PCBs were contained within the pit of the passenger elevator of the HFBR. The PCBs were secured in place with paint and the unit continues to remain on the inventory list.

Less than 10% of the ballasts in the building are expected to contain PCBs.

5.1.5 Discrete Radioactive Particles

Many survey units within the HFBR radiologically controlled areas were subject to discrete radioactive particle contamination, particularly the Operations and Equipment levels. Discrete radioactive particle contamination has also been seen on the Experimental level to a lesser degree. In some instances, localized

contamination was fixed in place by painting the areas, such as outside the fuel storage canal. Discrete radioactive particle were discovered in one area of a pipe trench on the Experimental level, however, they are now suspect within all trench areas.

5.2 OPERATIONS LEVEL

The Operations level contains the reactor top, support and maintenance areas, and the operations control room. There general areas are free from loose contamination. Radioactive materials are stored throughout the elevation in the open areas and behind offices. Most radioactive material appears to be adequately packaged to contain contamination. Contamination and elevated dose rates are expected around the reactor top and shielded experimental areas.. Fixed contamination is located on the walkway from the control room to the reactor top. Health physics and chemistry laboratories are on this elevation and they are currently using and storing radioactive and hazardous materials.

Much of the hazardous material contamination is in the form of removable heavy metals detected during wipe analyses. In office areas, asbestos tiles are common. The inside of the containment dome and crane are coated in lead and possibly PCB-based paint, although not positively identified.

5.3 BALCONY LEVEL

The balcony level is free of radiological contamination. However, the TRISTAN fire deposited contamination throughout the experimental and balcony levels. The area has since been decontaminated. The only apparent radioactive materials are check sources associated with area monitors on a few of the columns. These check sources are clearly marked.

Hazardous materials include asbestos floor and ceiling tiles.

5.4 EXPERIMENTAL LEVEL

During the March to September time frame, the experimental level was transitioning from a storage area to vacant space. When the characterization process was underway, the level was filled, as noted by the Figures in Appendix D, with hazardous and radioactive materials. The largest radiological hazard on the elevation is the "cheese box," containing many highly activated beam plugs. Radioactive materials and contamination areas exist throughout the level. Many of the laboratories are being used for hazardous and radioactive material sorting areas. The open walkways are generally clear and free of contamination. The TRISTAN fire occurred on this elevation.

One tritium exit sign was recognized in the receiving area outside building 750. Although this sign utilizes a sealed source, the unit can be damaged if not handled properly. These units routinely contain 10 Ci of tritium.

Asbestos floor and ceiling tiles are common throughout the laboratories. Wipe tests for heavy metals were performed in several areas yielding positive results for the chemicals of concern. Several satellite chemical storage areas exist.

5.5 EQUIPMENT LEVEL

The equipment level holds most of the primary and secondary structure, systems, and components for the HFBR. General walkways are free from radiological contamination; however, there are many areas where radiological contamination and discrete radioactive particles have been fixed in place. These areas are generally clearly marked on the floors. Due to the nature of the cooling and moderating of the reactor,

tritium contamination is of concern when primary and secondary systems develop leaks or are otherwise breeched. Mixed fission and activation products were not routinely encountered outside the primary equipment and shutdown cell areas. Higher dose rate areas include the primary cells and clean up systems (resin beds).

The special nuclear material (SNM) vault recently held several hundred dpm of alpha (TRU) contamination.

Hazardous materials are generally limited to asbestos insulation on pipes and heavy metal contamination as demonstrated through area wipe tests.

Current decommissioning plans assume that the Equipment Level will remain a radiologically controlled area with restricted access.

5.6 LOBBY

The lobby has one 0.1 uCi Sr-90 check source located within an area monitor in the conference room. Hazardous materials include an asbestos wall, and floor and ceiling tiles that are ACM.

5.7 SYSTEMS

Systems are generally characterized by the materials contained within. Primary systems and piping containing primary water were subject to mixed fission and activation products, as well has high levels of tritium. Bends in piping and valves are traps for fission and activation products leading to increased dose rates. This is evident in the primary heat exchangers.

Secondary systems were generally filled with light water, but were subjected to some transfer of tritium through historical leakage from the primary side. With the exception of large primary to secondary leakage, the effect of tritium contamination on the piping surfaces is minimal when compared to the contamination levels in Table 1.

Hazardous contaminants are consistent with the routine piping degradation, i.e., metals, and chemicals used to maintain water chemistry.

Appendix I and Appendix J provide gross volume estimates of piping and components for the Industrial Use end-state.

5.8 BUILDINGS

The HFBR and BGRR share a common ventilation stack. Contamination within the stack is significant. Other shared facilities, such as the Fan House, are maintained as radioactive material storage areas. The contamination potential for each facility is unique to the type of facility. For an area such as the stack, high levels of fission and activation products would be expected from the BGRR. The CNF also contains internally radiologically contaminated systems. Several radioactive sources are stored in the stack monitoring house.

Underground piping transported many of the reactor fluids and gases during operation of the facility. The D waste lines (transported treated/contaminated water to be distilled with the distillate stored in vaults) are stainless steel with a carbon steel liner. The FA310 tank, receiving cooling tower blowdown and overflow, used (2) 8" carbon steel lines which then delivered to the recharge basin. Secondary water was transported in 24" carbon steel lines. The sanitary line is an 8" line. Ventilation exhaust is carried to the fan house through a 30" concrete line.

Due to the age of many of the buildings, they are subject to the general concerns mentioned at the beginning of this section, including asbestos insulation, PCB and lead based paint, etc.

6.0 REFERENCES

ANSI N323a, 1997. "Radiation Protection Instrumentation Test and Calibration", 1997.

BNL7661, Final Safety Analysis Report on the Brookhaven High Flux Beam Research Reactor, April 1964.

BNL 1992, HFBR Handbook, Rev. 10/92.

BNL 1998, HFBR Safety Evaluation Report.

EPA 2000, MARSSIM, Multi-Agency Radiological Site Sampling and Investigation Manual, Revision 1, US EPA, US DOE, US NRC, US DOD, August 2000.

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NYSDEC 1994, HWR-94-4047, TAGM Limits, memo from NY State Department of Environmental Conservation, January 1994.

7.0 ACRONYMS AND ABBREVIATIONS

ACM	Asbestos Containing Material
Bal	Balcony Level
BGRR	Brookhaven Graphite Research Reactor
CNF	Cold Neutron Facility
cm^2	Centimeters squared
cpm	Counts per minute
DOE	Department of Energy
dpm	disintegrations per minute
Equip	Equipment Level
EPA	U.S. Environmental Protection Agency
Exp	Experimental Level
F.S.	Facility Support (Radiation Control Division)
HFBR	High Flux Beam Reactor
HSA	Historical Site Assessment
HVAC	Heating Ventilation and Air Conditioning System
Hx	Heat Exchanger
LLD	Lower Limit of Detection
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MFAP	Mixed Fission and Activation Products
mrem	millirem
MW	Megawatts
NIST	National Institute of Standards and Technology
Ops	Operations Level
PCB	Polychlorinated Biphenyl
RCD	Radiation Control Division
RIG	Reactor Instrument Group
RCG	Research Coordination Group (Reactor Division)
RMG	Reactor Maintenance Group
Rx	Reactor
SNM	Special Nuclear Material Vault
TCLP	Toxicity Characteristic Leachate Procedure
TRU	Transuranic Elements
TRISTAN	Terrific Reactor Isotope Separator to Analyze Nuclides
WCG	Water Chemistry Group (Reactor Division)

Survey Unit Number	Elevation / Area	Survey Area Description
BAL-01	Balcony	Offices B-6 to B-14
BAL-02	Balcony	Mens / Ladies Room
BAL-03	Balcony	Office B-4 & B-5
BAL-04	Balcony	Walkways
BAL-05	Balcony	Walls in open area
BAL-06	Balcony	Pipes in open area
BAL-07	Balcony	Ceiling in open area
BAL-08	Balcony	Crawl Space
LOB-01	Lobby	Lobby, Conference Room, office
OPS-01	Operations	Rx Group Offices (Leader/ass't leader/secretary)
OPS-02	Operations	Day Crew shop area
OPS-03	Operations	OPS Bullpen
OPS-04	Operations	Water Chemistry Laboratory (2 rooms)
OPS-05	Operations	RMG Hot Shop
OPS-06	Operations	Research Coordination Group Area
OPS-07	Operations	Dome
OPS-08	Operations	Crane
OPS-09	Operations	Trenches/Pipe trays
OPS-10	Operations	RMA above WCL
OPS-11	Operations	Iodine Sample Prep/Counting Area
OPS-12	Operations	Walkway behind South Stairwell
OPS-13	Operations	Custodians Area (behind North Stairwell)
OPS-14	Operations	Walkway behind locker room
OPS-15	Operations	Locker Room
OPS-16	Operations	Bridge from Rx top to control room
OPS-17	Operations	Control Room - Mens room
OPS-18	Operations	RIG Areas
OPS-19	Operations	Hutch
OPS-20	Operations	Dry box
OPS-21	Operations	Greenhouse
OPS-22	Operations	Top of Greenhouse
OPS-23	Operations	Security Observation Stations
OPS-24	Operations	General Walkways
OPS-25	Operations	Emergency Hatch Area
OPS-26	Operations	Reactor Top

Survey Unit Number	Elevation / Area	Survey Area Description
OPS-27	Operations	Reactor Pit (Upper and Lower)
OPS-28	Operations	Stairwells (North and South)
OPS-29	Operations	Offices (WCL, Day Crew Supervisors, HP)
OPS-30	Operations	Positron Blockhouse
EXP-01	Experimental	Mens Room
EXP-02	Experimental	L-2
EXP-03	Experimental	L-4
EXP-04	Experimental	L-6 & L-7
EXP-05	Experimental	L-8 & L-9
EXP-06	Experimental	L-9B & L-10
EXP-07	Experimental	L-10B
EXP-08	Experimental	L-11 & L-11A
EXP-09	Experimental	L-12 & L-13
EXP-10	Experimental	L-14 & L-15
EXP-11	Experimental	L-16
EXP-12	Experimental	Cheesebox
EXP-13	Experimental	H-1 trench to H-8 trench (floor) Not completed due to beam plug removal project
EXP-14	Experimental	H-7 trench to H-6 trench (floor) Not completed due to beam plug removal project
EXP-15	Experimental	H-5 trench to H-4 trench (floor) Not completed due to beam plug removal project
EXP-16	Experimental	H-9 trench to H-3 trench (floor) Not completed due to beam plug removal project
EXP-17	Experimental	H-2 trench to trench (floor) Not completed due to beam plug removal project
EXP-18	Experimental	C1 to C2 (floor)
EXP-19	Experimental	C2 to C3 (floor)
EXP-20	Experimental	C3 to C4 (floor)
EXP-21	Experimental	C4 to C5 (floor)
EXP-22	Experimental	C5 to C6 (floor)
EXP-23	Experimental	C6 to C7 (floor)
EXP-24	Experimental	C7 to C8 (floor)
EXP-25	Experimental	C8 to C10 (floor)
EXP-26	Experimental	C10 to C11 (floor)
EXP-27	Experimental	C11 to C12 (floor)
EXP-28	Experimental	C12 to C13 (floor)
EXP-29	Experimental	C13 to C14 (floor)

Survey Unit Number	Elevation / Area	Survey Area Description
EXP-30	Experimental	C14 to C15 (floor)
EXP-31	Experimental	C15 to C16 (floor)
EXP-32	Experimental	C16 to C1 (floor)
EXP-33	Experimental	Trenches
EXP-34	Experimental	Ceiling
EXP-35	Experimental	Crane Rail & Base
EXP-36	Experimental	South & North Quiet Rooms
EXP-37	Experimental	Health Physics Office
EXP-38	Experimental	Receiving Area
EXP-39	Experimental	Machine Shop
EXP-40	Experimental	RMG Storage Area
EXP-41	Experimental	Receiving/Storage Area
EXP-42	Experimental	North Truck Lock
EXP-43	Experimental	Outside Receiving Area
EXP-44	Experimental	Lunch Room
EXP-45	Experimental	Passenger Elevator
EXP-46	Experimental	Freight Elevator
EXP-47	Experimental	Experimental Radiation Survey
EQ-01	Equipment	Transformer Room
EQ-02	Equipment	Generator Room
EQ-03	Equipment	Blower Room
EQ-04	Equipment	Filter Room
EQ-05	Equipment	East Truck Lock
EQ-06	Equipment	D_2O Room
EQ-07	Equipment	SNM Vault
EQ-08	Equipment	Fuel Vault
EQ-09	Equipment	Locker Room
EQ-10	Equipment	Exhaust Plenum Area
EQ-11	Equipment	Resin Processing Area
EQ-12	Equipment	BG201 Area
EQ-13	Equipment	FA101 Pit
EQ-14	Equipment	CNF vacuum pump area
EQ-15	Equipment	A Cell
EQ-16	Equipment	B Cell
EQ-17	Equipment	Shutdown Cell
EQ-18	Equipment	Thermal Shield Area

Survey Unit Number	Elevation / Area	Survey Area Description
EQ-19	Equipment	Primary Purification System Beds
EQ-20	Equipment	Canal
EQ-21	Equipment	Fuel Handling Blower
EQ-22	Equipment	Overhead Piping
EQ-23	Equipment	Shutdown Pump Area
EQ-24	Equipment	RMG Hot Shop
EQ-25	Equipment	Ceiling
EQ-26	Equipment	Equipment Room (outside of building)
EQ-27	Equipment	Decontamination Sink Area
EQ-28	Equipment	Equipment Level Radiation Survey
EQ-29	Equipment	SNM & Fuel Vaults
704-01	Outside	Bldg 704, Fan House (HFBR portion of fan house)
705	Outside	Stack
707-01	Outside	Bldg 707 (Pump House) & Bldg 707A (SwitchGear)
707B	Outside	Water Treatment House
707B-01	Outside	Bldg 707B
715-01	Outside	Bldg 715, Stack Shack
750 Dome	Outside	Building 750 Dome (outside)
750A-01	Outside	Bldg 750A, Annex
753-01	Outside	Bldg 753 (Guard Shack)
751-01	Outside	Bldg 751, Cold Neutron Facility
SYS-01	Operations Experimental Equipment	Primary Cooling Water System & Instrumentation
SYS-02	Equipment	Primary Purification System
SYS-03	Equipment	Primary Acidification System
SYS-04	Equipment	Primary Sampling System
SYS-05	Equipment	Pri. Pump Seal Cold Trap System
SYS-06	Equipment Experimental Operations	DA Drain & D_2O Transfer System
	Equipment	
SYS-08	Operations	Reactor Vessel Cover Gas System & Instrumentation
SYS-09	Operations	SPAM System (Suppl. Poison Addition Method)

Survey Unit Number	Elevation / Area	Survey Area Description
SYS-10	Operations	Light Water Make Up System
	Experimental	
	Equipment	
	Outside	
SYS-11	Operations	Shutdown Cooling Water System & Instrumentation
	Experimental	
	Equipment	
SYS-12	Operations	Thermal Shield Cooling Water Syst. & Instrumentation
	Experimental	
	Equipment	
SYS-13	Operations	Bio. Shield Cooling Water Syst & Instrumentation
	Experimental	
	Equipment	
SYS-14	Equipment	Canal Cooling Water System
SYS-15	Equipment	Auxiliary Water Purification System BG201
SYS-16	Operations	Secondary Cooling Water System & Instrumentation
	Experimental	
	Equipment	
	Outside	
SYS-17	Outside	Secondary Cooling Water Treatment System
SYS-18	Operations	Building Ventilation System
	Experimental	
	Equipment	
	Outside	
SYS-19	Equipment	A/C Absorbers
SYS-20	Operations	Chill Water System
	Experimental	
	Equipment	
SYS-21	Operations	Hot Water Heating System
	Experimental	
	Equipment	
SYS-22	Equipment	Steam Heating System
SYS-23	Operations	Domestic Water System
	Experimental	
	Equipment	
	Outside	

Survey Unit Number	Elevation / Area	Survey Area Description
SYS-24	Operations	Sanitary System
	Experimental	
	Equipment	
SYS-25	Operations	Fire Protection System
	Experimental	
	Equipment	
	Outside	
SYS-26	Operations	Helium Supply System
	Experimental	
	Equipment	
	Outside	
SYS-27	Outside	Carbon Dioxide Gas System
	Equipment	
SYS-28	Experimental	Beam Tube Plugs
SYS-30	Operations	Vertical Irradiation Thimbles
SYS-31	Operations	Exper. Facilities Cooling Water Sys. & Instrumentation
	Experimental	
SYS-32	Experimental	Cold Neutron Facility Systems
	Equipment	
	Outside	
SYS-33	Operations	Building Compressed Air System
	Experimental	
	Equipment	
	Outside	
SYS-34	Operations	Liquid D/F Waste Systems
	Experimental	
	Equipment	
	Outside	
SYS-35	Operations	Breathing Air System
	Experimental	
	Equipment	
SYS-36	Equipment	Fuel Cladding Failure System
SYS-38	Equipment	Exit Air Monitoring System
	Equipment	
SYS-40	Operations	Water & Cover Gas Sampling & Monitoring
	Experimental	

Survey Unit Number	Elevation / Area	Survey Area Description
	Equipment	
SYS-41	Outside	Stack Effluent Monitoring Sys.
SYS-42	Operations	Break Tank Water Supply Sys.
	Experimental	
	Equipment	
SYS-43	Operations	Condensate Collection System
	Experimental	
	Equipment	
SYS-44	Outside	Emergency Generator & Propane Supply
SYS-45	Operations	Rx Poison Water System (Cd-Nitrate)
SYS-46	Equipment	Vent Seal Collection System

Appendix B - HFBR Survey Unit Reports - Operations Level

Survey Unit Number: OPS-01 **Survey Number:** 10

Description: Rx Group Offices (Leader/Assn't Leader/Secretary)

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	2		

Current Use: Currently occupied office space.

Previous Use: Same

Current Materials Present:
General office materials, computers, and files.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates indicate background levels.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
Asbestos identified in floor tiles for Group Leader, Assistant Group Leader, and Secretary's offices. Potential asbestos in wiring and insulation.

Recommendations for future work or samples:
Based on historical review and current survey data, the floors are considered Class 1 and remaining surfaces Class 2. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage. However, the areas may contain asbestos in wiring and insulation.

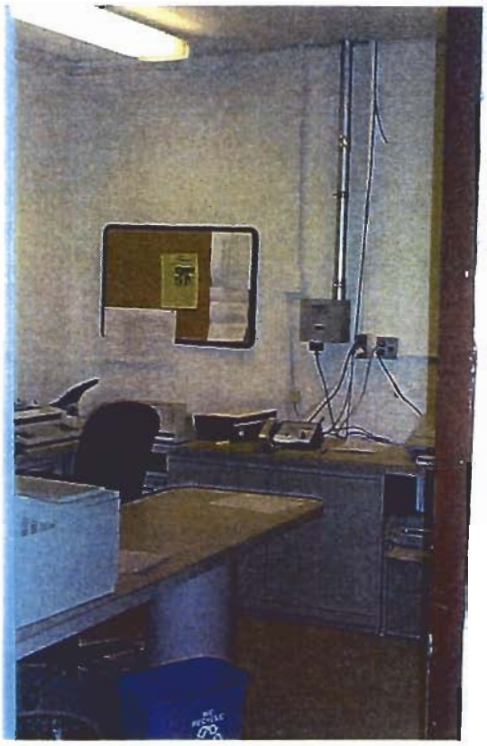

Figure OPS- 1

Figure OPS- 2

Survey Unit Number: OPS-02 **Survey Number:** 11

Description: Day crew shop area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	1		

Current Use: Currently occupied office space and non radioactive tools and supplies storage area.

Previous Use: Same

Current Materials Present:
Office areas and shop equipment. Several storage cabinets and bins. Potential for lead, cadmium, oils, and solvents used in shop repair. Wires and cables present (potential for asbestos).

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates indicate background levels.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
Multiple chemicals stored in this area, such as, tapping fluid, lubricating compounds, solder, vacuum grease, etc.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. Due to hazardous material storage and use, floor and horizontal surfaces are considered Class 1. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage.

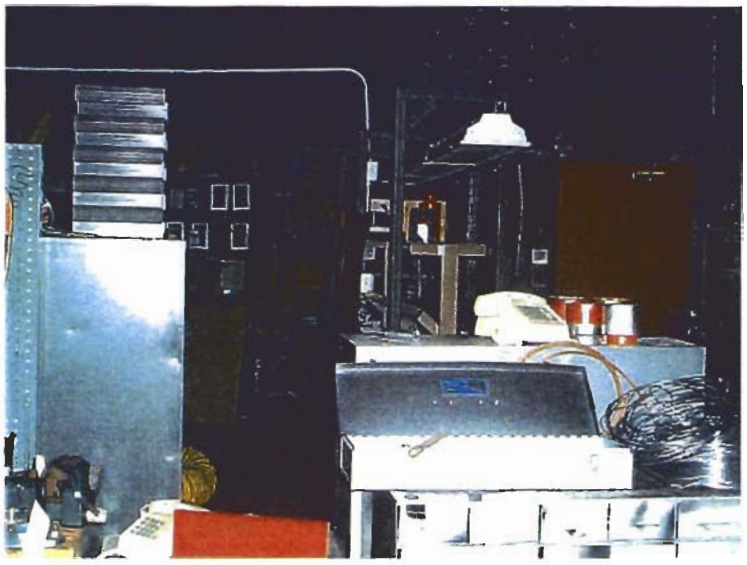

Figure OPS- 3

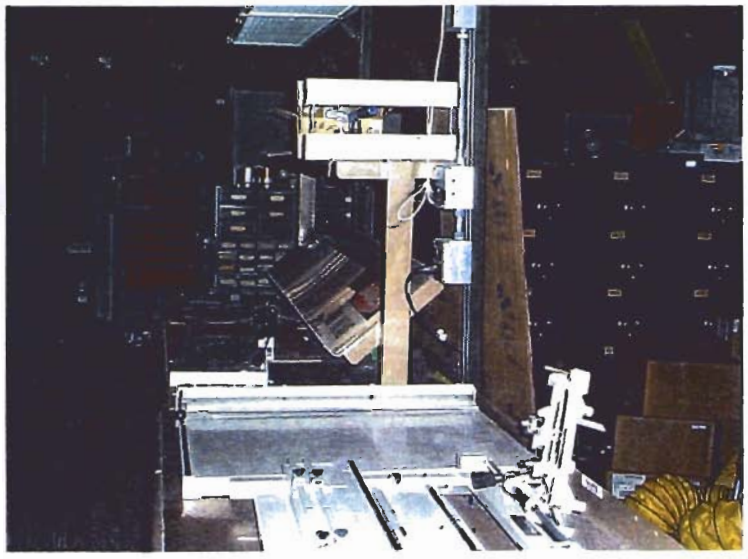

Figure OPS- 4

Survey Unit Number: OPS-03 **Survey Number:** 12

Description: OPS Bullpen

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Currently occupied office space.

Previous Use: Reactor Maintenance Group "hot" shop (radioactive material work area) and Research Coordination Groups "hot" shop (radioactive material work area)

Current Materials Present:
General office materials, computers, and files.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Suspect contamination under floor tiles due to historical chemical and radioactive material use.

Dose Rate
General area dose rates indicate background levels.

Description of remaining radioactive materials:
Radioactive material currently stored in area.

Hazardous materials:
Lead, cadmium, oils, and other solvents used. Wipe analyses identified Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, and Zn above instrument detection limits. However only Be, Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. Asbestos was not recognized in floor tiles.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject chemical and radioactive material storage and use.

Figure OPS- 5

Survey Unit Number: OPS-04 **Survey Number:** 13

Description: Water Chemistry Laboratory (2 rooms)

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Water Chemistry Lab; primary and secondary water, heavy water, cadmium nad gadolinium analyses.

Previous Use: Same

Current Materials Present:
Chemistry equipment, survey meters, solvent storage, and RAM use.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Suspect contamination in piping due to historical chemical and radioactive material use.

Dose Rate
General area dose rates greater than background levels (up to 0.2 mR/hr), mainly due to radioactive material storage area above.

Description of remaining radioactive materials:
Radioactive material currently stored in area.

Hazardous materials:
Hazardous materials currently stored in area including lead. Wipe analyses identified Al, As, Ba, Be, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, and Zn above instrument detection limits. However only Pb and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject chemical and radioactive material storage and use.

Figure OPS- 6

Survey Unit Number: OPS-05 **Survey Number:** 14

Description: RMG Hot Shop

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Reactor Maintenance Group hot-shop.

Previous Use: Fuel Vault.

Current Materials Present: Wires, assorted chemicals and radioactive material areas.

Radiological Data:

Contamination
Large area wipes indicate up to 4,500 cpm per wipe. Smears indicated less than the levels in Table 1 for removable contamination.

Dose Rate
Dose rates as high as 10 mR/hr on contact with filter. General area dose rates are 5 mR/hr to <0.2 mR/hr.

Description of remaining radioactive materials:
Area posted as a contaminated area, radioactive material area, and radiation area.

Hazardous materials:
Lead, solvents (flammable cabinet), degreasers, trichloroethane, oils, paints, rust inhibitors, epoxy, solder, tapping and cutting fluid, and asbestos wiring are present.

Recommendations for future work or samples:
Area contains radioactive and chemical contaminants. Excess items should be decontaminated and removed as time permits. Based on current chemical and radiological conditions, this survey unit is classified as Class 1.

Figure OPS- 7

Figure OPS- 8

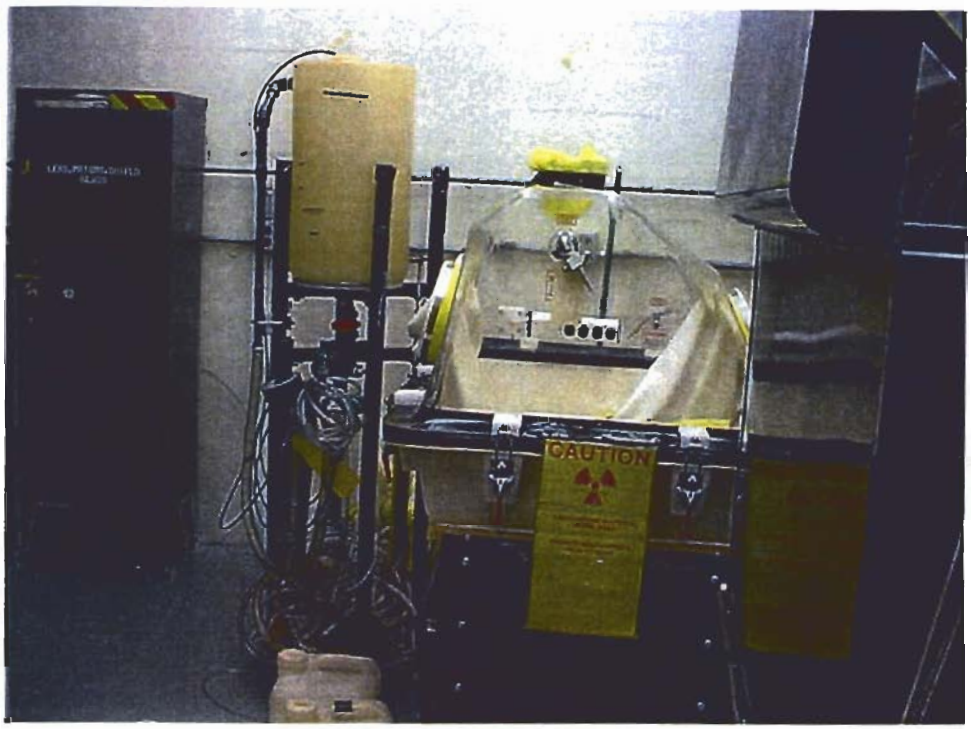

Figure OPS- 9

Survey Unit Number: OPS-06 **Survey Number:** 15

Description: Research Coordination Group Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Reasearch Coordination Group sample preparation area for verticle irradiations and battery room.

Previous Use: Same

Current Materials Present:
Current area is empty except for the presence of serveral batteries.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination survey indicates background levels.

Dose Rate
General area dose rates indicate background levels.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
Lead, cadmium, acids, and other solvents used. Battery components currently in area containing hazardous materials. Wipe analyses identified Al, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. Floor tiles contain asbestos-based material.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have not been subject to historical radioactive spills, incidents, or storage. However, the area has been subject to chemical spills, storage, and use.

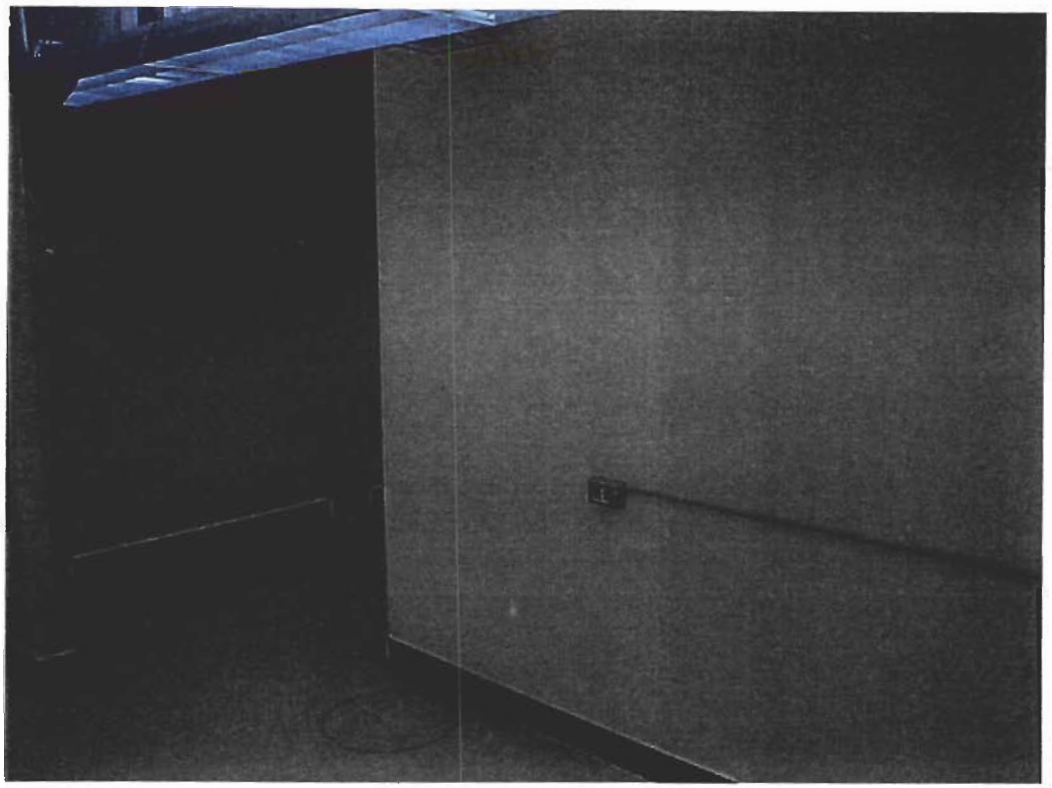

Figure OPS- 10

Figure OPS- 11

Survey Unit Number: OPS-07 **Survey Number:** 16

Description: Dome

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Containment Structure

Previous Use: Same

Current Materials Present:
No material stored on dome.

Radiological Data:

Contamination
No removable or fixed contamination identified greater than the levels in Table 1.

Dose Rate
Dose rates elevated based on radioactive material storage areas below the survey unit.

Description of remaining radioactive materials:
No radioactive materials identified.

Hazardous materials:
Dome is coated in lead based paint. Two sets of wipe analyses of dome I-beams identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on lead contaminants and radioactive contamination potential on the Operations level, this unit is considered Class 1. When radioactive material storage areas are removed, the area should be re-evaluated.

Figure OPS- 12

Figure OPS- 13

Survey Unit Number: OPS-08 **Survey Number:** 17

Description: Crane

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Crane

Previous Use: Same

Current Materials Present:
Crane currently contains oils and lubricants.

Radiological Data:

Contamination
No removable or fixed contamination identified greater than the levels in Table 1.

Dose Rate
Dose rates indicate background levels with the general area being 45 uR/hr. Crane over radioactive materials.

Description of remaining radioactive materials:
No materials stored on the crane.

Hazardous materials:
The survey unit contains lead-based paint and oil/lubricants within the crane. Metals analyses were performed on the crane and I-beams. Wipe analyses of the crane identified Al, Sb, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on lead contaminants and radioactive contamination potential on the Operations level, this unit is considered Class 1. When radioactive material storage areas are removed, the area should be re-evaluated.

Figure OPS- 14

Figure OPS- 15

Survey Unit Number: OPS-09 **Survey Number:** 18

Description: Trenches/Pipe trays

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Contain reactor cover gas lines, experimental cooling lines, and D_2O transfer lines.

Previous Use: Same

Current Materials Present:
Trenches contain internally contaminated lines and lead.

Radiological Data:

Contamination
No removable contamination identified greater than the levels in Table 1. Large area wipes also taken with no indication greater than background.

Dose Rate
Area dose rates up to 0.35 mR/hr.

Description of remaining radioactive materials:
Radioactive material areas are located on the Operations level proximal to the pipe trenches. Current data dose not indicate external contamination within the pipe trenches.

Hazardous materials:
Lead shielding is present in the pipe trenches.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage. However, the area contains lead shielding and primary system components.

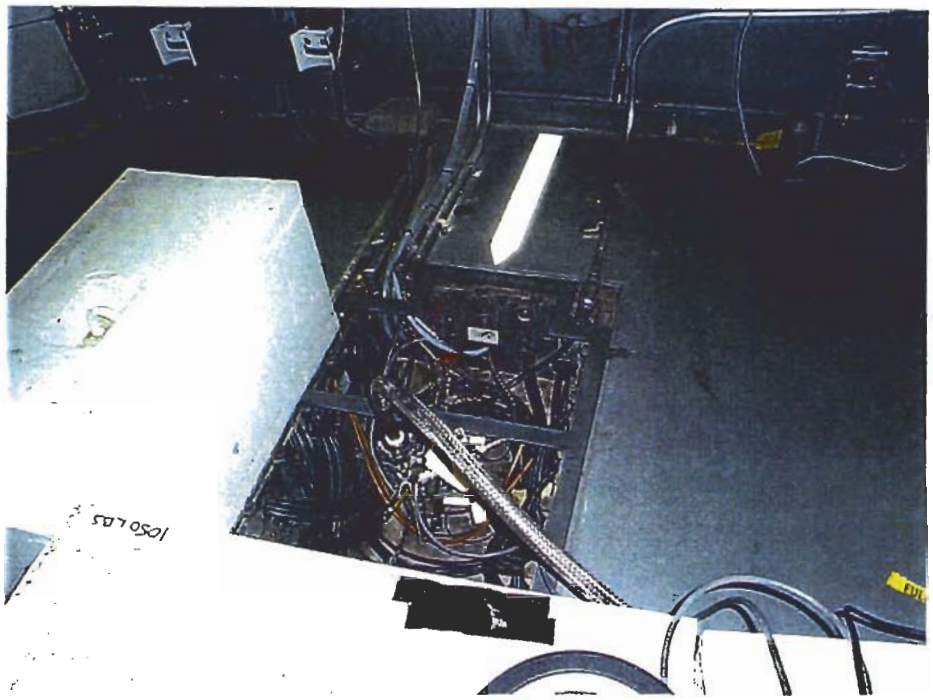

Figure OPS- 16

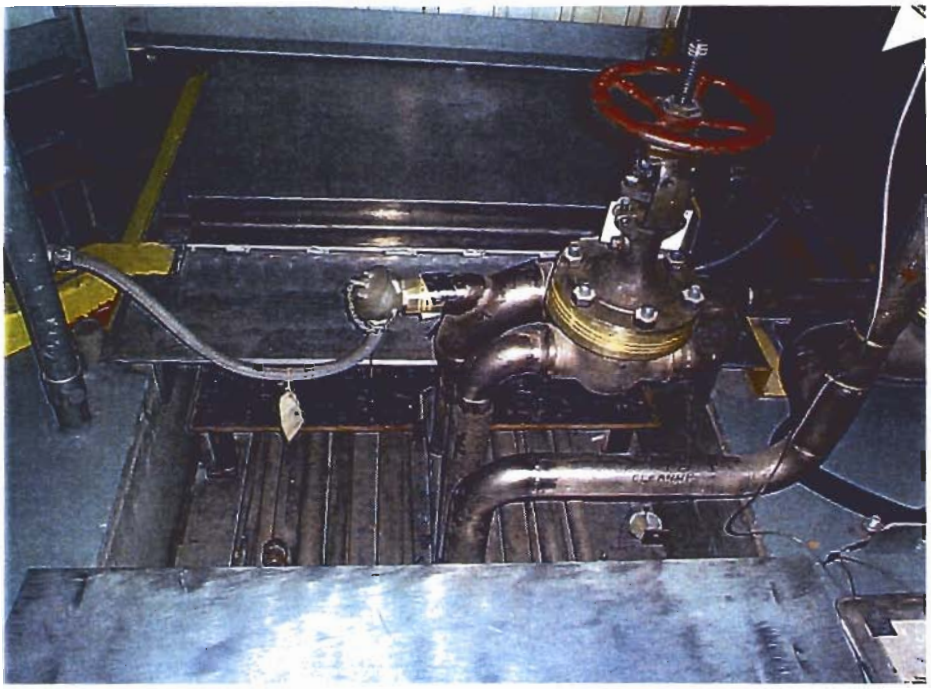

Figure OPS- 17

Figure OPS- 18

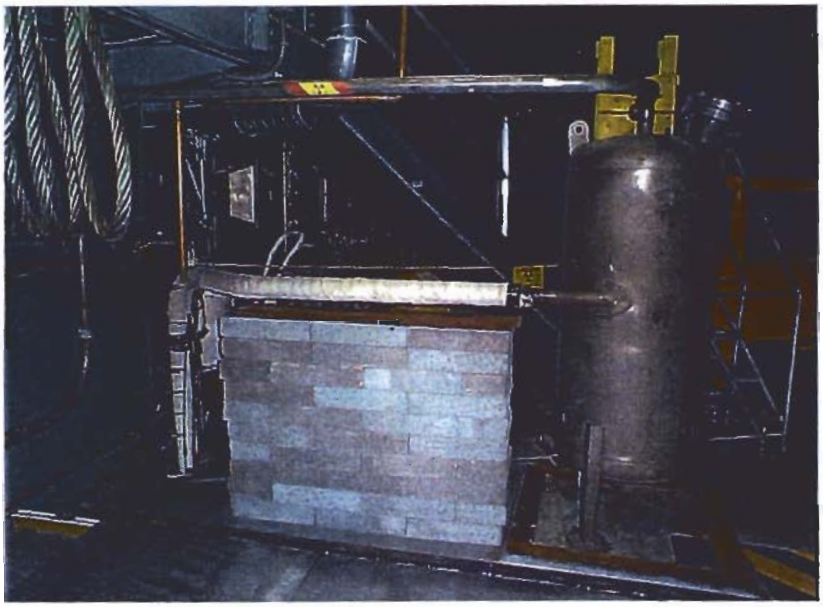

Figure OPS- 19

Survey Unit Number: OPS-10 **Survey Number:** 19

Description: Radioactive Material Area above Water Chemistry Laboratory

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Radioactive material area.

Previous Use: Same

Current Materials Present:
Material, labled as RAM, wrapped in yellow, and stored in an orderly fashion.

Radiological Data:

Contamination
No removable activity identified great than the values in Table 1.

Dose Rate
Contact dose rates up to 20 mR/hr. General area dose rates up to 2 mR/hr.

Description of remaining radioactive materials:
Currently activated and contaminated materials are stored in this area. Materials are wrapped, labeled and stored in an orderly fashion. Items include contaminated reactor vessel and canal tools.

Hazardous materials:
Lead is currently present in the form of shielding.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are consiered Class 1. These areas are currently subject to radioactive material storage.

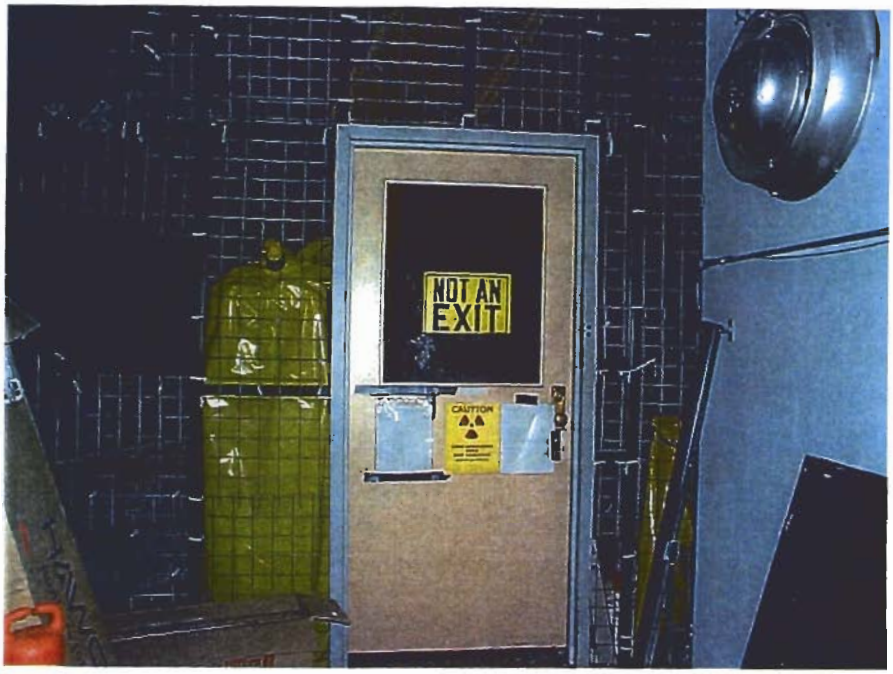

Figure OPS- 20

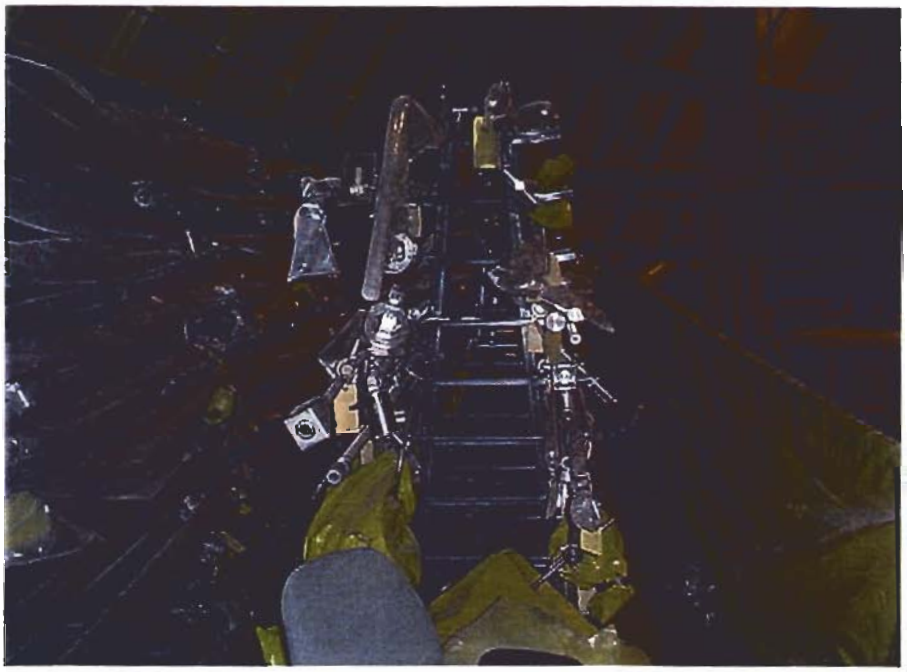

Figure OPS- 21

Figure OPS- 22

Figure OPS- 23

Figure OPS- 24

Survey Unit Number: OPS-11 **Survey Number:** 20

Description: Iodine Sample Prep/Counting Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Iodine sample preparation and sample counting area.

