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RF/RMRS-96-0071

DRAFT

Reconnaissance Level Characterization Report

For The 779 Cluster

October 1997

V 52

RECONNAISSANCE LEVEL CHARACTERIZATION REPORT

TABLE OF CONTENTS

REDO

2

3

REDO

FIGURES

REDO

ACRONYMS

ACM	Asbestos Containing Material
Am	Americium
Be	Beryllium
CCR	Colorado Code Of Regulations
CFR	Code Of Federal Regulations
Co	Cobalt
DOE	U. S. Department Of Energy
DQO	Data Quality Objective
EPA	U. S. Environmental Protection Agency
FY	Fiscal Year
HASP	Health And Safety Plan
HVAC	Heating, Ventilating, Air Conditioning
IH	Industrial Hygiene
OSHA	Occupational Safety and Health Act
PA	Protected Area
Pu	Plutonium
QA	Quality Assurance
QC	Quality Control
R&D	Research And Development
RFETS	Rocky Flats Environmental Technology Site
RLCP	Reconnaissance Level Characterization Plan
RLCR	Reconnaissance Level Characterization Report
RMRS	Rocky Mountain Remediation Services, L. L. C.
Sr	Strontium
U	Uranium
WMP	Work Management Plan
Y	Yttrium

RECONNAISSANCE LEVEL CHARACTERIZATION REPORT (RLCR)

1.0 INTRODUCTION

The Department of Energy (DOE) has established a goal of reducing the total built square footage at the Rocky Flats Environmental Technology Site (RFETS) by 2% in Fiscal Year (FY) 1997. RFETS management has determined that the Building 779 Cluster will be removed to help meet the 2% goal. This project will help RFETS management reduce operating costs and hazards.

Due to the change in mission of the RFETS from the production of nuclear components to environmental cleanup and shutdown, Building 779 and its associated facilities have no identified mission after FY96. Therefore, the 779 Cluster is being decommissioned to reduce operating costs and to eliminate hazards within the Cluster's buildings. The 779 Cluster consists of Buildings 727, 729, 779, 780, 780A, 780B, 782, and 783 through 787 in the RFETS Protected Area (PA) (see Figure 1-1).

1.1 PURPOSE

The purpose of this RLCR is to summarize the available historical data and process information pertaining to the 779 Cluster in an effort to characterize the subject facilities. The purpose of review was to identify the type, quantity, condition, and location of radioactive and hazardous substances which are, or which may be, present in the subject facilities. The compilation of the 779 Cluster project files established during the reconnaissance characterization, brought together pertinent data from various sources to serve as a practical reference for use during the decontamination and decommissioning efforts.

1.2 SCOPE

This report is prepared in support of the Building 779 Cluster characterization and decommissioning for the DOE at the RFETS located near Golden, Colorado. Figure 1-1 shows the location of the Building 779 Cluster facilities.

The information presented in this report pertains to the 779 Cluster facilities. The review of historical records and the collection of process knowledge information covers the operational time period from original cluster construction to present.

1.3 METHODOLOGY

The general methodology employed for the preparation of this report involved the identification, location, collection, and review of available 779 Cluster records. The information sources examined, in the course of this effort, are listed in Section 5.0.

The information collection process included interviews with RFETS employees which had first-hand process knowledge of the 779 Cluster operations. The specific individuals interviewed, in the course of this effort, are identified in the project files.

Comprehensive physical inspections of all accessible areas of the 779 Cluster were conducted during the months of October and November 1996 and will continue as decommissioning progresses. The primary purposes of these inspections were:

- To confirm the accuracy of file documentation pertaining to as-built or modified facility construction equipment installations and general facility conditions,
- obtain volume estimates for wastes that will be generated during removal activities.

Building 779 Cluster

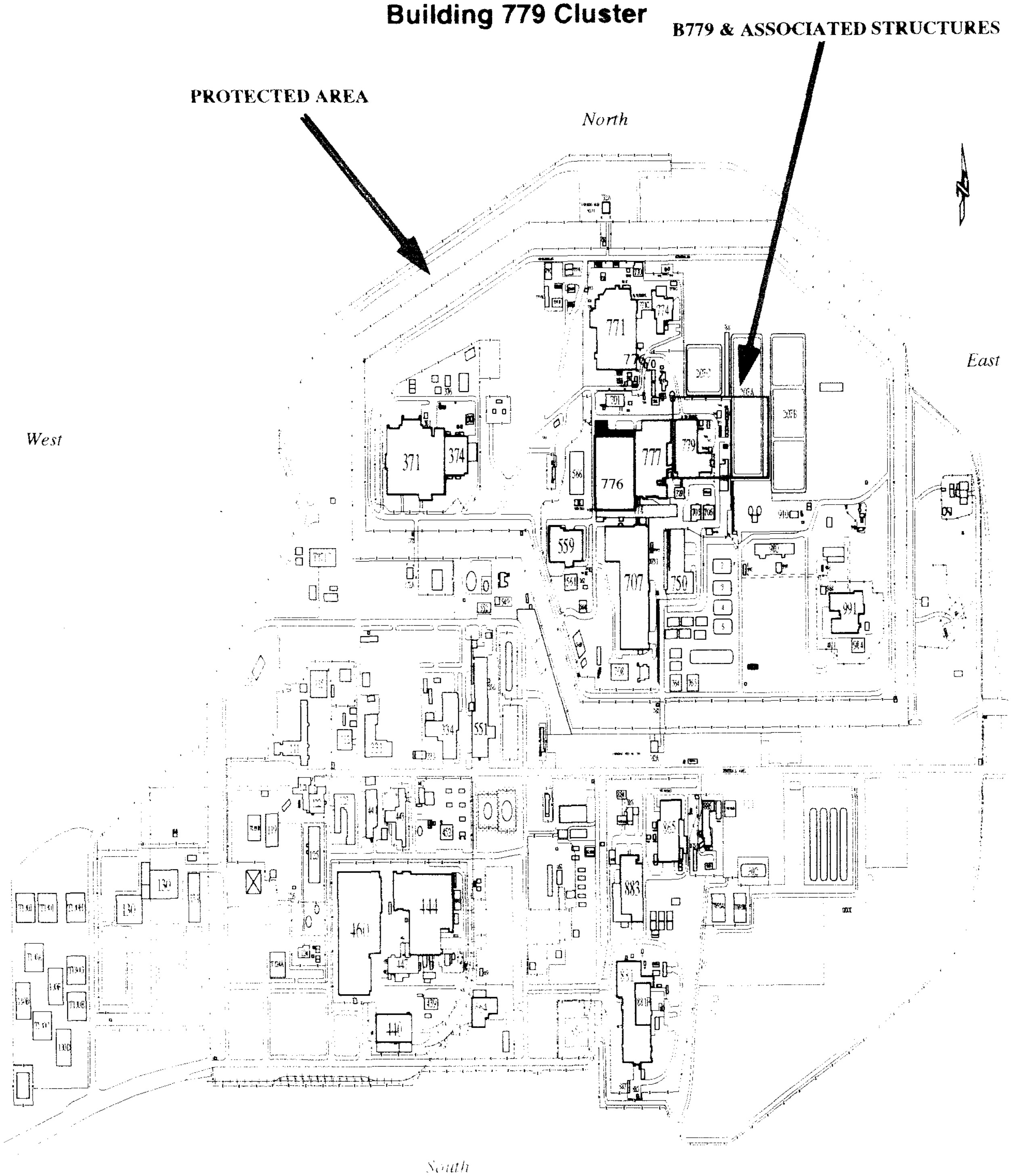

Figure 1-1

- identify equipment, structure, process lines, and associated items that will require hazardous and/or radioactive surveys and analytical sampling to further characterize the cluster,
- identify potential sources of lead and asbestos,
- identify potential chemical contamination (chemical contamination would be identified by signs of staining or unusual smell), and
- identify physical hazards (such as tripping hazards, loose/missing handrails, etc.).