Previous Use: Custodial closet and radioactive material area.

Current Materials Present:
Bench with NaI counting unit, lead shielding, and a chemical storage locker labeled as "oxidizer."

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates greater than background levels (up to 30 uR/hr), mainly due to RMG hot shop next to area.

Description of remaining radioactive materials:
Radioactive material currently stored in area.

Hazardous materials:
PCB, silver nitrate, potassium iodide used. Chemical storage locker in the area labeled as "oxidizer."

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject chemical and radioactive material storage and use.

Figure OPS- 25

Figure OPS- 26

Survey Unit Number: OPS-12 **Survey Number:** 21

Description: Walkway behind South Stairwell

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Radioactive material area.

Previous Use: Same

Current Materials Present:
Bagged and labeled activatated and contaminated materials.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates up to 70 uR/hr. Radioactive material in bags up to 5 mR/hr.

Description of remaining radioactive materials:
Radioactive material currently stored in area.

Hazardous materials:
Lead used primarily as shielding.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject chemical and radioactive material storage and use.

Figure OPS- 27

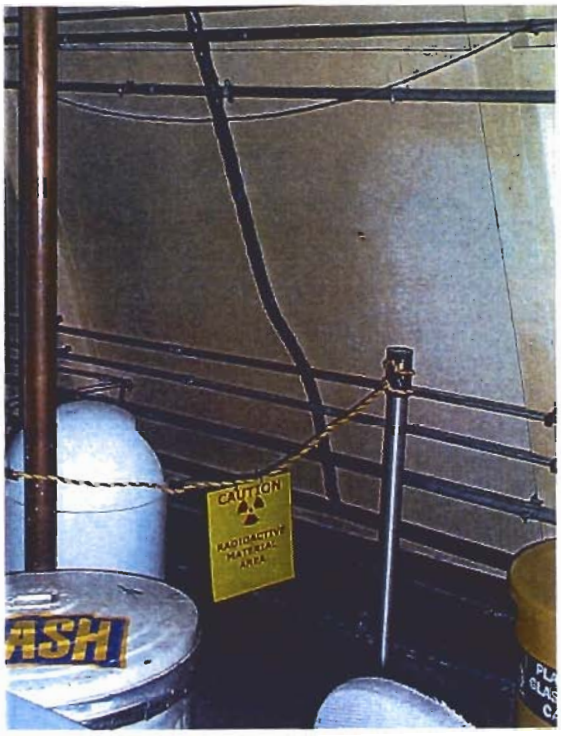

Figure OPS- 28

Survey Unit Number: OPS-13 **Survey Number:** 22

Description: Custodians Area (behind North Stairwell)

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Custodial Area

Previous Use: General area

Current Materials Present:
General cleaning materials and desks.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates indicate background levels.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
General cleaning products used and stored.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have not been subject to historical radioactive or chemical spills or incidents.

Figure OPS- 29

Survey Unit Number: OPS-14 **Survey Number:** 23

Description: Walkway behind locker room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Storage Area

Previous Use: Same

Current Materials Present:
Gas bottles, chromatography station, resins, and file storage.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates up to 10 uR/hr.

Description of remaining radioactive materials:
Radioactive material currently stored in a posted cabinet.

Hazardous materials:
Asbestos insulation, anion and cation resin, and sodium hydroxide flakes.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject chemical and radioactive material storage and use.

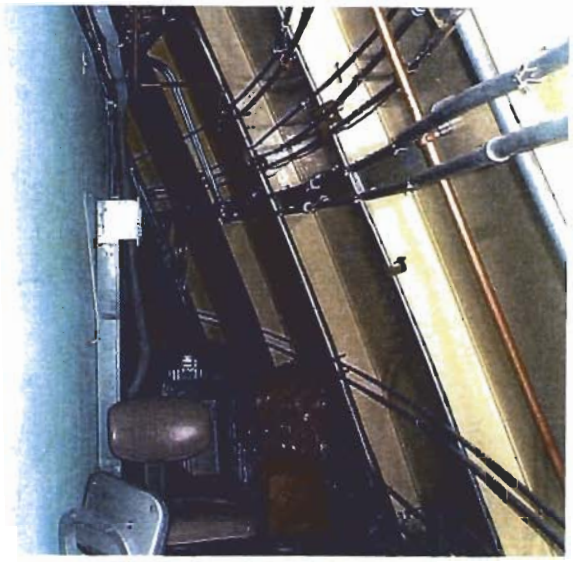

Figure OPS- 30

Figure OPS- 31

Survey Unit Number: OPS-15 **Survey Number:** 24

Description: Locker Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Mens and Ladies rooms including locker area and showers. Shower areas designated for personnel decontamination. Liquid scintillation counter in area.

Previous Use: Same

Current Materials Present:
Lockers, personal materials, liquid scintillation counter, modesty garments, and other protective clothing.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates indicate background levels, including drain traps.

Description of remaining radioactive materials:
Radioactive material currently stored in area (Instrument stds).

Hazardous materials:
Lead sheilding and liquid scintillation cocktail (Pdioxane, Beckmann, Ultima Gold). Asbestos floor tiles present in the area.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage. However, personnel decontamination showers are present and may have been used previously. A liquid scintillation counter is also present indicating use of scintillation cocktails and radioactive samples.

Figure OPS- 32

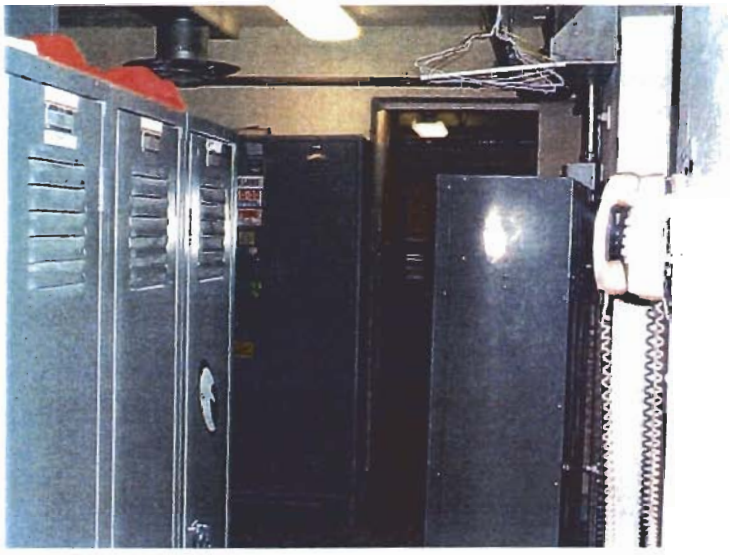

Figure OPS- 33

Survey Unit Number: OPS-16 **Survey Number:** 25

Description: Bridge from reactor top to control room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Walkway from control room to reactor top including stairs from OPS level to control room.

Previous Use: Same

Current Materials Present: Fixed contamination on one area of walkway, currently labeled as Radioactive Material

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. One area indicates fixed contamination at 27,000 dpm/100cm2.

Dose Rate
Dose rates increase proximal to reactor top.

Description of remaining radioactive materials:
Fixed radioactive contamination currently on stairs.

Hazardous materials:
No hazardous material present in the survey unit.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject radioactive material use and spills.

Figure OPS- 34

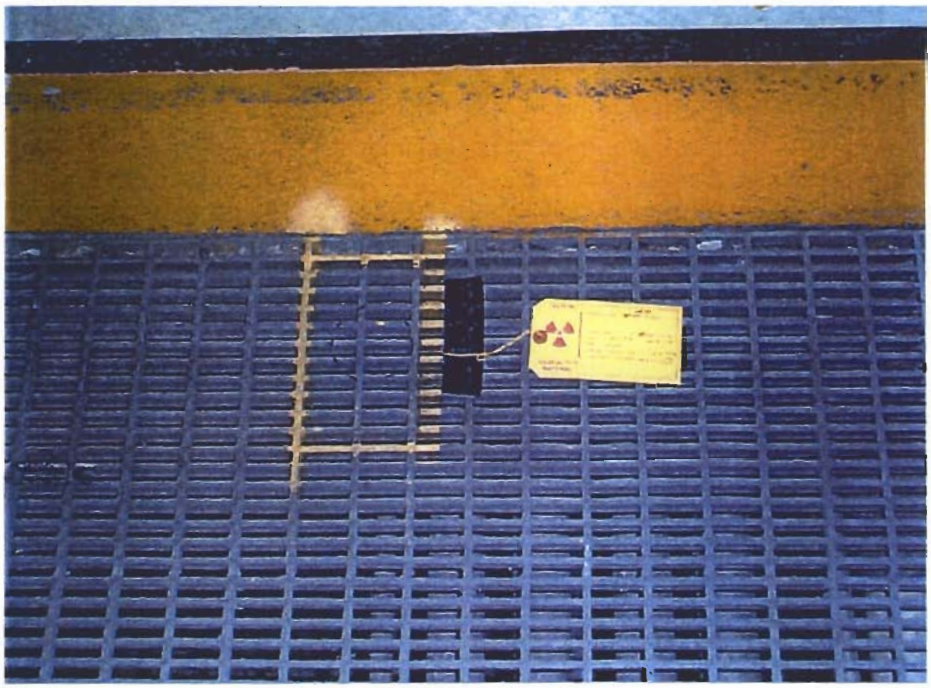

Figure OPS- 35

Survey Unit Number: OPS-17 **Survey Number:** 26

Description: Control Room - mens room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	2		

Current Use: Conrol room, office area, kitchen area, storage area.

Previous Use: Same

Current Materials Present:
General office material, refrigerator, lockers, files, protective clothing, and gas bottles.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates equivalent to background levels, except for locker room area (23 uR/hr) due to radioactive material storage OPS Survey Unit #10..

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
Floor tiles are asbestos containing material.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. However, due to asbestos floor tiles, the floors are considered Class 1. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage.

Figure OPS- 36

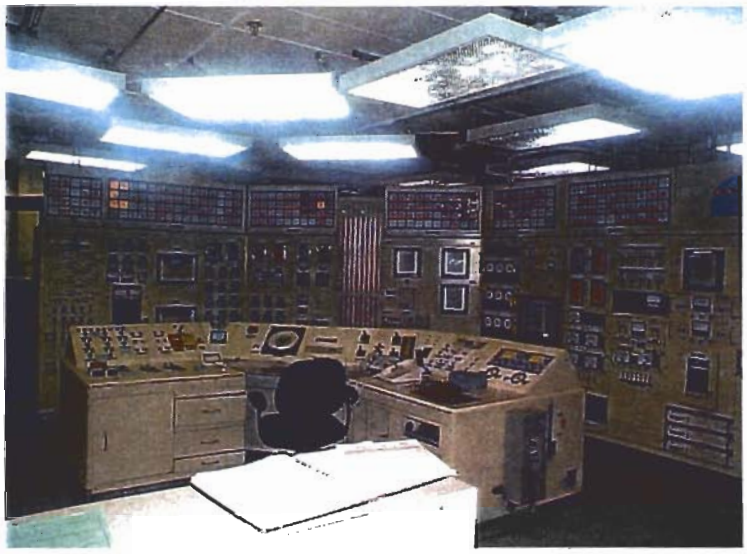

Figure OPS- 37

Figure OPS- 38

Figure OPS- 39

Survey Unit Number: OPS-18 **Survey Number:** 27

Description: RIG Areas

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Reactor Instrument Group Area; offices, shop area, and radioactive material storage area.

Previous Use: Same

Current Materials Present:
Shop equipment, general office materials, wires, cables, etc.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Areas greater than background levels. Up to 200 uR/hr at radioactive material area. Other areas indicate up to 8 uR/hr.

Description of remaining radioactive materials:
Radioactive material currently stored in area.

Hazardous materials:
Previous milling of lead. Lead, oils, solvents, and cleaners. Floor tiles are potentially asbestos containing material.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject chemical and radioactive material storage and use.

Figure OPS- 40

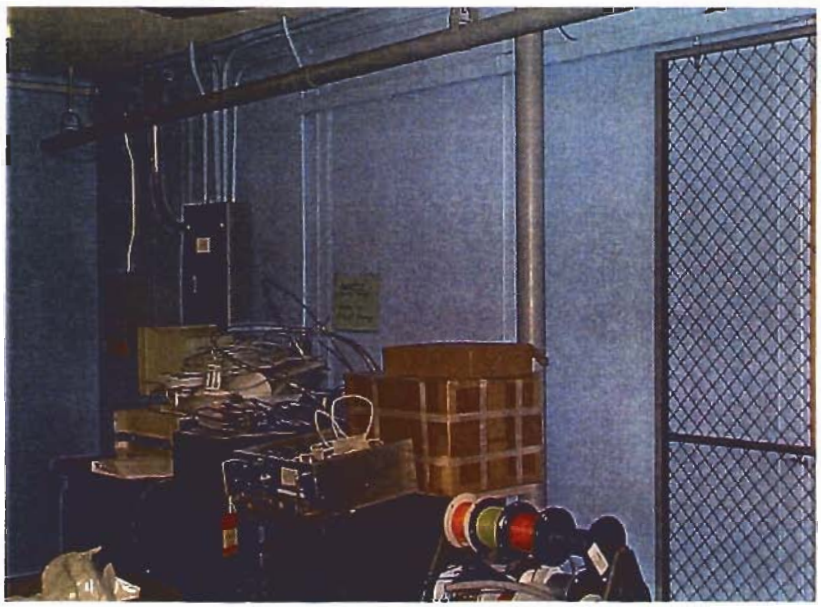

Figure OPS- 41

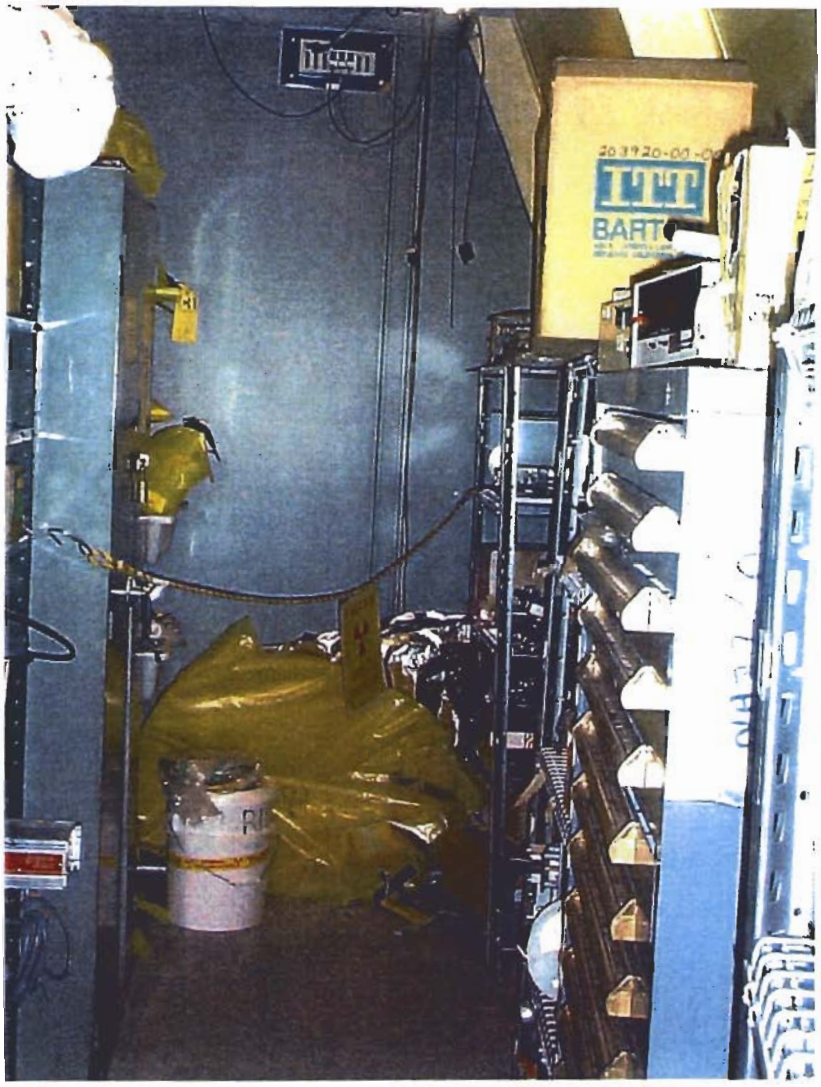

Figure OPS- 42

Survey Unit Number: OPS-19 **Survey Number:** 28

Description: Hutch

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Sheilded remote handling area fir irradiated samples.

Previous Use: Sheilded remote handling area fir irradiated samples.

Current Materials Present:
Remote operators, lead shielding, and cadmium.

Radiological Data:

Contamination
No external contamination greater than the levels in Table 1. Internal contamination 2,500 dpm/100cm^2 of fission and activation products (Co-60 & Zn-65).

Dose Rate
Less than 0.2 mR/hr on outside of Hutch. Internal dose rates up to 7 mR/hr on contact with bag inside.

Description of remaining radioactive materials:
Removable and fixed contamination remain.

Hazardous materials:
Lead and cadmium remain in the area.

Recommendations for future work or samples:
Based on historical review, this area is considered Class 1. This area has been subject to chemical and radioactive material use. Potential alpha contamination however not identified during internal survey.

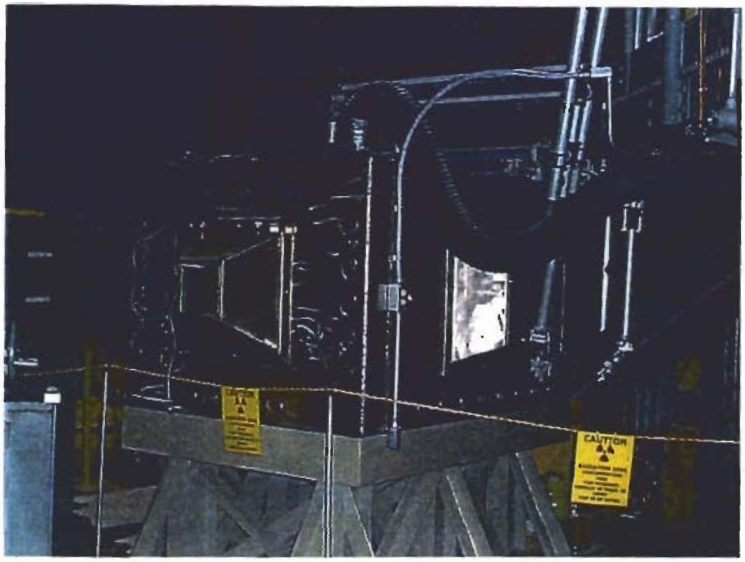

Figure OPS- 43

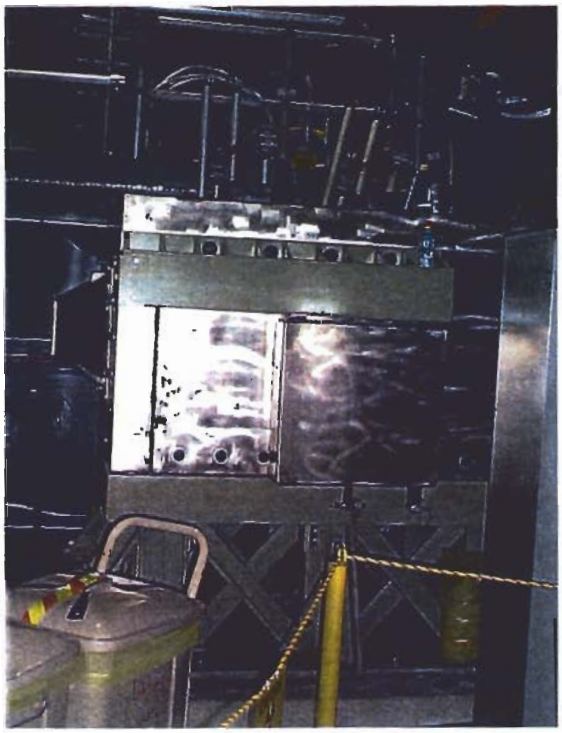

Figure OPS- 44

Survey Unit Number: OPS-20 **Survey Number:** 29

Description: Dry box

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Radioactive material area.

Previous Use: Same

Current Materials Present:
Area currently contains bagged contaminated and activated materials. Area is posted as a contaminated area.

Radiological Data:

Contamination
Area posted as a contaminated area, however removable activity is less than the levels reported in Table 1. Hot particles are a noted concern in this area. Fixed contamination data is not available.

Dose Rate
General area dose rates up to 1.5 mR/hr with a maximum contact reading of 18 mR/hr.

Description of remaining radioactive materials:
Area currently contains bagged contaminated and activated materials. Area is posted as a contaminated area.

Hazardous materials:
Lead, oils and petrochemicals, graphite spray, lubricants, and solvents.

Recommendations for future work or samples:
Based on historical review, this area is considered Class 1. This area has been subject ot chemical and radioactive material use.

Figure OPS- 45

Figure OPS- 46

Survey Unit Number: OPS-21 **Survey Number:** 30

Description: Greenhouse

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Experimental system, D2O storage tank, poison water tank, resin bed and filters, and recombiner.

Previous Use: Same

Current Materials Present:
Lead shielding and installed plant equipment.

Radiological Data:

Contamination
Removable contamination data less than levels reported in Table 1. Fixed contamination data not available.

Dose Rate
Area dose rates up to 20 mR/hr. Maximum contact dose rate, 150 mR/hr on experimental heat exchanger.

Description of remaining radioactive materials:
Co-60 source under thermal shield expansion tank (FA-201).

Hazardous materials:
Asbestos pipe wrap, lead shielding (coated and bare), cadmium, nitrates, and oils. Wipe analyses identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review, this area is considered Class 1. This area has been subject to chemical and radioactive material use.

Figure OPS- 47

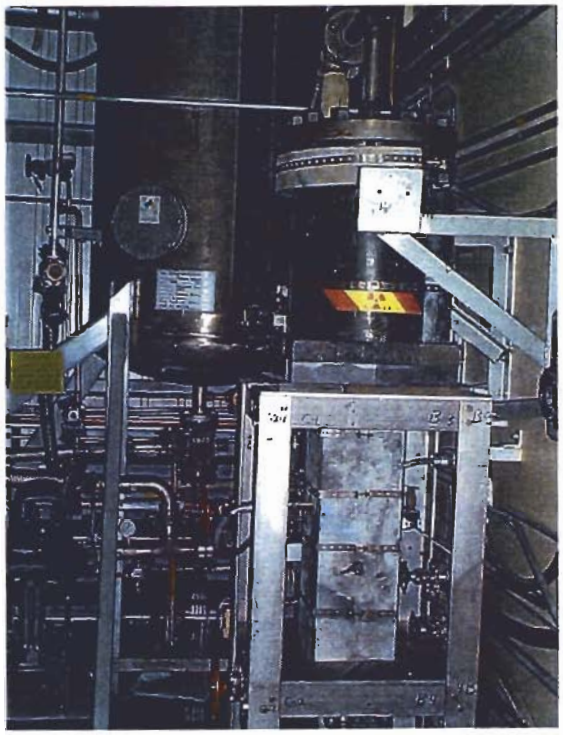

Figure OPS- 48

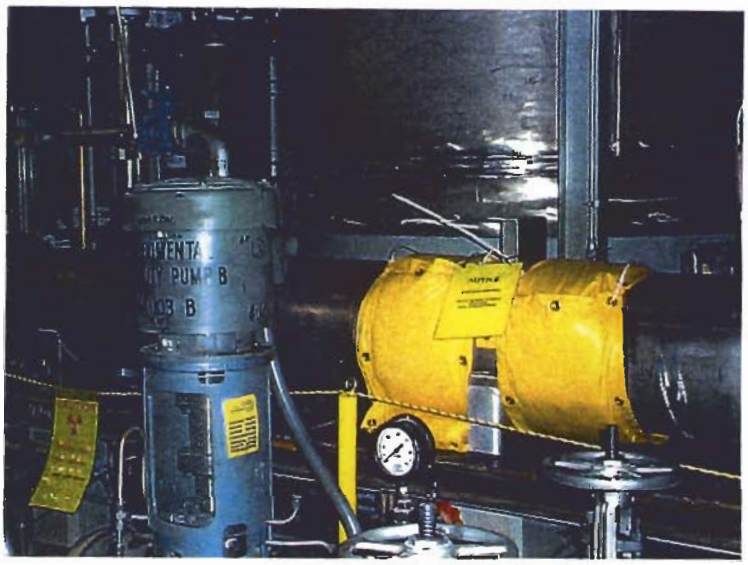

Figure OPS- 49

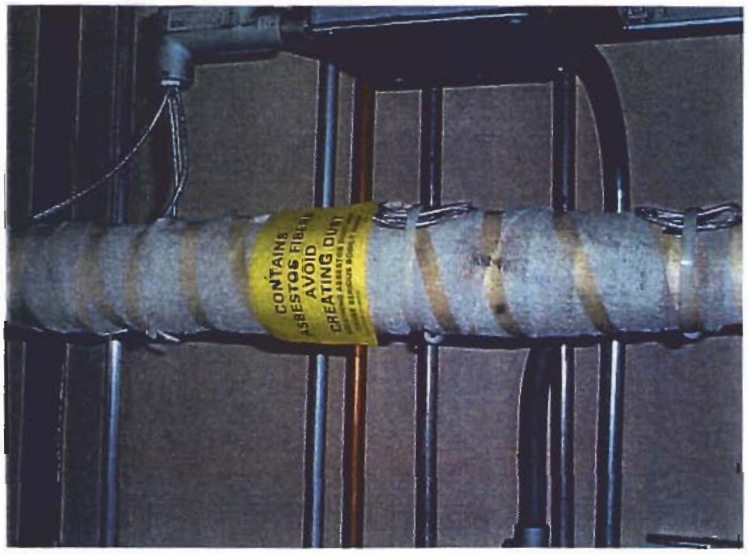

Figure OPS- 50

Survey Unit Number: OPS-22 **Survey Number:** 31

Description: Top of Greenhouse

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Top of greenhouse.

Previous Use: Same

Current Materials Present: No materials are currently stored atop the Greenhouse.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rate data not currently provided. However, elevated dose rates expected from materials in greenhouse such as shielded heat exchangers and tanks.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
No hazardous material present in the survey unit.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage.

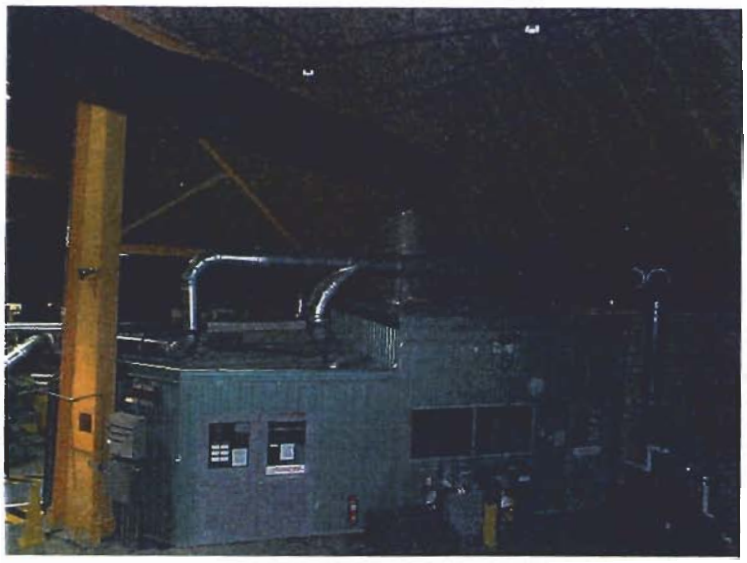

Figure OPS- 51

Figure OPS- 52

Survey Unit Number: OPS-23 **Survey Number:** 32

Description: Security Observation Stations

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Security Observation Stations

Previous Use: Same

Current Materials Present:
Desks, computer workstations, and SCBA units.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Areas greater than background levels, up to 15 uR/hr due to radioactive material storage areas.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
No hazardous material present in the survey unit.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage.

Figure OPS- 53

Figure OPS- 54

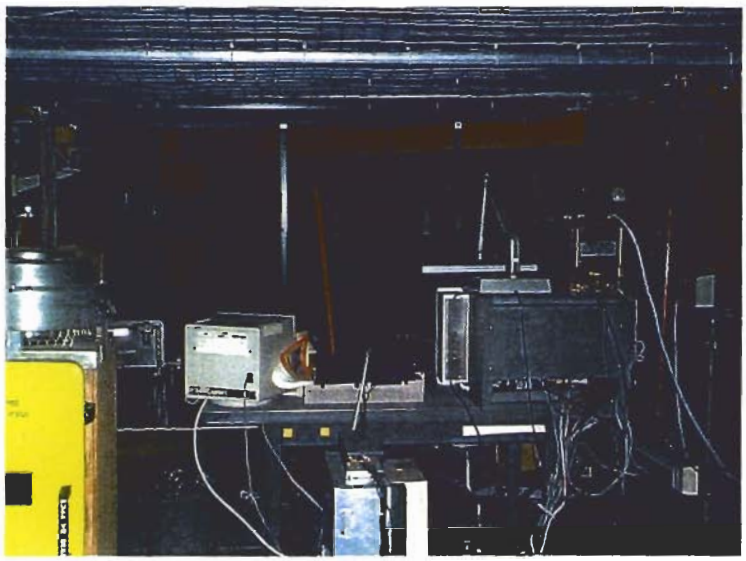

Figure OPS- 55

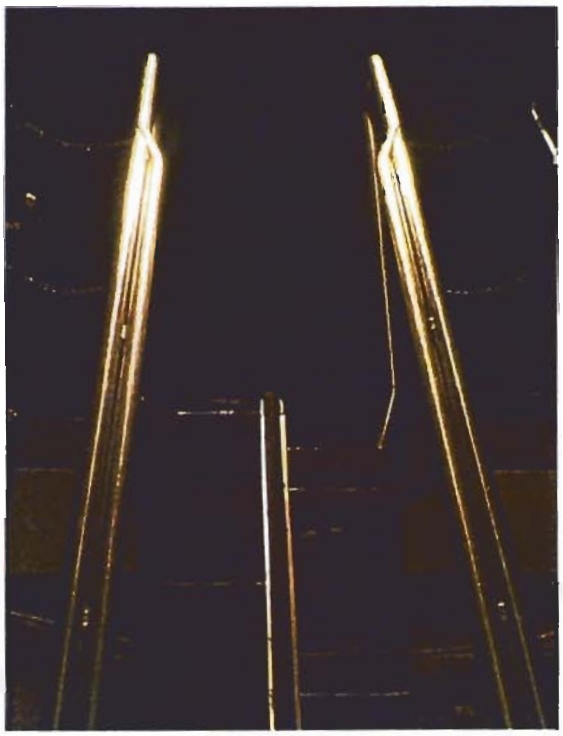

Figure OPS- 56

Survey Unit Number: OPS-24 **Survey Number:** 33

Description: General Walkways

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: General walkways.

Previous Use: Same

Current Materials Present:
Radioactive material storage areas, chemical storage cabinets, and D_2O drums.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Areas greater than background due to numerous radioactive material storage areas adjacent to the general walkways (up to 300 uR/hr).

Description of remaining radioactive materials:
Radioactive material currently stored in area.

Hazardous materials:
Lead used for shielding, oils, chemical storage cabinets, asbestos wrapped piping and potential asbestos wrapped wiring. Wipe analyses identified Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However only Be, Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject chemical and radioactive material storage and use.

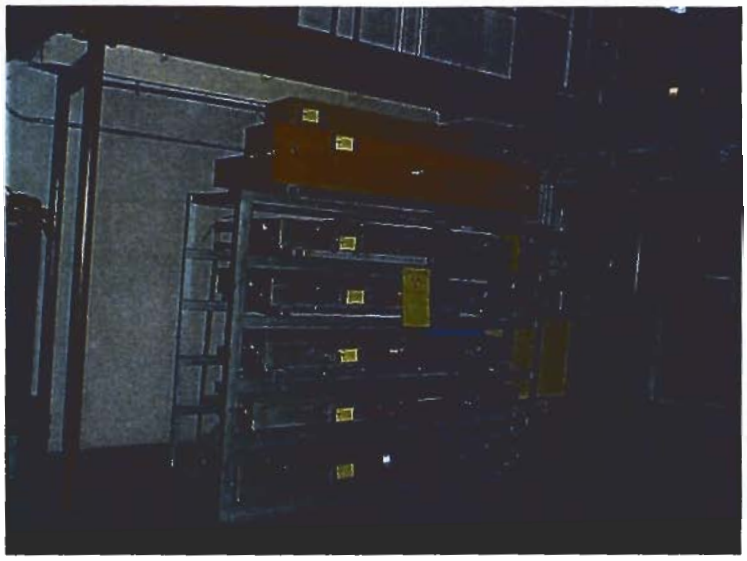

Figure OPS- 57

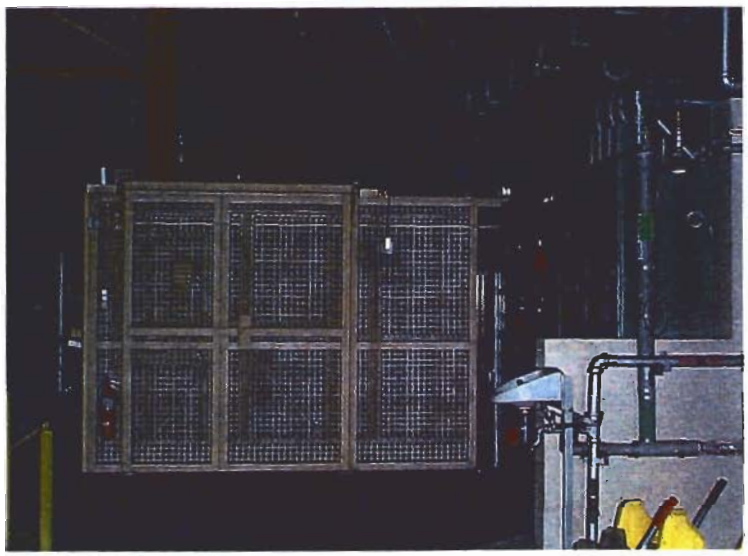

Figure OPS- 58

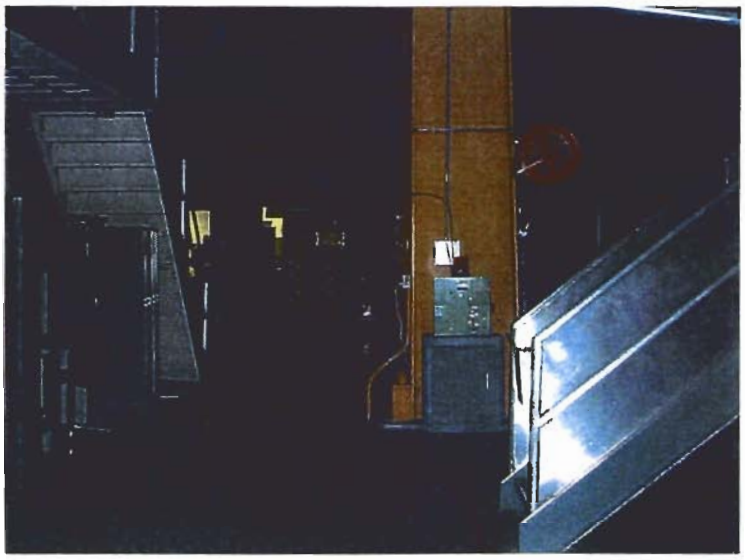

Figure OPS- 59

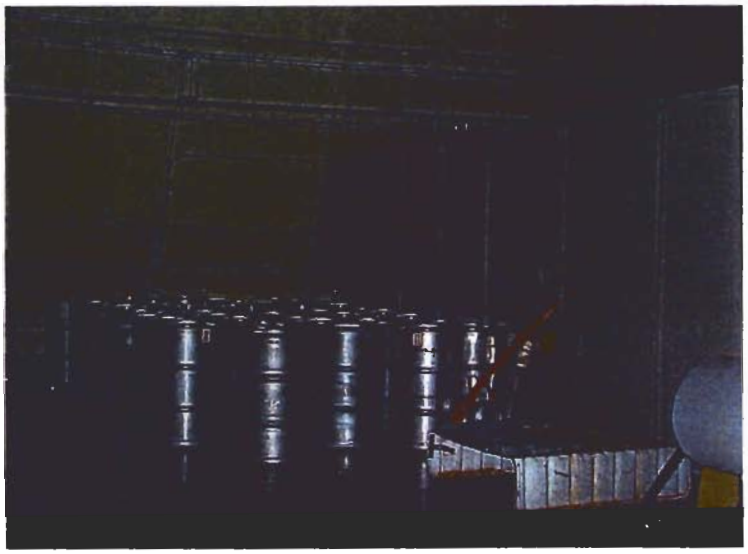

Figure OPS- 60

Survey Unit Number: OPS-25 **Survey Number:** 34

Description: Emergency Hatch Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Emergency hatch area.

Previous Use: Fuel test loop area, hood for iodine sample preparation, liquid scintillation counting prepration area.

Current Materials Present:
Small chemistry sample prep area on exterior wall of Chemistry lab.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Areas greater than background due to radioactive material storage areas adjacent to area (up to 12 uR/hr).

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
Lead used primarily as shielding, oils, small chemistry sample prep area for liquid scintiallation counting, etc..

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject to historical radioactive or chemical spills or incidents. Current data does not indicate potentially significant radiological contamination.

Figure OPS- 61

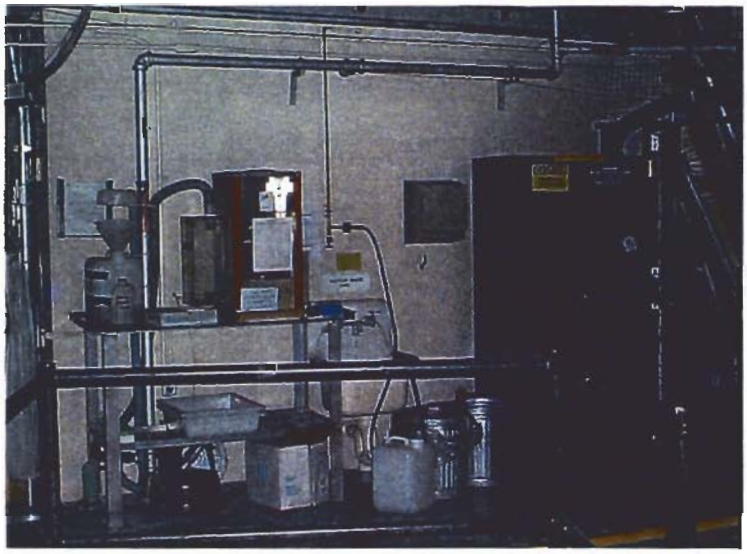

Figure OPS- 62

Survey Unit Number: OPS-26 **Survey Number:** 152

Description: Reactor Top

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1			1		1

Current Use: Upper area of bioshield for access to reactor pit, verticle irradiation facilities, and fuel handling operations.

Previous Use: Same

Current Materials Present:
Waste containers and installed plant equipment.

Radiological Data:

Contamination
Area posted as a contaminated area, however removable activity is less than the levels reported in Table 1. Hot particles are a noted concern in this area. Fixed contamination data is not available.

Dose Rate
General area dose rated up to 2.5 mR/hr. Maximum dose rate of 18 mR/hr on Tritium Containment Unit.

Description of remaining radioactive materials:
Contaminated materials present in this area. Hot particles are also suspect.

Hazardous materials:
Lead and pump grease and oils.

Recommendations for future work or samples:
Based on historical review and current survey data, this area is considered Class 1. This area is subject to radioactive and chemical contamination and spills.

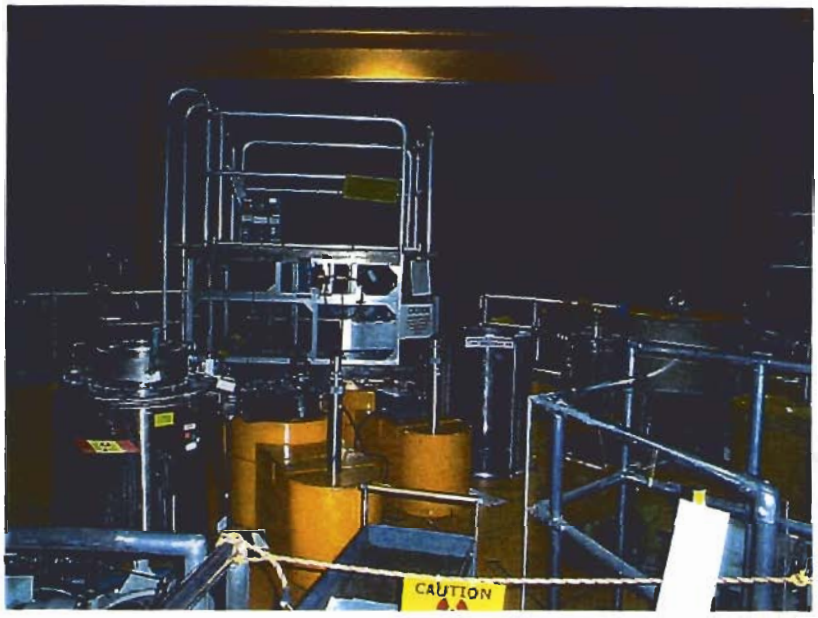

Figure OPS- 63

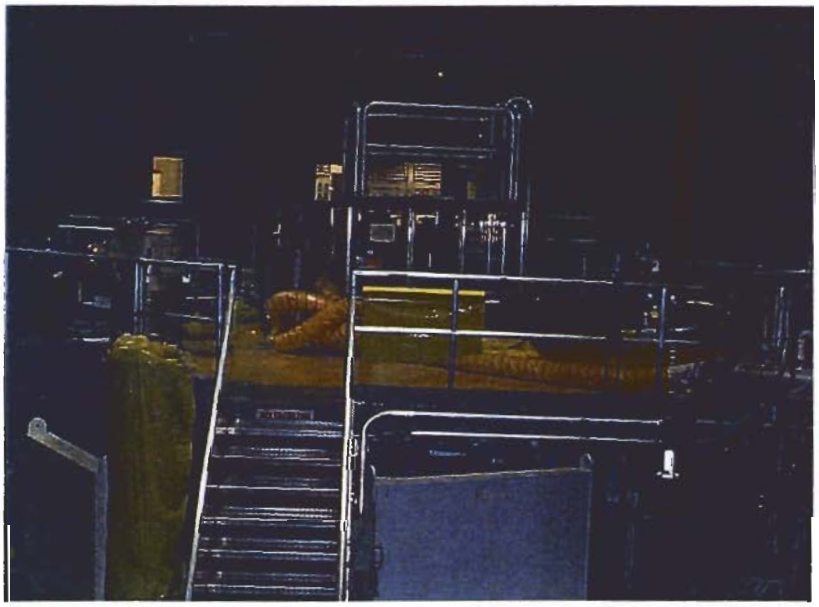

Figure OPS- 64

Survey Unit Number: OPS-27 **Survey Number:** 153

Description: Reactor Pit (upper and lower)

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Access to reactor vessel. The Reactor Pit is considered a "Confined Space".

Previous Use: Same

Current Materials Present:
Control rod drive motors, access to shutter drive motors, cooling lines to shutters, steam vent valves, upper H3 containment housing, and vessel cover.

Radiological Data:

Contamination
Area posted as a contaminated area, however removable activity is less than the levels reported in Table 1. Hot particles are a noted concern in this area. Fixed contamination data is not available.

Dose Rate
General area up to 20 mR/hr with a maximum contact reading of 80 mR/hr on the experimental water hold up tank.

Description of remaining radioactive materials:
Area is a posted contaminated area with activiated and contaminated plant systems and components.

Hazardous materials:
Area contains lead and oils and other petrochemicals.

Recommendations for future work or samples:
Based on historical review and current survey data, this area is considered Class 1. This area is subject to radioactive and chemical contamination and spills. The area potentially contains hot particles.

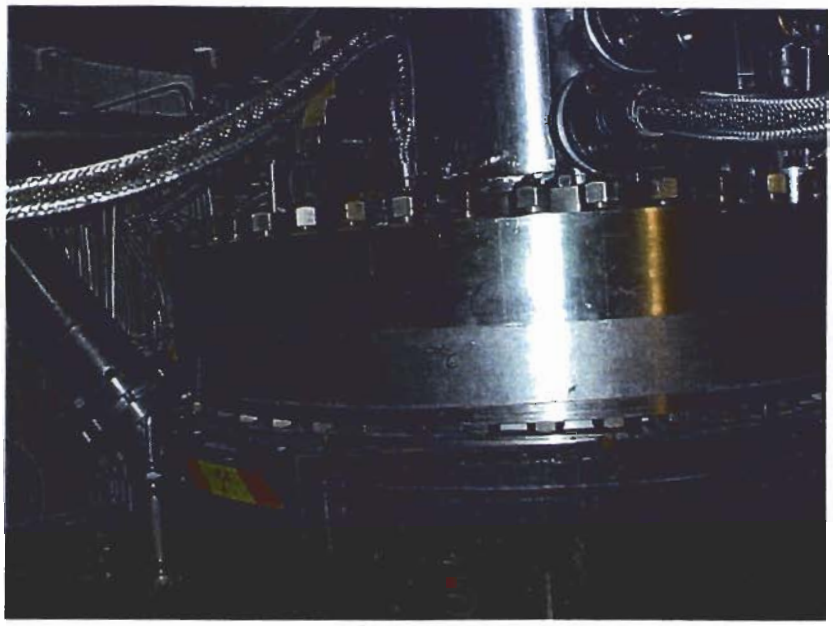

Figure OPS- 65

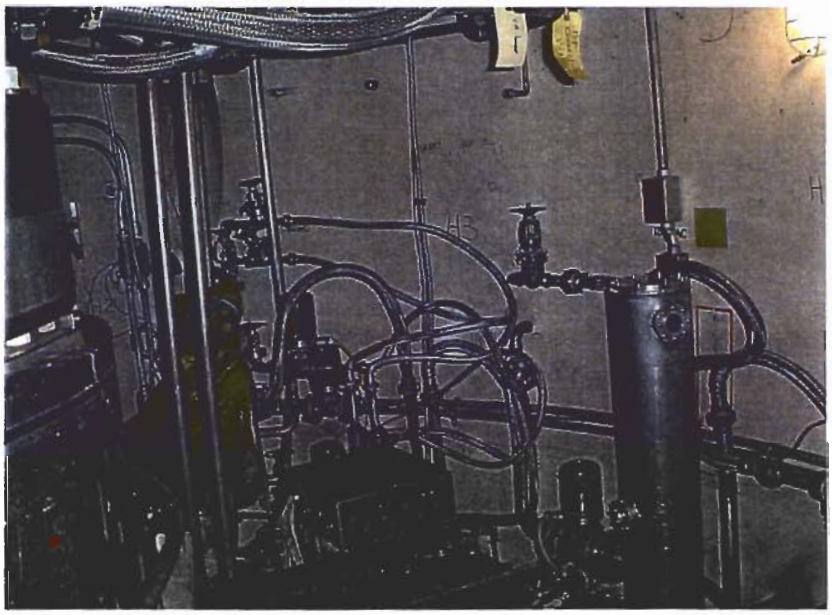

Figure OPS- 66

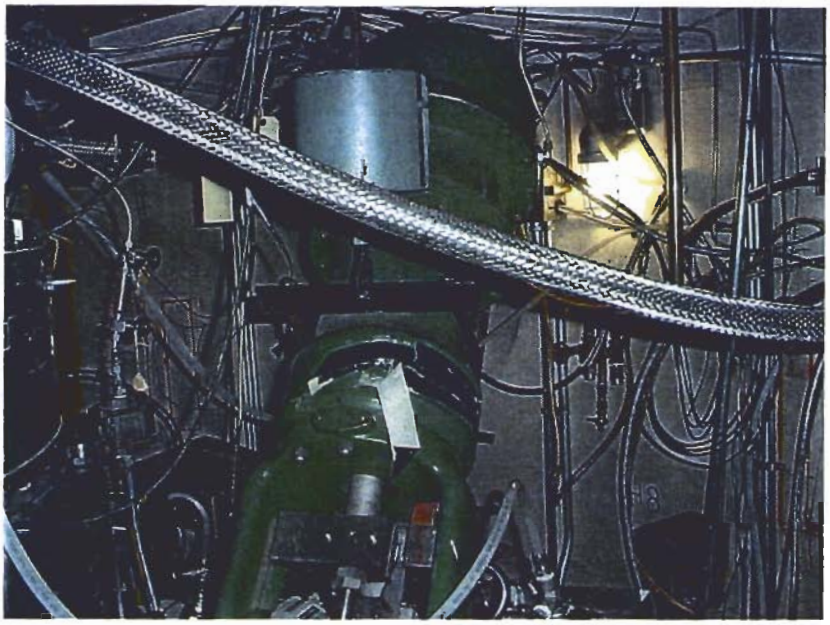

Figure OPS- 67

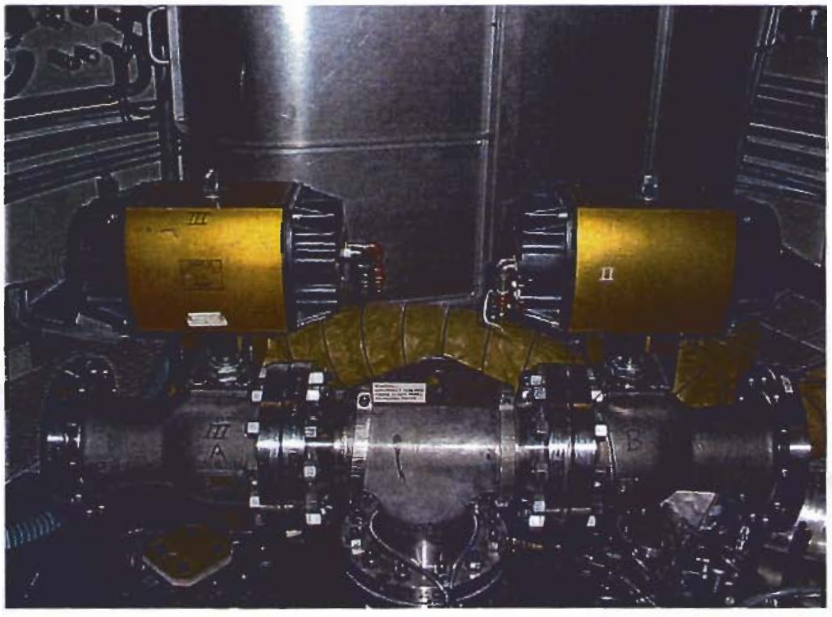

Figure OPS- 68

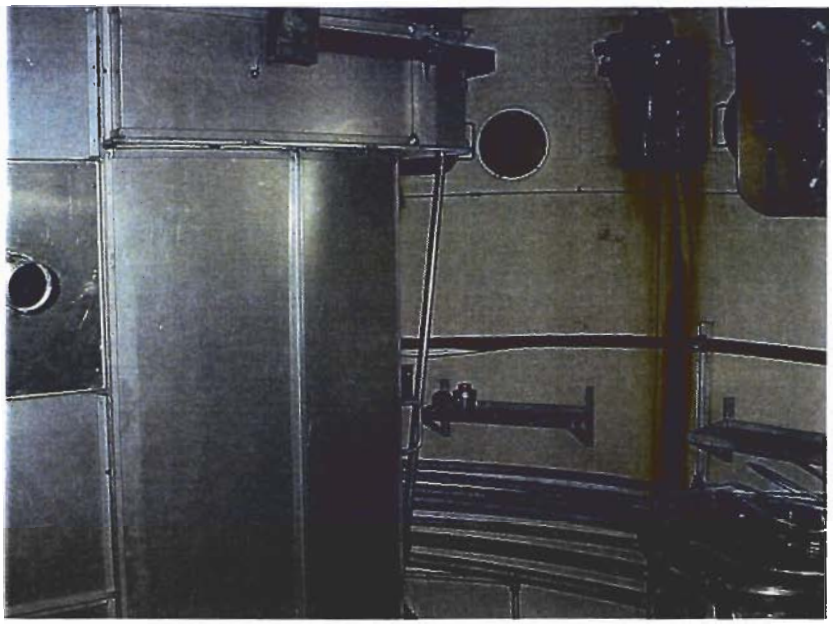

Figure OPS- 69

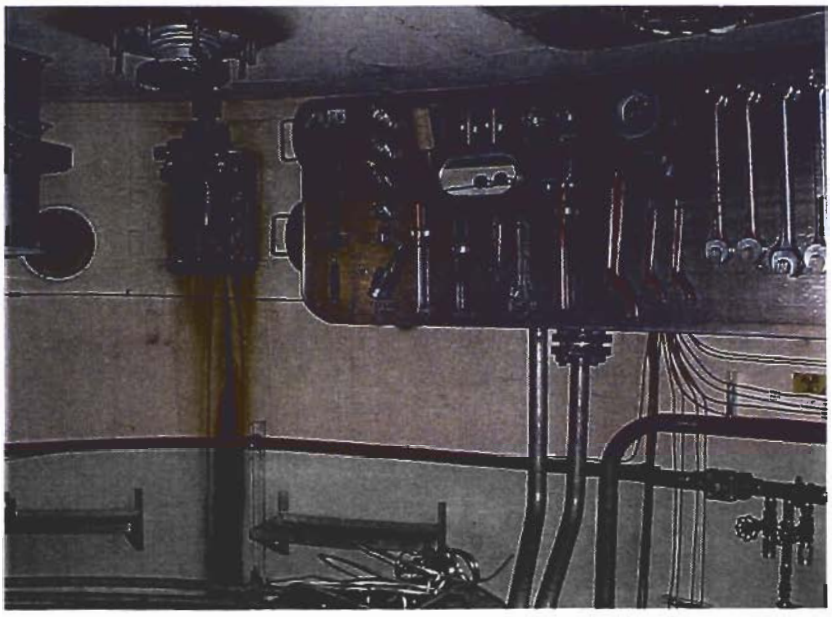

Figure OPS- 70

Survey Unit Number: OPS-28 **Survey Number:** 154

Description: Stairwells (North and South)

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Stairwells

Previous Use: Same

Current Materials Present: No materials currently stored in stairways.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
No hazardous material present in the survey unit.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage.

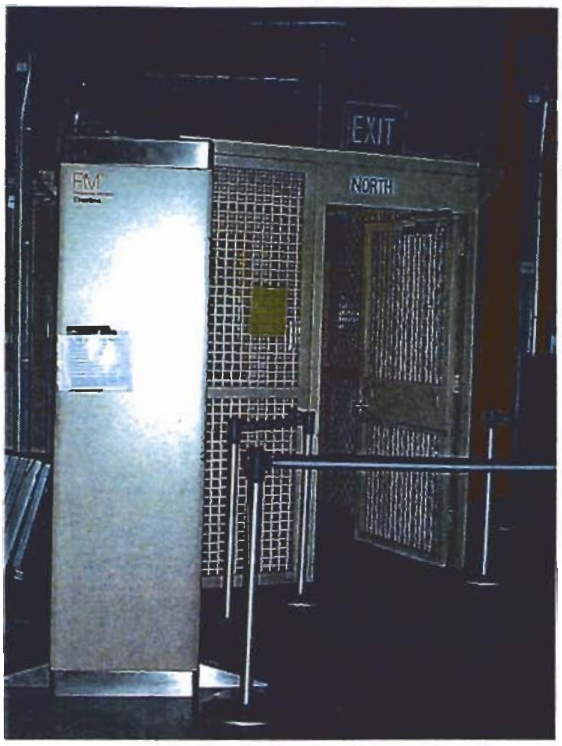

Figure OPS- 71

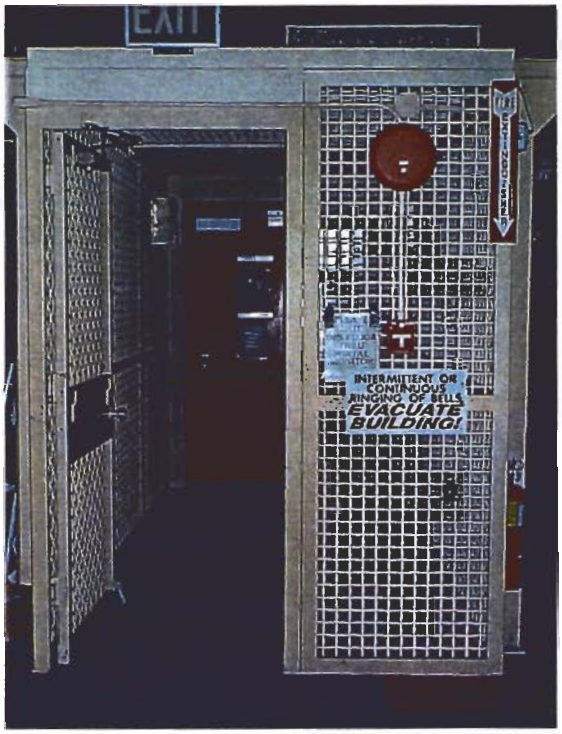

Figure OPS- 72

Survey Unit Number: OPS-29 **Survey Number:** 160

Description: Water Chemistry, HP, and Day Crew Supervisor Office Space

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	1	2		

Current Use: Office Space

Previous Use: Same

Current Materials Present:
General office materials present. HP office contains some instrumentation and lead.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Dust was analyzed for tritium and found to contain up to 1.70E-5 uCi/gm.

Dose Rate
Dose rates general area is 0.038 mR/hr due to radioactive material storage above the HP office area.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
Lead is currenly present in the form of shielding in the HP office. Ceiling tiles and insultated utilities are known to be asbestos in the ceiling above the asbestos free tiles. Floor tiles are asbestos containing material.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. However, the ceiling is Class 1 as the ceiling tiles contain asbestos. These areas have not been subject to historical radioactive or chemical spills, or incidents.

Figure OPS- 73

Figure OPS- 74

Figure OPS- 75

Survey Unit Number: OPS-30 **Survey Number:** 161

Description: Positron Block House

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Not currently in use

Previous Use: Nickel postitron activation experiment

Current Materials Present:
Hazardous materials detected through an area wipe.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1.

Dose Rate
Dose rates less than 0.2 mR/hr.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
Hazardous materials present. Aluminum, Barium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Mangenese, Nickel, Potassium, Selenium, Sodium, and Zinc were identified above instrument detection levels. However only Cadmium, Lead, and Zinc are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. These areas have been subject to historical radioactive or chemical spills, or incidents.

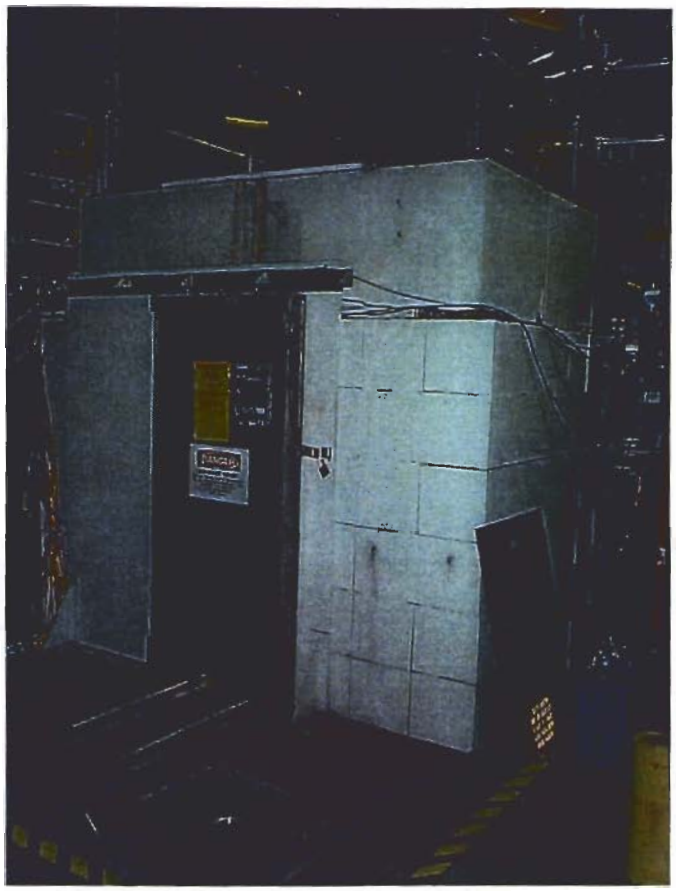

Figure OPS- 76

Appendix C - HFBR Survey Unit Reports - Balcony Level

Survey Unit Number: BAL-01 **Survey Number:** 1

Description: Offices B-6 to B-14

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	2		

Current Use: Currently occupied office space

Previous Use: Same

Current Materials Present: General office equipment

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates equivalent to background levels, except for Office B-10 ceiling area. Dose rates increase to 150 uR/hr due to radioactive material storage on OPS level.

Description of remaining radioactive materials:
No radioactive material currently stored in area

Hazardous materials:
Survey unit contains asbestos floor tiles

Recommendations for future work or samples:
Based on historical review and current survey data, the area is considered Class 2. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage. However, the areas contain asbestos floor tiles and as such the floors are considered as Class1.

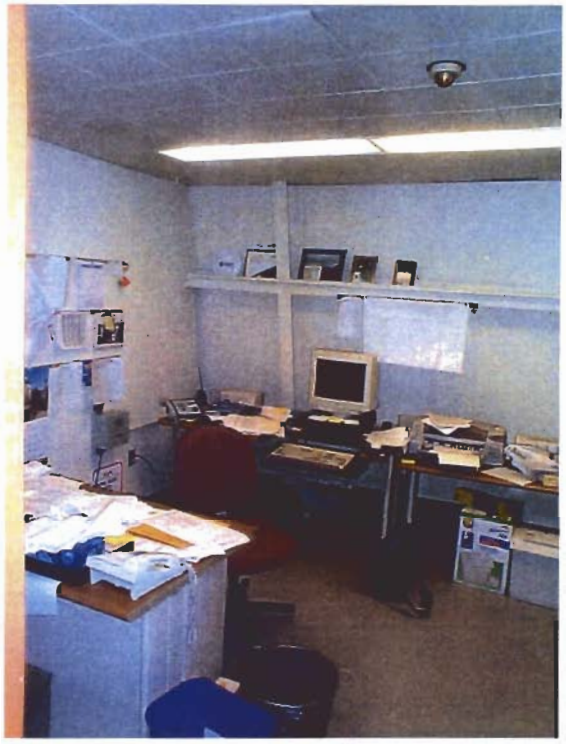

Figure BAL - 1

Figure BAL - 2

Survey Unit Number: BAL-02 **Survey Number:** 2

Description: Mens/Ladies room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Mens and Ladies rooms including locker area and showers. Shower areas designated for personnel decontamination.

Previous Use: Same

Current Materials Present: Personnel effects in lockers. Bioassay sample-drop off stations.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates indicate background levels.

Description of remaining radioactive materials:
No radioactive material currently stored in these areas

Hazardous materials:
No hazardous material present in the survey unit

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage. However, personnel decontamination showers are present and may have been used previously.

Figure BAL - 3

Figure BAL - 4

Survey Unit Number: BAL-03 **Survey Number:** 3

Description: Office B-4 and B-5

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	2		

Current Use: Currently occupied office space.

Previous Use: Same

Current Materials Present: General office equipment

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
General area dose rates indicate background levels.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
Survey unit contains asbestos floor tiles.

Recommendations for future work or samples:
Based on historical review and current survey data, the area is considered Class 2. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage. However, the areas contain asbestos floor tiles and as such are considered Class 1.

Figure BAL - 5

Survey Unit Number: BAL-04 **Survey Number:** 4

Description: General Area Walkways

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: General area walkways.

Previous Use: Same

Current Materials Present: Filing cabinets, storage cabinets, copy machines, and other administrative support equipment

---

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates equivalent to background levels, except for general walkway area outside ladies and mens room (10 uR/hr) due to radioactie material storage on OPS level.

Description of remaining radioactive materials:
Installed radioactive source on area monitors, e.g., column C5, Sr-90.

Hazardous materials:
No hazardous material present in the survey unit.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2 These areas have been subject to low levels of radioactive contamination due to the Tristan fire in 1994. Current radiological information shows that area conditions are at background levels for fixed and removable contamination levels.

Figure BAL - 6

Survey Unit Number: BAL-05 **Survey Number:** 5

Description: Walls in open areas

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
	2				

Current Use: General area walkways.

Previous Use: Same

Current Materials Present: Windows, shelves, and other administrative support materials.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates equivalent to background levels, except for general walkway area outside ladies and mens room (10 uR/hr) due to radioactie material storage on OPS level.

Description of remaining radioactive materials:
Installed radioactive sources within area monitors.

Hazardous materials:
No hazardous material present in the survey unit.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. These areas have been subject to low levels of radioactive contamination due to the Tristan fire in 1994. Current radiological information shows that area conditions are at background levels for fixed and removable contamination levels.

Figure BAL - 7 (Balcony open areas in relationship with the Experimental Level)

Survey Unit Number: BAL-06 **Survey Number:** 6

Description: Pipes and ceiling in open areas

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: General area balcony level.

Previous Use: Same

Current Materials Present: Air handling units and one sealed radioactive source on Column 5

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates equivalent to background levels, except for general walkway area outside ladies and mens room (10 uR/hr) due to radioactie material storage on OPS level.

Description of remaining radioactive materials:
Installed radioactive sources within area monitors.

Hazardous materials:
No hazardous material present in the survey unit

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. These areas have been subject to low levels of radioactive contamination due to the Tristan fire in 1994. Current radiological information shows that area conditions are at background levels for fixed and removable contamination levels.

Figure BAL - 8

Survey Unit Number: BAL-07 **Survey Number:** 7

Description: Ceiling in open areas

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Ceiling in open areas

Previous Use: Same

Current Materials Present: Ductwork, pipes, fire protection and HVAC equipment

---

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates equivalent to background levels, except for general walkway area outside ladies and mens room (10 uR/hr) due to radioactie material storage on OPS level.

Description of remaining radioactive materials:
Installed radioactive sources within area monitors.

Hazardous materials:
No hazardous material present in the survey unit

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. These areas have been subject to low levels of radioactive contamination due to the Tristan fire in 1994. Current radiological information shows that area conditions are at background levels for fixed and removable contamination levels.

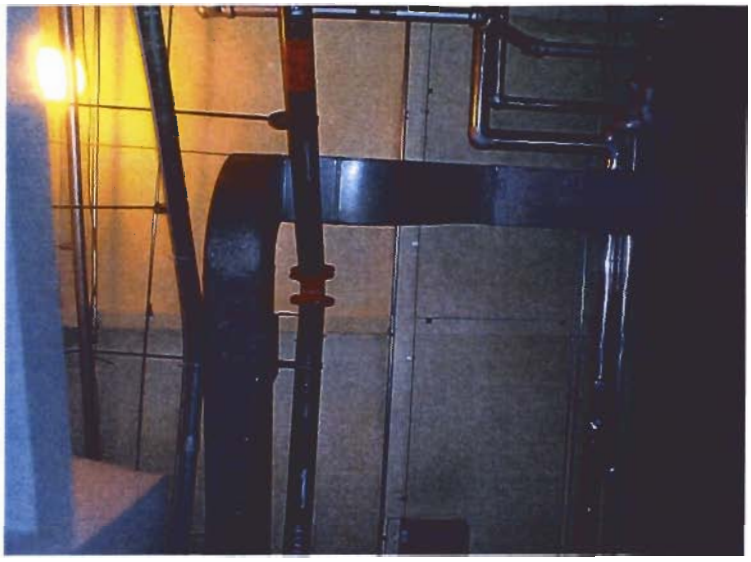

Figure BAL - 9

Survey Unit Number: BAL-08 **Survey Number:** 8

Description: Crawl spaces

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Crawl spaces.

Previous Use: Same

Current Materials Present: Pipe penetrations and pipes

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates equivalent to background levels, except for back storage area (50 uR/hr) due to radioactive material storage below.

Description of remaining radioactive materials:
No radioactive material currently stored in area.

Hazardous materials:
No hazardous material present in the survey unit.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2. These areas have not been subject to historical radioactive or chemical spills, incidents, or storage.

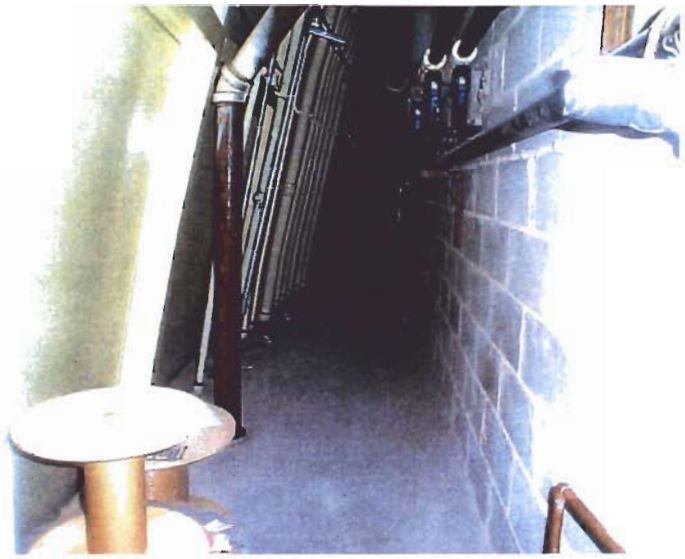

Figure BAL - 10

Figure BAL - 11

Appendix D - HFBR Survey Unit Reports - Experimental Level

Survey Unit Number: EXP-01 **Survey Number:** 35

Description: Mens Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Men's Room and Contaminated Waste Sink

Previous Use: Same

Current Materials Present:
No significant materials present.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels. Elevated counts on porcelain sink due to natural products.

Dose Rate
General area dose rates indicate background levels (5 uR/hr).

Description of remaining radioactive materials:
Sink is labeled as contaminated and is covered in yellow platics. Contamination may be prevalant in pipes and trap.

Hazardous materials:
No historical hazardous material spills in this area.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. This area is subject to decontamination activities. Surveys of the disposal sink and associated piping should be conducted during future evaluations.

Figure EXP - 1

Survey Unit Number: EXP-02 **Survey Number:** 36

Description: L-2

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Radioactive material and chemical storage area.

Previous Use: Machine shop for cutting and milling asbestos, lead, beryllium, and cadmium.

Current Materials Present:
Area is currently used as a chemical and radioactive material storage area. Multiple bins of chemicals are orderly stored. Radioactive material is also bagged and stored in the area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Elevated floor, wall and ceiling readings attributed to radioactive material storage in the area.

Dose Rate
Dose rates up to 0.8 mR/hr in radioactive material storage area and up to 0.12 mR/hr at the storage area boundary. General area dose rates ~0.02 mR/hr.

Description of remaining radioactive materials:
Area currently stores bagged and labeled radioactive materials with external dose rates up to 0.8 mR/hr.

Hazardous materials:
Asbestos floor tiles are within the laboratory. Several storage bin of chemicals are throughout the lab, including; beryllium, copper, lithium, sodium, iron, grease, lubricants, oils, solvents, and alcohols. Lead, cadmium, oils, and other solvents used. Wipe analyses identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. Direct reading lead measurments were negative on laboratory metal door.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. This area is subject to large amounts of chemical and radioactive material storage. Additional radioactive contamination surveys should be conducted after removal of the radioactive material contained within the storage area.

Figure EXP - 2

Figure EXP - 3

Figure EXP - 4

Figure EXP - 5

Survey Unit Number: EXP-03 **Survey Number:** 37

Description: L-4

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Low level radioactive sample counting laboratory.

Previous Use: Electronics shop with hood assembly for working with uranium targets.

Current Materials Present:
A liquid scintillation counter and HPGe counter are in the laboratory. Sealed and liquid radioactive sources are present. Other ancillary laboratory items remain.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Floor surveys indicate background levels. Walls and ceiling data indicate background levels.

Dose Rate
Highest dose rate is 0.07 mR/hr with general area dose rates at 0.03 mR/hr located near source storage drawer. Other areas are 5 to 7 uR/hr general area.

Description of remaining radioactive materials:
TRISTAN hood was in the back left hand corner of the room, but was removed. Potential contamination exists in duct work which supported this unit. Potential for alpha contamination. Other radioactive materials include low level radioactive samples stored by Health Physics personnel including large volumes of tritium samples and standards.

Hazardous materials:
Asbestos floor tiles are present. Asbestos wiring, ceiling tiles (above the drop ceiling asbestos free tiles), and insulation are/may be present. Material used previously include beryllium, alcohol, and platinum. Wipe analyses identified Al, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. Direct reading measurements for lead were negative on walls.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. This area is subject radioactive material storage and sample counting. Previous activities included radioactive material and chemical spills and incidents. Of these, at least spills of platinum are known. Further consideration should be given to the area that contained uranium target fume hood including any remaining exhaust duct work.

Figure EXP - 6

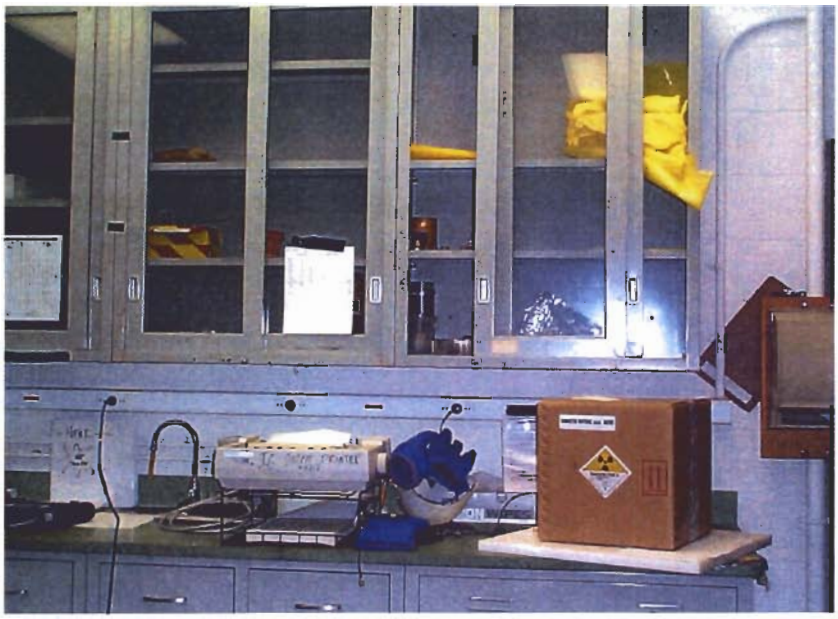

Figure EXP - 7

Survey Unit Number: EXP-04 **Survey Number:** 38

Description: L-6 & L-7

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Laboratory 6 - office area. Laboratory 7 - storage area and computer room.

Previous Use: Same

Current Materials Present:
Radioactive material bags, copper, steel, lead blankets, and a radioactive material sharps container.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates range from 3 uR/hr to 8 uR/hr.

Description of remaining radioactive materials:
Radioactive material bag and a radioactive material labeled sharps container.

Hazardous materials:
Asbestos floor tiles are present in L-7. Asbestos wiring, floor tiles, and ceiling tiles (above the drop ceiling asbestos free tiles) are/may be present. Beryllium, lead, cadmium, and copper were also used in this area. Lead and copper are still present in this survey unit. Mercury sample data was negative for inside sinks. In L-6, wipe analyses identified Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, and Zn above instrument detection limits. However in L-6 only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. In L-7, wipe analyses identified Al, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However in L-7 only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. This area is subject to radioactive sample storage.

Figure EXP - 8

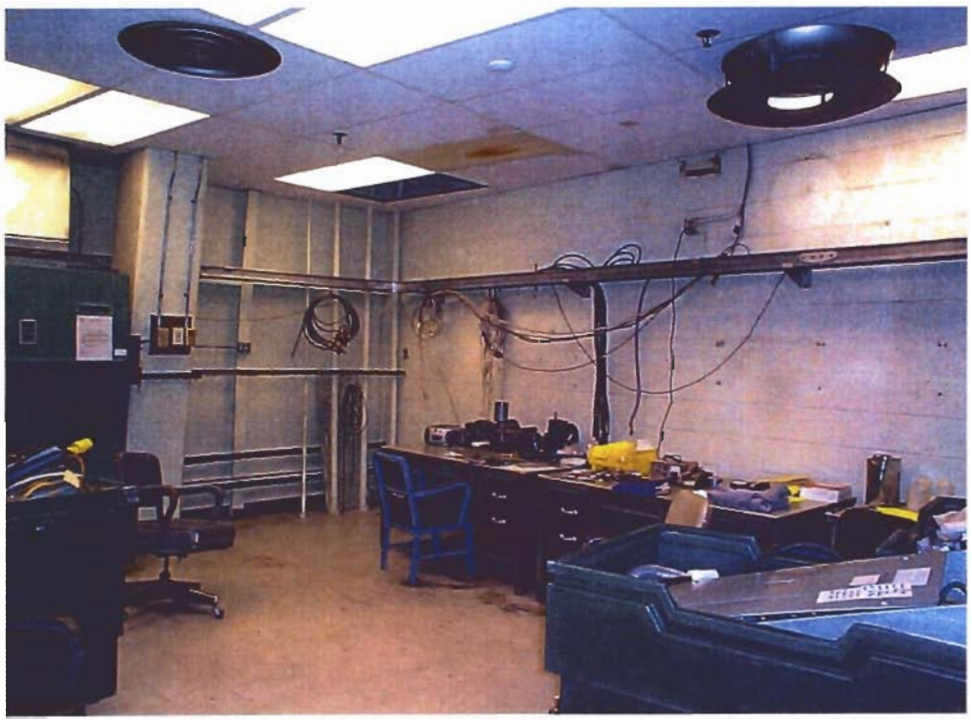

Figure EXP - 9

Survey Unit Number: EXP-05 **Survey Number:** 39

Description: L-8 &L-9

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Laboratory 8 - sample prep area. Laboratory 9 - storage area.

Previous Use: Laboratory 8 - computer room. Laboratory 9 - computer room, storage area, sample prep area.

Current Materials Present:
Areas contain storage boxes.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates range from 4 uR/hr to 7 uR/hr.

Description of remaining radioactive materials:
No radioactive material is evident in these laboratories.

Hazardous materials:
Beryllium, cadmium and lead used in these areas. Asbestos in floor tiles, wiring, and ceiling tiles above non-asbestos drop ceiling. Mercury sample data was negative for inside sinks. Al, Sb, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits in L-8. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. The hood in L-8 was also analyzed for hazardous materials, analyses identified Al, Ba, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 due to the impact of other hazardous materials.

Figure EXP - 10

Figure EXP - 11

Survey Unit Number: EXP-06 **Survey Number:** 40

Description: L-9B & l-10

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Laboratory 9B - machine shop, sample prep area, storage area. Laboratory 10 - sample prep area and computer room.

Previous Use: Same

Current Materials Present:
Lead shielding, bag of RAM, sharps container, shelves, work benches, boxes, computer components, desks, and other ancillary office equipment.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates are noted as background indicating 6 uR/hr to 14 uR/hr.

Description of remaining radioactive materials:
One bag of radioactive material stored in this area.

Hazardous materials:
Beryllium, acetone, alcohol, lubricants, degreasers, vythane, methanol, and solvent use. Asbestos in floor tiles, wiring, and ceiling tiles above non-asbestos drop ceiling. Mercury samples of the sink were negative. Direct lead analysis of the metal floor was negative. Wipe analyses identified Al, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 due to the impact of other hazardous materials.

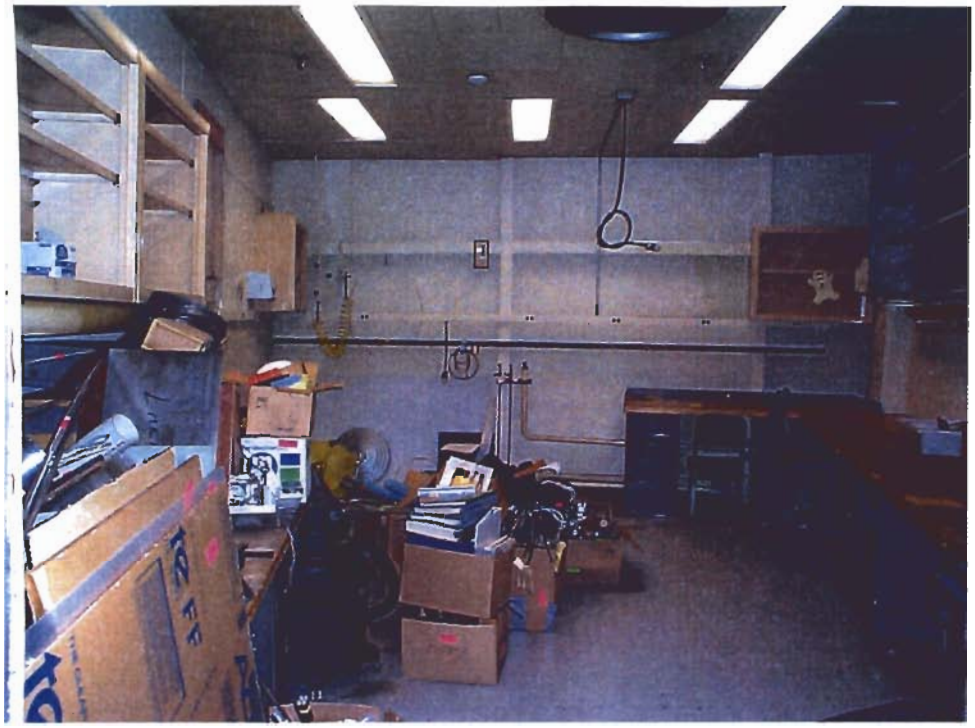

Figure EXP - 12

Figure EXP - 13

Survey Unit Number: EXP-07 **Survey Number:** 41

Description: L-10B

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Electronics lab and work shop area.

Previous Use: Same

Current Materials Present:
Pumps, oils, and drill press. Other ancillary materials include work benches, desks, and cabinets.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels in all areas except for a localized area in overhead just inside on left of doorway (~2000 dpm/100cm2 greater than background).

Dose Rate
Dose rates are noted as background indicating 4 uR/hr to 10 uR/hr.

Description of remaining radioactive materials:
Elevated direct survey reading on ceiling inside to left of door. No other indication of radioactive material present.

Hazardous materials:
Asbestos in floor tiles, wiring, and ceiling tiles above non-asbestos drop ceiling. Other hazardous materials include alcohol, degreasers, and oils. Wipe analyses identified Al, Sb, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 due to the impact of other hazardous materials. The small localized direct survey result does not significantly increase the radiological impact of the area.

Figure EXP - 14

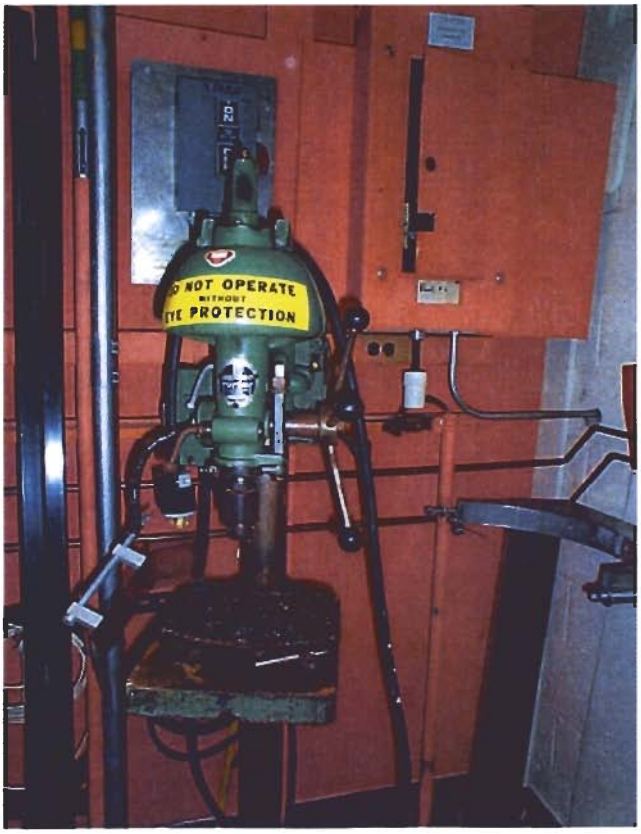

Figure EXP - 15

Survey Unit Number: EXP-08 **Survey Number:** 42

Description: L-11 & L-11A

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	1	2		

Current Use: Laboratory 11 - machine shop and storage area. Laboratory 11a - material and radioactive material storage area.

Previous Use: Laboratory 11 - cryogenics lab and machine shop. Laboratory 11a - sample prep, storage, and quiet areas.

Current Materials Present:
Electrical components, desks, compressed gas cyllinders (He and N), vacuum hoses, ion gauges, and oils.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Up to 10 mR/hr on contact with beam collimater in roped off contaminated area in L-11a. Other general area dose rates in L-11a from 3 uR/hr to 280 uR/hr. L-11 from 7 uR/hr to 14 uR/hr closest to L-11a and cheese-box.

Description of remaining radioactive materials:
L-11a contains a contaminated area containing multiple components.

Hazardous materials:
Asbestos in floor tiles, wiring, and ceiling tiles above non-asbestos drop ceiling. Other potential hazardous materials include lead, cadmium, beryllium, oils, solvents, and degreasers. Wipe analyses identified Al, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, the floors of these areas are considered Class 1 for radiological surveys. This area is also impacted by other hazardous materials.