A summary of conditions within each area of the 779 Cluster is provided in Appendix A. Appendix A also identifies surveys or sampling which needs to be completed as a part of the In-Process Characterization effort.

1.4 SUMMARY

A detailed examination of process knowledge and documents, relating to the 779 Cluster was initiated in September 1996. As part of this examination, a comprehensive survey of historical records was undertaken to determine the location and character of any radioactive and hazardous contaminants which may be present in the area. A room by room tabulation of relevant process knowledge and characterization information is presented in Section 4.0. After the project walkdown (see Section 1.3), an assessment of the necessity to complete further characterization to identify the type of contaminants to be sampled was determined using the Data Quality Objective (DQO) process. The results of the DQO process is documented in the Reconnaissance Level Characterization Plan (RLCP) for the Building 779 Cluster. This document (RLCR) summarizes the characterization information gathered and obtained by implementing the RLCP. As a part of the RLCP examination, a comprehensive survey of historical records was undertaken to determine the location and character of any radioactive and hazardous contaminants. The following is a summary of characterization information:

- Presently, the 779 Cluster is in a safe shut-down condition. All required utility services (i.e., electrical service, and water supply) are active. Building air ventilation and High Efficiency Particulate Air filtered exhaust systems, instrument air supply compressors, and necessary radiological monitoring instrumentation systems are in normal continuous operation. All manually-actuated and automated fire/alarm suppression systems are operational. All installed facility security and radiological alarm systems are normal. All remote-handling mechanisms and auxiliary facility support equipment are operational or are available for activation and use.
- The 779 Cluster presently houses a significant quantity of material and equipment which are radioactive, radioactively-contaminated, and/or contain lead, asbestos, beryllium (Be).
- Building 779 was used for Research and Development (R&D) in support of nuclear weapons production. Although a wide variety of plutonium (Pu) activities were conducted in the building, large quantities of Pu were not processed. Areas of Pu holdup within the building have been identified and the areas with significant quantities (above category C) were cleaned up to a category D or below during the deactivation process. Room 228 contains a gamma-cell experimentation device, which contains a radioactive cobalt 60 source. The Building 779 Holdup Results are detailed in Appendix B of this report.
- Contamination from Pu, Be, uranium (U), and other materials processed in Building 779 is known to exist (see Appendix A). Excess chemicals were removed as a deactivation activity.

- Machine, hydraulic, lubricating oil, and greases exist in various machines in Building 779. Equipment which was thought to contain hazardous substances were put in the Idle Equipment Program. This ensured the equipment fluids would be tested for the presence of hazardous substances. Equipment fluids found to contain a hazardous substance were removed during deactivation. Due to the age of the facility, considerable amounts of asbestos are present in the insulation and building materials. Lead is present in the glovebox shielding and in some of the building materials.

1.5 CONCLUSIONS

The following decisions/conclusions were made from the reconnaissance characterization data:

1. There are some areas which are clearly identified as contamination areas which are not in B-boxes or gloveboxes. There are no accessible areas which have radiation levels above 1 millirem. Room 160 in Building 779 is the only room known to have significant amounts of fixed radioactive contamination in the room's painted surfaces. As equipment is removed from the 779 Cluster to expose the painted surfaces, a thorough sampling and analysis for fixed radiation contamination will be completed. Current planning is to remove paint from all rooms which handled significant quantities of radioactive material.

2. Although there were hazardous chemicals in the 779 Cluster facilities, all excess and hazardous chemicals were removed from the 779 Cluster facilities during the deactivation process. Because the chemicals have been removed and there are no known areas which have a buildup of chemical residue, no special chemical characterization is anticipated. Should a chemical be found during the decommissioning process, the chemical will be handled in accordance with existing chemical identification and handling procedures.

3. The specific quantity and distribution of asbestos containing material (ACM) is known and a complete asbestos inspection of the facilities has been completed. The inspection revealed that there is asbestos in some insulation material, and potentially in some ceiling tiles, floor tiles, mastic and wall board taping compound. Much of the insulation material has been wrapped in place to prevent the asbestos from being disturbed. The other areas which have a potential for containing asbestos are in good condition. Asbestos abatement will precede any activity which would disturb the potential ACM. The Summary Table from the asbestos report for these buildings have been included as Appendix C. The complete report is available in the project files and is entitled "Asbestos Characterization Report For The 779 Cluster Project " (RF/RMRS-97-091.UN).

4. It is assumed that the majority of painted surfaces associated with safety markings and fire protection systems contain lead. This assessment is based on previous sampling conducted by the Industrial Hygiene (IH) group and is documented in the Health and Safety Lead Abatement Plan files. The first decommissioning effort in each area will be to wipe down and thoroughly clean all surfaces. This effort is to remove any dust which may contain contaminants. Computer modeling and leachability studies have demonstrated that lead in paint, if it exists, will not create a disposal problem. The amount of lead in the painted surfaces will be determined and compared to the previous model, as necessary, to support the decommissioning effort. Lead paint samples will be collected as "In-Process" samples for Toxicity Characteristic Leaching Procedure analysis to support the waste characterization program.

5. Be metal was removed from the 779 Cluster facilities during the deactivation process. However, because Be was machined in some areas of the facility, the first decommissioning effort, in each area, will be to wipe down and thoroughly clean all surfaces. This effort is to remove any dust which may contain lead or Be. A more thorough sampling and analysis will be completed prior to work in areas previously identified as Be work areas. A preliminary Be survey was conducted in the Building 779 Cluster. The results of this report is presented in Appendix D.

6. The 779 Cluster facilities' fluorescent lights and fluorescent light ballast will be removed and disposed in accordance with appropriate RFETS procedures. Due to the age of the buildings and guidance from the RFETS Toxic Substances Control Act specialist, the ballasts will be segregated and managed as Polychlorinated Biphenyl (PCB) – containing items during the decommissioning effort. Additional PCB samples for suspect building materials will be taken as part of "In-Process" characterization for waste management purposes.

The 779 Cluster Decommissioning project-specific Health and Safety Plan (HASP) contains information on how the above information will be implemented as the decommissioning effort is completed.

2.0 ANALYTICAL TESTING

Specific rationale for the Sampling and Analysis was presented in the RLCP for the 779 Cluster. Sample and survey results are presented in Section 3.0 of this document.