Figure EXP - 16

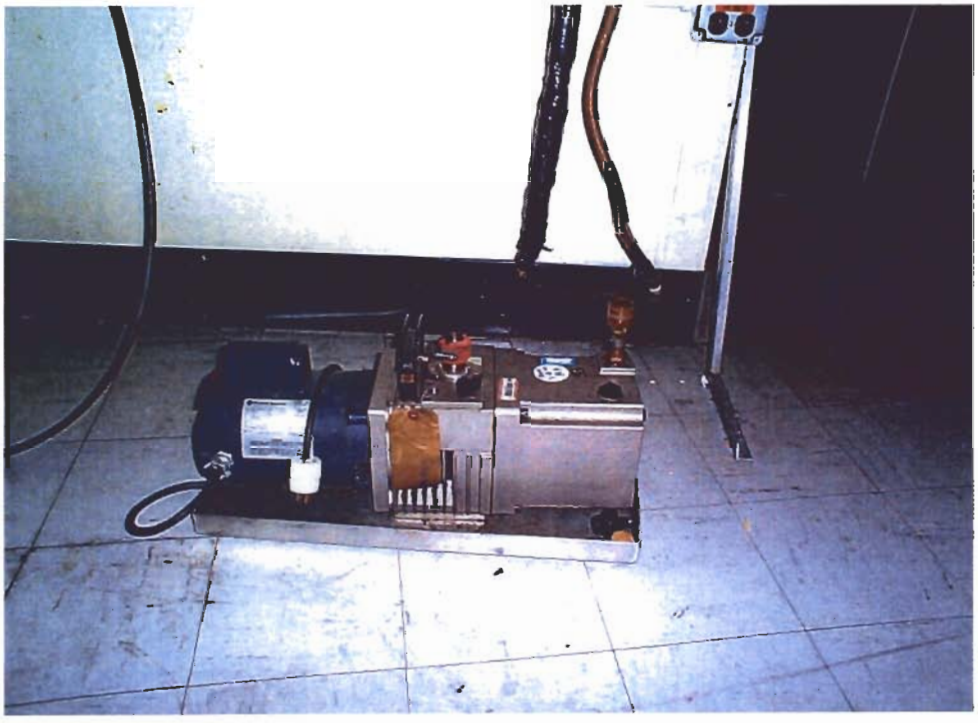

Figure EXP - 17

Survey Unit Number: EXP-09 **Survey Number:** 43

Description: L-12 &L-13

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Laboratory 12 - Gloveboxes and storage area. Laboratory 13 - computer room and storage area.

Previous Use: Laboratory 12 - electronics and machine shop. Laboratory 13 - computer room.

Current Materials Present:
Lab12 contains glove boxes, shield block, radioactive material labeled vacuum parts, and cabinets. Lab 13 contains desk, shelves, boxes, and cables.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels. Elevated counts on ceiling in L-12 due to radioactive filter storage on Experimental Level general area. Gloveboxes were surveyed and no removable activity was detected.

Dose Rate
Dose rates in L-12 from 5 uR/hr to 20 uR/hr. Highest reading in vicinity of shield block with RAM labeled vacuum parts and light gray glove box. Dose rates in L-13 from 6 uR/hr to 10 uR/hr. Gloveboxes were surveyd and dose rates were at background levels.

Description of remaining radioactive materials:
One small plastic bag labeled radioactive material remains in L-12 on top of a shield block. Two suspect glove boxes are stored in the area.

Hazardous materials:
Asbestos in floor tiles (L-12), wiring, and ceiling tiles above non-asbestos drop ceiling. Other potential hazardous materials include lead, cadmium, ethyl alcohol, oils, solvents, and degreasers. Direct lead analysis of concrete floor was negative. Wipe analyses of L-12 identified Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. Wipe analyses were also performed inside the two glove boxes contained within the area. The refrigerated glove box analyses identified Al, Ba, Be, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. The sandblast glove box identified Al, Sb, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, V and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 due to the impact of hazardous materials.

Figure EXP - 18

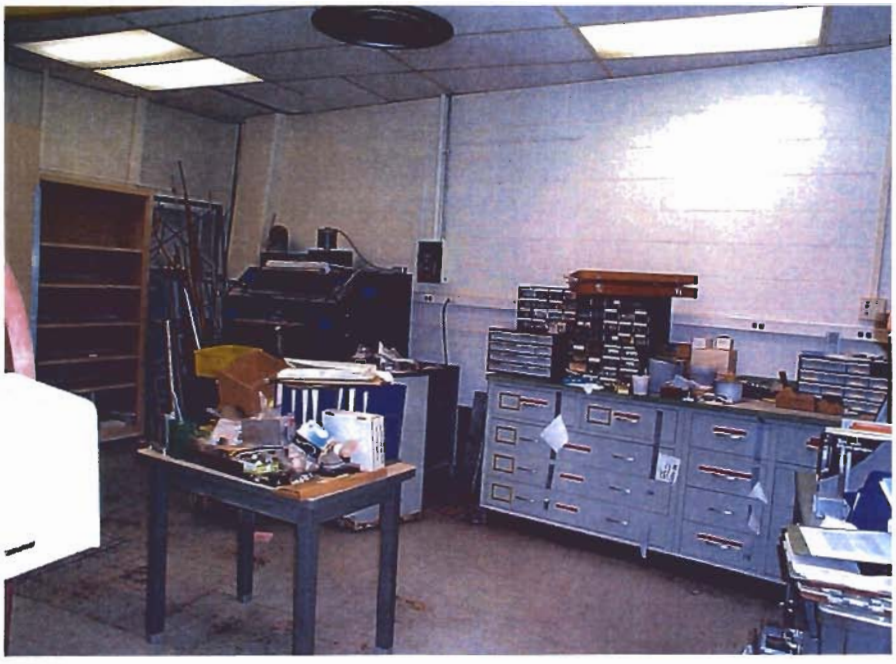

Figure EXP - 19

Figure EXP - 20

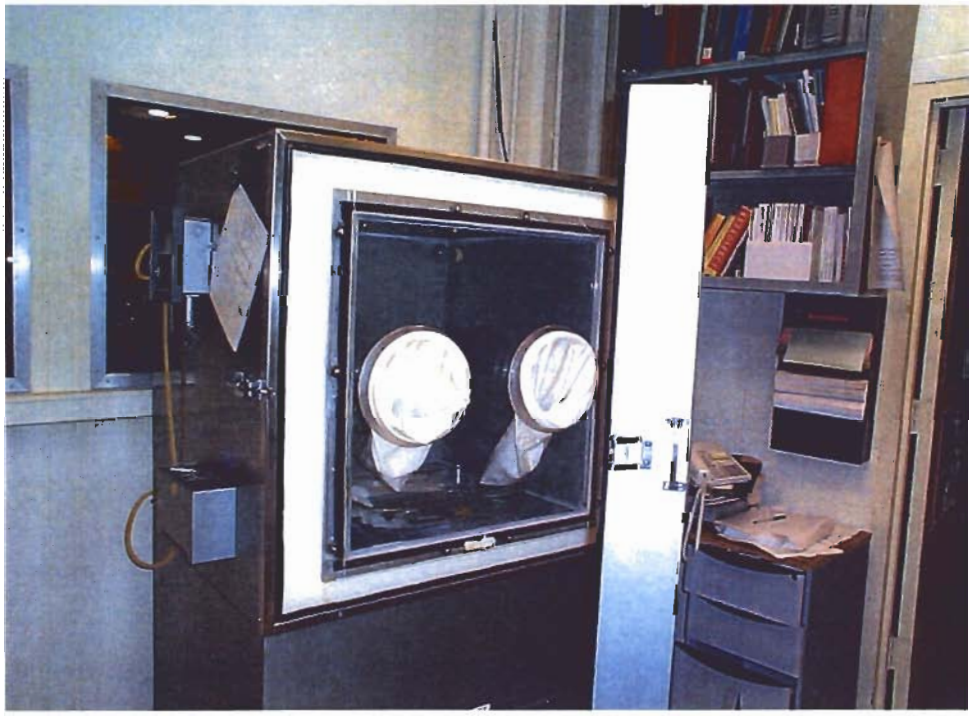

Figure EXP - 21

Survey Unit Number: EXP-10 **Survey Number:** 44

Description: L-14& L-15

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Laboratory 14 - wood shop and RMA. Laboratory 15 - machine shop.

Previous Use: Laboratory 14 - cryogenic/vacuum lab and radioactive material storage. Laboratory 15 - machine shop cutting and milling asbestos, Pb, Cd, and Be.

Current Materials Present:
Lab 14 contains wood and other carpentry tools. Lab 15 contains desks, sink, hood, and metal machining tools.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates are from 4 uR/hr to 14 uR/hr (door to experimental level).

Description of remaining radioactive materials:
No radioactive material is evident in these laboratories.

Hazardous materials:
Asbestos in floor tiles, wiring, and ceiling tiles above non-asbestos drop ceiling. Other potential hazardous materials include alcohol, epoxy, beryllium, indium, acetone, oxidized cadmium, cadmium, and lead. In L-14, wipe analyses identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, and Zn above instrument detection limits. However in L-14 only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. In L-15, wipe analyses identified Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However in L-15 only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. For the hood in L-15, wipe analyses identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. Mercury samples taken in the sink, hood and thermostat were negative.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 due to the impact of hazardous materials.

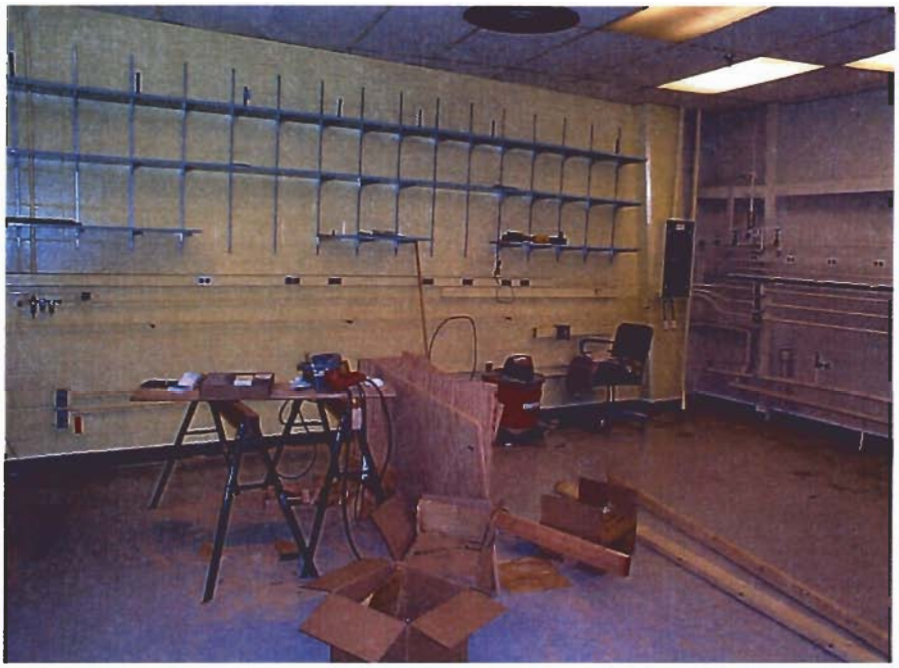

Figure EXP - 22

Figure EXP - 23

Survey Unit Number: EXP-11 **Survey Number:** 45

Description: L-16

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Storage

Previous Use: Electronics lab using solder, cadmium, and epoxy.

Current Materials Present:
Acetylene, grinding wheel, and offices are currently in the area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels at 5 uR/hr.

Description of remaining radioactive materials:
No radioactive material is evident in this laboratory.

Hazardous materials:
Asbestos in floor tiles, wiring, and ceiling tiles above non-asbestos drop ceiling. Epoxy, oxidized cadmium, and beryllium were also used in the area. wipe analyses identified Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However in L-16 only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 due to the impact of hazardous materials.

Figure EXP - 24

Figure EXP - 25

Survey Unit Number: EXP-12 **Survey Number:** 46
(Beam Plugs are also referenced as System 28)

Description: Cheesebox

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Beam plug and support equipment storage.

Previous Use: Same

Current Materials Present:
Irradiated and contaminated beam plugs and support equipment for beam plug removal and maintenance.

Radiological Data:

Contamination
Removable activity on external surfaces of box are less than the levels reported in Table 1. Internal contamination levels will exceed the levels in Table 1. Fixed contamination surveys were not taken due to high background levels.

Dose Rate
Dose rates on the external surface of the box up to 12 mR/hr. Beam plugs read several R/hr. Dose rate profiles are being performed as the plugs are removed. This data is maintained for future characterization.

Description of remaining radioactive materials:
Currently several beam plugs and beam support and maintenance equipment are stored in the area. These items are activated and contaminated.

Hazardous materials:
Lead used in shielding and potentially asbestos insulated wiring are contained within this survey unit.

Recommendations for future work or samples:
Based on historical review and current survey data, the "cheesebox" is considered Class 1 for radiological surveys. This area is also impacted by other hazardous materials such as lead.

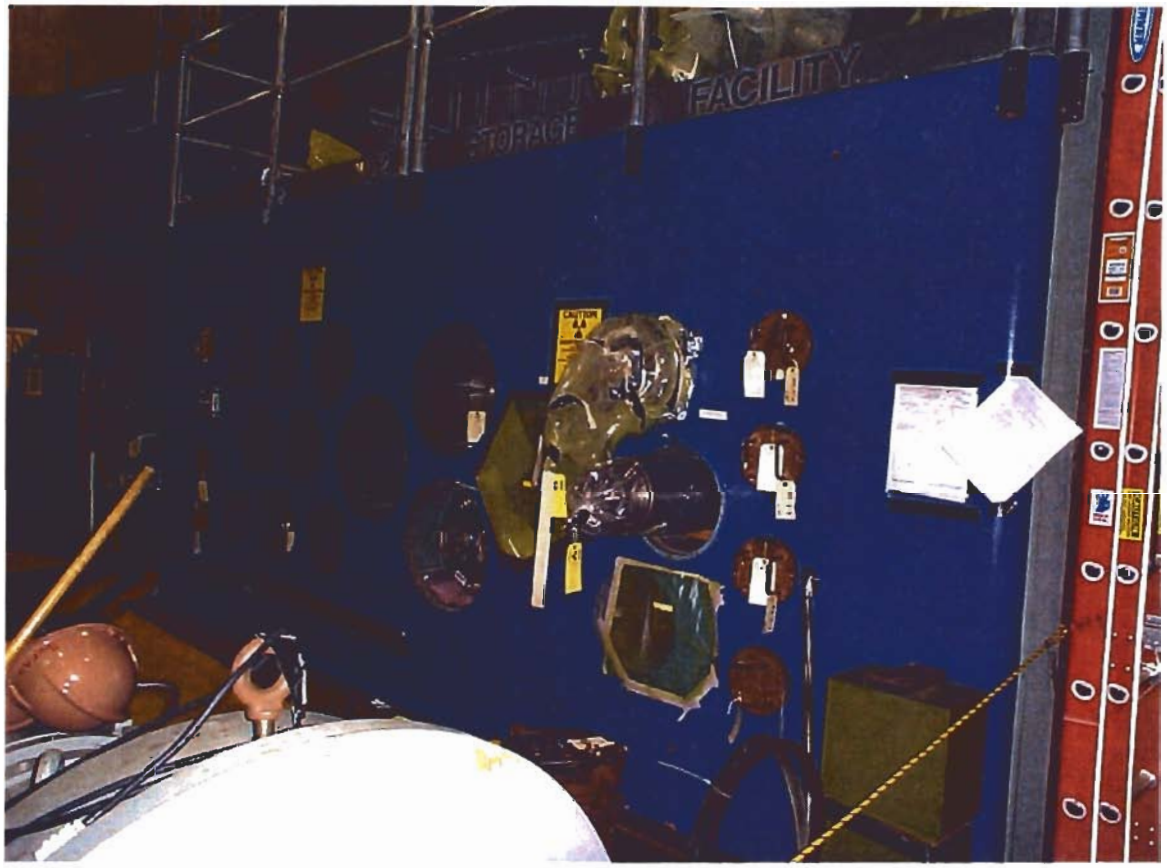

Figure EXP - 26

Survey Unit Number: EXP-13 **Survey Number:** 47

Description: H-1 trench to H-8 trench

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Work area and material staging and storage. NOTE: This area was not characterized for radiological information due to the beam plug removal project.

Previous Use: Experimental floor.

Current Materials Present:
To be determined after area is cleared of materials and reactor beam area work is completed.

Radiological Data:

Contamination
To be determined after area is cleared of materials and reactor beam area work is completed.

Dose Rate
To be determined after area is cleared of materials and reactor beam area work is completed.

Description of remaining radioactive materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Hazardous materials:
Floor tiles by H1 beam line tested positive for asbestos (9.8% chrysotile).

Recommendations for future work or samples:
Evaluate area after beam plug removal is completer and floor is cleared of storage items.

Figure EXP - 27

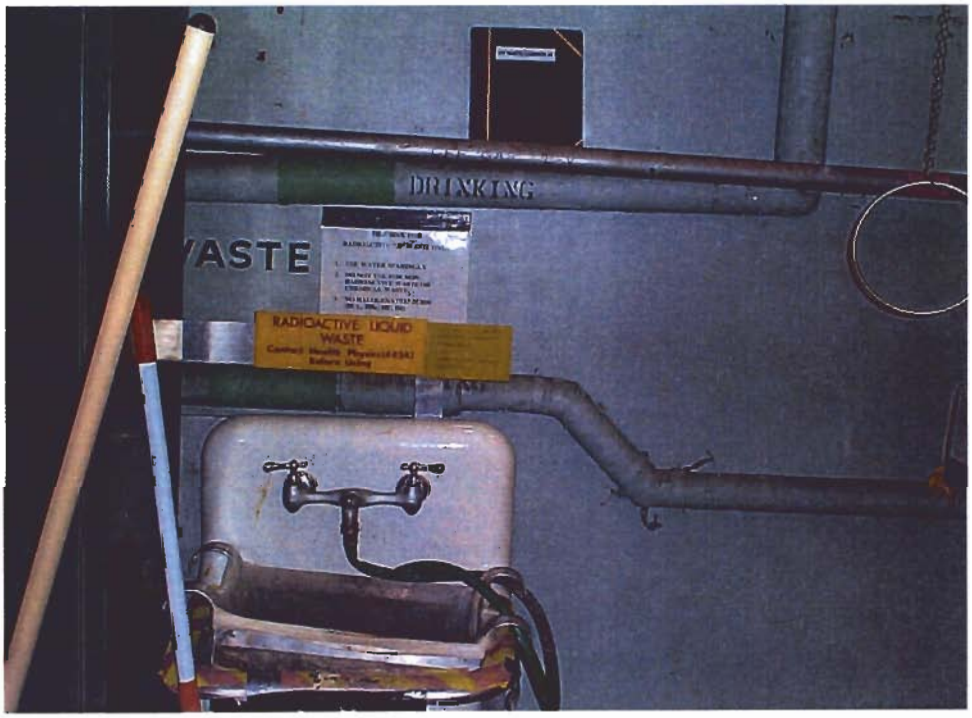

Figure EXP - 28

Figure EXP - 29

Figure EXP - 30

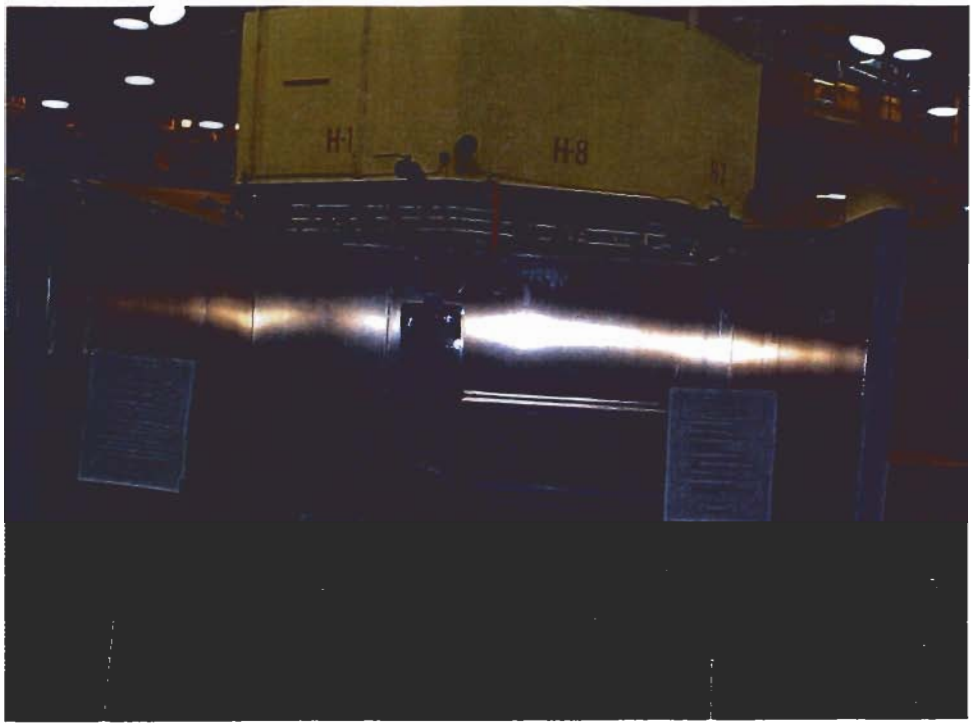

Figure EXP - 31

Survey Unit Number: EXP-14 **Survey Number:** 48

Description: H-7 trench to H-6 trench

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Work area and material staging and storage. NOTE: This area was not characterized for radiological information due to the beam plug removal project.

Previous Use: Experimental floor.

Current Materials Present:
To be determined after area is cleared of materials and reactor beam area work is completed.

Radiological Data:

Contamination
This area was not characterized for radiological contamination due to the beam plug removal project.

Dose Rate
To be determined after area is cleared of materials and reactor beam area work is completed.

Description of remaining radioactive materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Hazardous materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Recommendations for future work or samples:
Evaluate area after beam plug removal is completer and floor is cleared of storage items

Figure EXP - 32

Figure EXP - 33

Survey Unit Number: EXP-15 **Survey Number:** 49

Description: H-5 trench to H-4 trench

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Work area and material staging and storage. NOTE: This area was not characterized for radiological information due to the beam plug removal project.

Previous Use: Experimental floor.

Current Materials Present:
To be determined after area is cleared of materials and reactor beam area work is completed.

Radiological Data:

Contamination
To be determined after area is cleared of materials and reactor beam area work is completed.

Dose Rate
To be determined after area is cleared of materials and reactor beam area work is completed.

Description of remaining radioactive materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Hazardous materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Recommendations for future work or samples:
Evaluate area after beam plug removal is completer and floor is cleared of storage items

Figure EXP - 34

Figure EXP - 35

Survey Unit Number: EXP-16 **Survey Number:** 50

Description: H-9 trench to H-3 trench

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Work area and material staging and storage. NOTE: This area was not characterized for radiological information due to the beam plug removal project.

Previous Use: Experimental floor.

Current Materials Present:
To be determined after area is cleared of materials and reactor beam area work is completed.

Radiological Data:

Contamination
To be determined after area is cleared of materials and reactor beam area work is completed.

Dose Rate
To be determined after area is cleared of materials and reactor beam area work is completed.

Description of remaining radioactive materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Hazardous materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Recommendations for future work or samples:
Evaluate area after beam plug removal is completer and floor is cleared of storage items

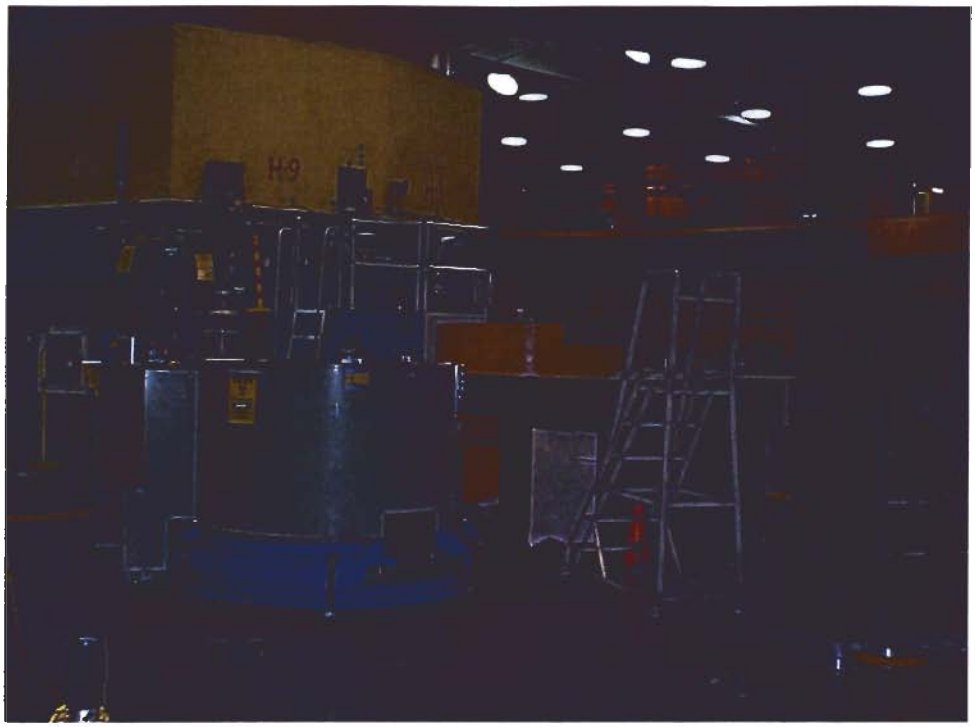

Figure EXP - 36

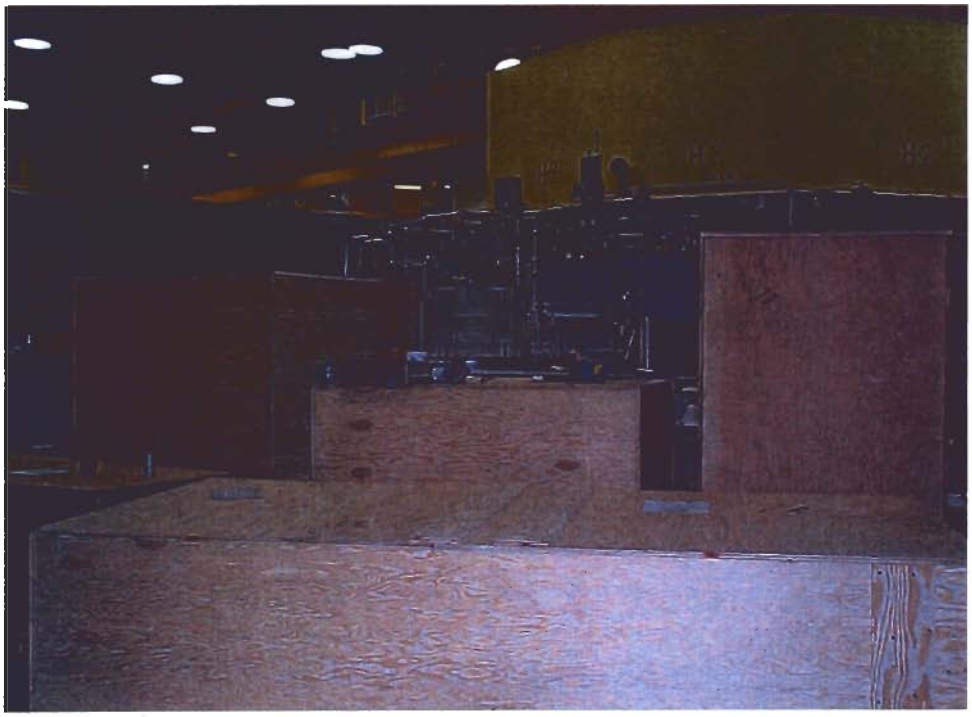

Figure EXP - 37

Survey Unit Number: EXP-17 **Survey Number:** 51

Description: H-2 trench

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Work area and material staging and storage. NOTE: This area was not characterized for radiological information due to the beam plug removal project.

Previous Use: Experimental floor.

Current Materials Present:
To be determined after area is cleared of materials and reactor beam area work is completed.

Radiological Data:

Contamination
To be determined after area is cleared of materials and reactor beam area work is completed.

Dose Rate
To be determined after area is cleared of materials and reactor beam area work is completed.

Description of remaining radioactive materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Hazardous materials:
To be determined after area is cleared of materials and reactor beam area work is completed.

Recommendations for future work or samples:
Evaluate area after beam plug removal is completer and floor is cleared of storage items

Figure EXP - 38

Figure EXP - 39

Survey Unit Number: EXP-18 **Survey Number:** 52

Description: C1 to C2

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 40

Figure EXP - 41

Survey Unit Number: EXP-19 **Survey Number:** 53

Description: C2 to C3

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 42

Figure EXP - 43

Survey Unit Number: EXP-20 **Survey Number:** 54

Description: C3 to C4

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels. Dust was analyzed for tritium and found to contain 2.29e-5 uCi/gm.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 44

Figure EXP - 45

Survey Unit Number: EXP-21 **Survey Number:** 55

Description: C4 to C5

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 46

Figure EXP - 47

Survey Unit Number: EXP-22 **Survey Number:** 56

Description: C5 to C6

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

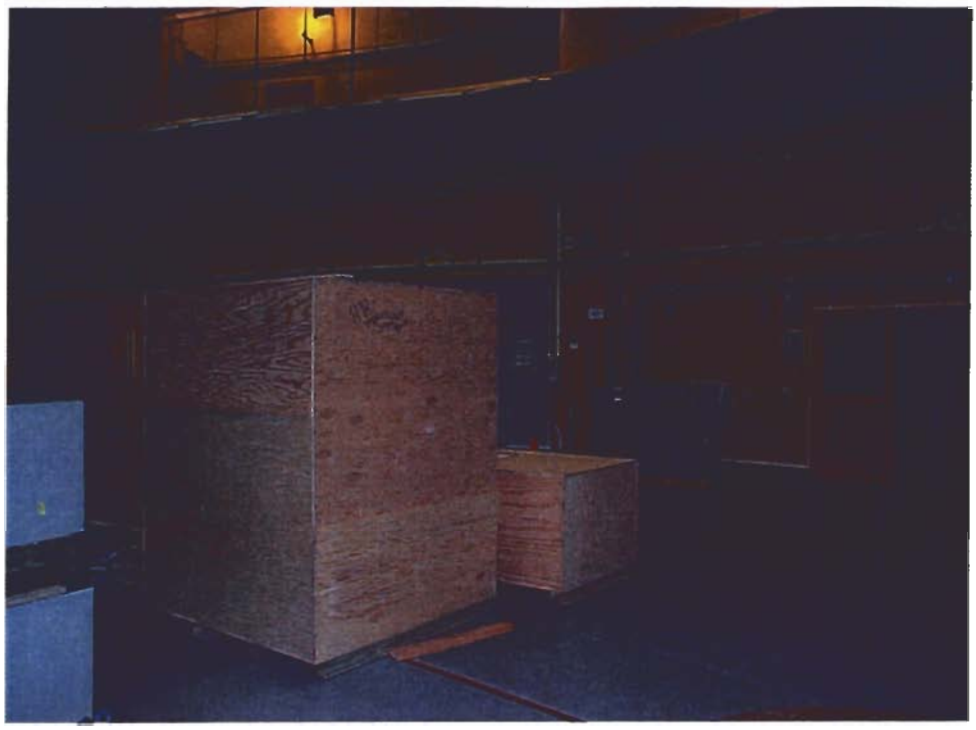

Figure EXP - 48

Figure EXP - 49

Survey Unit Number: EXP-23 **Survey Number:** 57

Description: C6 to C7

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
Area currently contains a radioactive material area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Survey Unit Number: EXP-24 **Survey Number:** 58

Description: C7 to C8

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
Area currently contains a radioactive material area and beam plug storage area (cheesebox).

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

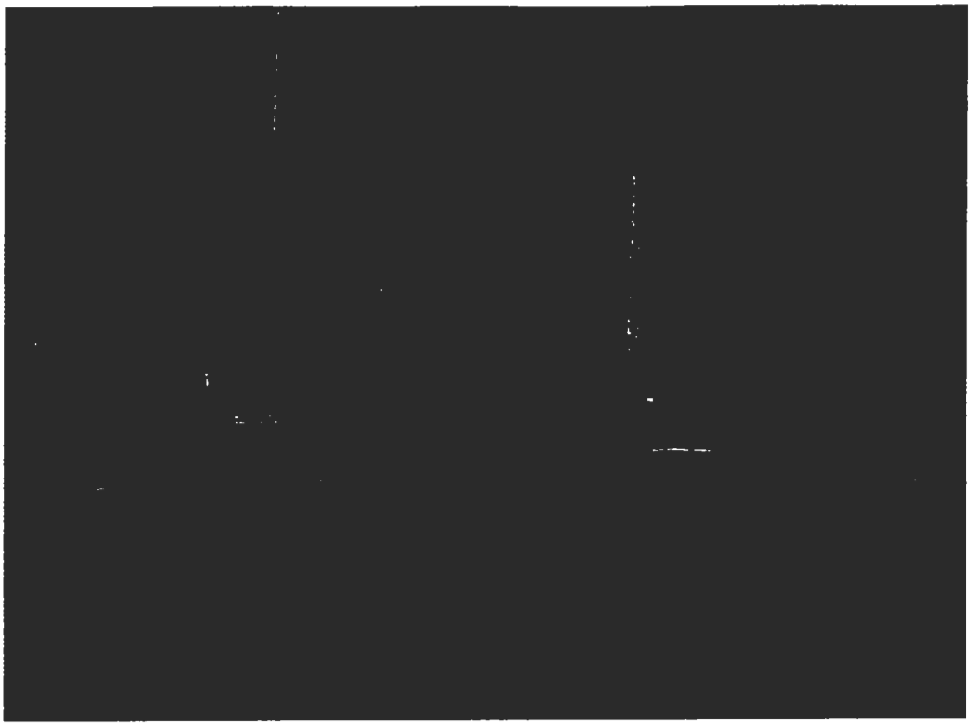

Figure EXP - 50

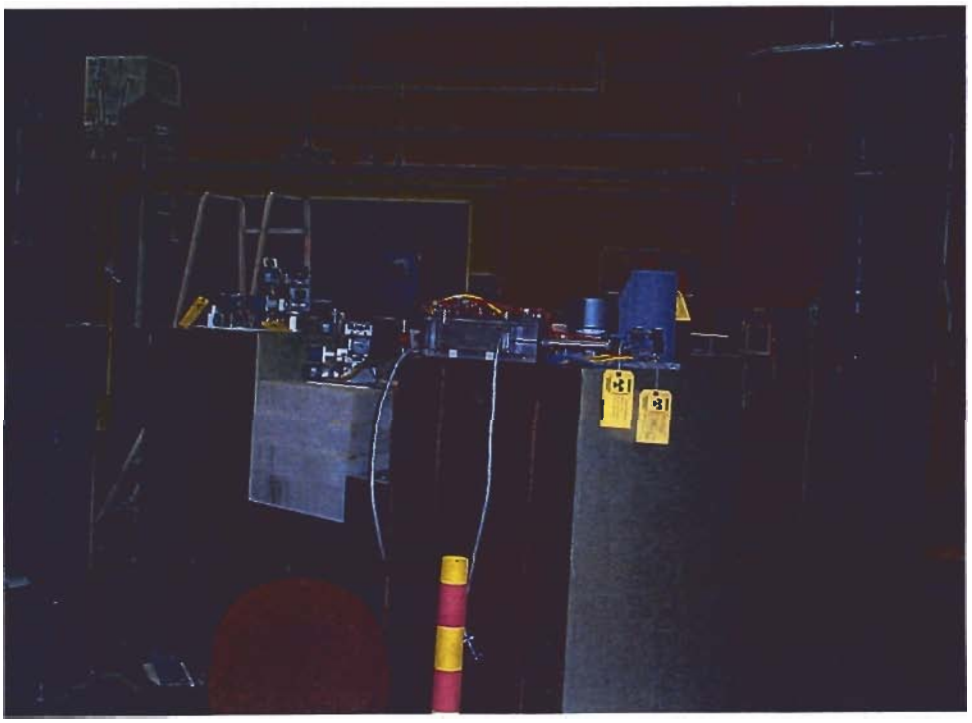

Figure EXP - 51

Survey Unit Number: EXP-25 **Survey Number:** 59

Description: C8 to C10

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
Area currently contains a radioactive material area and beam plug storage area (cheesebox).

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

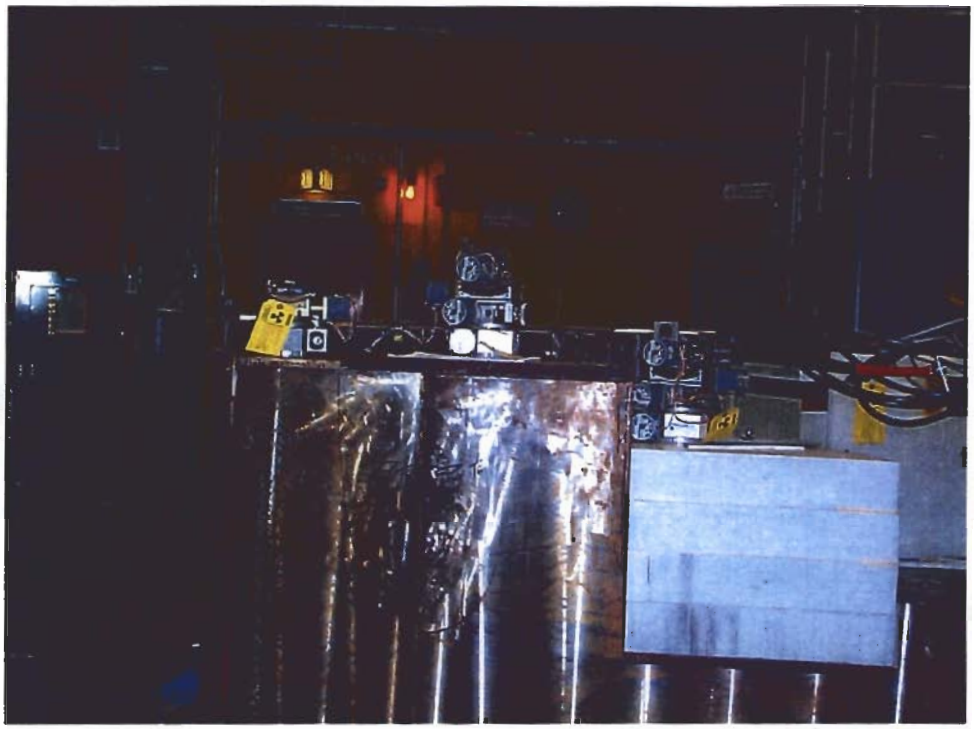

Figure EXP - 52

Figure EXP - 53

Survey Unit Number: EXP-26 **Survey Number:** 60

Description: C10 to C11

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
Area currently contains beamline filters and a radioactive material area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 54

Survey Unit Number: EXP-27 **Survey Number:** 61

Description: C11 to C12

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 55

Survey Unit Number: EXP-28 **Survey Number:** 62

Description: C12 to C13

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
Area currently contains two radioactive material B-12 boxes and a radioactive material area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos may included in wire insulation.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 56

Survey Unit Number: EXP-29 **Survey Number:** 63

Description: C13 to C14

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos wiring is a potential in this survey unit.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 57

Survey Unit Number: EXP-30 **Survey Number:** 64

Description: C14 to C15

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
Area currently contains a radioactive material area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos wiring is a potential in this survey unit.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 58

Survey Unit Number: EXP-31 **Survey Number:** 65

Description: C15 to C16

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos wiring is a potential in this survey unit.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 59

Survey Unit Number: EXP-32 **Survey Number:** 66

Description: C16 to C1

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1					

Current Use: Floor area

Previous Use: Same

Current Materials Present:
Area contains storage containers holding potential hazardous and radioactive materials throughout the characterization and decommissioning process.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Beryllium, cadmium, lead, and petroluem products used in these areas. Asbestos wiring is a potential in this survey unit.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill, this area is considered Class 1 for radiological surveys.

Figure EXP - 60

Survey Unit Number: EXP-33 **Survey Number:** 67

Description: Trenches

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1		1		

Current Use: Miscellaneous wiring for experiment support.

Previous Use: Same

Current Materials Present:
Miscellaneous wires and cables remain in the trenches. Some cables have been removed.

Radiological Data:

Contamination
Two hot particles (Co-60) identified during characterization survey (150k dpm and 30k dpm) in radial trench proximal to C15 and arc trench proximal to H7.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas.

Description of remaining radioactive materials:
Identified hot particle during characterization survey. No radioactive materials are stored in the trenches.

Hazardous materials:
Asbestos wiring is a potential in this survey unit.

Recommendations for future work or samples:
Based on historical review and identification of hot particles, this area is considered Class 1 for radiological surveys.

Survey Unit Number: EXP-34 **Survey Number:** 68

Description: Ceiling

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
		1	1		

Current Use: Ceiling

Previous Use: Same

Current Materials Present:
Ceiling currently supports lighting and sprinkler fixtures.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels. Elevated reading proximal to radioactive material areas and reactor center.

Description of remaining radioactive materials:
No material currently stored in this area.

Hazardous materials:
Lead based paint suspect in this area.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill (Tristan), this area is considered Class 1 for radiological surveys.

Figure EXP - 61

Figure EXP - 62

Survey Unit Number: EXP-35 **Survey Number:** 69

Description: Crane Rail and Base

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1		1		

Current Use: Crane Rail and Base

Previous Use: Same

Current Materials Present:
No materials currently stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates not provided.

Description of remaining radioactive materials:
No material currently stored in this area.

Hazardous materials:
Crane unit subject to oil and petroleum products and suspect lead based paint.

Recommendations for future work or samples:
Based on historical review and probability for radioactive spill (Tristan), this area is considered Class 1 for radiological surveys.

Figure EXP - 63

Figure EXP - 64

Survey Unit Number: EXP-36 **Survey Number:** 70

Description: South & North Quiet Rooms

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: North Quiet Room - radioactive material area for sample storage (<2 mR/hr) / South Quiet Room - computer and meeting room.

Previous Use: North Quiet Room - stockroom / South Quiet Room - same.

Current Materials Present:
North Quiet Room - contains radioactive material storage area. South Quiet Room contains general office materials and computer equipment.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
South Quiet Room indicates background levels. North Quiet Room contains a radioactive material area. Dose rates in this area are up to 150 mR/hr.

Description of remaining radioactive materials:
North Quiet Room contains a radioactive material area with bagged and tagged materials less than 2 mR/hr.

Hazardous materials:
North Quiet Room - asbestos in floor tiles, wiring, and ceiling tiles. South Quiet Room - asbestos in wiring and ceiling tiles above non-asbestos drop ceiling. Wipe analyses in North Quiet room identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 for radiological surveys. Current storage or radioactive material is adequate to prevent spread of contamination. However, this area is impacted by hazardous materials.