2.1 WASTE MANAGEMENT

Procedures are in place to insure that sampling and analysis of generated wastes will be in accordance with the U. S. Environmental Protection Agency (EPA) and State regulations. Hazardous and radioactive contaminant data is acquired, to a level consistent with regulatory and procedural requirements, for wastes that will be generated. The requirements for characterization of hazardous waste is specified in several RFETS waste management procedures, based on requirements established primarily by 40 Code of Federal Regulations (CFR) 261 and 6 Colorado Code of Regulation (CCR) 1007-3, 261. Waste materials demonstrating hazardous or radioactive characteristics are managed in accordance with the Low-Level or Hazardous Waste Requirements Manual.

A project specific Waste Management Plan (WMP) will be generated that details the final amounts of waste produced and how the waste was dispositioned (i.e., recycled, low-level built or free release).

2.2 INDUSTRIAL HYGIENE

The potential for exposure to hazardous or radioactive substances will be evaluated, prior to conducting the operation, according to Occupational Safety and Health Act (OSHA) and National Institute of Occupational Safety and Health requirements. A Demolition Plan will be written by the subcontractor. This requirement is driven by OSHA 1926.62 for lead and driven by other sections of OSHA for other constituents. Data is acquired for contaminants associated with equipment, building materials, residuals within construction areas, or other potential sources of hazardous exposure to the workers. Preliminary screening and sampling is required in decommissioning areas for materials which the workers may be exposed. The documentation will be included in the project files for Integrated Work Control Program closeout. Buildings will be decommissioned according to Engineering and Administrative Controls, Decontamination, or use of Personal Protective Equipment, as implemented under appropriate plans and procedures to meet OSHA requirements.

3.0 RECONNAISSANCE SURVEY RESULTS

Location-specific information concerning the characterization of each area of the 779 Cluster and each room in Building 779 is presented in this section. This localized characterization includes descriptions of specific events, operations, installations, construction, equipment operation, and other process knowledge information relating to the 779 Cluster. The information collected in this section has been obtained from several sources, including past/current records and interviews with RFETS personnel which had relevant 779 Cluster work experience or related knowledge. A complete listing of the information sources examined for this report is provided in Section 5.0.

3.1 FACILITY WORK AREA

Building 779 has been divided into six work areas for the purpose of deactivation and decommissioning. The six areas are as follows:

Area 1 - First-floor Rooms 146, 147, 149, 150, 151, 152, 153 (a & b), 154, 155, 156, 157, 158, 159, 160, 160a, 161, 163, 165, 167, and 167a

Area 2- Second-floor Rooms 215, 216, 217, 218, 219, 220, 221 (a, b, & c), 222, 222a, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 234a, 235, 273, 274, 275, and 277

Area 3- First-and second-floors Rooms 123, 124, 125, 128, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140 (a & b), 141 (a, b, & c) 171, 172, 173, 270, 271, and 272

Area 4- Rooms 121, 121a, 122, 123, and other areas of the building not expected to be radiologically contaminated

Area 5- Rooms 001, 126, 127, and 142

Area 6- Support Buildings 727, 729, 780, 780a, 782, 783, and associated cooling towers

Exposure assessments of the hazards that may be encountered during specific decommissioning activities is discussed in the 779 Cluster Project HASP. Information contained in the 779 Cluster Project HASP and this document will be incorporated into the planning process of each activity (via Activity Hazard Analysis evaluations) to ensure maximum protection of the worker.

3.2 FACILITY CHARACTERIZATION

The following table (Appendix A) is organized by decommissioning areas as described above and includes a description of the operation and process information available for each room and area, the materials that were used in the room based on historical information, the contamination considerations for each room, and the proposed confirmation analysis which will be performed prior to and during decommissioning activities. Additional characterization information will be obtained using the decommissioning characterization protocols. The types and volumes of wastes generated during the 779 Cluster decommissioning is discussed in the 779 Cluster Project WMP.

Facility walk-downs were conducted from November 1996 through September 1997 to identify potential hazards associated with the buildings. In addition, the buildings were inspected for the presence of asbestos containing building materials by a state-certified building inspector. Information was also collected on the presence of lead-containing paints used in construction, although no samples were taken.

Appendix A is organized by decommissioning areas as described above and includes a description of the information available for each room and area, the contamination considerations for each room, and the confirmation analysis which was performed prior to decommissioning activities to further characterize the facility, and wastes generated.

The primary purpose of the reconnaissance characterization activity is to provide a baseline of hazards within the 779 Cluster. This baseline (RLCR) will aid the DOE in determining if a Decommissioning Operations Plan is required for the decommissioning effort. This characterization information may also be used:

1. to quantify and qualify the physical and chemical characteristics of radiological and hazardous material contamination and the extent of contaminant distribution;

2. to quantify and qualify parameters that effect potential human exposure from existing and residual radiological or hazardous material contamination;

3. to support evaluation of detailed planning of a preferred approach for decontamination, equipment removal and waste disposal; and,

4. to support project plan considerations of dose assessments and As Low As Reasonably Achievable analyses to support selection of cleanup criteria and approach.

Data collected during the characterization activities consists of two types:

1. field measurements using portable instruments or test kits and

2. sample analyses of media using fixed laboratory equipment or systems.

There are no areas within the 779 Cluster which have significant amounts of unidentified/uncontrolled/unmarked radioactive contamination. There are some areas which are clearly identified as contamination areas which are not in B-boxes or gloveboxes. There are no accessible areas which have radiation levels above 1 millirem. Room 160 in Building 779 is the only room known to have significant amounts of fixed radioactive contamination in the room's painted surfaces. As equipment is removed from the 779 Cluster to expose the painted surfaces a thorough sampling and analysis for fixed radiation contamination will be completed. Current planning is to remove paint from all rooms which handled significant quantities of radioactive material.

Radiological surveys will be performed in areas as identified in Appendix A. The survey requirements will be outlined in specific radiological survey instructions developed for a given area. The level of detail for specific surveys will be based on the radioactive contamination potential for the area.

Four area classifications may be used to design the 779 Cluster surveys. These classifications are defined as follows:

<u>Class 1 Impacted (Affected) Areas:</u> are areas that have potential contamination (based on building operating history) or known contamination (based on past or preliminary characterization survey data). This would normally include areas where radioactive materials were used and stored and where records indicate spills or other unusual occurrences could have resulted in the spread of contamination. The survey frequency will be a minimum of one fixed survey measurement and one removable survey measurement per square meter. In addition, an alpha/beta scan survey of 100% of the applicable surface areas, including fixed equipment, is required.

<u>Class 2 Impacted (Affected) Areas:</u> are areas that have or had a potential for radioactive contamination or known contamination, but are not expected to exceed the applicable contamination limits. The survey frequency will be a minimum of one fixed survey measurement and one removable survey measurement at intervals as determined utilizing MARSSIM statistical calculations. In addition, a scan survey for alpha and beta of 10 to 100% of the applicable surface areas, including fixed equipment, will be performed as directed by Radiological Engineering personnel.