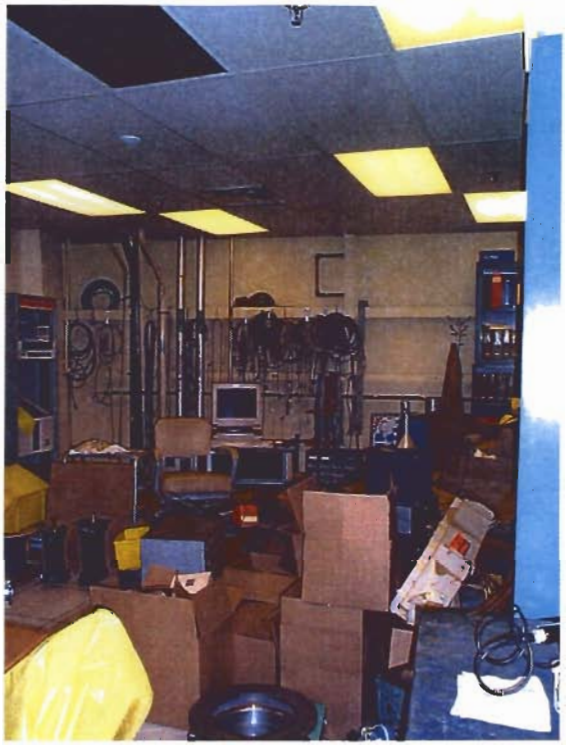

Figure EXP - 65

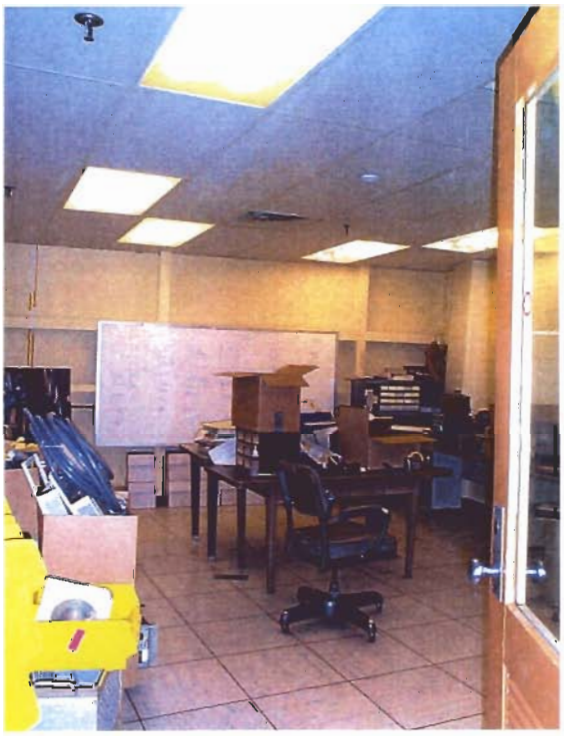

Figure EXP - 66

Figure EXP - 67

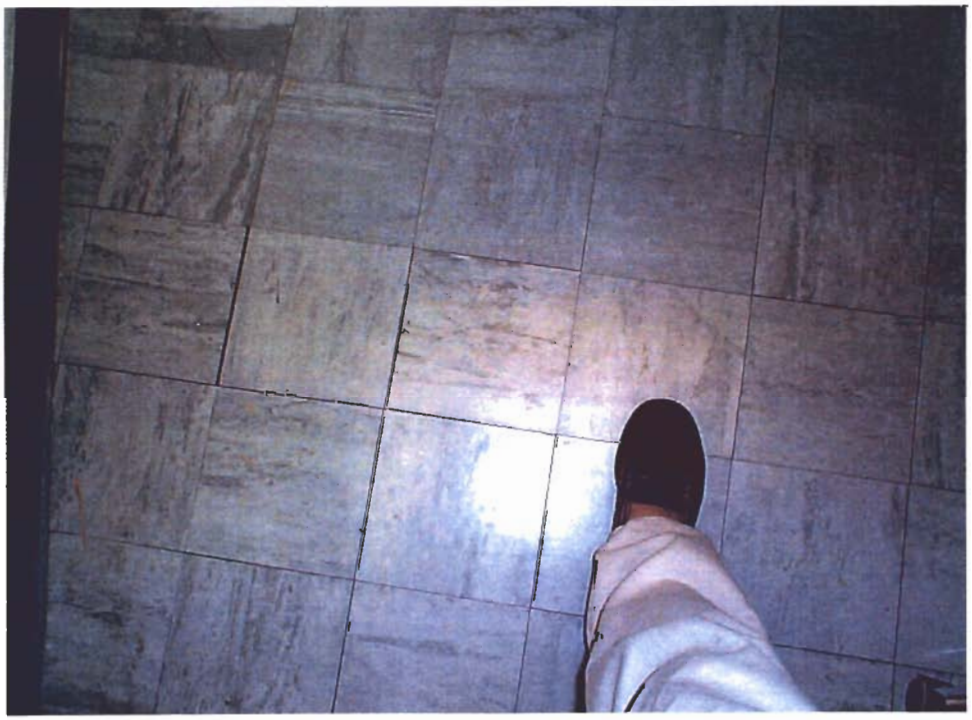

Figure EXP - 68

Survey Unit Number: EXP-37 **Survey Number:** 71

Description: Health Physics Office

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Health Physics Office

Previous Use: Same

Current Materials Present:
Area contains radioactive samples, sealed sources, instrumentation, tools, and general office equipment.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels, from 7 uR/hr to 20 uR/hr (proximal to source storage).

Description of remaining radioactive materials:
Area contains radioactive calibration sources.

Hazardous materials:
Asbestos floor tiles present. Direct readings taken for mercury. Results negative. Direct readings taken for lead based paint on area walls, concrete, and tile. Results negative.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. This area is subject to radioactive material storage.

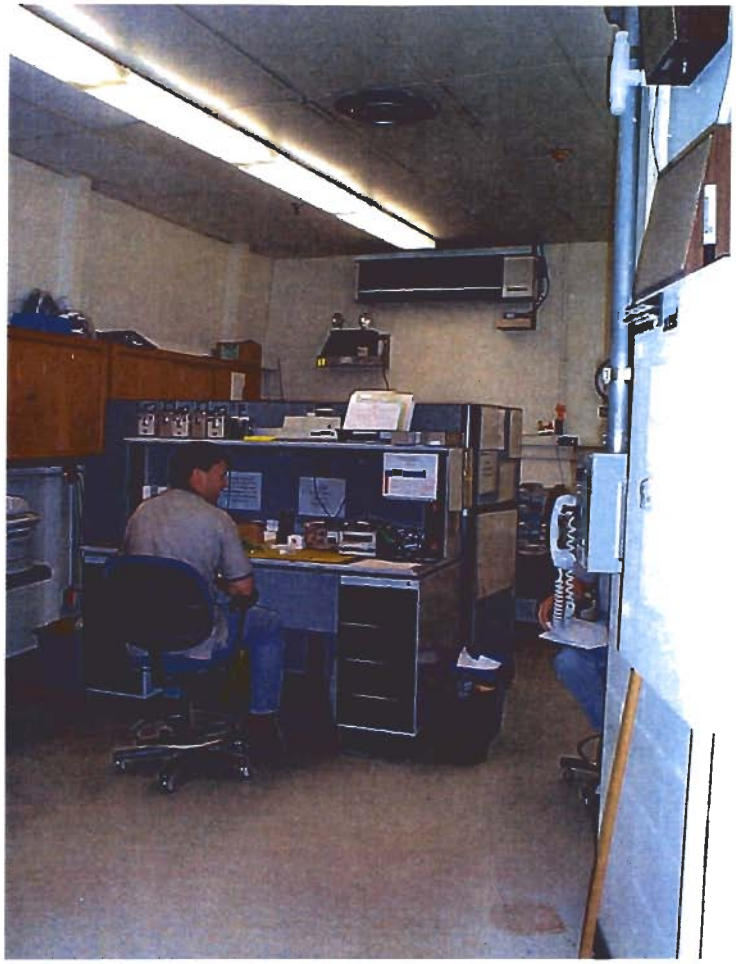

Figure EXP - 69

Survey Unit Number: EXP-38 **Survey Number:** 72

Description: Receiving Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	2		

Current Use: Receiving area, assess to confinement, deluge valves for fire protection system, shutdown heat exhcanger, and wall water suppliy line.

Previous Use: Same including security accsess to builging.

Current Materials Present:
Gas cylinders outside of airlock door and personal contamination monitors.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates up to 10 uR/hr in turnstile area. Appears to be due to natural occuring radioactive material in bricks. Other areas indicate background levels.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Asbestos in floor tiles, wiring, and ceiling tiles above non-asbestos drop ceiling.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2 for all but the floors. This area is impacted by hazardous materials and as such the floors are considered Class 1.

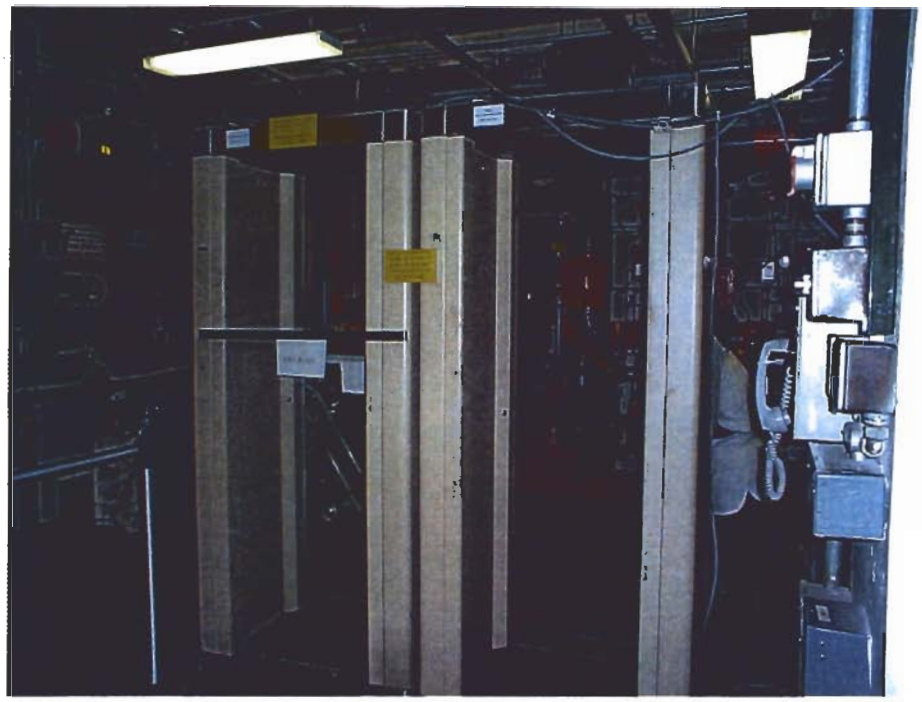

Figure EXP - 70

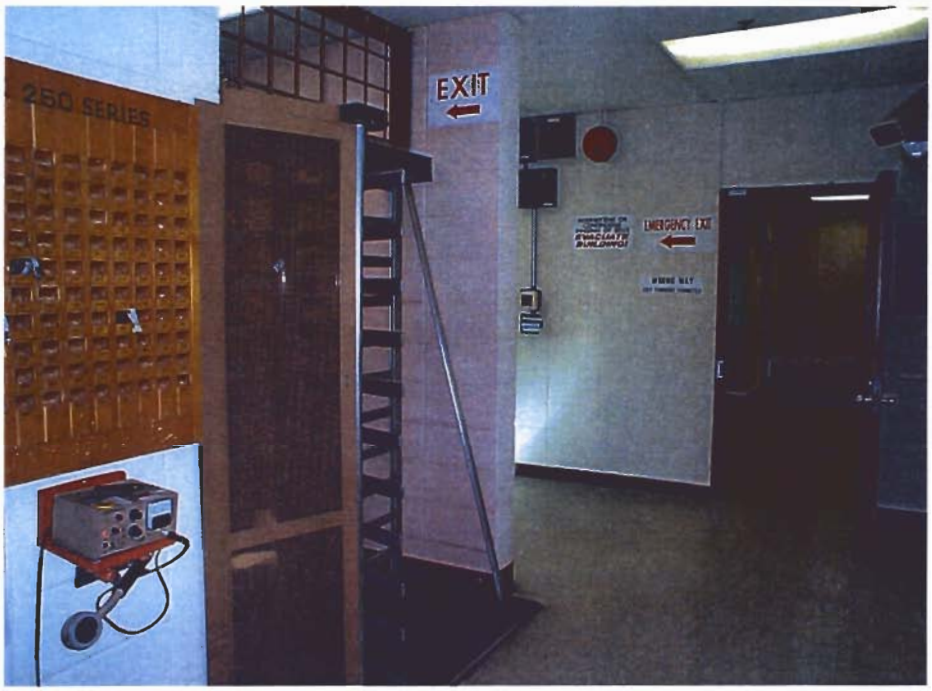

Figure EXP - 71

Figure EXP - 72

Survey Unit Number: EXP-39 **Survey Number:** 73

Description: Machine Shop

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	2		

Current Use: Machine shop, office area, and lunch room.

Previous Use: Same including milling of asbestos, beryllium, cadmium, and lead.

Current Materials Present:
Office areas, break room, and machining tools.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels, from 4 uR/hr to 7 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Asbestos in floor tiles, fire brick, wiring, and ceiling tiles above non-asbestos drop ceiling. Other hazardous materials include cadmium, lead, solvents, degreasers, and beryllium. Area surveyed for mercury. No mercury identified.

Recommendations for future work or samples:
Based on historical review and current survey data, the floor are considered Class 1 and the remaining areas are considered Class 2 for radiological surveys. The floor was subject to contamination when a contaminated dummy fuel element was transferred to the area.

Figure EXP - 73

Figure EXP - 74

Figure EXP - 75

Survey Unit Number: EXP-40 **Survey Number:** 74

Description: RMG Storage Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	2		

Current Use: Reactor Maintenance Group Storage Area

Previous Use: Same

Current Materials Present:
Oil storage (drums and smaller containers), flammable storage cabinet, pumps, cabinets, and shelves.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels, 5 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Asbestos in floor tiles (confirmed by analysis), wiring, ceiling tiles, and insulation. Other hazardous materials present, acetone, kerosene, spray paints, methyl alcohol, and petroleum products.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 for surveys due to the impact of hazardous materials.

Figure EXP - 76

Survey Unit Number: EXP-41 **Survey Number:** 75

Description: Receiving/Storage Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	1	2		

Current Use: Storage area, seismic area, emergency equipment storage area.

Previous Use: Same

Current Materials Present:
Currently items stored include SCBA units, protective clothing, and files.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels, 2.5 uR/hr to 3 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Asbestos in wiring, ceiling tiles, and insulation.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2 for radiological surveys. However, this ceiling is impacted by hazardous materials and is considered Class 1.

Figure EXP - 77

Survey Unit Number: EXP-42 **Survey Number:** 76

Description: North Truck Lock

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: North truck lock - radioactive material area.

Previous Use: Same

Current Materials Present:
Contaminated wood boards and stanchions cordoning off buffer area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels, 4 uR/hr to 6 uR/hr.

Description of remaining radioactive materials:
Two areas posted as radioactive material areas.

Hazardous materials:
Lead, cadmium, and oils and petroleum products used in this area. A direct lead survey was performed on the floor in the area with results reported as negative. Paint chips were analyzed by an outside laboratory for PCBs and determined to contain greater than 1 ppm. Paints was also analyzed for lead and determined positive at 0.0034 ppm.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1. This area is subject to radioactive material storage.

Figure EXP - 78

Survey Unit Number: EXP-43 **Survey Number:** 155

Description: Receiving Area Ouside Bldg. 750

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Receiving and storage area.

Previous Use: Same

Current Materials Present:
Protective clothing, gas cylinders, fire proof cabinets, and other items in storage.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels, 5 uR/hr.

Description of remaining radioactive materials:
Area contains re-usable protective clothing. A tritium exit sign hangs in the area.

Hazardous materials:
Fire proof cabinets containing solvents and paints.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2 for radiological surveys. However, this area may be impacted by other hazardous materials.

Figure EXP - 79

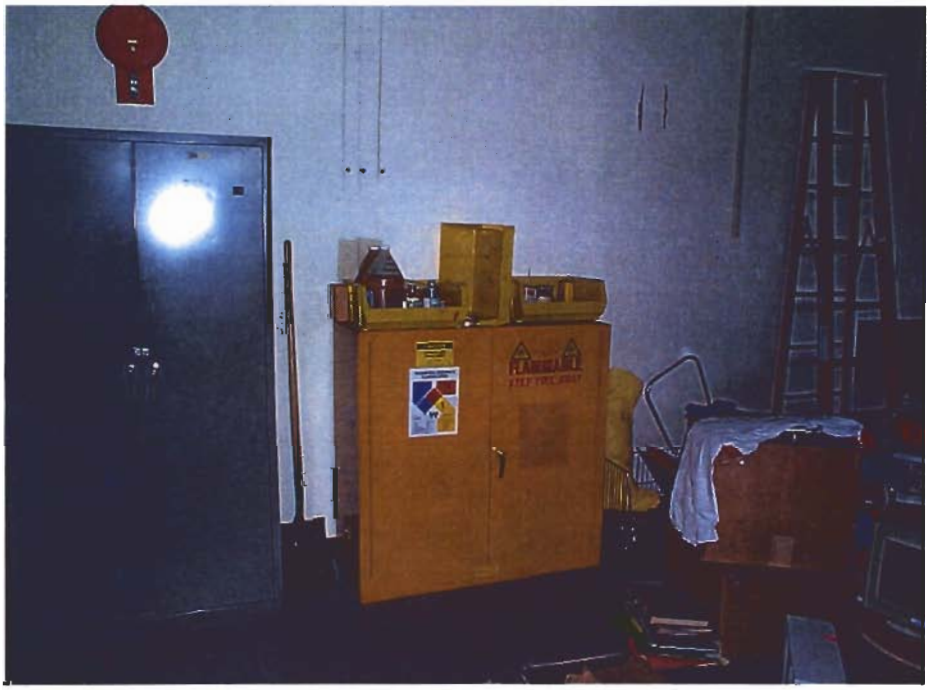

Figure EXP - 80

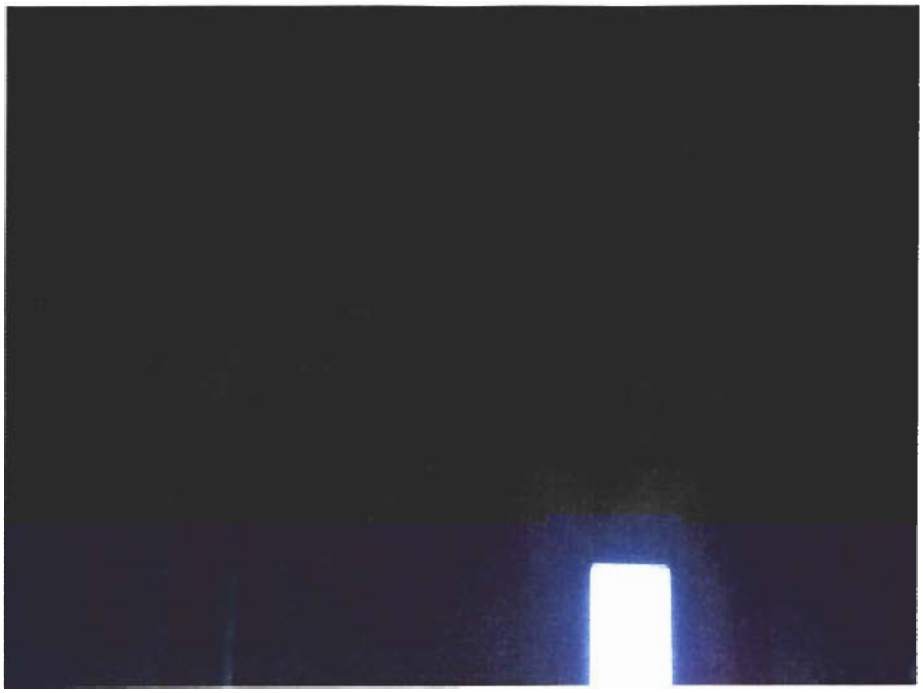

Figure EXP - 81

Survey Unit Number: EXP-44 **Survey Number:** 156

Description: Lunch Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	1	2		

Current Use: Lunch Room

Previous Use: Same

Current Materials Present:
Kitchen supplies and refrigerator.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels, 6 uR/hr to 10 uR/hr at the doorway to the Experimental floor.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Asbestos in floor tiles, wiring, and ceiling tiles above non-asbestos drop ceiling. Other hazardous materials used in the area include lead. A survey for mercury was performed. Results were reported as negative.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2 for radiological surveys. Future surveys should include further evaluation of the sink trap. The ceiling and floors are considered for Class 1 due to their impact with hazardous materials.

Figure EXP - 82

Survey Unit Number: EXP-45 **Survey Number:** 162

Description: Passenger Elevator

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Elevator

Previous Use: Same

Current Materials Present:
No materials stored in this area.

Radiological Data:

Contamination
Elevator oil was analyzed for tritium and determined to be less than the MDL (2/01). In 1997, oil contained 3.05E-5 uCi/mL of tritium. No reactor related radionuclides were identified through gamma spectroscopy. Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels with general area approximately 5 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
The elevator hydraulic system has been classified as a PCB containing system with the EPA. Current concentrations are less than 50 ppm. However, the EPA has not yet recognized the system as non-PCB. PCBs, oils, and petrochemicals are hazardous material concerns in this area. Personnel elevator was surveyed by direct measurment for lead. The results (doors and walls) were reported as negative.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2 for radiological surveys. Evaluation is required for oils, petrochemicals, and PCBs.

Survey Unit Number: EXP-46 **Survey Number:** 163

Description: Freight Elevator

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Elevator

Previous Use: Same

Current Materials Present:
No materials stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates indicate background levels with general area approximately 5 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Oils, and petrochemicals are hazardous material concerns in this area. Freight elevator was surveyed by direct measurment for lead. The results (doors and walls) were reported as negative. PCB contamination has never been found in the freight elevator pit.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 2 for radiological surveys. Evaluation is required for oils, petrochemicals, and PCBs.

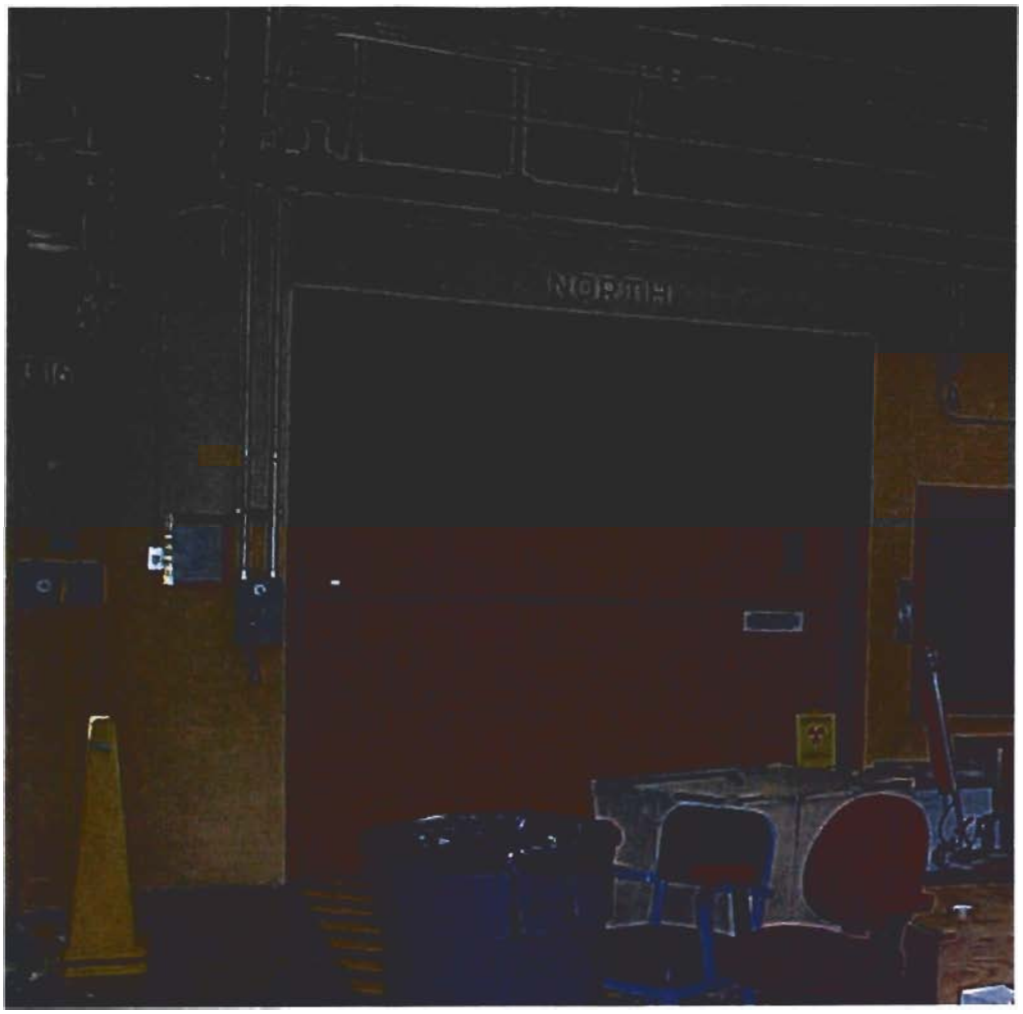

Figure EXP - 83

Survey Unit Number: EXP-47 **Survey Number:** 166

Description: Experimental Level Floor

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Work area and material staging and storage.

Previous Use: Experimental floor.

Current Materials Present:
Area contains radioactive material areas, satellite hazardous material storage areas, and several crated materials for removal.

Radiological Data:

Contamination
Data is dose rate only.

Dose Rate
Dose rates vary based on radioactive material storage in the area. Dose rates up to 12 mR/hr general area, proximal to the beam ports.

Description of remaining radioactive materials:
Area contains multiple radioactive material storage areas. Area also contains beam plug removal areas, contaminated areas.

Hazardous materials:
Hazardous material currently include satellite hazardous and radioactive material storage areas, lead shielding, cadmium, oils and petrochemicals, and beryllium.

Recommendations for future work or samples:
Based on historical review and current survey data, these areas are considered Class 1 for radiological surveys. The area has been subject to radioactive material spills and incidents, such as the TRISTAN fire.

Figure EXP - 84

Figure EXP - 85

Appendix E - HFBR Survey Unit Reports - Equipment Level

Survey Unit Number: EQ-01 **Survey Number:** 77

Description: Transformer Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Transformer Room

Previous Use: Transformer room with uninterruptible power supply.

Current Materials Present:
No material is currently stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicate background levels.

Dose Rate
General area dose rates indicate background levels, 4 uR/hr. Increased levels to 10 uR/hr due to equipment in other areas.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
This area is subject to oils, petrochemicals, mechanical pump fluid, and vacuum pump oil. Transformers are dry, i.e., they do not contain oil.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 2 for radiological surveys.

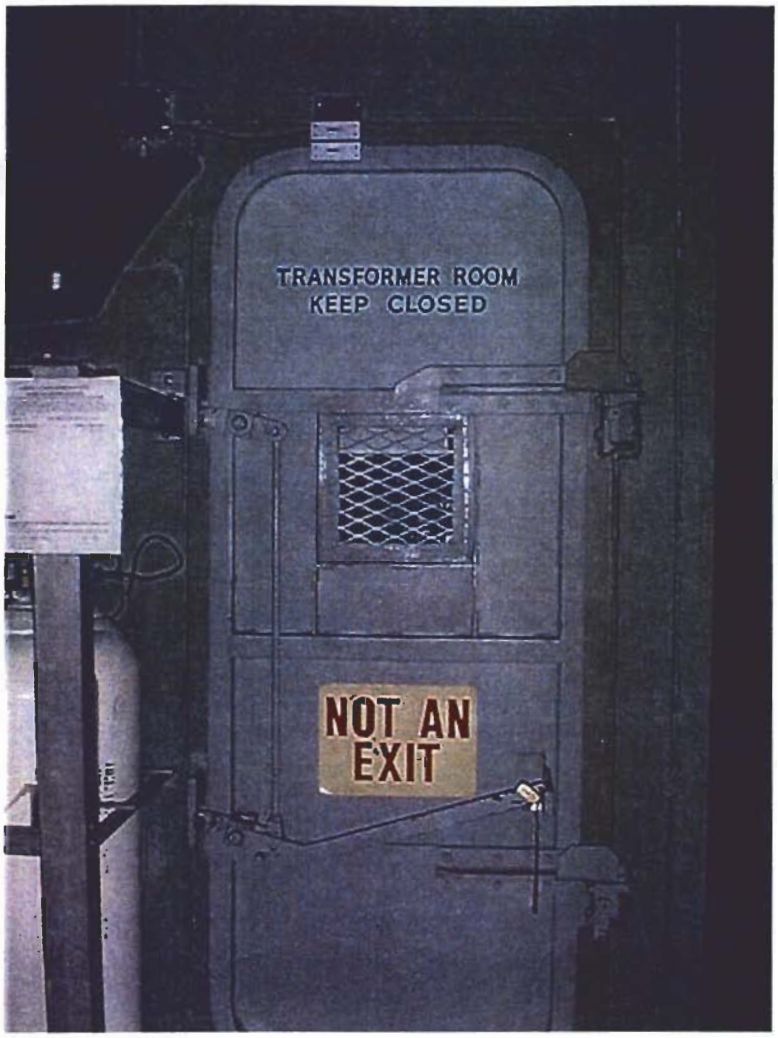

Figure EQ - 1 (room inaccessible)

Survey Unit Number: EQ-02 **Survey Number:** 78

Description: Generator Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Generator Room with steam piping.

Previous Use: Same

Current Materials Present:
No material is currently stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicate background levels. Background levels are higher in this area due to the radiation levels on the equipment level of building 750.

Dose Rate
General area dose rates indicate levels of 7 uR/hr. Increase to 100 uR/hr due to Equipment Level 750 in other area.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Oils, petrochemicals, and antifreeze were maintained in this area. Systems are drained of oils and antifreeze.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 2 for radiological surveys.

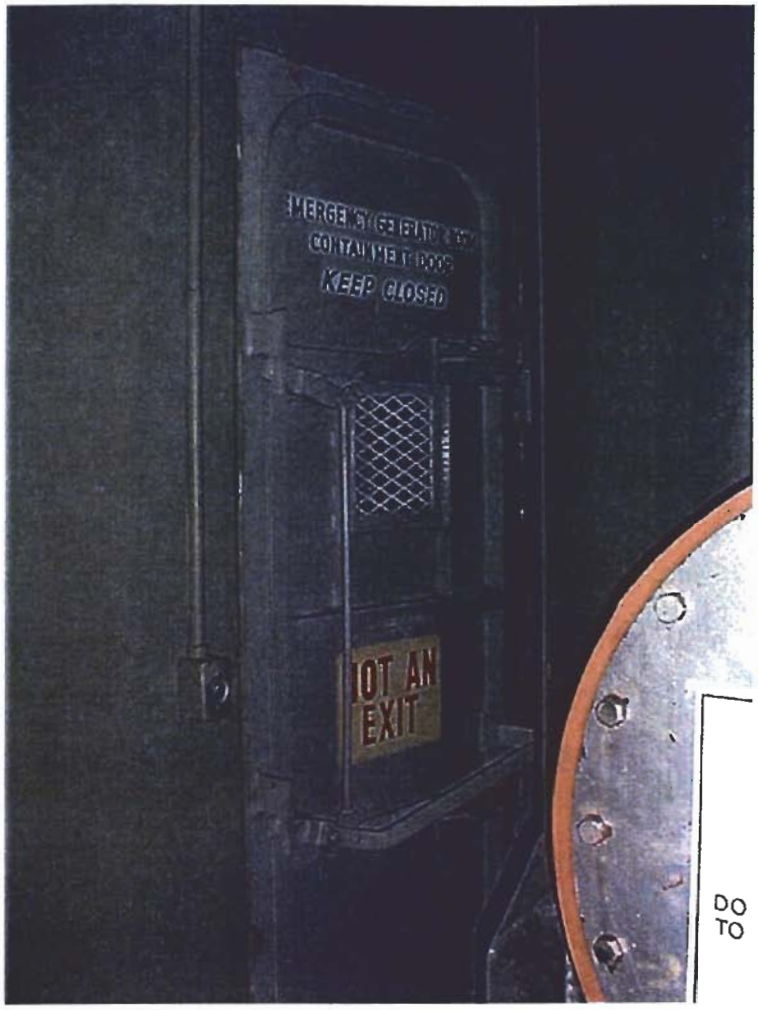

Figure EQ - 2 (room inaccessible)

Survey Unit Number: EQ-03 **Survey Number:** 79

Description: Blower Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		2

Current Use: Building ventilation fans.

Previous Use: Same

Current Materials Present:
No material is currently stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicate background levels.

Dose Rate
General area dose rates indicate levels of 7 uR/hr. Dose rates increase to 70 uR/hr due to filter storage in the plenum area.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Hazardous materials potentially in this area include, grease, oils, petrochemicals, and DTE extra heavy oil.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 2 for radiological surveys.

Survey Unit Number: EQ-04 **Survey Number:** 80

Description: Filter Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: HVAC filter room.

Previous Use: Same

Current Materials Present:
12 pre filters and 12 bag filters in filter bank.

Radiological Data:

Contamination
To be determined. Area was subject to area contamination during filter replacement.

Dose Rate
Access to area noted as 70 uR/hr. Previous surveys indicate general area dose rates of 0.3 mR/hr and up to 2.0 mR/hr on contact with ductwork.

Description of remaining radioactive materials:
Contaminated filters within the system.

Hazardous materials:
No hazardous materials noted in area. However, hazards include confined space.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events during filter replacement activities.

Survey Unit Number: EQ-05 **Survey Number:** 81

Description: East Truck Lock

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Truck access to equipment level.

Previous Use: Same

Current Materials Present:
B-25 container and contaminated wood.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Hot particles are known to be fixed in place.

Dose Rate
General area dose rates up to 25 uR/hr as approach equipment level. Dose rates at 5 uR/hr away from equipment level.

Description of remaining radioactive materials:
A B-25 and contaminated pieces of wood are in the area.

Hazardous materials:
Lead is a potential hazardous material in this area.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events. Hot particles are currently fixed in place.

Figure EQ - 3

Figure EQ - 4

Survey Unit Number: EQ-06 **Survey Number:** 82

Description: D_2O Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Store, purify, and transfer D_2O.

Previous Use: Same

Current Materials Present: Stored D_2O

Note: The D_2O room is not a confined space

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Area is posted as a contaminated area. Low levels of tritium identified in area, 1,258 dpm/100cm2.

Dose Rate
General area dose rates are less than 0.2 mR/hr. Equipment contained within the area exhibit dose rates of 2.0 mR/hr.

Description of remaining radioactive materials:
Bucket reading 1.5 mR/hr.

Hazardous materials:
No hazardous materials noted in area. However, hazards include confined space.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events.

Survey Unit Number: EQ-07 **Survey Number:** 83

Description: SNM Vault

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Special nuclear material storage.

Previous Use: Bathroom, locker room, and shower (contaminated and sanitary drains)

Current Materials Present:
Special nuclear material is currently stored in the area.

Radiological Data:

Contamination
Removable activity greater than the levels report in Table 1 for alpha contamination. Multiple transuranics identified in gamma spectroscopy results, e.g., Ce, Tl, Fr, and Am.

Dose Rate
General area dose rates less than 0.2 mR/hr.

Description of remaining radioactive materials:
Radioactive sources stored in this area.

Hazardous materials:
Lead, firebrick, and resin based paint.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events. Most recently (2001), alpha contamination identified in area at several hundred dpm.

Figure EQ - 5

Survey Unit Number: EQ-08 **Survey Number:** 84

Description: Fuel Vault

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Storage of dummy fuel elements and fuel test equipment

Previous Use: Same with addition of fuel elements containing 351 grams of HEU. Prior to fuel storage, this area contained lockers and bathrooms.

Current Materials Present:
Dummy fuel assemblies are maintained in this area; HEU is no longer stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels.

Dose Rate
Dose rates up to 1 mR/hr due to radioactive material storage in the area, including dummy fuel assemblies.

Description of remaining radioactive materials:
Radioactive sources stored in this area.

Hazardous materials:
Area may contain asbestos wiring, alcohol, and petroleum products such as grease and oils.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to radioactive contamination.

Figure EQ - 6

Survey Unit Number: EQ-09 **Survey Number:** 85

Description: Locker Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Bathroom, shower, and locker room.

Previous Use: Open floor space.

Current Materials Present:
Lockers and other personal items.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicate background levels. Increased fixed levels due to radioactive material storage in other area. Crud sample (1997) from drain identified Na22 (2.69E-7 uCi/g), Co60 (1.88E-4 uCi/g), Zn65 (1.37E-6 uCi/g), and Cs137 (3.21E-6 uCi/g).

Dose Rate
Elevated dose rates due to radioactive material storage in other areas. Dose rates to 60 uR/hr in toilet area. Dose rates area 14 uR/hr by locker area.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Floor tiles potential asbestos containing material. Surveys for mercury were performed in the eyewash stations and sinks. Results did not identify any mercury.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area was open floor space during previous operation of HFBR. Crud sample from bathroom drain cover box identified mix fission and activation products.

Figure EQ - 7

Figure EQ - 8

Survey Unit Number: EQ-10 **Survey Number:** 86

Description: Exhaust Plenum Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Exhaust plenum area.

Previous Use: Failed fuel element testing area

Current Materials Present:
In addition to plant structures, system and componets, the area contain radioactive material storage.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination greater than the levels reported in Table 1. Hot particles are known to be fixed in place.

Dose Rate
Dose rates elevated towards contaminated area boundary by Hx shield wall, 0.6 mR/hr. General area dose rates are 0.03 to 0.2 mR/hr.

Description of remaining radioactive materials:
Condensate drums stored in area, tritium. Shutdown Hx cell area contains drums of contaminated tools and debris from spent fuel removal.

Hazardous materials:
Lead shielding is located in the area.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area was open floor space during previous operation of HFBR. Radioactive material storage and contaminated areas exist in this survey unit.

Figure EQ - 9

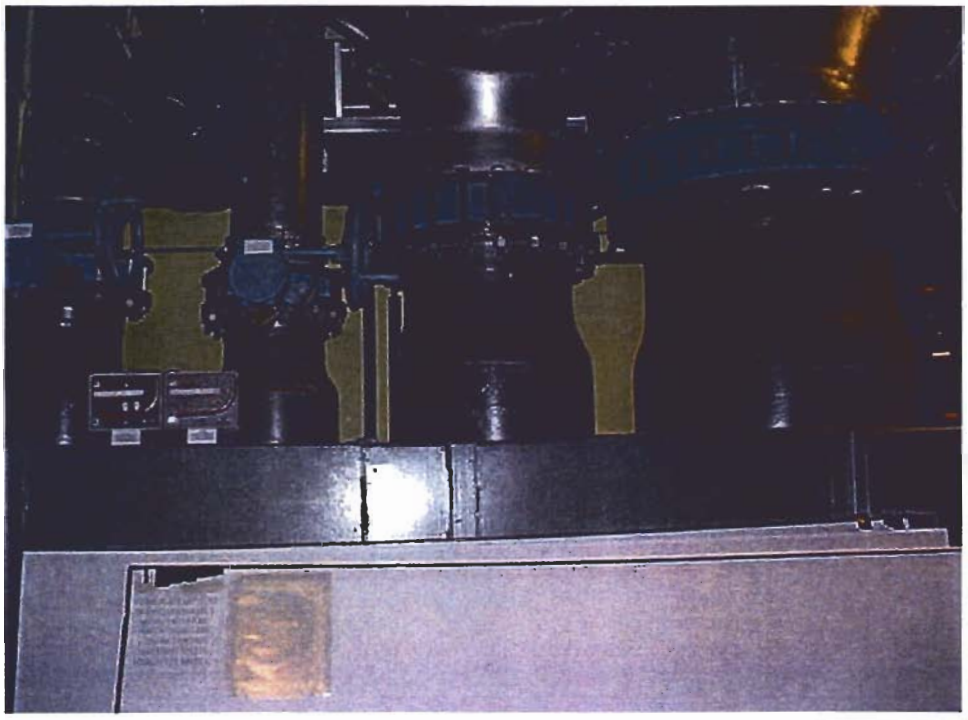

Figure EQ - 10

Survey Unit Number: EQ-11 **Survey Number:** 87

Description: Resin Processing Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Resin bed processing and disposal area.

Previous Use: Same

Current Materials Present:
In addition to plant structures, system and components, the area contain radioactive material storage.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Maximum removable beta concentration at 507 dpm/100cm2. Plant installed equipment posted as a contamination area. Fixed contamination greater than the levels reported in Table 1. Hot particles are known to be fixed in place. Maximum fixed contamination identified at 100k dpm/100cm2.

Dose Rate
General area dose rates are 20 uR/hr to 40 uR/hr. Dose rates increase towards storage cask, 300 uR/hr.

Description of remaining radioactive materials:
B-25 boxes, 55 gallon drums, and storage casks labeled as radioactive material.

Hazardous materials:
Lead shielding and resin beads are located in the area.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

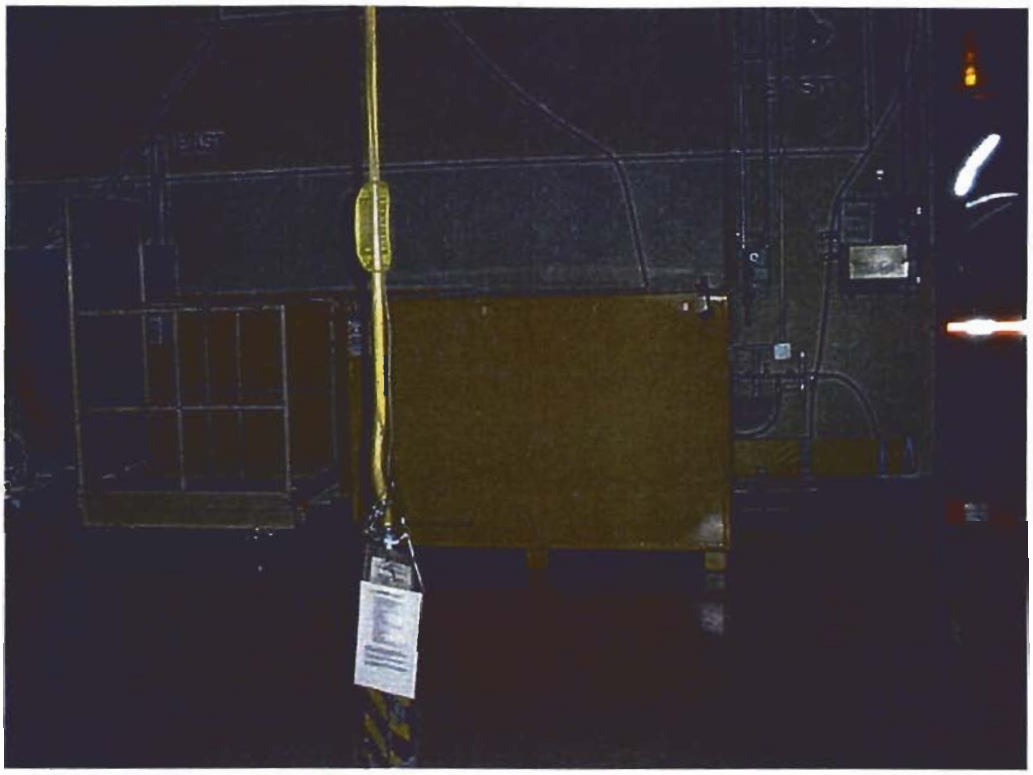

Figure EQ - 11

Survey Unit Number: EQ-12 **Survey Number:** 88

Description: BG201 Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Waste sump, charcoal filters, resin beds, and acid and caustic tanks.