Class 3 Impacted (Unaffected) Areas: are all areas not classified as Class 1 or Class 2 Impacted or Non-Impacted. These areas are not expected to contain residual contamination above the applicable limits, based on knowledge of building history and previous survey information. However, insufficient documentation is present to exclude the area from survey requirements. The survey frequency will be a minimum of one fixed survey measurement and one removable survey measurement per 50 square meters or 30 points, whichever is greater. In addition, an alpha/beta scan survey of 10% of the applicable surface areas, including fixed equipment, is required.

Non-Impacted Areas: are all areas not classified as Class 1, Class 2 or Class 3 Impacted. These areas are areas where there is no reasonable potential for residual contamination, based on knowledge of building history and/or previous survey information. Sufficient information is present to be assured that no residual contamination is present above the applicable contamination limits.

A complete building inspection of the 779 Cluster was conducted for ACM in accordance with Asbestos Hazard Emergency Response Act and State of Colorado Regulations by a certified building inspector. The results are summarized in Appendix C.

During the physical inspection of the 779 Cluster, various painted surfaces were observed. These paints included white on drywall, grey on floors, amber (red-brown) on beams, yellow on safety rails, and red on fire suppression systems and fire extinguisher location boards. These paints have tested positive for detectable levels of lead in other buildings in a consistent manner. Although additional paint samples have not been taken, the demolition work practices will continue with the assumption that the paints contain lead and appropriate precautions will be taken. Additional media samples of construction materials will be taken.

Appendix A lists the locations and the types of samples that were required for characterization purposes. A trained sampling team was selected to perform the sampling activities required for characterization purposes. Analysis for characterization purposes was performed using EPA approved procedures through laboratory facilities. Data Quality Objectives are established for the analytical methods referenced and are on file at the on-site Analytical Projects Office in Building 881. Sampling and analysis activities were conducted in accordance with the RLCP and the "characterization protocols" which describe the methods for sampling and analysis for various contaminants of concern including asbestos, PCBs, and radioactive constituents.

Appendix A includes the descriptions associated with each area, process information regarding the processes conducted in each room, radioactive and/or hazardous considerations (i.e., known materials associated with a specific process or area), and the confirmation analysis that were performed. Lead and asbestos surveys were conducted by a state-certified inspector and results have also been compiled in Appendix C.

Be surface samples were conducted for selected rooms within the 779 Cluster. The results of these surveys are presented in Appendix D. Additional Be samples will be taken as an "In-Process" sampling activity during the Decontamination and Decommissioning effort.

3.3 QUALITY ASSURANCE (QA) PROGRAM

The QA Program for characterization activities follows the same program established for management of hazardous wastes on-site and meets the minimum requirements established by "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA (SW-846, 1986, Third Edition. QA/Quality Control (QC) procedures addressing waste characterization are maintained at the site. The DQOs for characterization activities were addressed in the 779 Cluster RLCP.

3.3.1 Waste Management

The requirements for characterization of hazardous waste is specified in several RFETS waste management procedures that are based on the requirements established primarily by 40 CFR 261 and 6 CCR 1007-3, 261. If the waste materials tested demonstrate hazardous or radioactive characteristics, then they will be managed as such in accordance with the Low-Level or Hazardous Waste Requirements Manual. A more thorough discussion of the project's waste management is in the 779 Cluster Project WMP.

3.3.2 Health And Safety/IH

All decommissioning activities are reviewed in the context of potential exposure of workers to hazards within the facility. Exposure assessments are discussed in the 779 Cluster Project HASP.

4.0 GENERAL OPERATING HISTORY

Building 779 was originally constructed in 1965 with additions added on in 1968 and 1973 for a total area of 67,710 sq. ft., of which, approximately 48,000 sq. ft. is included in the Material Access Area. The primary function of the facility was one of R&D. The facility was devoted to many phases of research with a variety of materials, which included not only Pu, but also U, Be, tantalum, and other exotic materials. Activities conducted in the building throughout its history included those concerned with Pu chemistry, physical metallurgy, product integrity and surveillance, joining, coatings, and machining. Typical research projects included the investigation of gas-metal interface reactions, thermodynamic measurements on Pu, electron-microscope investigations of metal structure, and the development of sophisticated joining techniques. In all, there were 39 processes conducted in the building throughout its history.

The east side of the building (on both the first and second floors) is not contaminated with radiological constituents. This space (approximately 19,700 sq. ft.) contains office, machine shop, and loading dock areas. If radiological constituents are discovered, a reevaluation of the work activities will be performed and adequate protective measures will be initiated.

4.1 ASSOCIATED FACILITIES

Buildings 729 and 782 (constructed in the early 1970s) house filter plenums and contain radioactive contamination. These buildings are 2,740 and 6,200 sq. ft., respectively. Of the support buildings, in the 779 Cluster, the two plenum buildings will require the most work to deactivate. Buildings 780 and 780A, which are used for miscellaneous storage, are constructed of corrugated metal and lumber. Building 783, and it's associated fans, supply cooling water to Building 779.

4.2 IDENTIFIED BUILDING HAZARDS

Building 779 was used for R&D in support of nuclear weapons production. Although a wide variety of Pu activities were conducted in the building, large quantities of Pu were not processed. It is anticipated that the holdup of radionuclide material will be found during deactivation. One laboratory contains a gamma-cell experimentation device, which contains a radioactive cobalt 60 source.

Contamination is expected from Pu, Be, U, and other materials processed in Building 779. In addition, a wide variety of chemicals were used for laboratory tests. These chemicals will be removed through the deactivation process.

Machine, hydraulic, lubricating oil, and greases exist in various machines in Building 779. PCBs are also likely to be encountered in equipment and electrical devices. Due to the age of the facility, considerable amounts of asbestos are present in the insulation and building materials. Lead is also present in the glovebox shielding and in some of the building materials.

4.3 DESCRIPTION OF OPERATIONS

This section describes the R&D and support operations which were previously conducted in Building 779. Operations are separated into five areas of responsibility:

1. Process Chemistry Technology
2. Physical Metallurgy
3. Machining and Gaging
4. Joining Technology
5. Hydriding Operations

Because research operations were constantly changing during facility operations, only a general description of them is provided.

4.3.1 Process Chemistry Technology

The chemistry laboratories in Building 779 were engaged in weapons process development, stockpile reliability testing, and methods development for recovering, separating, and purifying actinides from waste streams and residues. Some research activities and operations were performed on a continuous basis in production-scale facilities. Other activities were short-term and were performed on a laboratory scale using more highly specialized equipment.

Actinide elements, compounds, and other radioactive materials encountered include the following isotopes and other associated trace isotopes or radioactive decay products:

- Am
  Am-241
- Cobalt
  Co-60
- Pu
  Pu-238
  Pu-239
  Pu-240
  Pu-241
  Pu-242
- Strontium (Sr)/Yttrium (Y)
  Sr-90/Y-90
- Thorium (Th)
  Th-232
- Tritium
  H-3
- U
  U-235
  U-238

16

Chemicals not used in other parts of Building 779 were used in Process Chemistry Technology operations. They included elemental iodine hydrazine, dimethylamine, ammonium hydroxide, soda lime, hydrochloric acid, alkali metals and compounds, and hydrogen.

4.3.1.1 Ion Exchange

Ion exchange resins were tested for the purification and separation of Pu from other actinides. Purified Pu eluate was returned to production for conversion to Pu metal. Safe control of the ion exchange processes required proper sequencing of column feed adjustments, open-end columns for protection from pressure, specific instructions for eluting before the end of a work shift and never allowing resin to dry (nitrated dry resin is unstable), and safe-diameter columns and storage vessels.

4.3.1.2 Precipitation

The Pu peroxide precipitation and calcination process was simulated on a laboratory scale. The process converted Pu solutions to a Pu peroxide precipitate. The precipitate was then calcined to a Pu oxide powder, which is transferred to Building 771 for reduction to metal. The process required critically safe operating and storage vessels.

4.3.1.3 Thermodynamics

Thermodynamics studies of nuclear materials were conducted on a laboratory scale. Experiments involved measurement of chemical energy changes associated with certain chemical reactions, as well as the determination of heat capacities and enthalpies of nuclear materials, some of which were radioactive.

Solvent extractants were tested for the separation and removal of actinides from acid and salt wastes. Aqueous and organic wastes were transferred to Waste Operations for disposal. Solvent extraction involved contacting aqueous and organic phases in small vials and used nonfriable or high-flash point solvents for safety.

4.3.1.4 Thermogravimetric Analysis

Equipment is in place which was used for characterizing solids and their interactions and reactions with solids and vapors at subatmospheric pressure and at subzero, ambient, and high temperature. These capabilities used both vacuum microbalances and differential thermal analysis and thermogravimetric equipment. Specific measurements included (1) determining surface area of powders, (2) measuring adsorption and desorption of gases from solid surfaces, (3) measuring the kinetics of solid-gas reactions, (4) measuring equilibrium vapor pressures, and (5) defining the pressure-temperature composition relationships and phase equilibria of solid-gas systems. Radioactive, nonradioactive, and air sensitive materials were studied. Sample sizes were generally less than 5 grams.

4.3.1.5 Surface Studies

Methods used to study the surface of solid samples included auger electron spectroscopy, low energy electron diffraction, electron spectroscopy for chemical analysis, and ellipsometry. Both radioactive and nonradioactive materials were examined.

4.3.1.6 Radiation

Effects of radiation on various solids, liquids, and gases were considered, using gamma, beta, and alpha irradiation sources. These studies determined the radiation stability of materials used in a number of production operations at Rocky Flats. Detailed planning of experiments, use of protective equipment, and radiation shielding helped ensure the safety of these experiments.

4.3.1.7 Compatibility

Compatibility and chemical studies were performed with Pu and U samples. Equipment used in these tests included pressure volume-temperature systems, dynamic gas analyses systems, and high vacuum, gas, and acid-handling systems. The laboratory performed kinetic tests and, using gravimetric methods, tests for corrosion. These sometimes involved chemical reagents not normally used in other operations in the building.

Experiments were carefully planned to ensure that they were conducted safely. The systems used were leak and pressure tested. The systems had burst discs, check valves, and in-line particulate filters. Experiments were conducted in gloveboxes having atmospheres with less than 3% oxygen. Adequate radiation shielding was provided.

4.3.1.8 Product Testing And Surveillance

This area included process development research, production support experimentation, and stockpile reliability evaluations. Process development was performed in response to design agency guidance related to various phases of weapon cycle use (production, stockpile, deployment, command and control, surveillance, and site-return evaluation). These processes, typically, involved coupon-size samples used for determining reactivity and reaction mechanisms. Production support experimentation was typified by testing of materials proposed for production use. Each material was tested for compatibility with war reserve metals and other production materials before it was approved. Experimentation for these determinations was performed using small samples that were stored for several weeks. Full scale pit testing was performed in response to specific design agency requests.

Product was tested under a variety of field-simulated conditions of temperature, pressure, and chemical environment. This area of work included short-term operational cycle experiments, as well as accelerated aging studies and subzero temperature shelf-life testing.

Operational-cycle-experiments were done under controlled conditions using gas-tight, vacuum and high pressure metallic systems. Product aging and shelf-life testing were accomplished in a DOE-approved nuclear materials storage and vault facility.

4.3.1.9 Evaporative Separation

A high-temperature furnace was used to develop methods for distillation of salts and volatile metals from Pu and Americium (Am) alloys and residues. Volatile metals were mostly zinc and magnesium. This process was a tool for purifying alloys and upgrading salt residues.

4.3.1.10 Pyrochemical Processes

Pyrochemical Process Development was associated with production equipment and production process applications of the pyrochemical techniques. This group experimented with molten salt extraction, salt sparging, direct oxide reduction, and electrorefining.

Molten salt extraction was performed to remove impurities (i.e., undesirable radionuclides) from Rocky Flats Pu. The molten salt extraction operation was performed at an elevated temperature to melt the Pu metal. Molten metal was combined with a salt mixture that contained magnesium chloride, which served to oxidize the impurities in the Pu metal. Once molten, the mixture was separated into a salt phase (which contained the impurities) and a metal phase. Upon cooling, the salt was removed and processed for reuse. The purified Pu button was returned to production.

Spent salts from molten salt extraction were melted and combined with calcium metal to reduce the Pu and Am contained in the salt to pure metal form. A calcium/Pu/Am alloy resulted, along with the purified salt. The salt was either reused or discarded if Pu levels were low enough. The metal alloy button was further treated by vacuum melting, which drove off the more volatile nonradioactive metal components, resulting in a purified Pu/Am button, which could be separated by a variety of processes, including molten salt extraction as described above.

Direct oxide reduction was a one-step process for converting Pu oxide into Pu metal. PuO_2, calcium chloride, and calcium metal were placed into a crucible and melted. The molten mixture was stirred to allow the reduction reaction to take place. The molten products were then poured into mold and allowed to cool. Breakout of the cooled contents yielded a Pu metal button and a discardable salt.

Electrorefining was another method of Pu purification based on the mobility of Pu ions in the presence of an electric current. Pu was heated to a molten state in the presence of molten salt. A direct current source is applied to the molten mixture through a tantalum anode placed in the mixture. The molten metal mixture acted as the anode. Pu ions collected at the cathode and were reduced to pure Pu metal. Impurities remained in the molten salt phase. The resultant Pu metal was returned to production, and the spent salt was sent to salt sparging for reprocessing.

4.3.2 Physical Metallurgy

Physical Metallurgy conducted research on various metals, alloys, and materials required by plant missions. The group also supported different research groups, design agencies, plant production, and others in metallurgical studies of materials and manufacturing techniques for components and processes. Support operations by the group included optical and electron metallography, microprobe analysis, X-ray diffraction, tensile testing, hardness testing, and dilatometry.

Physical Metallurgy personnel experimented with small samples of metals, such as Pu, U, Be, steel alloys, copper, and various ceramics and glasses. Laboratories with gloveboxes were used for handling radioactive materials. Tensile testing and electron metallography facilities were housed in special laboratory rooms. Below are some of the operations conducted by this group.