Previous Use: Same

Current Materials Present:
Miscellaneous tools and hoses.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Hot particles have been previously identified in the area.

Dose Rate
General area dose rates are 25 uR/hr to 200 uR/hr as approach the tanks.

Description of remaining radioactive materials:
Area currently posted as a contaminated area. Miscellaneous tools and hoses are maintained in the area.

Hazardous materials:
Hazardous materials include sulfuric acid, sodium hydroxide, lead, and asbestos insulation.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

Figure EQ - 12

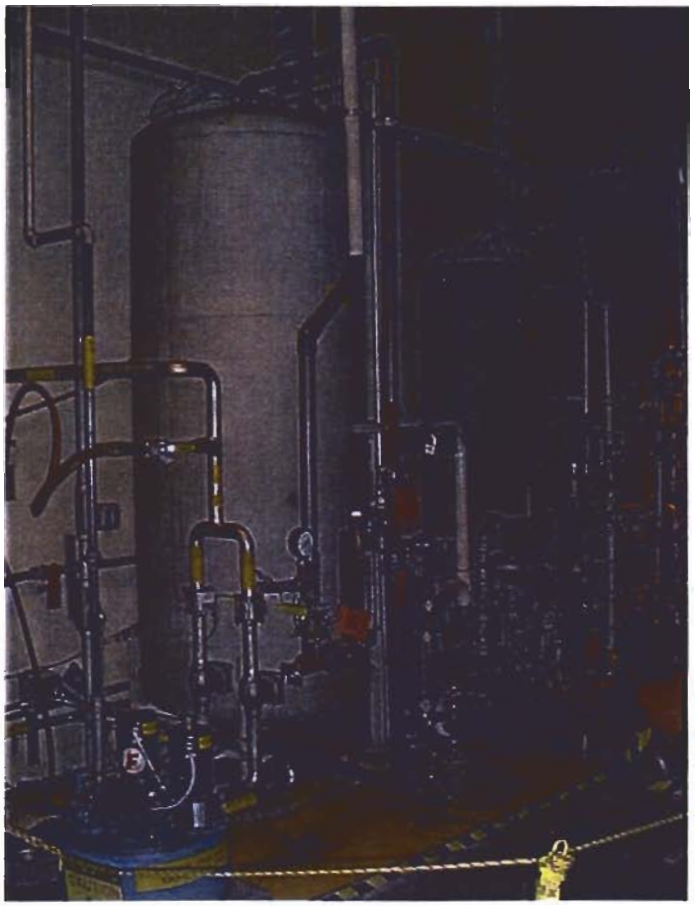

Figure EQ - 13

Survey Unit Number: EQ-13 **Survey Number:** 89

Description: FA101 Pit

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Transfer pump and sump and D_2O storage tank and associated drains.

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Note: FA101 Pit is a confined space

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Elevated dose rates impede the ability to identify fixed contamination. However fixed contamination is highly probable.

Dose Rate
Area posted as a High Radiation Area. General area dose rates up to 150 mR/hr. Contact readings up to 600 mR/hr. Dose rates are subject to change based on decay and water level in tank.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Lead shielding is located in the area. Other hazards include confined space.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

Figure EQ - 14

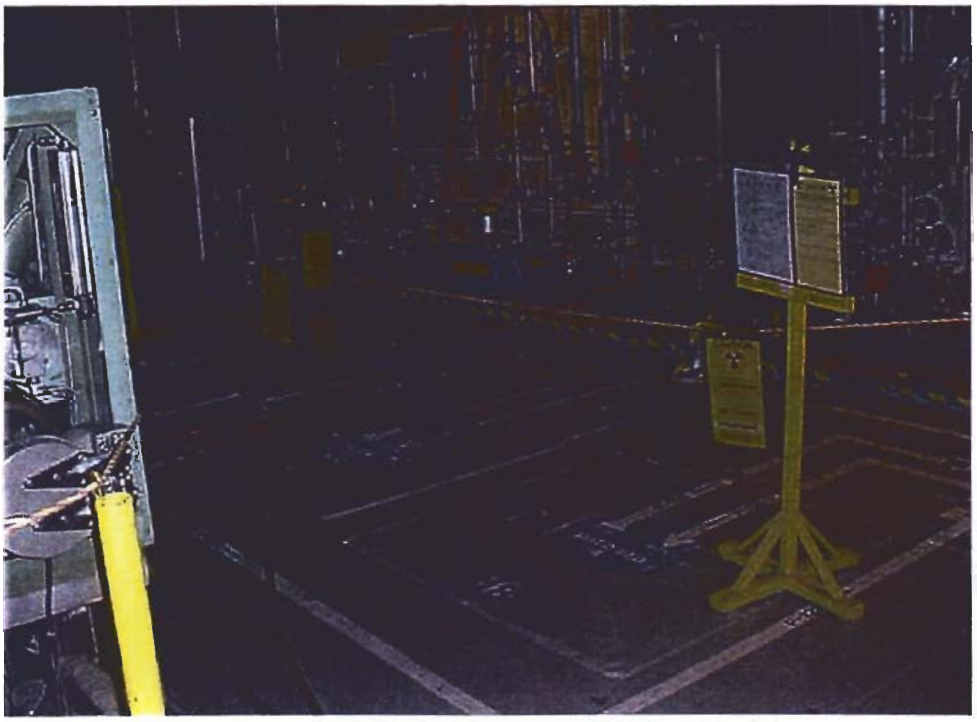

Figure EQ - 15

Survey Unit Number: EQ-14 **Survey Number:** 90

Description: CNF Vacuum Pump Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Vacuum pump and CO_2 gauge area.

Previous Use: Vacuum pump, CO_2 gauge area, resin bed and shielded cask area.

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicate background levels. Not all areas could be evaluated for fixed contamination due to increased dose rates in the area.

Dose Rate
General area dose rates are 0.02 mR/hr to 1 mR/hr. Maximum contact dose rate is 1 mR/hr on cask.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Oils, petrochemicals, and lead shielding are potential hazardous materials present in this area.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

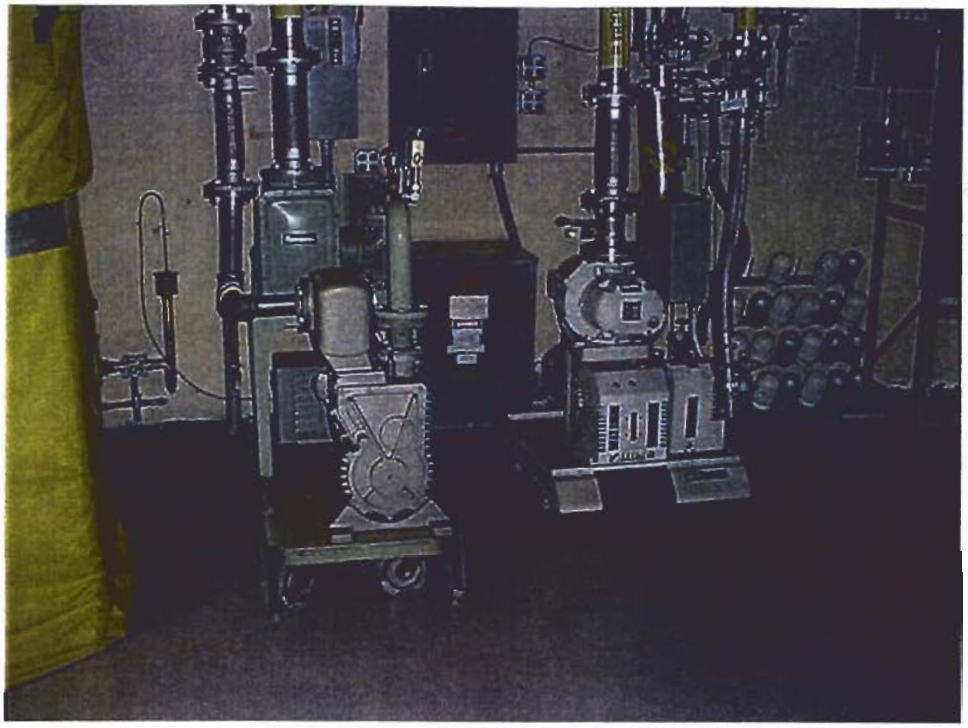

Figure EQ - 16

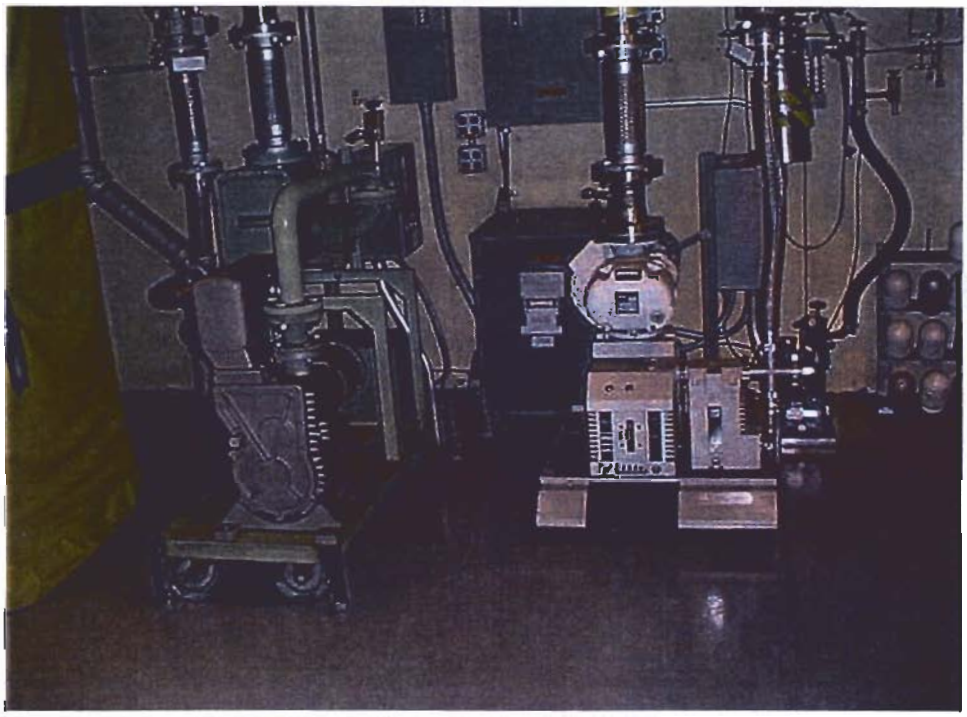

Figure EQ - 17

Survey Unit Number: EQ-15 **Survey Number:** 91

Description: A Cell

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Primary pump, check valve, heat exchanger and vent seal collection tank.

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Previous smear analysis show Co60 and Cs137 as the radionuclides present. Elevated dose rates impede the ability to identify fixed contamination. However fixed contamination and hot particles are highly probable.

Dose Rate
Area posted as a High Radiation Area. General area dose rates up to 8 mR/hr. Maximum contact dose rate is 200 mR/hr at cold leg of heat exchanger.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Lead shielding, oils, and petrochemicals are present. PID/FID survey performed. Results were inconclusive. Area is also classified as a confined space.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

Figure EQ - 18

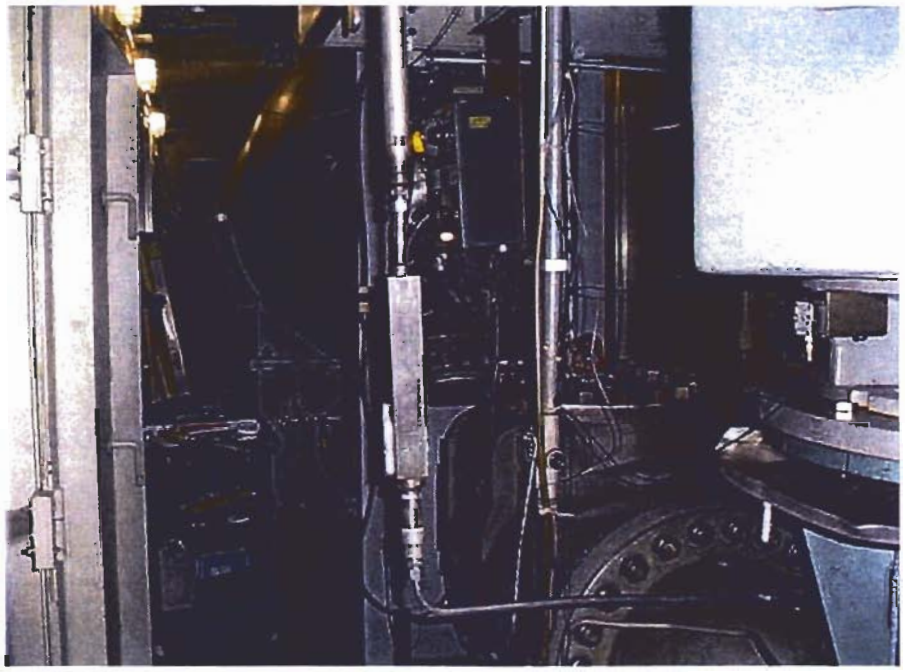

Figure EQ - 19

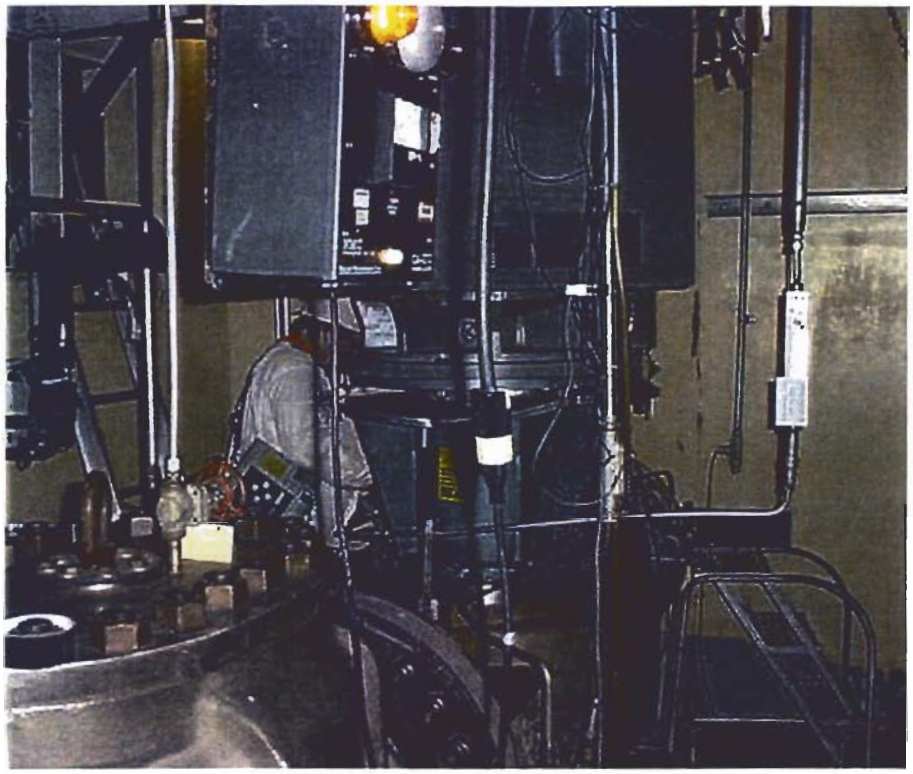

Figure EQ - 20

Survey Unit Number: EQ-16 **Survey Number:** 92

Description: B Cell

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Secondary pump, check valve, heat exchanger and vent seal collection tank.

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Highest removable contamination identified 682 dpm/100cm2. Large area wipes analyzed by gamma spectroscopy identified Co60, Cs137, and Zn65. Elevated dose rates impede the ability to identify fixed contamination. However fixed contamination and hot particles are highly probable.

Dose Rate
Area posted as a High Radiation Area. General area dose rates up to 40 mR/hr. Maximum contact dose rate is 100 mR/hr at cold leg of heat exchanger.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Lead shielding, oils, and petrochemicals are present. PID/FID survey performed. Results were inconclusive. Area is also classified as a confined space.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

Figure EQ - 21

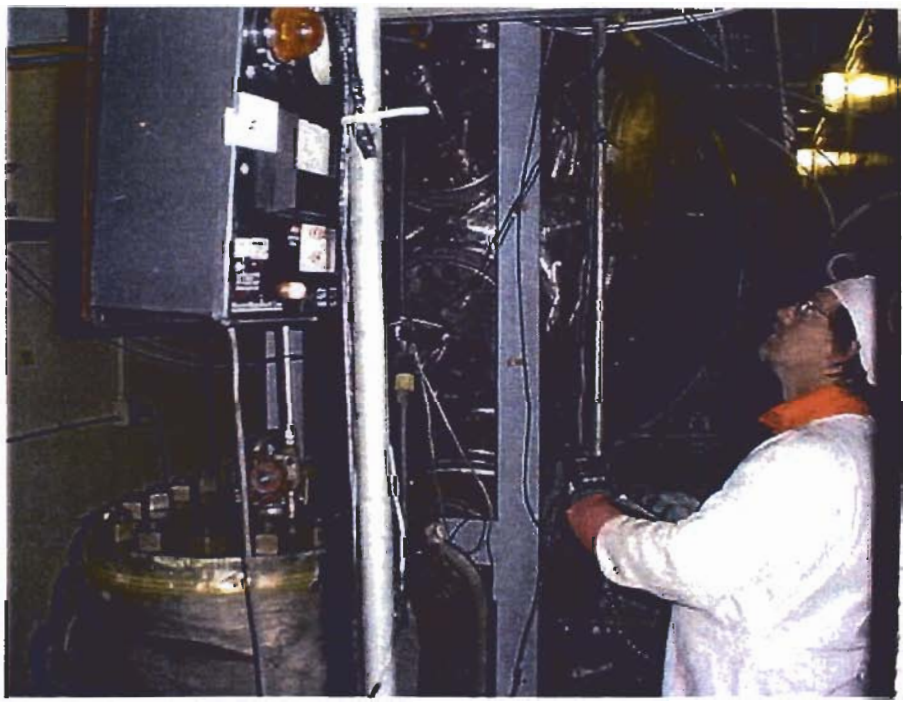

Figure EQ - 22

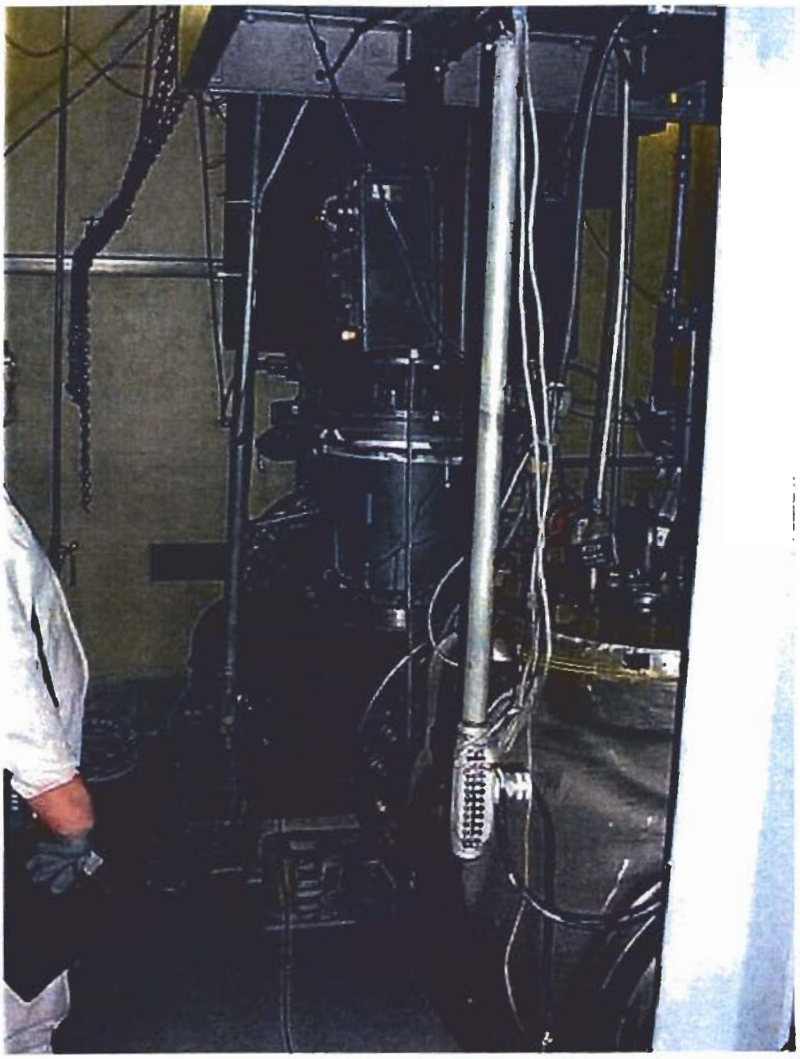

Figure EQ - 23

Survey Unit Number: EQ-17 **Survey Number:** 93

Description: Shutdown Cell

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Primary pump suction valves, reactor vessel discharge lines, shutdown heat exchanger, and helium eductor pump.

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity identifed at 2,604 dpm/100cm2. Large area wipes analyzed by gamma spectroscopy identified Co60, Cs137, Zn65, and Pm-147. Elevated dose rates impede the ability to identify fixed contamination. However fixed contamination and hot particles are highly probable.

Dose Rate
Area posted as a High Radiation Area. General area dose rates up to 30 mR/hr. Maximum contact dose rate is 60 mR/hr at HC102B.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Lead shielding, oils, and petrochemicals are present. PID/FID survey performed. Results were inconclusive. Area is also classified as a confined space.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

Figure EQ - 24

Figure EQ - 25

Figure EQ - 26

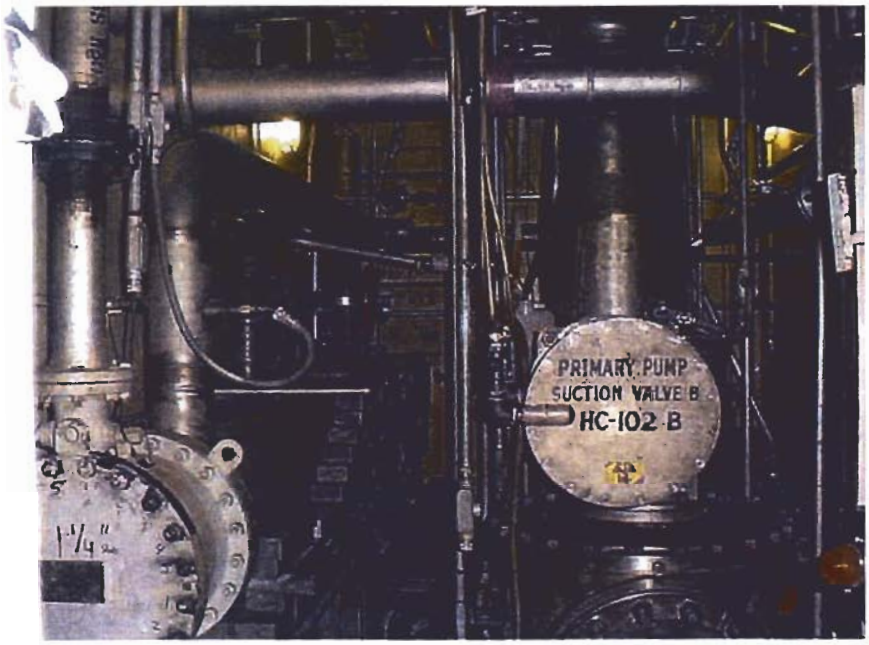

Figure EQ - 27

Survey Unit Number: EQ-18 **Survey Number:** 94

Description: Thermal Shield Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Thermal shield pumps, clean up system, and heat exchanger.

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Areas could not be evaluated for fixed contamination due to increased dose rates in the area.

Dose Rate
Areas posted as radiation areas. General area dose rates are from 3 mR/hr - 6 mR/hr. Highest contact dose rate is 15 mR/hr on the purification system.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Lead shielding and lithium hydroxide resins are present. Wipe analyses of the heat exchanger identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However on the heat exchanger, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. On the thermal shield cooler, wipe analyses identified Al, Sb, Ba, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, K, Na, and Zn above instrument detection limits. However, only Pb and Zn are included and were detected above the levels contained within Table 2. On pump GA201A, wipe analyses identified Al, Sb, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, V, and Zn above instrument detection limits. However only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

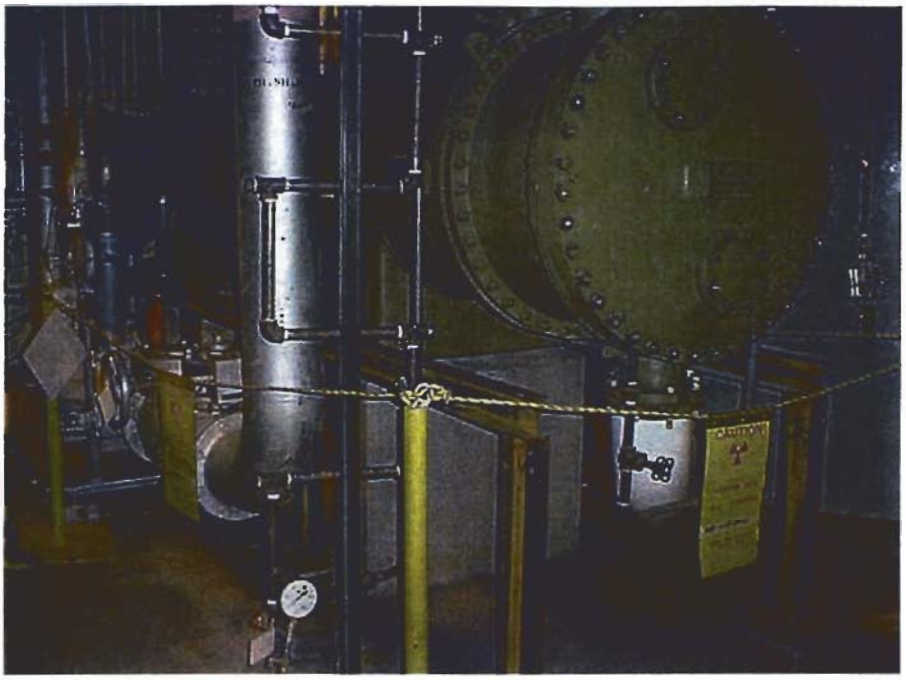

Figure EQ - 28

Figure EQ - 29

Survey Unit Number: EQ-19 **Survey Number:** 95

Description: Primary Purification System Beds

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Primary purification beds.

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Areas could not be evaluated for fixed contamination due to increased dose rates in the area.

Dose Rate
Purification trench maximum contact is 5 mR/hr.

Description of remaining radioactive materials:
Radioactive materials limited to remaining resins.

Hazardous materials:
Resin beds are manufactured by pouring lead into steel containers. Wipe analyses on the primary acid tank identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, and Zn above instrument detection limits. However, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area has been subject to contamination events and radioactive spills.

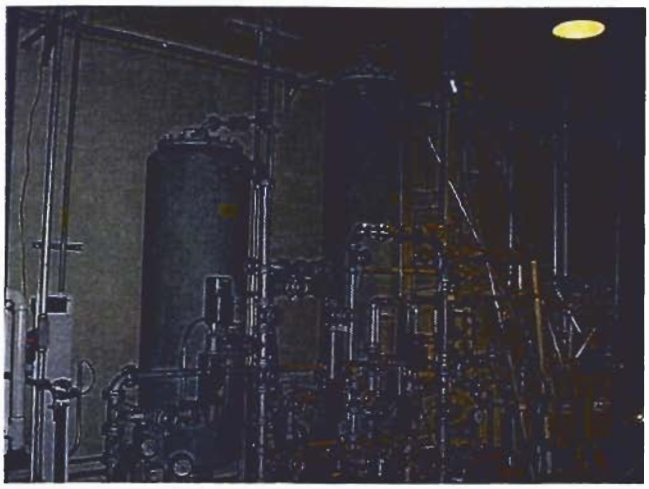

Figure EQ - 30

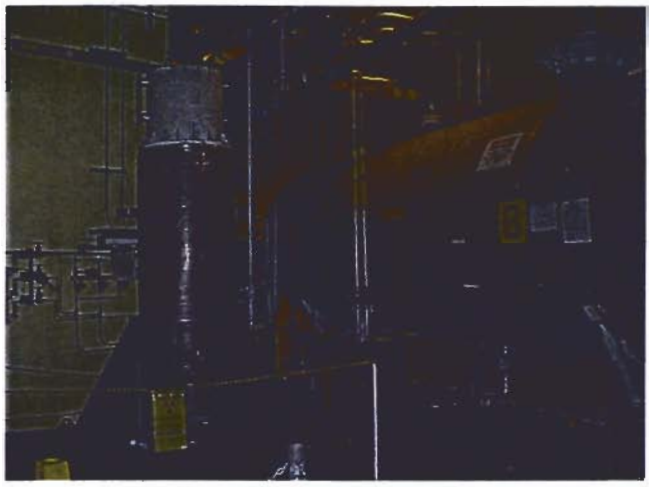

Figure EQ - 31

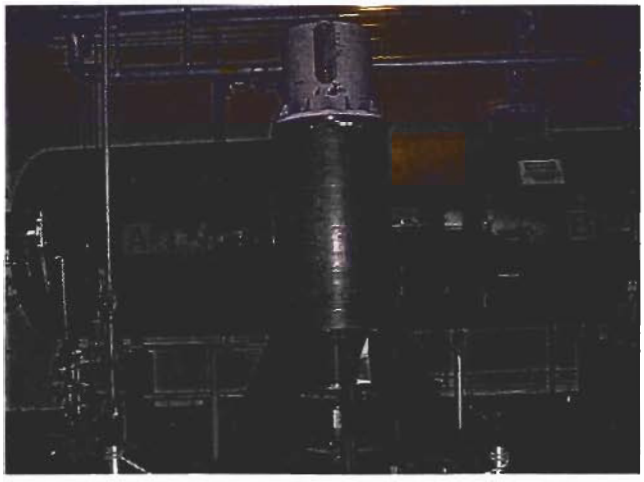

Figure EQ - 32

Survey Unit Number: EQ-20 **Survey Number:** 96

Description: Canal

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Stainless steel lined canal. Liner installed but not tested for leaks and canal not flooded.

Previous Use: Storage of spent fuel, control rod drive blades, flow reversal valves and miscellaneous activated equipment. Contained underwater saw for fuel cutting operations.

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Tritium in the canal area averages ~500 dpm/100cm2. Hot particles have been previously identified and fixed in and around the canal area. Materials (metal objects) characterized from the pool are predominately Fe55 (>80%) and Co60 (10%). Transuranics are also identified and expected. Area is posted as a contaminated area.

Dose Rate
Maximum area dose rates in canal area (not in canal) were 7 mR/hr on contact with bag of radioactive material.

Description of remaining radioactive materials:
Bags of radioactive trash and proctective clothing are maintained in the area.

Hazardous materials:
Lead, leaded paint, oils, petrochemicals, and gear oil from underwater cutting operations.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area is demonstrated as uncontaminated, however, the liner was not tested for integrity and below the liner is the contaminated concrete liner.

Figure EQ - 33

Figure EQ - 34

Survey Unit Number: EQ-21 **Survey Number:** 97

Description: Fuel Handling Blower

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Fuel handling blower

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Area dose rates too high to assess fixed contamination levels.

Dose Rate
Maximum contact dose rate is 20 mR/hr and 2 mR/hr general area.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Lead shielding and grease are potential hazardous materials in this area.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys.

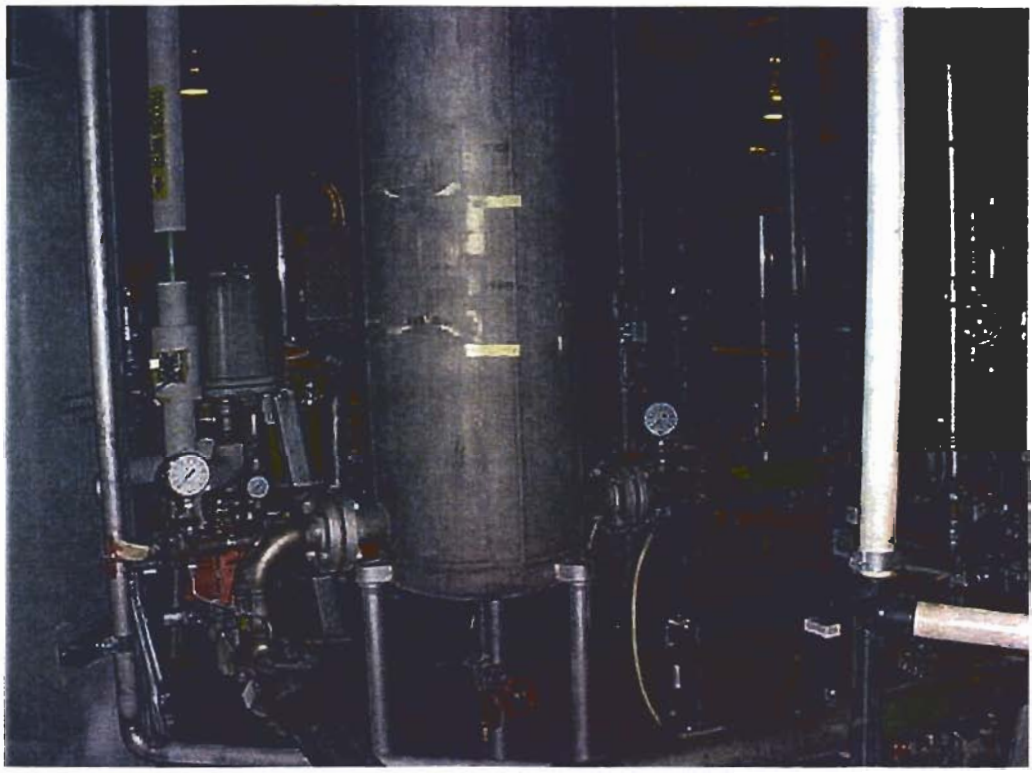

Figure EQ - 35

Survey Unit Number: EQ-22 **Survey Number:** 98

Description: Overhead Piping

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
		1	1		

Current Use: Pipe, conduit, and associated hangers

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Contamination data is for external surfaces only. One area indicated contamination (2,723 dpm/100 cm2) greater than the levels in Table 1. Follow up surveys indicated less than the values in Table 1.

Dose Rate
General area dose rates up to 300 uR/hr proximal to A-14.

Description of remaining radioactive materials:
Overhead not used for storage of radioactive materials.

Hazardous materials:
No hazardous materials identified in the area.

Recommendations for future work or samples:
Area has been subject to radiological contamination from pipe breaches, maintenance, and airborne radioactivity. Based on historical information, these areas are Class 1 for radiological surveys.

Survey Unit Number: EQ-23 **Survey Number:** 99

Description: Shutdown Pump Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: Shutdown pumps.

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Hot particles have been previously identified and fixed in place. Area is posted as a contaminated area.

Dose Rate
Maximum contact dose rate is 90 mR/hr under P95. General area dose rates are 0.5 mR/hr.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Lead shielding and grease/lubricants are potential hazardous materials in this area. Wipe analyses of the right side of the pumps identified Al, Sb, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. On the left side of the pumps, wipe analyses identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, and Zn above instrument detection limits. However, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys.

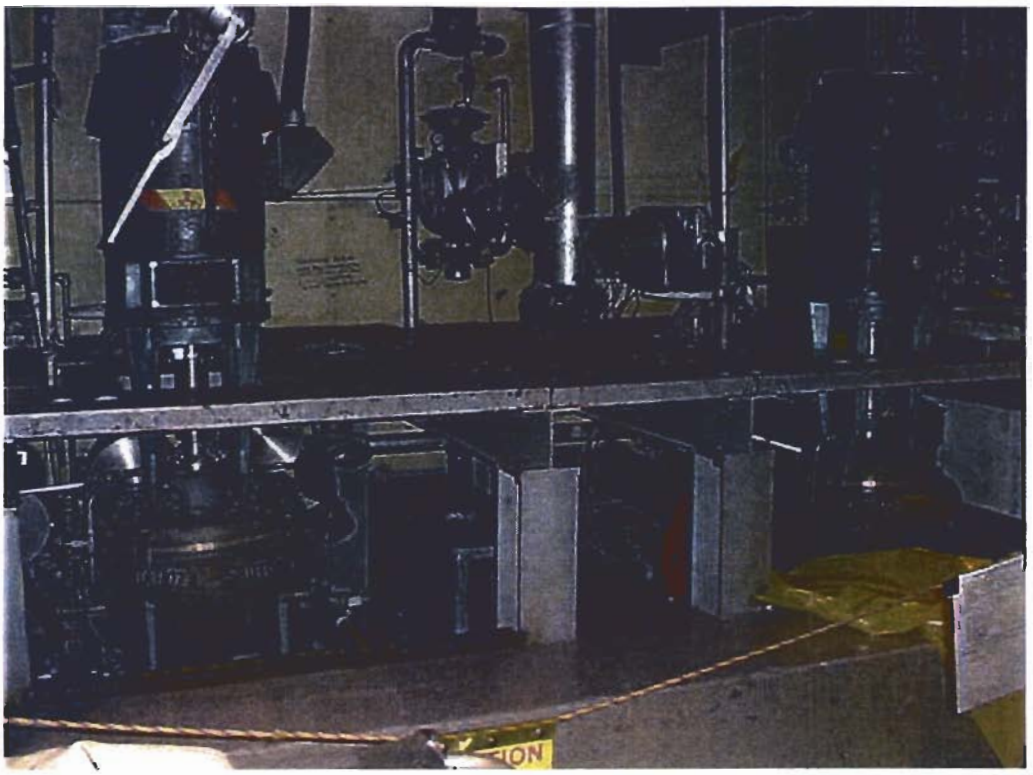

Figure EQ - 36

Survey Unit Number: EQ-24 **Survey Number:** 100

Description: RMG Hot Shop

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Maintenance and machining on contaminated equipment and Change-out area for contaminated vacuum bags and filters.

Previous Use: Same

Current Materials Present:
Area contains maintenance equipment and bagged radioactive material.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Elevated dose rates hinder the ability to evaluate for fixed contamination. Area is posted as a contaminated area.

Dose Rate
Maximum dose rate is 8 mR/hr on a bag of radioactive material. General area dose rates are less than 0.2 mR/hr.

Description of remaining radioactive materials:
Area contains items and bags labeled as radioactive material. Area is posted as a contaminated area.

Hazardous materials:
Lead shielding and grease/lubricants are potential hazardous materials in this area. Wipe analyses of the floor outside the vacuum storage area identified Al, Sb, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2. Wipe analysis of lead outside the vacuum storage area identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Tl, and Zn. However, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys.

Figure EQ - 37

Survey Unit Number: EQ-25 **Survey Number:** 101

Description: Ceiling

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
		1			

Current Use: Ceiling

Previous Use: Same

Current Materials Present:
No materials are stored in this area.

Radiological Data:

Contamination
Large area wipes taken. Results less than the levels reported in Table 1.

Dose Rate
Data not available at this time.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
No hazardous materials identified in the area.

Recommendations for future work or samples:
Area posted as a contaminated area. This area is Class 1 for radiological surveys.

Survey Unit Number: EQ-26 **Survey Number:** 159

Description: Outside Equipment Room

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	1		

Current Use: Houses compressed air, HVAC systems, and air lock door operating system.

Previous Use: Same

Current Materials Present:
Compressors and HVAC support equipment.

Radiological Data:

Contamination
Radioactive materials never stored in this area.

Dose Rate
Radioactive materials never stored in this area.

Description of remaining radioactive materials:
Radioactive materials never stored in this area.

Hazardous materials:
Asbestos insulation present around piping.

Recommendations for future work or samples:
Area is accessed outside of Blg 750. Based on present and historical data, this area is Class 1 for the piping wrapped in asbestos insulation. Systems that interact within Bldg. 750 should be evaluated for contamination potential. Remaining areas are Class 2.

Survey Unit Number: EQ-27 **Survey Number:** 157

Description: Decon Sink Area

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Decontamination sink used for cleaning equipment.

Previous Use: Same

Current Materials Present:
Cleaning and mild decontamination support items.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Area is posted as a contaminated area. Up to 997 dpm/100cm2 (β/γ) identified in the sink area and low levels of tritium.

Dose Rate
General area dose rates are less than 0.2 mR/hr.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
Lead and degreasers are potential hazardous materials in this area.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys. Area is posted as a contaminated area.

Figure EQ - 38

Survey Unit Number: EQ-28 **Survey Number:** 164

Description: General Area Equipment Level

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: General Area

Previous Use: Same

Current Materials Present:
Most areas are clear. Some minor radioactive material storage and shielding.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Hot particles have been previously identified and fixed in place throughout the area.

Dose Rate
General area dose rates are 3.5 mR/hr with a maximum contact of 42 mR/hr.

Description of remaining radioactive materials:
Miscellaneous radioactive material stored throughout the area.

Hazardous materials:
Asbestos insulation and wiring in the area. Lead extensively used in shielding. Mercury, cadmium and oils also used in the area.

Recommendations for future work or samples:
Based on historical and current data and information, this area is Class 1 for radiological surveys.