4.3.2.1 Optical And Electron Metallography

Analysis of materials was made by examining their structures with light and electron microscopes. Gram samples, which were usually mounted in plastic holders, were prepared by cutting or sawing. Several cutting and sawing devices were used. Be and depleted U were handled in machines with hoods and air exhausts for protection against toxic dust and fumes while Pu samples were handled in gloveboxes. Cutting fines were collected and stored in a drum, which was sent to Building 774 for disposal.

Materials in plastic mounts were usually ground and polished in specialized metallographic equipment to yield a polished surface for examination. Grinding was performed wet and the fines were constantly flushed into the process waste drain. Usually, a chemical treatment followed to reveal the structure in detail. Specimens were then examined in appropriate microscopes. The internal structure of some materials was studied by preparing thin films of the material, and passing an electron beam through the film. Specimens were retumed to the originator; waste material was disposed of in waste collection drums.

4.3.2.2 Microprobe Analysis

Samples of materials prepared metallographically, including freshly polished and clean Pu, were inserted in the microprobe chamber. An electron beam scanned across the specimen was used to obtain a chemical analysis by determination of the spectra that were collected.

4.3.2.3 X-Ray Diffraction

The atomic crystal structure of materials was examined by the use of X-ray diffraction. Technical information was obtained by such X-ray studies. Specimens of up to a few grams were placed in the X-ray beams. Radioactive materials were covered with a thin plastic film for protection against contamination.

4.3.2.4 Mechanical Testing

The mechanical behavior of radioactive or fissile materials was determined by use of a testing machine enclosed in a glovebox. Nonradioactive materials were tested in open machines. Materials were evaluated by the application of tensile, compressive, and shear loading. Relatively small machined specimens were used for testing. Radioactive materials were handled according to appropriate safety procedures.

4.3.2.5 Dilatometry

Dimensional changes of a material were measured by use of a dilatometer that detected these changes as the material was heated and cooled. Machined specimens were small, and radioactive materials were tested in this system. The dilatometer was contained within a glovebox.

4.3.3 Machining And Gaging

Machining operations within the buildings were conducted in three shops, two general machine shops and a general machining laboratory located in original Building 779 and in Building 779-2.

One general machine shop supports Joining Technology. The work consisted of making tooling, fixtures, and special order parts of steel, cast iron, and other common materials. Shop equipment included lathes, mills, tool grinders, a belt sander, and a power hack saw. Standard shop practices, monthly safety inspections, and trained operating personnel provided a safe working environment. Only non-nuclear material was handled (excluding Be).

The second general machine shop was a maintenance shop used in support operations. It is equipped with a lathe, mill, drill press, and tool grinders. General machining tasks employed common materials such as aluminum, brass, copper, and steel. Again, only non-nuclear materials were handled.

The general machining laboratory was used for high-precision machining of special orders, machining tests, and general machining jobs. It was equipped with a direct numerically controlled lathe, tracer lathe, straight lathe, mill, jig borer, drill press, electrodischarge machine, band saw, surface grinder, monoset grinder, and tool grinders. Waste generated in the machining of common materials was collected in drums in each shop and disposed of according to written procedures.

4.3.4 Joining Technology

Joining Technology activities were conducted in original Building 779 and in Building 779-2. There was only one Joining area for the handling of nuclear material, which was in Building 779-2. Joining activities included electron-beam welding, gas-tungsten-arc welding, pressure gas-metal-arc welding, gas welding, brazing, metallography, machining, dimensional inspection, and electronics development.

The Coatings facility in Building 779, has three hot-hollow cathode systems and associated hardware. The function of this facility was to define the required parameters associated with the deposition of various materials onto specified substrate geometries. The material most often deposited was silver. However, other materials, such as gold, silicon dioxide, and silicon monoxide, were also deposited.

Substrate materials were usually Vascomax, steel, stainless steel, Be, and U-238, in a variety of forms. At no time were the substrate materials mechanically worked on, as in sectioning or grinding, in this facility. Coatings were deposited onto the substrates in a closed chamber and under partial vacuum.

Each of the hot-hollow cathodes was contained in a separate high-vacuum chamber. For any one system, vacuum pumps, gages, and necessary electronics were housed in a cabinet that also doubled as a table surface for the vacuum chamber.

There are, at present, two power supplies being shared among the hot-hollow cathodes. Both power supplies are enclosed in cabinets with safety interlocks on the panels and doors. Although on-off switches are mounted on the cabinets, breaker switches on the wall are used as an additional precaution in initiating and shutting off current to the power supply.

Hazardous materials used in the Coatings facility were methanol, nitric acid, and sodium hydroxide. These materials were present in small quantities.

4.3.5 Hydriding Operations

Hydride Operations received parts with recoverable Pu, and through the process of hydriding, removed Pu from the part in the form of Pu hydride. This hydride was then dehydrided and converted to Pu metal or oxidized to Pu oxide.

In the hydriding process, the procedure can vary depending upon the material being processed; however, the general procedure is outlined below. The part was placed in the hydriding vessel; which was evacuated and backfilled with pure hydrogen. In the hydriding reaction, the hydrogen gas in the vessel was consumed in the reaction; therefore, hydrogen was continuously added by an automatic controller to maintain proper operation pressures.

Upon completion of the reaction, the hydride was placed in the oxidation reactor. Oxidation occurred by passing air through the oxidation reactor. When oxidation was complete, the material was burned in the presence of pure oxygen, to ensure that all the hydride was converted to oxide.

Since the above reactions involved high temperatures, pyrophoric materials, and potentially explosive gases, several safety systems were designed to prevent any adverse consequences. Both reaction vessels are contained within a glovebox that is inerted with argon. This glovebox was monitored for high oxygen and hydrogen concentrations. Additionally, the electrical design of the system made it impossible to perform the hydriding and oxidizing operations simultaneously. Finally, if the pressure of the glovebox exceeded a set pressure, a pressure-relief valve would open, allowing pressurized gases to be exhausted through the hydrogen burning glovebox.

5.0 INFORMATION SOURCES

The preparation of this report involved the retrieval, from various sources, and review of several documentation files pertaining to the 779 Cluster and past operations therein. The following sections list the files that have been reviewed in the course of this reconnaissance characterization.

This investigation effort also included the collection of first-hand process knowledge interviews from RFETS employees with Building 779 experience. A listing of personnel who contributed first-hand information is available in the project files.

5.1 FACILITY RECORDS

The following 779 Cluster records are available for retrieval from the 779 Cluster Decommissioning Project Document Files:

5.1.1 Building 779 Routine Radiological Monitoring Contamination Survey Reports, dated January 1990 through present.

5.1.2 Building 779 Work Summary Plan BDP-779-003, Revision 0, Part A, September 9,1996.

5.1.3 RFETS Glovebox Data List, October 1, 1996.

5.1.4 Building 779 Waste Stream and Residue Identification and Characterization.

5.2 NUCLEAR SAFETY AND COMPLIANCE RECORDS

5.2.1 Holdup Measurements Results for Building 779, Safe Sites of Colorado Interoffice Correspondence, October 15,1997.

5.2.2 Summary of Building 779 Pu Holdup Breakdown by System, DKS-001-93, EG&G Rocky Flats, Inc. Interoffice Correspondence, March 12,1993.

5.2.3 Safety Analysis Report for Building 779, June 1987.

5.3 FACILITIES ENGINEERING RECORDS

5.3.1 Basic Information for the Decommissioning of Building 779.

5.3.2 Facilities Engineering Drawings of the 779 Cluster.

5.3.3 Facilities photographs from walk-downs conducted November 1996.

5.4 FIRST-HAND PROCESS KNOWLEDGE INFORMATION

5.4.1 RFETS staff members previously/currently assigned to/or associated with the 779 Cluster:

Process information on operations within the 779 Cluster was obtained from various individuals associated with the project. A complete listing of persons contacted during the building characterization is available in the project files.

6.0 REFERENCES

Building 779 Radiological Monitoring Contamination Survey Reports, January 1990.

Building 779 Work Summary Plan BDP-779-003, Revision 0, Part A, September 9,1996.

RFETS Glovebox Data List, dated October 1, 1996.

Holdup Measurements Results for Building 779, Safe Sites of Colorado Interoffice Correspondence, September 27,1996.

Summary of Building 779 Pu Holdup Breakdown by System, DKS-001-93, EG&G Rocky Flats, Inc. Interoffice Correspondence, March 12,1993.

Safety Analysis Report for Building 779, June 1987.

Basic Information for the Decommissioning of Building 779.

Facilities Engineering Drawings of the 779 Cluster.

Facilities photographs from walk-downs conducted November 1996.

Appendix A

Building 779 Reconnaissance Characterization Table

Appendix B

Building 779 Holdup Results

Appendix C

779 ACBM Summary Table

Appendix D

779 Cluster Beryllium Survey Sample Results

26

Appendix A

Building 779 Reconnaissance Characterization Table

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	Results 4 ~~Confirmation~~ Analysis
Area 1 - First Floor Rooms			
146	Office Area	N/A	ACBM Rad Survey (Class 1)
147	This room was used for drum storage for rad waste. It also supported Room 150 with nuclear joining.	Tungsten welding (Thorium)	Rad Survey (Class 1) ACBM
149	Hallway	N/A	Rad Survey (Class 1) ACBM
150	Room 150 was used for nuclear joining of metal weapon components and for super critical CO_2 cleaning. Cleaning and rinsing of the components was performed prior to the welding operation. The process involved tungsten arc welders, electron beam welders, and torch brazing.	Hydrochloric, nitric, hydrofluoric, phosphoric, oxalic, sulfuric acids, acetone, ethanol, copper sulfate, oils, alcohol, Pu, U, and Be Tungsten welding (Thorium)	Rad Survey (Class 1) ACBM Be [illegible]
151	Office	N/A	Rad Survey (Class 2) ACBM
152	Room 152 was used as an experimental casting lab to test metal compatibilities with graphite mold substrates. Pu and non-nuclear metals were heated until molten and poured into graphite molds. The molds were then examined and analyzed. There is a vault on the north end of the room and it has not been used for material storage for many years. A power generator located south of Glovebox 208. Because of its age, it is thought to contain PCBs. There is radiological contamination in the northwest corner of the room.	Pu, U, graphite, carbon, calcium fluoride, tantalum, and freon Metallurgy	Rad Survey (Class 1) ACBM
153	This room is used for rad waste drum storage and contains a trash compactor.	RAD Contaminants	Rad Survey (Class 1) ACBM
153A	This room has a compactor for hot waste, a lead drum shield, two bottles, and three abandoned pumps. The room appears to have been used for drum storage at one time.	RAD Contaminants	Rad Survey (Class 1)
153B	This room has a downdraft table used to repackage waste. The room is posted as respiratory protection required.	RAD Contaminants	Rad Survey (Class 1)
154	This room was used for hydrating and dehydrating Pu from substrates. Hydride could still be present in the glovebox system. Glovebox 1363 and 1364 is where hydrating/dehydrating was accomplished. Hydride acid boil down.	Pu. Sulfuric Acid, Hydrochloric Acid. Nitric Acid. Tantulum. And Other Metals Pu Hydriding (Pu buttons fabricated)	Rad Survey (Class 1) ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	~~Confirmation Analysis~~ results
155	This room was a Pu sample-mounting laboratory supporting auger spectroscopy. It had etching, polishing, a furnace, and B-boxes to pull samples out of line. Hood 155 NE - This hood is used as a 90-day accumulation area (7792269). It has contained numerous chemicals. There is possible transite (asbestos) lining the hood. The hood is labeled "NO FISSILE MATERIAL ALLOWED."	Pu, organic solutions, orthophoric, and oxalic acids. Metallurgy photographs Am and Pu	Rad Survey (Class 1) ACBM Be <0.1
156	This room is the calorimeter room. There are, besides the calorimeter, 2 large gas cylinders and two contaminated portable air handlers.	RAD Contaminants	Rad Survey (Class 1) ACBM
157	Tensile Testing Lab. Glovebox 222 - This glovebox was never placed in service. It contains a tensile testing machine. Glovebox 223 - This box is non-leadlined and houses a hot tensile testing machine. There is a heat detection unit (old stacked-style storage rack). There is a supply line on the east end. Glovebox 224 - This glovebox was used to prepare samples and is contaminated. Glovebox 225 - This glovebox was never placed in service and has no gloves. Glovebox 226 - This glovebox is clean except for one gallon can and a few tools. The airlock ledge inside the box has dust and items. There are two filter housings located external to and above the glovebox.	Pu, Pu contaminated metals, isopropanol Metallurgy (Tensile Testing)	Rad Survey (Class 1) ACBM Be <0.1
159	This is a permitted storage area for RCRA waste (Unit 779-90.42). There are several drums stored here containing mixed residues.	Residues Am and Pu (Pyrochemical)	Rad Survey (Class 1) [illegible]
160	This room was retrofitted in the early 1980s as a pyrochemical development facility. Operations that took place in this room included DOR, ER, MSE, Salt Scrub, and other high temperature studies with Pu and Am.	Calcium Oxide, Magnesium Oxide, Magnesium Chloride, Sodium Chloride, Calcium Chloride, Am, and Pu (Pyrochemical) Oxide Reduction	[illegible] ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	~~Confirmation Analysis~~ Results
	In 1985 there was a major stationary furnace breach in Glovebox 865 which contaminated the entire room with Pu and Am. Smears taken immediately after from around the room measured infinity. It took an entire year to completely decontaminate the room. Walls, floors, ceiling, and pipes were painted after decontamination to fix any remaining contamination. There were reports of contamination in the ventilation system servicing the room. This contamination may have migrated to adjacent rooms.	Molten Extraction Salt Scrub Electrorefining	
160A	Room 160A was a vault which contained Special Nuclear Material (SNM). SNM was removed from this vault in 1996.	Radiological Contamination Am and Pu	Rad Survey (Class 1)
161	Janitor Closet	N/A	Rad Survey (Class 1) ACBM
162	Machine Shop	WD-40 Methyl alcohol Machine parts Machine turnings	Rad Survey (Class 1) ACBM
163	This room is currently being used for empty drum storage.	N/A	Rad Survey (Class 1) ACBM
163A	Office	N/A	Rad Survey (Class 1)
164	Hallway (Airlock)	N/A	Rad Survey (Class 2)
165	Double Doors	N/A	Rad Survey (Class 1)
166	Airlock	N/A	Rad Survey (Class 3)
167	Women's Locker Room	N/A	Rad Survey (Class 1)
167A	Women's Shower	N/A	Rad Survey (Class 2) ACBM
202	Office	N/A	Rad Survey (Class 3) ACBM
203	Office	N/A	Rad Survey (Class 3) ACBM
204A	Office	N/A	Rad Survey (Class 3) ACBM
204B	Office	N/A	Rad Survey (Class 3) ACBM
205	Office	N/A	Rad Survey (Class 3) ACBM
207A	Office	N/A	Rad Survey (Class 3) ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	~~Confirmation Analysis~~ results
209	Office	N/A	Rad Survey (Class 3) ACBM
212	Office	N/A	Rad Survey (Class 3) ACBM
212A	Office	N/A	Rad Survey (Class 3) ACBM
214	Office	N/A	Rad Survey (Class 3) ACBM
Area 2 - Second Floor Rooms			
215	Hallway (Airlock)	N/A	Rad Survey (Class 1) ACBM
216	Hallway	N/A	Rad Survey (Class 1) ACBM
217	Room 217 was part of Product Physical Chemistry which performed research and development studies for production support, product material surveillance, material research, and material compatibility studies. Equipment - This room contains a contaminated auger and surface analysis ESCA. This was attached to a relatively new (late 1980s) stainless steel, non-lead lined glovebox (Glovebox 330-371).	Pu, trichloroethane, freon, ethanol, methanol, and uranium	Rad Survey (Class 1) ACBM Be 0.08
218	Room 218 was part of Product Physical Chemistry which performed research and development studies for production support, product material surveillance, material research, and material compatibility studies.	Pu, U, oils, solvents, inks, trichloroethane, methanol, freon TF, and ethanol	Rad Survey (Class 1) ACBM Be <0.
219	Restroom	N/A	Rad Survey (Class 1) ACBM
220	Metallurgy Laboratory Polymer Preparation Plutonium reaction studies	Pu, U, oils, solvents, inks, trichloroethane, methanol, freon TF, and ethanol	Rad Survey (Class 1) ACBM
221	This room stored several lecture bottles of gases and a large gas cylinder at one time.	N/A	Rad Survey (Class 1)
221A, 274, 275, 277	These rooms have miscellaneous furniture and equipment.	N/A	Rad Survey (Class 1) ACBM
221B	There is a drum liner stored here with fixed contamination. There is also laboratory jack which has fixed contamination. There is an uncontaminated vacuum system also present.	RAD Contaminants	Rad Survey (Class 1) ACBM
221C	Equipment Storage	N/A	Rad Survey (Class 1) ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	Results ~~Confirmation Analysis~~
222	Room 222 was part of Product Physical Chemistry which performed research and development studies for production support, product material surveillance, material research, and material compatibility studies.	Pu, U, oils, solvents, inks, trichloroethane, methanol, freon TF, and ethanol.	Rad Survey (Class 1) ACBM Be <0.1
222A	Storage Room	N/A	Rad Survey (Class 1)
223	Room 223 was a coatings laboratory which coated U, Be, stainless steel, and aluminum parts with a thin layer of metal. The basic process equipment used consisted of a vacuum chamber, arc welder, vacuum pump, and associated water cooling equipment. Hood 223-1 was used for beryllium coatings work. The floor in front of the hood is contaminated and there is probably contamination in the exhaust line from the hood. The hood is dirty inside and contains cans and beakers. There is fixed contamination on the sink top next to the hood. In the northwest corner there is a heater attached to a vent. Lead tape covers the holes in the south side of the heater cabinet. There is fixed contamination on the front of the filters leading into the cabinet. In the south center of the room is a vacuum coating furnace. The inside of the furnace is open to the room through an open side port. The furnace exhausts directly into the room so it is probably not contaminated inside. There is contamination in the lab on the north wall with large vacuum systems on the east wall. It is unclear if these systems are contaminated.	U, Be, aluminum, stainless steel, gold, platinum, palladium, vanadium, tantalum, yttrium, rhodium, nitric acid, and ethyl alcohol	Rad Survey (Class 1) ACBM Be <0.1
224	Decontamination Room	RAD Contaminants	Rad Survey (Class 1) ACBM
225	Room 225 was a coatings laboratory which coated U, Be, stainless steel, and aluminum parts with a thin layer of metal. The basic process equipment consisted of a vacuum chamber, arc welder, vacuum pump, and associated water cooling equipment.	U, Be, aluminum, stainless steel, gold, platinum, palladium, vanadium, tantalum, yttrium, rhodium, and nitric acid.	Rad Survey (Class 1) ACBM Be 0.2