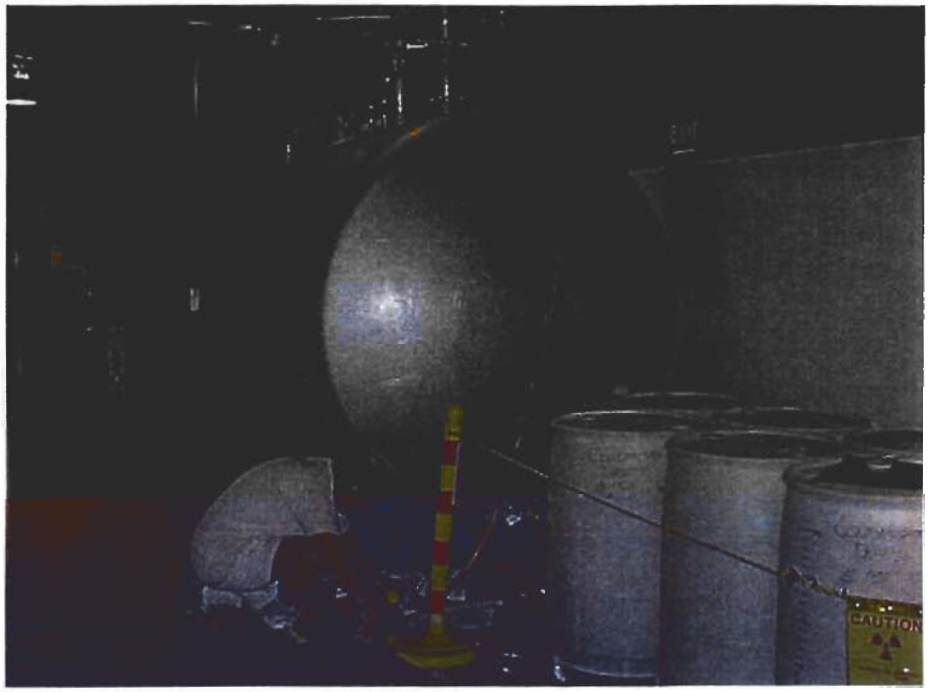

Figure EQ - 39

Figure EQ - 40

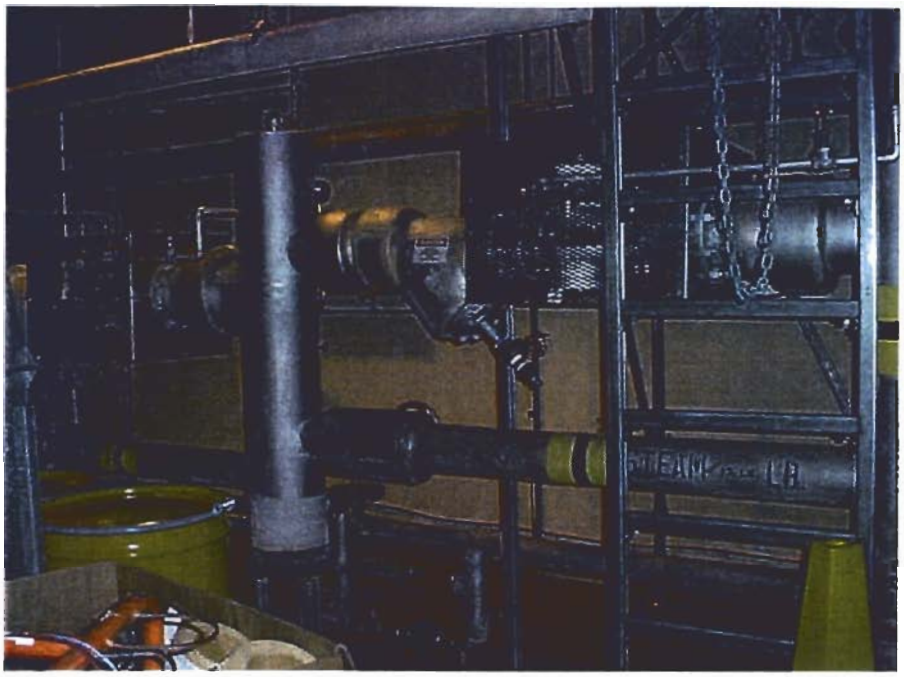

Figure EQ - 41

Figure EQ - 42

Survey Unit Number: EQ-29 **Survey Number:** 165

Description: Roof SNM & Fuel Vaults

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1			1		

Current Use: Roof of Storage Vaults

Previous Use: Same

Current Materials Present:
No material currently stored in these areas.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1.

Dose Rate
Area dose rates from 10 to 30 uR/hr due to radioactive material storage in the vaults.

Description of remaining radioactive materials:
No radioactive material currently stored in this area.

Hazardous materials:
No hazardous materials currently in this area.

Recommendations for future work or samples:
Area may have been subject to some airborne deposition over time. Based on this potential, this area is Class 1 for radiological surveys.

Appendix F - HFBR Survey Unit Reports - Lobby

Survey Unit Number: LOB-01 **Survey Number:** 9

Description: Lobby, conference room, and offices

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	2	2		

Current Use: Lobby, conference room, and offices.

Previous Use: Lobby, conference room, offices, and security screening area.

Current Materials Present:
General office equipment.

Radiological Data:

Contamination
Removable activity less than the levels reported in Table 1. Fixed contamination indicates background levels. Elevated counts on porcelain sinks and slate floors due to naturally occurring radioactive material.

Dose Rate
General area dose rates indicate background levels.

Description of remaining radioactive materials:
Sr-90 check source installed area monitor in conference room.

Hazardous materials:
Potential for asbestos coated wires and an asbestos transite wall. Floor tiles may be asbestos containing material.

Recommendations for future work or samples:
Based on historical survey data, this area is considered a Class 1 survey unit for the asbestos containing wall and floor. The remaining areas are Class 2.

Figure LOB- 1

Figure LOB- 2

Survey Unit Number: SYS-01 **Survey Number:** 109

System Name: Primary Cooling Water System & Instrumentation

System Description:
The Primary cooling Water system (PCWS) removed fission heat from the fuel elements in the reactor core. Heavy water entered the neck of the reactor vessel flowing downward through the flow shroud and then through the core. After passing through the core, the coolant was dispersed outward through the reflector and upward to the annulus. The coolant left the vessel through an elbow, downward through a pipe in the biological shield and through the venturi meter, measuring primary system flow. Here the flow divided into two parallel streams each containing a suction valve, primary pump, check valve, primary heat exchanger, and a primary flow control valve. The shell and tube-type heat exchanger transferred reactor heat from the heavy water to cooling tower light water. Downstream of the control valves, the two coolant streams came together again with the primary coolant flowing up through a pipe in the biological shield into the reactor vessel.

System Location(s): System spans the equipment, experimental, and operations levels.

Current Status: System in place

System Environment: System is predominately drained with a helium blanket of 1.5 lbs. Approximately 115 inches of light water is in the reactor vessel.

System Classification: 1

Radiological Data:

Contamination Data
Internal contamination is expected with primary water at concentrations of 1.6 mCi/mL of H-3 and 3.2 E-5 uCi/mL of Co-60. Piping is generally externally contamination in the area of the reactor and primary cells.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:

System may contain corrosion products.

Appendix G - HFBR Survey Unit Reports - Reactor Systems

Survey Unit Number: SYS-02 **Survey Number:** 110

System Name: Primary Purification System

System Description:
The primary coolant purification system maintained the primary system D_2O free from radioactive and non-radioactive suspended particulate matter and dissolved ionic solids. Mixed resin beds produced an effluent with an approximately neutral pD. Nitric acid was added to the effluent to maintain the primary coolant slightly acidic. The system is located primarily below the floor of the equipment level, which provided adequate shielding for the system. Shielding consisted of one foot thick concrete block are over the resin beds and three inch thick steel plates over the system piping and valves. The purification flow is provided from differential pressure across the reactor vessel when the primary cooling pumps are operating. Particulates were removed through one of two inlet filters and four mixed resin beds. A final filter in line removed resin fines. An acidification system was interconnected. The system could also be used to purify D_2O prior to its use as makeup to the primary coolant system or lower the reactor vessel level.

System Location(s): Equipment Level

Current Status: Beds of the system are in place.

System Environment: System/beds are drained. Beds contain resin.

System Classification: 1

Radiological Data:

Contamination Data
Internal contamination is expected with primary water at concentrations of 1.6 mCi/mL of H-3 and 3.2 E-5 uCi/mL of Co-60. Stainless steel corrosion products are anticipated. Mixed resin may contain isotopes such as; Na22, Co57, Co60, Zn65, Cs137, Eu155, and Hg203. Cation resin may contain isotopes such as; Sc44, Mn54, Co60, Zn65, Ce144, and Eu155.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contains resins and corrosion products.

Survey Unit Number: SYS-03 **Survey Number:** 111

System Name: Primary Acidification System

System Description:
The acidification subsystem was used to inject a nitric acid D_2O mixture into the primary system. The injection point was located downstream of the purification system mixed resin beds. The purpose of the system was to maintain system pD. The system consisted of a mixing-storage tank; two stainless steel, positive displacement, diaphragm pump, an acid tank stirrer; and various indicators and controls.

System Location(s): Equipment Level

Current Status: System is in place.

System Environment: System is drained, rinsed, and neutralized with NaOH.

System Classification: 1

Radiological Data:

Contamination Data
Internal contamination is expected with primary water at concentrations of 1.6 mCi/mL of H-3 and 3.2 E-5 uCi/mL of Co-60.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Potential for nitric acid.

Survey Unit Number: SYS-04 **Survey Number:** 112

System Name: Primary Sampling System

System Description:
The primary sampling system provides a means to sample either just before the inlet filter, just after the inlet filter, or after the resin bed(s) to verify compliance with D_2O chemistry specifications. It is located on the equipment level. The station is a Plexiglas housing with a hinged door connected to off gas to minimize tritium exposure. stainless-steel tube with inside and outside valves penetrates the box at the top. A tee connects a pressure gauge to the inlet, the other path has a flowmeter to determine recirculation flow rates before sampling. Grab samples are collected periodically for tests with a pD meter and for determination of nitrate levels to confirm that pD is in the required range.

System Location(s): Equipment Level

Current Status: System is in place.

System Environment: System is drained and blown down.

System Classification: 1

Radiological Data:

Contamination Data
Internal contamination is expected with primary water at concentrations of 1.6 mCi/mL of H-3 and 3.2 E-5 uCi/mL of Co-60.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contained primary water.

Survey Unit Number: SYS-05 **Survey Number:** 113

System Name: Primary Pump Seal Cold Trap System

System Description:
Pump seals provide a sealing mechanism between the rotating pump shaft and stationary pump casing. This minimizes leakage of primary coolant around the pump shaft, as well as release of primary gases and vapors, particularly tritium. Pump seal drain collection tanks collect D_2O. liquid leakage past the pump shaft seals, and off-gas heavy water vapor and gases via the cold trap apparatus. The cold trap apparatus condenses most of the heavy water from a vapor, which is collected and drained to a waste container weekly. Increased volumes in the collection tanks are indicative of degradation of the mechanical seal. Primary pumps and seals are located in the "A" and "B" cells. The cold trap is located outside the "B" cell.

System Location(s): Equipment Level

Current Status: Functioning system.

System Environment: Functioning system.

System Classification: 1

Radiological Data:

Contamination Data
Internal contamination is expected with primary water at concentrations of 1.6 mCi/mL of H-3 and 3.2 E-5 uCi/mL of Co-60.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contained primary water.

Survey Unit Number: SYS-06 **Survey Number:** 114

System Name: DA Drain & D_2O Transfer System

System Description:
The transfer system filled the primary, shutdown, and experimental systems and replaced any D_2O lost from those systems. It also collected D_2O drained from system components during maintenance, and collected D_2O that continually drained from components such as seal leakage. The system stored an inventory of D_2O in FA102 to be used as emergency primary makeup to the reactor vessel. The DA drains connected heavy water systems with the heavy water storage tank FA101. The D_2O transfer system consisted of two tanks (FA101 and FA102) and three transfer pumps (GA104A, B, and C). All cooling system circulating pumps and the control rod drives have shaft seal drains connected to the DA system. FA101 is located below the floor of the equipment level serving as a low point for gravity drain. FA102 is located on the OPS level for emergency heavy water make up.

System Location(s): System spans the equipment, experimental, and operations levels.

Current Status: System is in place.

System Environment: System is drained, pressurized, and under a helium blanket.

System Classification: 1

Radiological Data:

Contamination Data
Internal contamination is expected with primary water at concentrations of 1.6 mCi/mL of H-3 and 3.2 E-5 uCi/mL of Co-60.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contained primary water.

Survey Unit Number: SYS-08 **Survey Number:** 116

System Name: Reactor Vessel Cover Gas System & Instrumentation

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System Description:
The cover gas provided: 1) an inert, compressible gas in the surge volume at the top of the reactor vessel to enable pressurization, pressure control, and absorption of liquid surges, 2) a means of maintaining a low concentration of radiolytic-form O_2 and corrosion and radiolytic-formed D_2, to prevent explosive levels of D_2 gases in the reactor vessel surge volume, 3) a means of reducing the loss of D_2O moisture and radioactive fission products to the off gas system. Gas was administered to the reactor vessel through control valves. The helium circulating subsystem took gas from the surge volume in the reactor vessel and passed it through a recombiner (HC104) before returning it to the surge volume. The recombiner functioned to keep the D_2 gas low.

System Location(s): Operations level

Current Status: System is in place.

System Environment: System is in service with a helium blanket.

System Classification: 1

Radiological Data:

Contamination Data
Internal and external contamination is expected.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Helium cover gas.

Survey Unit Number: SYS-09 **Survey Number:** 117

System Name: SPAM System

System Description:
The secondary poison water addition method system (SPAM) was set to function as a backup to the poison water addition method during a seismic event. The system is not normally connected to any primary or secondary systems. If required, the SPAM system needed to be manually connected via a flexible hose to one of two separate seismically qualified lines that are permanently routed through the reactor shield to provide access to the vessel. The system consisted of 5 sets of four 55 gallon stainless steel drums stored on the OPS level in seismically qualified unistrut racks. A gadolinium nitrate poison water solution is contained in one drum of each set while the other three are light water. A 120 foot hose stored at each station was used to add the water to the vessel through the vessel light flanges.

System Location(s): Operations level

Current Status: System is partially removed. Flex hoses, piping and drums removed from the isolation valve to the reactor on the operations level.

System Environment:

System Classification: 1

Radiological Data:

Contamination Data
No radionuclides were identified in the samples from the drum solutions.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Gadolinium nitrate

Survey Unit Number: SYS-10 **Survey Number:** 118

System Name: Light Water Make Up System

System Description:
Under normal conditions, no makeup was needed. Light water was only used after the poisoning of the reactor coolant. Light water addition is employed only after a Primary System Rupture by passing it through the poison water tank following the dumping of poison into the reactor vessel. Light water was provided by the Auxiliary Water Purification and Domestic Water Systems.

System Location(s): System spans the equipment, experimental, and operations level and outside building 750.

Current Status: System is partially removed. Flex hoses, piping and drums removed from the isolation valve to the reactor on the operations level.

System Environment: Filled with light water.

System Classification: 1

Radiological Data:

Contamination Data
System is presumed internally clean to the operations level.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
No gadolinium nitrate was introduced into system.

Survey Unit Number: SYS-11 **Survey Number:** 119

System Name: Shutdown Cooling Water System & Instrumentation

System Description:
The Shutdown Cooling Water System & Instrumentation removed fission product afterheat from the fuel elements in the core of the reactor when the primary cooling pumps were not operating and the reactor was shut down. The system is largely independent of the primary system. Two pumps (GA102A and GA102B) were connected in parallel with one running continuously at 300 gpm and the other in standby. A bypass line was incorporated to prevent overheating of the pumps. Bypass flow was returned to the low pressure side of the primary system at the main pump suction lines. Suction of the system was taken slightly downstream of the primary system venturi. The system discharged into the reactor vessel at a point above the primary coolant inlet.

System Location(s): System spans the equipment, experimental, and operations levels.

Current Status: System is in place.

System Environment: System is drained and under a helium blanket.

System Classification: 1

Radiological Data:

Contamination Data
Internal contamination is expected with primary water at concentrations of 1.6 mCi/mL of H-3 and 3.2 E-5 uCi/mL of Co-60.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contained primary water.

Survey Unit Number: SYS-12 **Survey Number:** 120

System Name: Thermal Shield Cooling Water System & Instrumentation

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System Description:
The Thermal Shield and Cooling Water System protected the biological shield concrete structure from excessive heating by radiation leakage from the reactor. The thermal shield also provided support for the reactor vessel. The thermal shield was comprised of an upper and lower shield. The cooling water system consisted of two circulating water pumps (GA201A and GA201B), heat exchanger (EA201), expansion tank (FA201), and a bypass flow cleanup system connected to the cooling circuits in the thermal shield. Manual valves adjusted flow to three flowpaths in the shield, to the lower thermal shield lead layer, to the upper thermal shield, and to the lower thermal shield. The water was demineralized light water purified through a small side stream fed by the differential pressure of the two circulating water pumps. A purification booster pump was also available. The purification system consisted of filters, mixed resin, and anion resin. A third resin bed tank was also available.

System Location(s): System spans the equipment, experimental, and operations levels.

Current Status: System is in place.

System Environment: System is drained. Pumps disconnected. Valves shut.

System Classification: 1

Radiological Data:

Contamination Data
6.26 E-2 uCi/mL H3 in system cooling with 6.33E-7 uCi/mL Co60 and 1.99E-5 uCi/mL Zn65.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contained demineralized light water.

Survey Unit Number: SYS-13 **Survey Number:** 121

System Name: Biological Shield Cooling Water System & Instrumentation

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System Description:
The biological shield reduced the radiation from the reactor core and thermal shield to an acceptably low level for human biological tolerance in the reactor building. The cooling system removed heat generated by radiation absorption in the beam port shutters, beam port plugs, and the biological shield. The system was divided into three parallel loops. Demineralized light water was circulated by two pumps (GA203A or GA203B) and heat was removed by a single heat exchanger (EA203). The heat removed was dissipated through the cooling tower system. Two manifolds (TW221 and TW224), cast into the heavy concrete of the biological shield, supply cooling water to the shutters brought into the upper pit through 1" supply and return connections. These headers also supply cooling to the thermopile plug located in a cavity in the upper thermal shield. The plugs in the beam ports and vacuum chamber on H9 plug are cooled through two headers (TW223 and TW225) located in an upper chase on the outer face of the biological shield. Cooling water was also supplied to coils embedded in portions of the biological shield structure that surrounds the reactor. Flow of cooling water in these systems provide alarm indications to the control room if they fall below normal levels. In addition, the two pumps with the shutter coolant flowmeter (FIa203) provided logic setback signal in the reactor safety system. Makeup water was supplied to the system surge tank from a deionizing column located on the operations level. Large amounts of water required after maintenance were supplied from the auxiliary water purification system (BG201). A small side stream driven by the differential pressure of the two pumps is passed through a purification system, mixed bed deionizer with inlet and outlet filters. Expansion volumes of the system are accommodated in the expansion tank (FA203) mounted on the operations level.

System Location(s): System spans the equipment, experimental, and operations levels.

Current Status: System is in place.

System Environment: System is drained. Valves shut. Electrical leads for pumps are lifted.

System Classification: 1

Radiological Data:

Contamination Data
1.11 E-2 uCi/mL H3 in system cooling. Silt identified Co60 at 4.26E-6 uCi/sample in addition to natural products.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contained demineralized light water.

Survey Unit Number: SYS-14 **Survey Number:** 122

System Name: Canal Cooling Water System

System Description:
The Canal Cooling Water System was a circulating water system designed to maintain water clarity are remove decay heat. The system contains a filter bed, heat exchanger (EA202), and a pump (GA202). The pump draws a suction on a number of 2-inch suction lines. 75-100 gpm are circulated through the filter. Approximately 25 gpm is diverted to the auxiliary water purification system and 75 gpm to the heat exchanger. The system is located on the equipment level on the north end of the canal.

System Location(s): Equipment Level

Current Status: System is in place.

System Environment: System is drained and re-routed to BG201.

System Classification: 1

Radiological Data:

Contamination Data
Old system is internally contaminated. New double weld system has never been used.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contained primary cooling water from fuel storage pool. Resin beads, concentrated metals, and corrosion products are expected.

Survey Unit Number: SYS-15 **Survey Number:** 123

System Name: Auxiliary Water Purification System BG 201

System Description:
The system maintained purity of the canal water by using a system of ion exchange resins. This system was also used to add makeup water to the poison water tank and for gross make up to both the biological shield and thermal shield cooling water system. The water came from the canal or the domestic water system from the break tank. Circulating pump GA204 maintained flow through the filter beds (carbon, cation, and resin). Other support equipment includes caustic and acid dilution tanks, Heat exchanger, steam regulating valve, and temperature instrumentation were used during regeneration of demineralizer units.

System Location(s): Equipment Level

Current Status: System is in place.

System Environment: System is drained. Resin is removed but charcoal remains in purification system.

System Classification: 1

Radiological Data:

Contamination Data
System contained contaminated water. Tritium results up to 1.21E-1 uCi/mL identified.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Sodium hydroxide and hydrochloric acid are anticipated.

Survey Unit Number: SYS-16 **Survey Number:** 124

System Name: Secondary Cooling Water System & Instrumentation

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System Description:
The system consisted of five induce draft cooling towers mounted above a concrete basin proximal to the HFBR & BGRR stack. The system contained five pumps, three located in the pump house and two on an outdoor platform at the north section of the cooling tower basin. The secondary cooling water flows through one side of conventional shell and tube heat exchanger. In the primary D2O heat exchanger and the biological shield heat exchanger, secondary cooling water flowed through the shell side. In the other heat exchanger, secondary cooling water flowed through the tube side. Cooling tower blowdown and overflow flowed to FA310, located outside the confinement structure, and then to the recharge basin. An alternate path was provided directly to the recharge basin. A gravity feed line was supplied at the basin to the shutdown heat exchanger for cooling the reactor during shutdown. This line also fed the emergency source of cooling for the shutdown and primary heat exchanger. A site domestic water supply was regulated to supply make up water as necessary. An emergency supply could be made by connecting a fire hose between a nearby hydrant and the connection located in the water connection area on the north loading dock. Water supplied to the shutdown heat exchanger in this manner was discharged to the storm sewer via overflow from the equipment level sump from GA303A.

System Location(s): Outside building 750.

Current Status: System is drained. Tanks flushed and neutralized.

System Environment: Drained

System Classification: 2

Radiological Data:

Contamination Data
Water from secondary pump house identified tritium at 1.18E-7 uCi/mL in 2001. Secondary heat exchanger secondary water identified only tritium contamination at 1.87E-5 uCi/mL in 1998.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System maintained Betz chemicals and sulfuric acid. Secondary water penetrations possess asbestos containing material.

Survey Unit Number: SYS-17 **Survey Number:** 125

System Name: Secondary Cooling Water Treatment System

System Description:
The system consisted of a concrete block structure, Building 707B, which housed the chemical day tanks, chemical sink, pumps, and controllers for monitoring secondary water. It also included outdoor tanks for storing sulfuric acid and chemical, associated piping, valves, and an emergency eyewash and shower. The sulfuric acid and chemical storage tanks were housed under open shed-type structures and were installed in concrete secondary containment dikes with level markers. The dike for the chemical tanks had a 12' x 12" x 12" deep sump for pumping out the dike, ladders and platforms for access to the top of the tanks, and vales at the tanks' level gauges.

The water treatment system consisted of a sulfuric acid addition system, a chemical feed system, and a secondary cooling return water blowdown. The secondary cooling water system controlled the pH and biological growth in the water system by blowing down to reject part of the high conductivity secondary cooling water. Several chemicals (Betz 30K, 65, and 419) were added to the secondary cooling water during operation. The secondary containment dikes were designed to hold the contents of a tank in case of leakage, and they had the ability to discharge into the cooling tower basin. Cooling tower supply water to the water treatment house was fed from a 24-inch aboveground WS301 line through valve WTS8. This supply line branches off into two branches, one which is discharged directly into the cooling tower basin, and the other which is injected with chemicals and is then discharged into the cooling tower basin.

System Location(s): Outside building 750.

Current Status: System is partially removed.

System Environment: System is drained, flushed, and partially neutralized.

System Classification: 1

Radiological Data:

Contamination Data
Clean system.

Dose Rate Data
Background levels.

Hazardous materials:
Betz chemicals and sulfuric acid.

Survey Unit Number: SYS-18 **Survey Number:** 126

System Name: Building Ventilation System

System Description:
Building ventilation maintained the confinement structure at a slightly negative pressure in relation to the atmosphere and provided a mechanism for sealing off the reactor building in the event of an incident. The ventilation was supplied to the BAL/EXP level. Ducting was arranged to maintain areas subject to radioactive contamination at a lower pressure than clean areas. Only units required to maintain the pressure gradients throughout the confinement, and those units which supply outdoor air to and exhaust air from the confinement, were considered essential.

System Location(s): System spans the balcony, equipment, operations, and experimental levels.

Current Status: System currently in place.

System Environment: Operational section of the HFBR HVAC unit.

System Classification: 1

Radiological Data:

Contamination Data
Co-60 and Fe-55 have been detected on the inlet filters of the supply and recirculation sections. Tritium contamination is also a concern due to the large amount of humidity handled through this unit, although not identified on cursory survey. Previous condensate sample identified tritium at 2.5E-5 uCi/mL. Area wipes less than the values in Table 1.

Dose Rate Data
Approximately background levels.

Hazardous materials:
Evaluations were made for mercury contamination. None was noted.

In L-16 vents, wipe analyses identified Al, Ba, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, V, and Zn above instrument detection limits. However in L-16 vents only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

In L-10 vents, wipe analyses identified Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However in L-10 vents, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

In L-2 vents, wipe analyses identified Al, Sb, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However in L-10 vents, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

In small duct over south stairs, wipe analyses identified Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However in small duct over south stairs, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

In vent by operations level crane, wipe analyses identified Al, Sb, As, Ba, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, V, and Zn above instrument detection limits. However in small duct over south stairs, only Cd, Pb, and Zn are included and were detected above the levels contained within Table 2.

Wipes of air handlers on the equipment level also identified Cd, Pb, and Zn above the levels contained within Table 2.

Survey Unit Number: SYS-19 **Survey Number:** 127

System Name: A/C Absorbers

System Description:
Two AC absorbers are provided to supply the necessary chilled water for air conditioning the building. Normally only one is operated, but both may be operated in parallel for high loads.

System Location(s): System is primarily located on the equipment level.

Current Status: System currently in place.

System Environment: Operational section of the HFBR HVAC unit.

System Classification: 1

Radiological Data:

Contamination Data
Elevated tritium levels in the liquids (1.76E-4 uCi/mL)

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contains lithium bromide (Trane), aresenite (Trane) and chromate (Carrier) solutions.

Survey Unit Number: SYS-20 **Survey Number:** 128

System Name: Chill Water System

System Description:
Chill water can be supplied by the BNL central steam plant to the local AC units in building 750. The chill water is supplied by the mechanical equipment area on the equipment level. Condenser water for the AC absorbers is supplied by a two-celled draw through air condition cooling tower located on the northwest side of the building.

System Location(s): System spans the balcony, equipment, operations, and experimental levels.

Current Status: System currently in place.

System Environment: Operational section of the HFBR HVAC unit.

System Classification: 2

Radiological Data:

Contamination Data
System contains elevated tritium levels at concentrations up to 1.46E-5 uCi/mL.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contains ethylene glycol. Chill water inlet lines possess asbestos containing material.

Survey Unit Number: SYS-21 **Survey Number:** 129

System Name: Hot Water Heating System

System Description:
The hot water is supplied by the hot water heating system. Hot water is supplied by the BNL central steam plant. Hot water reheat pumps are located on the west side of the chillers.

System Location(s): System spans the balcony, equipment, operations, and experimental levels.

Current Status: System currently in place.

System Environment: Operational section of the HFBR HVAC unit.

System Classification: 2

Radiological Data:

Contamination Data
System contains elevated tritium levels at concentrations up to 1.05E-6 uCi/mL. No nuclides identified on the gamma spectroscopy analysis.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contains water from BNL central steam plant.

Survey Unit Number: SYS-22 **Survey Number:** 130

System Name: Steam Heating System

System Description:
The hot water is supplied by the hot water heating system. Hot water is supplied by the BNL central steam plant. Hot water reheat pumps are located on the west side of the chillers.

System Location(s): System is primarily located on the equipment level.

Current Status: System currently in place.

System Environment: Operational section of the HFBR HVAC unit.

System Classification: 2

Radiological Data:

Contamination Data
Tritium concentrations up to 2.79E-6 uCi/mL.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System contains water from BNL central steam plant.

Survey Unit Number: SYS-23 **Survey Number:** 131

System Name: Domestic Water System

System Description:
The domestic water system supplied potable water for building AC, fire systems, break tank, secondary water system makeup, shutdown heat exchanger secondary cooling, normal staff use, emergency generator cooling, air compressor cooling, safety showers and eyewashes, CNF compressor cooling, cooling the cover gas demister inlet gas, makeup to thermal shield and bio-shield systems, ultimate cooling water connection to fill poison water tank, and alternate canal water makeup. The domestic water system is self contained within BNL. No water is received from any outside sources. Domestic water entered the HFBR through the equipment level overhead (column 13) and the east side of the receiving area. While operating the reactor, the water demand was approximately 710,000 gallons per day.

System Location(s): System spans the balcony, equipment, operations, and experimental levels.

Current Status: System currently in place.

System Environment: System is currently operational.

System Classification: 2

Radiological Data:

Contamination Data
System is expected to "clean." Water in the system indicates tritium concentrations up to 1.63E-6 uCi/mL.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
West side wall penetrations on equipment level possess asbestos containing material.

Survey Unit Number: SYS-24 **Survey Number:** 132

System Name: Sanitary System

System Description:
Sanitary effluent sampling system monitors Building 750 sanitary effluent for the presence of tritium. During an accident where fission products are released. The sanitary sampling system can be used to monitor environmental releases through the sanitary effluent stream.

System Location(s): System spans the balcony, equipment, operations, and experimental levels.

Current Status: System currently in place.

System Environment: System is currently operational.

System Classification: 1

Radiological Data:

Contamination Data
Tritium concentrations up to 1.52E-3 uCi/mL and Co-60 3.55E-5 uCi/mL and Cs-137 1.54E-6 uCi/mL also identified in sanitary water.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
System may contain bacteria from biological material decay.

Survey Unit Number: SYS-25 **Survey Number:** 133

System Name: Fire Protection System

System Description:
The Fire Protection Systems provides fire detection, alarm, and suppression capabilities to protect personnel and plant equipment. The fire detection system detects fire and smoke, transmits signals to the building alarm system, initiates a response from the Fire/Rescue Group, activates the fire suppression systems, gives warning when fire protection supervisory equipment has malfunctioned or has been disabled, and provides a remote means for determining the location of a fire or smoke hazard. Two independent fire suppression systems include, the Automatic Sprinkler System and the Halon 1301 fire Suppression System. The sprinkler system protects the entire building 750, except the machine shop and lobby area. Certain areas within the building confinement are specifically excluded from the sprinkler system to exclude light water from critical areas. The sprinkler system is a dry pipe system to prevent inadvertent release of water onto exposed equipment should a sprinkler head be damaged. The Halon system is limited to protecting the control panels in the control room of building 750. Water is available from the domestic water supply system and the building siamese connections. The machine shop, lobby, fan house, and pumphouse have automatic fire detection systems but are maintained with portable extinguishers. One manually operated system is also available, the standpipe system in the north and south stairwells.

System Location(s): System spans the balcony, equipment, operations, and experimental levels.

Current Status: System currently in place.

System Environment: System is currently operational.

System Classification: 2

Radiological Data:

Contamination Data
System is presumed clean. Analyses of water indicated low levels of tritium at 1.84E-5 uCi/mL. No gamma emitting nuclide were identified on gamma spectroscopy report.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Water is maintained from the domestic water system.

Survey Unit Number: SYS-26 **Survey Number:** 134

System Name: Helium Supply System

System Description:
The system supplies high pressure and low pressure helium. Helium was provided by a supply trailer located outside the building confinement to a supply manifold on the equipment level. Emergency supply banks were located on the equipment level to provided uninterrupted supply during trailer changeout. These are recharged from the supply trailer. High pressure gas was supplied to the reactor vessel cover gas system, poison water tank, reactor liquid level instruments, siphon break valve, and chromatograph. Low pressure gas was supplied to the D_2O storage tank, FA101, FA102, liquid level indicators LI104 and LI105, poison water tank, primary acid tank, experimental facilities heat exchanger, experimental facilities cooling system head tank, and experimental thimble holdup tanks blowdown.

System Location(s): System spans the outside, equipment, operations, and experimental levels.

Current Status: System is in place.

System Environment: System is currently operational providing a cover gas over the vessel.

System Classification: 2

Radiological Data:

Contamination Data
System is presumed clean.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Helium gas.

Survey Unit Number: SYS-27 **Survey Number:** 135

System Name: Carbon Dioxide Gas System

System Description:
The carbon dioxide gas systems provided gas to the reactor vessel shield cavity and the shutter cavities to maintain an air free atmosphere precluding the activation of air which can cause Ar41, C14, and nitric acid (corrosion product). The system consisted of a CO_2 receiver, cavity gas system, analyzer system, and a pressurizing system.

System Location(s): System is located on the equipment level and outside.

Current Status: System is in place.

System Environment: No CO_2 remains in the system.

System Classification: 2

Radiological Data:

Contamination Data
System is presumed clean.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Carbon Dioxide gas.

Survey Unit Number: SYS-28 **Survey Number:** 136

System Name: Beam Tube Plugs/Shutters

System Description:
Beam tube shutters provided a means of opening up and closing off the neutron beams form the nine horizontal beam tubes and provide shielding from reactor components when experimental beam port plugs or other apparatus were removed during reactor shutdowns.

System Location(s): Experimental level reactor face and "cheesebox."

Current Status: Plugs in process of removal.

System Environment: Solid metal plugs.

System Classification: 1

Radiological Data:

Contamination Data
High contamination.

Dose Rate Data
Dose rates vary by neutron flux over time. Can read up to several hundred R/hr.

Hazardous materials:
None anticipated.

Survey Unit Number: SYS-30 **Survey Number:** 137

System Name: Vertical Irradiation Thimbles

System Description:
Vertical irradiation thimbles permitted the insertion of samples near the reactor core for irradiation with fast or thermal neutrons. Seven thimble units exist. V10, V11, and V12 were thermal irradiation thimbles. V13, V14, V15, and V16 were fast irradiation thimbles.

System Location(s): Operations level

Current Status: System is in place.

System Environment: System is currently drained.

System Classification: 1

Radiological Data:

Contamination Data
High contamination.

Dose Rate Data
Dose rates in January 2001, V13 ~5.9K R/hr, V14 ~11K R/hr, and V10 2.3K R/hr. See survey unit file for specific dose profiles. There is no survey unit file for thimble dose rates. The following data from 8/2000 is the only available data:
4" from thimble bottom- level with CR blades- V13 ~2,825 R/hr
V14 ~10,160 R/hr
33" from thimble bottom- level with transition plate- V13 ~5925 R/hr
V14 ~11,480
36" from thimble bottom- 3" above transition plate- V13 ~8800 R/hr
7" from thimble bottom- V10 ~1630 R/hr

Hazardous materials:
None anticipated.

Survey Unit Number: SYS-31 **Survey Number:** 138

System Name: Experimental Facilities Cooling Water System & Instrumentation

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System Description:
The EFCS used heavy water as a coolant to reduce contamination of the reactor coolant. The system supplied cooling water to the seven irradiation thimbles via supply and return connections on the 4" manifolds in the process area (greenhouse) of the OPS level. Flow was monitored on the supply and temperature on the return. Low flow indicated an alarm on the control room panel. Two pumps (GA103A and GA103B) circulated water through the system, one in standby. Heat removed was transferred through a heat exchanger (EA102) to the secondary cooling water system. A head tank (FA103) was mounted above the heat exchanger to provide surge volume and a positive suction for the pumps, pressurized by the helium system. A cleanup system removed ionic impurities and particulates from a side stream.

System Location(s): Experimental and Operations levels

Current Status: System is in place.

System Environment: System is currently drained.

System Classification: 1

Radiological Data:

Contamination Data
Tritium contamination in water at 2.7e-2 uCi/mL.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
None anticipated.

Survey Unit Number: SYS-32 **Survey Number:** 139

System Name: Cold Neutron Facility Systems

System Description:
The Cold Neutron Facility was developed to provide researchers with a source of very low energy, slow (cold) neutrons. A special thimble in the H9 beam port was used to further slow down the neutrons produced using liquid nitrogen as a moderator in the tip of the plug. Gaseous helium was circulated to remove energy from absorbed radiation and any kinetic energy. The hydrogen moderator was maintained in a vacuum chamber cooled by the biological shield cooling system. Liquid nitrogen was available as a auxiliary cooling supply. The CNF control console was located on the experimental level and the refrigeration facility in the CNF (Building 751). A CNF Accident on 3/18/83 did not involve a release of radioactive contamination within the CNF or building 750.

System Location(s): Equipment level, experimental level, and Bldg, 751.

Current Status: System is in place.

System Environment: System originally placed under He blanket at 10 psi. Residual oil may remain in systems.

System Classification: 1

Radiological Data:

Contamination Data
Closed loop cooling water identified tritium at 1.26E-7 uCi/mL. Compressor cooling water identified tritium at 2.36E-7 uCi/mL. Compressor oils identified tritium at 2.12E-2 uCi/mL. No reactor related gamma emitters were positively identified in recent CNF support system liquid samples. Cs137 was identified in He charcoal at 1.78E-5 uCi/g, may be due to fallout during charcoal manufacturing.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Residual nitrogen, helium and oils.

Survey Unit Number: SYS-33 **Survey Number:** 140

System Name: Building Compressed Air System

System Description:
The system provides air to pneumatically operated instrumentation, valves, research facilities, air lock door controls and other general use. Air is compressed by one or both rotary air screw compressors (GB301A and GB301B) discharging to an aftercooler, to a moisture separator, a three filter manifold to remove particulate matter, a common aftercooler, and into a receiver (FA303X). A third compressor of the reciprocating type is available as a backup (GB301C).

System Location(s): All elevations and outside building 750.

Current Status: System is in place.

System Environment: System in service.

System Classification: 2

Radiological Data:

Contamination Data
Compressor oil has tritium contamination at 5.6E-4 uCi/mL.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
No hazardous materials identified.

Survey Unit Number: SYS-34 **Survey Number:** 141

System Name: Liquid D/F Waste Systems

System Description:
The liquid waste system provided a means of storage and disposal of potentially contaminated liquid wastes, including spilled heavy water. "D" wastes were almost certainly contaminated by radioactive material and were collected in the GA304 pump sump on the equipment level. "D" waste was pumped either to the Hot laboratory waste storage tanks or to the D side of the F/D tank (located on the equipment level next to the passenger elevator). From the Hot Lab, it was sampled and chemically treated. It was then pumped to the BNL waste treatment area where it was distilled with the distillate being solidified in waste disposal vaults. The "F" wastes were those that may possibly contain radioactive materials. They are collected in the F/D storage tank on the equipment level and sampled for radioactive material. At one time, waste below the tolerance levels could have been transferred to the sewer system. Waste above the tolerance levels are pumped to the Hot Laboratory. Waste has not been pumped to the sanitary sewer system for at least 10 years.

System Location(s): All elevations and outside building 750.

Current Status: System is in place.

System Environment: System in service.

System Classification: 1

Radiological Data:

Contamination Data
Tritium contamination at 2.85E-2 uCi/mL and Co-60 at 2.03E-6 uCi/mL.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Unknown.

Survey Unit Number: SYS-35 **Survey Number:** 142

System Name: Breathing Air System

System Description:
The breathing air system provided clean, oil free air with proper moisture content and temperature to the nonpressurized protective clothing of six people simultaneously. The compressor (equipment level) received air from outside the confinement. The air was controlled for moisture and temperature and distributed through manifolds to the experimental and operations levels.

System Location(s): System spans the equipment, operations, and experimental levels.

Current Status: Not in service.

System Environment: Piping is disconnected with air compressor in place.

System Classification: 2

Radiological Data:

Contamination Data
Suspect internal tritium contamination.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
No oil contained with system.

Survey Unit Number: SYS-36 **Survey Number:** 143

System Name: Fuel Cladding Failure System

System Description:
The key systems that contribute to the Fuel Cladding Failure System include, reactor cover gas activity monitor (RRa105), exit air gas activity monitor (RRa306), exit air particulate activity monitor (RRa305), fuel cladding failure safety channels (RRa101, RRa102, and RRa103), primary water activity monitor (RRa100), and area gamma radiation monitors (HT2, HT3, and HT6). The most sensitive online instrumentation was RRa100.

System Location(s): Removed

Current Status: Removed

System Environment: Removed

System Classification: 1

Radiological Data:

Contamination Data
NA

Dose Rate Data
NA

Hazardous materials:
NA

Survey Unit Number: SYS-38 **Survey Number:** 144

System Name: Exit Air Monitoring System

System Description:
The Exit Air Activity Monitoring System (EEAM) continuously monitored the particulate and gaseous activity of the building exhaust air after it had passed through the building exhaust filter bank. An isokinetic sample was drawn into a filter tape and gas sampler. The moving filter tape was analyzed by a beta/gamma monitor (GM) and the gas was sampled by a gamma scintillation detector. Installed radioactive sources tested the operability of each detector and ratemeter. The sampling equipment was located in the southwest area of the blower room on the equipment level.

System Location(s): Blower Room

Current Status: System is in place.

System Environment: System in service.

System Classification: 1

Radiological Data:

Contamination Data
Suspect tritium and Co60 contamination.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
None anticipated.

Survey Unit Number: SYS-40 **Survey Number:** 145

System Name: Water & Cover Gas Sampling & Monitoring

System Description:
The system ensured the quality of D_2O and H_2O in the various systems was being maintained, monitored the performance of the resin beds, determined the presence of abnormal fission product concentrations in the primary cooling water system, determined the presence of tritium activity in the secondary cooling water system, continually analyzed the reactor vessel cover gas to ensure that the proper balance of O_2 and D_2 was being maintained. It also checked the Cd content of the poison water tank solution, and determined the presence of tritium activity in the HFBR sanitary effluent.

System Location(s): Operations level

Current Status: System is in place.

System Environment: System is out of service.

System Classification: 1

Radiological Data:

Contamination Data
Suspect tritium, Co60 and other activation product contamination.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
None anticipated.

Survey Unit Number: SYS-41 **Survey Number:** 146

System Name: Stack Effluent Monitoring System

System Description:
The stack effluent monitoring system consisted of several detectors sampling for tritium, gases and particulates. The system was run continuously during reactor operation with check sources stored in the facility.

System Location(s): Bldg. 715

Current Status: System in place

System Environment: System in service.

System Classification: 1

Radiological Data:

Contamination Data
Suspect H3, Co60, Cs137 and other activation product contamination.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
None anticipated.

Survey Unit Number: SYS-42 **Survey Number:** 147

System Name: Break Tank Water Supply System

System Description:
The Break Tank Water Supply System prevents the backup or overflow of potentially contaminated water into the domestic water system. The system also provides a backup supply of cooling water for the secondary side of shutdown heat exchanger EA103, cooling water for the secondary side of canal heat exchanger EA202, makeup water to BG201, and cooling water to the charcoal filters. The 62-inch 125 gallon tank is located on the operations level in the southwestern area next to the greenhouse.

System Location(s): Operations level

Current Status: System in place

System Environment: System is valved off.

System Classification: 1

Radiological Data:

Contamination Data
No contamination is anticipated. Tritium results less than minimal detectable activity.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
None anticipated.

Survey Unit Number: SYS-43 **Survey Number:** 148

System Name: Condensate Collection System

System Description:
The condensate collection system is on the equipment level. Condensate is collected in a large tank and transferred to drums to go onto a container disposal truck.

System Location(s): Equipment level

Current Status: System in place

System Environment: System in service.

System Classification: 1

Radiological Data:

Contamination Data
Tritium contamination is identified at 5.5E-3 uCi/mL. No nuclides identified through gamma spectroscopy.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
None anticipated.

Survey Unit Number: SYS-44 **Survey Number:** 149

System Name: Emergency Generator & Propane Supply

System Description:
The emergency generator assembly was located in the generator room on the equipment level adjacent to the exhaust blower room. Routine access was through he exhaust blower room. The generator was driven by propane supplied by a 1000 gallon propane tank buried on the north side of the reactor, just outside the HFBR fence. This line has been cut and capped. An underground line transferred the propane into the generator room. The engine was a water cooled, oil-lubricated, propane fueled, internal combustion engine. The generator had the ability to be automatically or manually started or shut down.

System Location(s): Outside building 750.

Current Status: System in place

System Environment: Propane tank empty and valved off.

System Classification: 2

Radiological Data:

Contamination Data
Tritium contamination is identified in waste antifreeze and lube oil drained in 1999.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Oil and antifreeze drained in 1999.

Survey Unit Number: SYS-45 **Survey Number:** 150

System Name: Reactor Poison Water System (Cd - Nitrate)

System Description:
The reactor water poison system served to ensure adequate reactor shutdown margin in the event of light water flooding of the core and to serve as a backup shutdown mechanism. It also allowed for the use of light water makeup to the vessel during certain emergencies, in order to keep the core covered with water. The cadmium nitrate, stored in FA202, absorbs neutrons and remains in solution through a wide range of temperatures. From the dump valve under the tank in the greenhouse, the water flowed through two block valves to the suction side of the helium gas eductor (EG101). System makeup was provided by the auxiliary water purification system or a domestic water source on the equipment level through a dead man valve that was spring-returned to the closed position. The poison water tank had connections for supporting systems, such as low pressure and high pressure helium, off-gas exhaust, and makeup water addition.

System Location(s): Operations level

Current Status: System in place

System Environment: System drained and flushed.

System Classification: 2

Radiological Data:

Contamination Data
Tritium contamination at 1E-2 uCi/mL. Pb214 identified in gamma spectroscopy report.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
Cadmium nitrate.

Survey Unit Number: SYS-46 **Survey Number:** 151

System Name: Vent Seal Collection System

System Description:
The pump seal packages were supplied with coolant from the discharge. The water stream cooled the washer and seat removing the heat of friction generated at the interface. An auxiliary seal limited flow of air into the collection chamber. The chamber was drained to a collection tank for liquid leakage and was maintained at an air pressure less than that in the pump room by the exhaust connection to an evacuated tank. This tank was part of the pump seal drain tank vent compressor/cold trap apparatus, which collected and condensed most of the water vapor and discharges the gas to the off-gas system. This ensured that tritium vapor leakage from past the main seal did not enter the room atmosphere. The seal leak off was collected in the seal collection tanks.

System Location(s): Equipment level

Current Status: System in place

System Environment: In service and pressurized 80-120 psi.

System Classification: 1

Radiological Data:

Contamination Data
Internal contamination is expected with primary water at concentrations of 1.6 mCi/mL of H-3 and 3.2 E-5 uCi/mL of Co-60.

Dose Rate Data
Dose rates are identified by the area survey units.

Hazardous materials:
None anticipated.

Appendix H - HFBR Survey Unit Reports – Buildings

Survey Unit Number: 704-01 **Survey Number:** 102

Description: BLDG 704, Fan House (HFBR Portion)

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Out of Service facility currently used for material storage.

Previous Use: Electrical switchgear, battery room, office, bathroom, and fan cells

Current Materials Present:
The area has become a storage area for a variety of materials, such as packaged and unpackaged RAM, protective clothing, etc.

Radiological Data:

Contamination
Fixed contamination levels exceed those in Table 1. East area proximal to the filter bypass facility entrace identified fixed contamination up to 75k dpm/100cm2.

Dose Rate
General area dose rates are 5 uR/hr to 10 uR/hr with maximum at 20 uR/hr by radioactive material area/radiation area. Basement plenum area is up to 200 uR/hr.

Description of remaining radioactive materials:
Several areas of RAM storage are present.

Hazardous materials:
Currently hazardous materials include lead, batteries, applied lead paint, asbestos wiring, insulation, and roof under the tar, oils and petrochemicals, PCBs, and mercury. Direct reading for lead paint show positive results on the door of the battery room. Sampling for mercury revealed negative results, however, mercury is suspected in the ballasts, capacitors, light ballasts, gear boxes, and in limit torque valve control oils.

Recommendations for future work or samples:
Based on current and historical data, these areas are classified as Class 1 for radiological surveys. The area has exhibited some fixed contamination, handled air from BGRR and HFBR, and currently contains radioactive material areas.

Figure 704 - 1

Figure 704 - 2

Figure 704 - 3

Figure 704 - 4

Figure 704 - 5

Survey Unit Number: 707-01 **Survey Number:** 103

Description: Bldg 707 and 707A, Pump House and Switchgear

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Out of Service

Previous Use: Pump House and Switchgear

Current Materials Present:
Area contains three secondary cooling water pumps, FA309 water tank and electrical switchgear.

Radiological Data:

Contamination
Contamination levels are less than the values specified in Table 1.

Dose Rate
Dose rates indicate background levels from 4 uR/hr to 7 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently or historically stored in this area.

Hazardous materials:
Currently, hazardous materials included lead and PCB based paints. Oils and petrochemicals, and asbestos in pipe insulation, penetrations, and wiring are also suspect. Asbestos is also suspect in switchgear spark arrestors. Transformers may contain residual PCB contaminated oil. Direct reading lead analysis identified lead paint on green pipe flanges. Mercury results were negative.

Recommendations for future work or samples:
Based on current and historical data, these areas are classified as Class 1 due to the impact of hazardous materials in the area. The area does not demonstrate any current contamination and no radioactive materials were stored in the building.

Figure 707 - 1

Figure 707 - 2

Figure 707 - 3

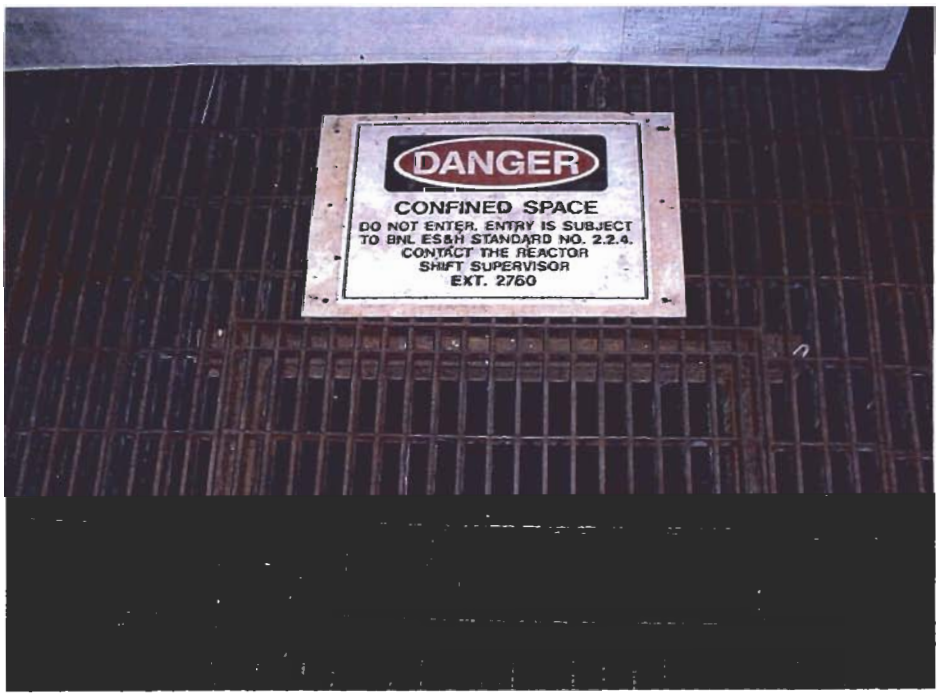

Figure 707 - 4

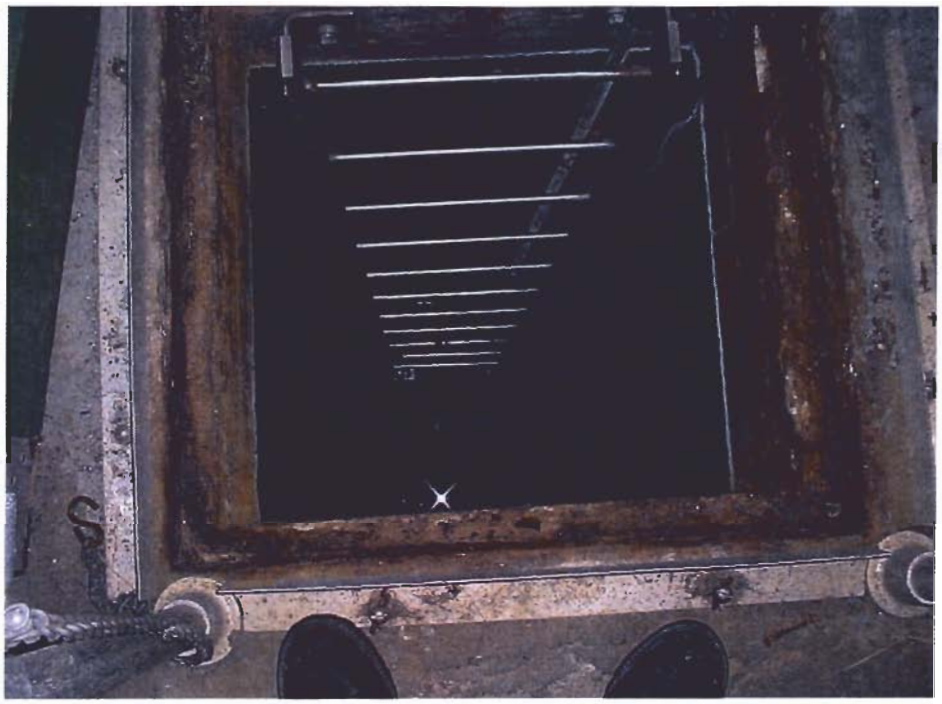

Figure 707 - 5

Figure 707 - 6

Survey Unit Number: 707B-01 **Survey Number:** 104

Description: Bldg 707B, Water Treatment House

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
3	3	3	3		

Current Use: Out of Service

Previous Use: Water Treatment Facility - pH stabilization, TDS removal, etc.

Current Materials Present:
No materials stored in this area.

Radiological Data:

Contamination
Contamination levels are less than the values specified in Table 1. Tritium was identified in Betz samples prior to disposal at a maximum concentration of 6.69E-5 uCi/mL prior to disposal.

Dose Rate
Dose rates indicate background levels at 8 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently or historically stored in this area.

Hazardous materials:
NaOH and H_2SO_4 (Betz 419, 65, 508, 30k, 55, and 365) were used for water treatment. Chemical storage tanks are drained and rinsed. Direct reading lead analysis did not identify lead based paint. Mercury results were negative.

Recommendations for future work or samples:
Based on current and historical data, these areas are classified as Class 3 for radiological surveys. The area does not demonstrate any current contamination and no radioactive materials were stored in the building.

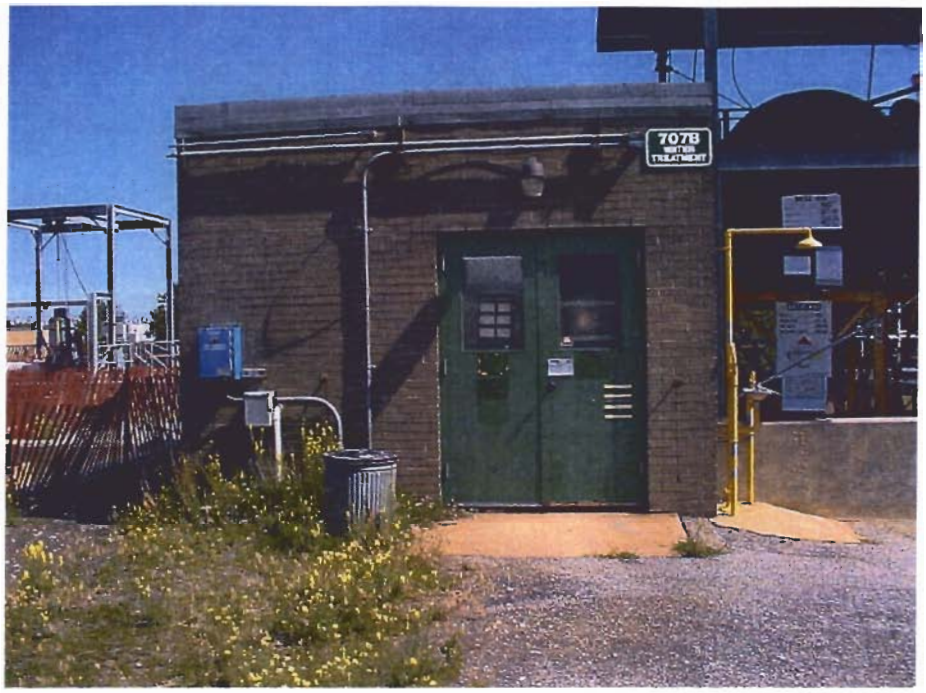

Figure 707B - 1

Figure 707B - 2

Survey Unit Number: 715-01 **Survey Number:** 105

Description: Bldg 715, Stack shack

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
2	2	2	2		

Current Use: Stack Effluent Monitors

Previous Use: Stack Effluent Monitors

Current Materials Present:
Air sampling equipment, sealed sources, and lead shielding are maintained in this area.

Radiological Data:

Contamination
Contamination levels are less than the values specified in Table 1. Fixed contamination levels could not be evaluated due to increased dose rates from the stored sealed sources.

Dose Rate
General area dose rates are <0.2 mR/hr. With a maximum contact reading of 2.5 mR/hr on a source shield.

Description of remaining radioactive materials:
This area currently holds several sealed sources for instrument performance checks. Many of them are multi-milliCurie sources shielded in lead pigs and behind lead bricks.

Hazardous materials:
Area currently contains bare lead shielding. Direct reading lead analysis did not identify lead based paint. Mercury results were negative

Recommendations for future work or samples:
Based on current and historical data, these areas are classified as Class 2 for radiological surveys. The area does not demonstrate any current contamination but does store radioactive material. Taking grab samples is considered a system confinement break.

Figure 715 - 1

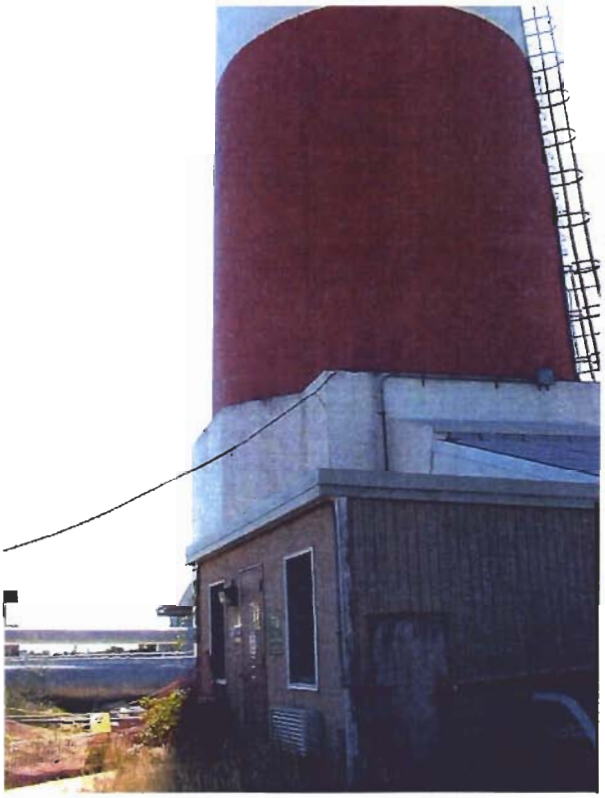

Figure 715 - 2

Figure 715 - 3

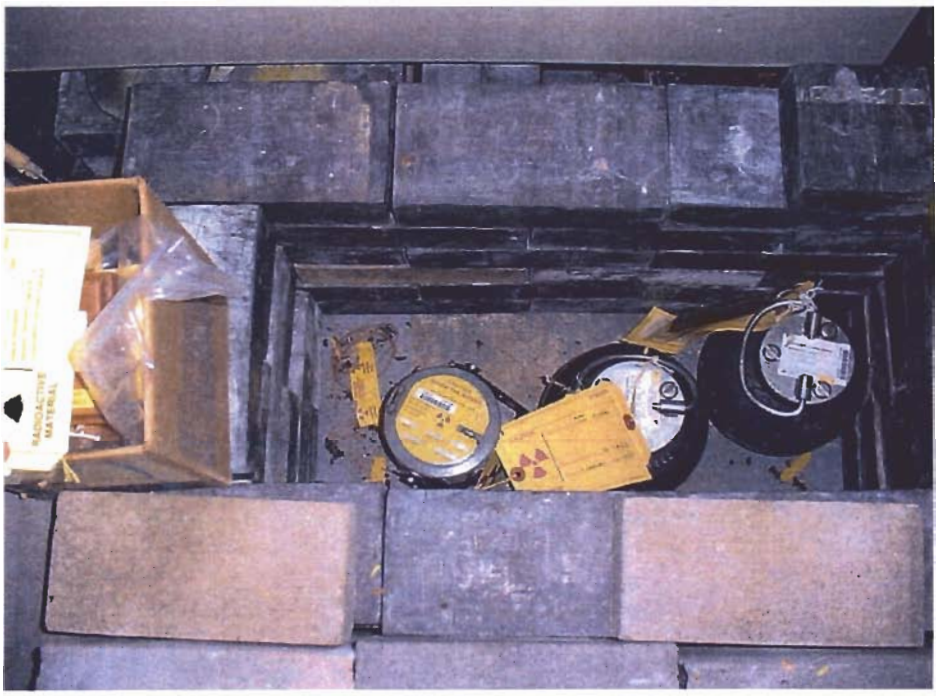

Figure 715 - 4

Survey Unit Number: 750A-01 **Survey Number:** 106

Description: Bldg 750A, Annex

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
3	3	3	3		

Current Use: Office Area

Previous Use: Same

Current Materials Present:
General office support equipment, e.g., desks, computers, file cabinets, etc.

Radiological Data:

Contamination
Contamination levels are less than the values specified in Table 1.

Dose Rate
Dose rates indicate background levels at 5 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently or historically stored in this area.

Hazardous materials:
Mercury evaluation results were negative. This area does not contain hazardous materials.

Recommendations for future work or samples:
Based on current and historical data, these areas are classified as Class 3 for radiological surveys. The area does not demonstrate any current contamination and no radioactive materials were stored in the building.

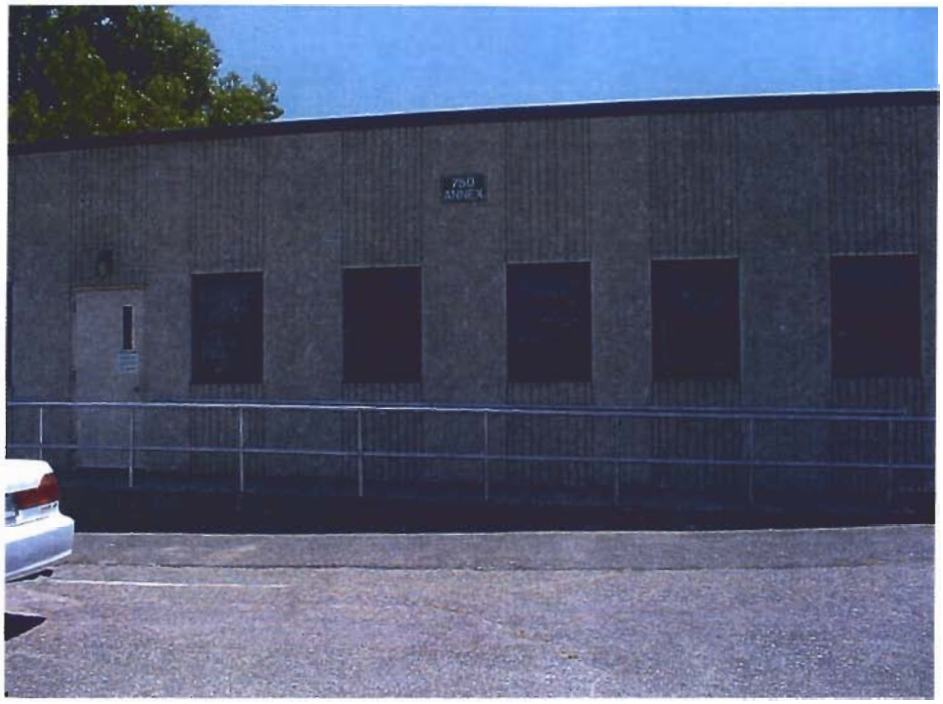

Figure 750A - 1

Figure 750A - 2

Survey Unit Number: 753-01 **Survey Number:** 107

Description: Bldg 753, Guard Shack

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
3	3	3	3		

Current Use: Not occupied.

Previous Use: Security Station

Current Materials Present:
No significant materials stored in this area.

Radiological Data:

Contamination
Contamination levels are less than the values specified in Table 1.

Dose Rate
Dose rates indicate background levels at 3 uR/hr.

Description of remaining radioactive materials:
No radioactive material currently or historically stored in this area.

Hazardous materials:
No hazardous materials are currently stored in this area.

Recommendations for future work or samples:
Based on current and historical data, these areas are classified as Class 3 for radiological surveys. The area does not demonstrate any current contamination and no radioactive materials were stored in the building.

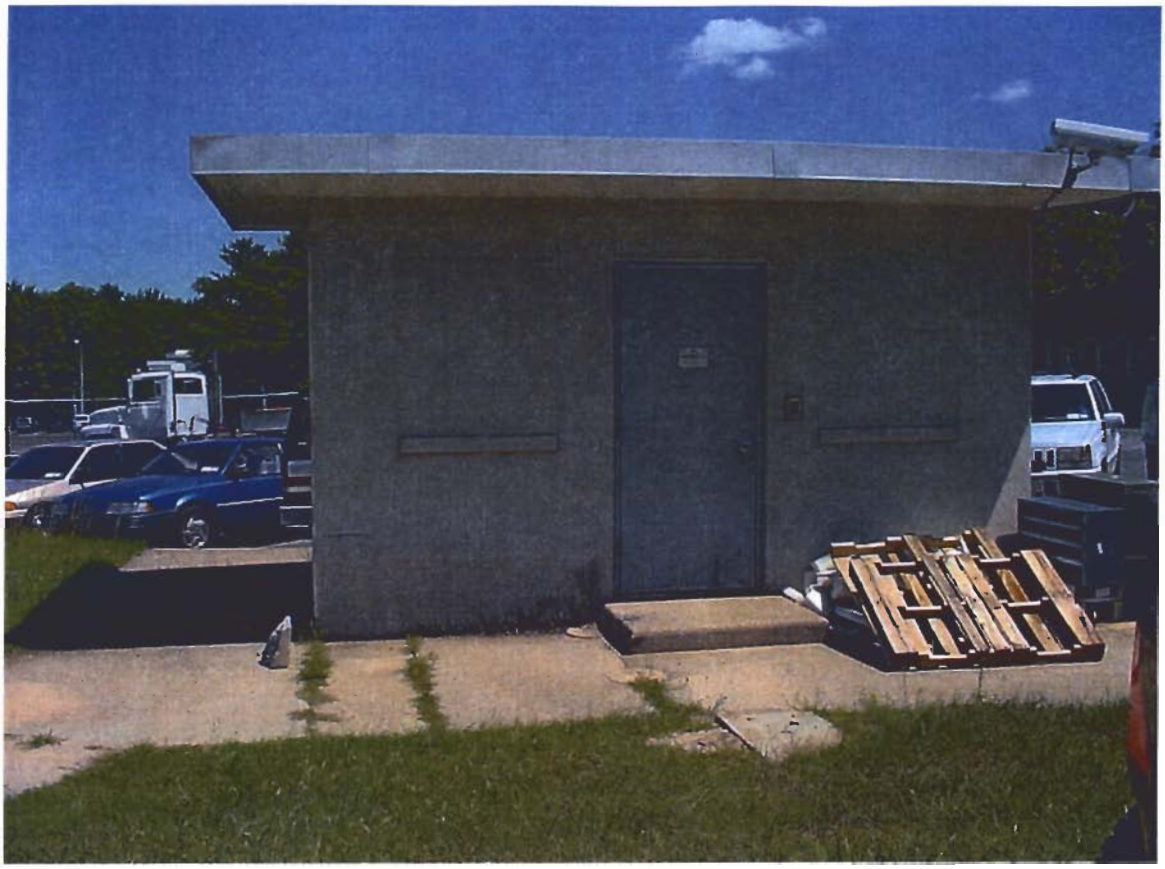

Figure 753 - 1

Survey Unit Number: 751-01 **Survey Number:** 108

Description: Bldg 751, Cold Neutron Facility

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	2	2	1		

Current Use: Out of Service

Previous Use: Cold Neutron Facility Support Equipment. Radioactive material was also stored here, including used PPE and rad waste containers.

Current Materials Present:
Refrigeration system, turbines, heat exchangers, and compressor.

Radiological Data:

Contamination
External contamination levels are less than the values specified in Table 1.

Dose Rate
Dose rates indicate background levels at 5 uR/hr.

Description of remaining radioactive materials:
No radioactive material is currently stored in this area. However components are internally contaminated.

Hazardous materials:
Hazardous materials include solvents, degreasers, lubricants, liquid nitrogen, oils and petrochemicals, and lead shielding.

Recommendations for future work or samples:
Based on current and historical data, these areas are classified as Class 2 for radiological surveys. Areas subject to hazardous material impact will be coordinated as Class 1. The area does not demonstrate any current contamination but system components are known to be internally contaminated (refrigeration system, turbine, heat exchanger, and compressor) and there have been radioactive material spills in the area. Area posted as a radioactive material area.

Figure 751 - 1

Figure 751 - 2

Survey Unit Number: 750-FBF **Survey Number:** 158

Description: Filter Bypass Facility

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		

Current Use: Charcoal and HEPA filters for HFBR and BGRR exhaust.

Previous Use: Charcoal and HEPA filters for HFBR and BGRR exhaust.

Current Materials Present:
Charcoal and HEPA filters.

Radiological Data:

Contamination
Contamination levels are less than the values specified in Table 1.

Dose Rate
General area dose rates are approximately 0.5 mR/hr with contact readings on the filter banks up to 1 mR/hr (1999).

Description of remaining radioactive materials:
No radioactive material currently or historically stored in this area. However components are internally contaminated.

Hazardous materials:
No hazardous materials are currently stored in this area.

Recommendations for future work or samples:
Based on current and historical data, these areas are classified as Class 1 for radiological surveys. The area does not demonstrate any current contamination but system components are known to be internally contaminated and there have been radioactive material spills in the area. Area posted as a radioactive material area.

Figure 751FBF - 1

Survey Unit Number: 705 **Survey Number:** 168

Description: HFBR / BGRR Stack

Survey Unit Classification:

Floors	Walls	Ceilings	Horizontal Surfaces	Grounds	System Internals
1	1	1	1		1

Current Use: HFBR and BGRR ventillation exhaust.

Previous Use: Same.

Current Materials Present:
Trench, drain line, and sump are maintained in the area.

Radiological Data:

Contamination
Up to 22,000 dpm/100 cm2 removable contamination identified. Isotopic analysis shows Cs-137 is present on smears of stack, inlet plenum, and sump. Na-22, Co-60, Zn-65, Cs-137, Pm-147, Ra-226, and Am-241 identified in soil from the stack indicating both MFAP and TRU (fuel-alpha) contaminants. Air sample data indicated Cs-137 at less than 30% DAC.

Dose Rate
Dose rates are 1.5 mR/hr general area inside the stack (closed window) and 3 mR/hr (open window).

Description of remaining radioactive materials:
No RAM is stored in this area, however significant contamination exists in both alpha and beta/gamma.

Hazardous materials:
Stack may contain lead paint and PCBs.

Recommendations for future work or samples:
Based on current and historical data, this area is Class 1 for radiological surveys.

Figure 705 - 2

Appendix I - HFBR Component Removal Estimate for Industrial Use

HFBR COMPONENT REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Component	Quantity	Material	Unit Weight (lbs.)	Unit Volume (cu. Ft.)
Primary Cooling Water System & Instrumentation	Equip. Level	Pumps	2	S.S.	5000	22
		400hp motors	2	C.S., copper	2500	16
		Pony motors	2	C.S., copper	500	4
		Hx's	2	S.S. & C.S.	60000	630
		Seal drain tanks	2	S.S.	200	2
Primary Purification System	Equip. Level	Inlet filters	2	S.S.	200	2
		Outlet filter	1	S.S.	525	3
		Resin Beds	4	S.S.	800	7
Primary Acidification System	Equip. Level	Tank	1	S.S.	200	5
		Acid pumps & motors	2	S.S., C.S., copper	200	2
Primary Sampling System	Equip. Level					
Pri. Pump Seal Cold Trap Sys	Equip. Level	Refrig. unit	1	C.S.	100	2
		Vacuum Tank	1	C.S.	300	5
DA Drain & D2O Transfer Sys	Ops. Level	FA102 Tank	1	S.S.	10600	800
	Exp. Level					
	Equip. Level	FA101 Tank	1	S.S.	10600	800

HFBR COMPONENT REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Component	Quantity	Material	Unit Weight (lbs.)	Unit Volume (cu. Ft.)
		Transf. pumps & motors	2	S.S., C.S., copper	400	8
		104C pump & motor	1	S.S., C.S., copper	200	2
		rod drive seal drain tank	1	S.S.	200	1
Reactor Vessel Cover Gas System & Instrumentation	Ops. Level	Demister	1	S.S.	550	14
		Recombiner	1	S.S., platinum	500	7
		Partic. filters	2	S.S.	400	3
		Iodine filters	2	S.S., carbon	400	3
Reactor Poison Water System	Ops. Level	Tank	1	S.S.	2200	55
		Circ. Pump/motor	1	S.S., C.S., copper	200	2
Shutdown Cooling Water System & Instrumentation	Equip. Level	Heat Exchanger	1	S.S.	4600	38
		S/D pumps	2	S.S.	2000	5
		15hp motors	2	C.S., copper	1000	6
		Eductor pump & motor	1	S.S., C.S., copper	200	1
		S/D pump seal tanks	2	Al.	100	1

HFBR COMPONENT REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Component	Quantity	Material	Unit Weight (lbs.)	Unit Volume (cu. Ft.)
Thermal Shield Cooling Water System & Instrumentation	Ops. Level	Head Tank	1	C.S.	450	11
	Equip. Level	pumps	2	C.S.	500	6
		15hp motors	2	C.S., copper	500	5
		Hx	1	C.S., brass	29000	236
		filters	2	C.S.	200	3
		Resin beds	3	C.S.	200	3
		Circ. Pump & motor	1	C.S.	200	3
Biological Shield Cooling Water Sys & Instrumentation	Ops. Level	Head tank	1	S.S.	300	4
	Equip. Level	pumps	2	S.S.	400	4
		10hp motors	2	C.S., copper	400	5
		Hx	1	S.S.	1700	14
		Filters	2	S.S.	150	2
		Resin bed	1	S.S.	150	2
Canal Cooling Water System	Equip. Level	Pump	1	S.S.	400	4
		10hp motor	1	C.S., copper	400	5
		filter	1	S.S.	850	13
		Hx.	1	S.S.	1700	14
Auxiliary Water Purification	Equip. Level	Carbon filter	1	C.S.	3000	77

HFBR COMPONENT REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Component	Quantity	Material	Unit Weight (lbs.)	Unit Volume (cu. Ft.)
System BG201		Cation bed	1	C.S.	4200	35
		Mixed bed	1	C.S.	4200	50
		Circ. pump	1	C.S.	100	1
		5hp motor	1	C.S., copper	150	2
Secondary Cooling Water System & Instrumentation	Ops. Level					
	Exp. Level					
	Equip. Level	311 tank	1	C.S.	4500	150
		303B pump	1	C.S.	100	1
		5hp motor	1	C.S., copper	150	2
		303A pump	1	C.S.	500	4
		5hp motor	1	C.S., copper	150	2
	Outside	Pumps	5	C.S.	7000	20
		250hp motors	5	C.S., copper	2500	8
		309 tank	1	C.S.	4500	150
		310 tank	1			
Secondary Cooling Water Treatment System	Outside	Sulfuric acid tank	1	poly	600	3000
		Betz tanks	2	poly	1000	3000

HFBR COMPONENT REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Component	Quantity	Material	Unit Weight (lbs.)	Unit Volume (cu. Ft.)
Carbon Dioxide Gas System	Outside	CO_2 tank	1	C.S.	5000	200
	Equip. Level					
Beam Tube Plugs	Exp. Level	plugs	9	concrete	1500	10
Vertical Irradiation Thimbles	Ops. Level					
Experimental Facilities Cooling Water Sys. & Instrumentation	Ops. Level	Exp. Hx.	1	S.S.	4600	38
		Head tank	1	S.S.	600	15
		pumps	2	S.S.	2000	5
		15hp motors	2	C.S., copper	1000	6
		filters	2	S.S.	200	2
		Resin bed	1	S.S.	800	7
		Hold up tanks	4	S.S.	200	4
Liquid D/F Waste Systems	Equip. Level	305 tank	1	S.S.	7500	575
		Circ pump	1	S.S.	100	2
		2hp motor	1	C.S., copper	100	2
		Pump receiver units	2	C.S.	200	2
		1 hp motors	4	C.S., copper	50	.5
AGRMs	Ops. Level	Check sources				
	Exp. Level	Check sources				

HFBR COMPONENT REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Component	Quantity	Material	Unit Weight (lbs.)	Unit Volume (cu. Ft.)
	Equip. Level	Check sources				
FCF	Equip. Level	Check sources				
NIAS	Balcony	Check sources				
BAMs	Ops. Level	Check sources				
	Exp. Level	Check sources				
	Equip. Level	Check sources				
Exit Air Monitoring System	Equip. Level	Check sources				
Criticality Alarm Systems	Ops. Level	Check sources				
	Equip. Level	Check sources				
Water & Cover Gas Sampling & Monitoring	Ops. Level	Check sources				
	Exp. Level	Check sources				
	Equip. Level	Check sources				
Break Tank Water Supply Sys.	Ops. Level	Break tank	1	S.S.	500	10
	Exp. Level					
	Equip. Level					
Cheese Box	Exp. Level					
Emergency Generator & Propane Supply	Outside	Propane tank	1	C.S.	2000	150

Appendix J - HFBR Piping Removal Estimate for Industrial Use

HFBR PIPING REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Pipe Material	Dia.(in.)/sched.	Length (ft.)	Weight (lbs.)	Volume (cu. Ft.)
Primary Cooling Water System & Instrumentation	Ops., Exp., Equip. Levels	Al.	20" / 40	60'	2408	131
		S.S.	20" / 10	20'	1055	44
		S.S.	18" / 10	100'	4834	177
		S.S.	1" / 10	20'	28	.2
		S.S.	1 ½" / 10	20'	42	.4
Primary Purification System	Equip. Level	S.S.	1 ½" / 10	40'	84	.8
		S.S.	2" / 10	40'	106	1.2
DA Drain & D2O Transfer Sys	Ops. Level	S.S.	1 ½" / 10	150'	315	3
	Exp. Level	S.S.	1 ½" / 10	40'	84	.8
	Equip. Level	S.S.	¾" / 10	200'	228	1.2
		S.S.	1 ½" / 10	1000'	2100	20
		S.S.	2' / 10	200'	532	6
Reactor Vessel Cover Gas System & Instrumentation	Ops. Level	S.S.	1" / 10	100'	142	1
		S.S.	1 ½" / 10	200'	420	4
		S.S.	2" / 10	50'	133	1.5
Reactor Poison Water System	Ops. Level	S.S.	¾" / 10	20'	23	.1
		S.S.	1" / 10	10'	14	.1
Shutdown Cooling Water System & Instrumentation	Ops., Exp., Equip. Levels	S.S.	8" / 10	30'	402	12
		S.S.	6" / 10	70'	657	4
		S.S.	1 ½" / 10	50'	105	1

HFBR PIPING REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Pipe Material	Dia.(in.)/sched.	Length (ft.)	Weight (lbs.)	Volume (cu. Ft.)
		S.S.	2" / 10	20'	432	.6
Thermal Shield Cooling Water System & Instrumentation	Ops. Level	Carbon Steel	¾" / 40	50'	57	.3
		Carbon Steel	1" / 40	50'	85	.5
		Carbon Steel	1 ½" / 40	60'	163	1
	Exp. Level	Carbon Steel	2" / 40	20'	73	.6
		Carbon Steel	3" / 40	60'	455	4
	Equip. Level	Carbon Steel	¾" / 40	80'	90	.5
		Carbon Steel	1" / 40	80'	134	.8
		Carbon Steel	2" / 40	100'	365	3
		Carbon Steel	3" / 40	100'	758	7
		Carbon Steel	8" / 40	200'	5710	82
Biological Shield Cooling Water Sys & Instrumentation	Ops. Level	S.S.	¾" / 10	40'	46	.2
		S.S.	1 ½" / 10	40'	84	.3
		S.S.	2" / 10	100'	266	.8
		S.S.	3" / 10	20'	87	3
	Exp. Level	S.S.	2" / 10	300'	798	1.4
		S.S.	3" / 10	40'	175	9
	Equip. Level	S.S.	¾" / 10	20'	23	3
		S.S.	2" / 10	50'	133	.1
		S.S.	3" / 10	150'	656	11

HFBR PIPING REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Pipe Material	Dia.(in.)/sched.	Length (ft.)	Weight (lbs.)	Volume (cu. Ft.)
Canal Cooling Water System	Equip. Level	S.S.	1/2" / 10	10'	9	.04
		S.S.	3/4" / 10	10'	12	.06
		S.S.	1" / 10	10'	14	.1
		S.S.	1 1/2" / 10	10'	21	.2
		S.S.	2" / 10	10'	27	.3
		S.S.	3" / 10	10'	44	.7
		S.S.	4" / 10	10'	57	1
Auxiliary Water Purification System BG201	Equip. Level	Carbon Steel	1 ½" / 40	200'	544	4
Secondary Cooling Water System & Instrumentation	Ops. Level	Carbon Steel	3" / 40	200'	1516	14
	Exp. Level	Carbon Steel	24" / 20	100'	9462	314
	Equip. Level	Carbon Steel	20" / 20	150'	11790	328
		Carbon Steel	16" / 30	150'	9387	210
		Carbon Steel	6" / 40	100'	1251	24
		Carbon Steel	4" / 40	100'	1079	11
		Carbon Steel	3" / 40	100'	758	7
		Carbon Steel	2" / 40	100'	365	3
		Carbon Steel	1" / 40	100'	168	1
	Outside	Carbon Steel	24" / 20	400'	37848	1256
		Carbon Steel	20" / 20	200'	15720	437
		Carbon Steel	18" / 20	200'	14118	354

HFBR PIPING REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Pipe Material	Dia.(in.)/sched.	Length (ft.)	Weight (lbs.)	Volume (cu. Ft.)
		Carbon Steel	12" / 40	200'	9800	178
		Carbon Steel	8" / 40	900'	25695	369
		Carbon Steel	6" / 40	300'	3753	72
		Carbon Steel	4" / 40	100'	1079	11
		Carbon Steel	3" / 40	100'	758	7
Secondary Cooling Water Treatment System	Outside	pvc	1" / 40	200'	64	2
Building Ventilation System	Ops. Level	Galv. steel	Various	1000'	31000	2000
	Exp. Level	Galv. steel	Various	1000'	31000	2000
	Equip. Level	Galv. steel	Various	1000'	31000	2000
	Outside	Steel	30"	1000'	31000	2000
Sanitary System	Ops. Level	Carbon steel	1 ½" / 40	60'	163	1.2
		Carbon steel	2" / 40	60'	219	2
		Carbon steel	3" / 40	60'	455	4.2
		Carbon steel	4" / 40	60'	647	7
	Exp. Level	Carbon steel	1 ½" / 40	300'	816	6
		Carbon steel	2" / 40	300'	1095	9
		Carbon steel	3" / 40	300'	2274	21
		Carbon steel	4" / 40	300'	3237	33
	Equip. Level	Carbon steel	1 ½" / 40	100'	272	2

HFBR PIPING REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Pipe Material	Dia.(in.)/sched.	Length (ft.)	Weight (lbs.)	Volume (cu. Ft.)
		Carbon steel	2" / 40	100'	365	3
		Carbon steel	3" / 40	100'	758	7
		Carbon steel	4" / 40	100'	1079	11
Helium Supply System	Ops. Level	S.S.	3/8" tube	250'	65	.2
	Exp. Level	S.S.	3/8" tube	50'	13	.04
	Equip. Level	S.S.	3/8" tube	600'	156	.42
	Outside	S.S.	3/8" tube	70'	18	.05
Carbon Dioxide Gas System	Outside	S.S.	¼" tube	300'	39	.1
		S.S.	¾" tube	300'	144	1
	Equip. Level	S.S.	¼" tube	200'	26	.06
		S.S.	½" tube	200'	60	.28
		S.S.	4" / 10	40'	227	4.4
		Carbon Steel	2" / 40	200'	730	6
		S.S.	2" / 10	600'	1596	18
		S.S.	1 ½" / 10	300'	630	6
Vertical Irradiation Thimbles	Ops. Level	Al.	4" / 80	250'	1296	28
		Al.	2" / 80	250'	434	8
Experimental Facilities Cooling Water Sys. & Instrumentation	Ops. Level	S.S.	1" / 10	200'	284	
		S.S.	1 1/2" / 10	200'	420	2
		S.S.	2" / 10	50'	133	4

HFBR PIPING REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Pipe Material	Dia.(in.)/sched.	Length (ft.)	Weight (lbs.)	Volume (cu. Ft.)
		S.S.	4" / 10	50'	284	1.5
	Exp. Level	S.S.	1 1/2" / 10	200'	420	5.5
CNF Systems	Exp. Level	S.S.	Various tubing	300'	195	6.6
	Equip. Level	S.S.	Various tubing	200'	130	4.4
	Outside	S.S.	Various tubing	200'	130	4.4
Building Compressed Air Sys	Ops. Level	Copper	1" or less	200'	134	.6
	Exp. Level	Copper	1" or less	600'	402	2
	Equip. Level	Carbon Steel	2" / 40	150'	548	3.5
		Copper	1" or less	1300'	871	4
	Outside	Copper	1" or less	300'	201	1
Liquid D/F Waste Systems	Ops. Level	S.S.	2" / 10	20'	53	.6
	Exp. Level	S.S.	1 ½" / 10	100'	210	2
		S.S.	2" / 10	100'	266	3
		S.S.	3" / 10	100'	437	7
	Equip. Level	S.S.	1 ½" / 10	500'	1050	10
		S.S.	2" / 10	500'	1330	16
		S.S.	3" / 10	100'	437	7
		S.S.	4" / 10	100'	567	11
	Outside	S.S.	2" / 10	600'	1596	19
Breathing Air System	Ops. Level	Copper	3"	200'	875	14

HFBR PIPING REMOVAL ESTIMATE FOR INDUSTRIAL USE

System Name	Location(s)	Pipe Material	Dia.(in.)/sched.	Length (ft.)	Weight (lbs.)	Volume (cu. Ft.)
	Exp. Level	Copper	3"	200'	875	14
	Equip. Level	Copper	3"	200'	875	14
Break Tank Water Supply Sys.	Ops. Level	Carbon Steel	2" / 40	100'	365	2.5
	Exp. Level	Carbon Steel	2" / 40	40'	146	1
	Equip. Level	Carbon Steel	2" / 40	200'	730	5
Emergency Generator & Propane Supply	Outside	Carbon Steel	1" / 40	400'	672	2.5