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	Results Confirmation Analysis
	There is contamination on the northeast cabinet. There is a large vacuum. The room was used for sample preparation for X-ray analyses, Pu metallurgy, and tensile testing.		
226	Stairway	RAD Contaminants	Rad Survey (Class 1)
228	This room was used for sample preparation for X-ray analysis, Pu metallurgy, and tensile testing. Saltcrete Sample Analysis	Pu, U, oils, organic solvents, isopropanol, varsol, diamond paste, and freon TF. Saltcrete, Isocut cutting fluid, CDTA.	Rad Survey (Class 1) ACBM Be 1.42
229	Office	N/A	Rad Survey (Class 1) ACBM Be < 0.1
230	Office	N/A	Rad Survey (Class 1) ACBM Be < 0.1
231	Office	N/A	Rad Survey (Class 1) ACBM
232	Office	N/A	Rad Survey (Class 1) ACBM Be < 0.1
233	Metallurgy	Metallurgy, Be, U	Rad Survey (Class 1) ACBM Be < 0.1
234	Room 234 was part of the Pu physical metallurgy research and development group which prepared, analyzed, and collected various metallurgical samples.	Pu, oils, organic solvents, isopropanol, nitric acid, hydrofluoric acid, carbon tetrachloride, diamond paste, and freon TF.	Rad Survey (Class 1) ACBM Be 1.16
234A	Room 234 was part of the Pu Physical Metallurgy research and development group which prepared and analyzed various metallurgical samples. The X-ray unit has been removed from room. This room contains four empty drums and one empty overpack that was for a project that is no longer funded. Yellow paint was painted on the floor to cover contamination.	RAD Contaminants	Rad Survey (Class 1) ACBM
234B	This room was used as a dark room. There is no contamination.	Samples handled outside of gloveboxes.	Rad Survey (Class 1) ACBM
235	This room has a contaminated transmission electron microscope.	RAD Contaminants	Rad Survey (Class 1) ACBM Be < 0.1
236	Airlock and Bridge to B777	N/A	Rad Survey (Class 1)
237	Hall to Annex	N/A	Rad Survey (Class 1) ACBM Be 0.2
273	This room has fixed contamination on a box of electrical connectors.	RAD Contaminants	Rad Survey (Class 1) ACBM
274	Equipment Storage	N/A	Rad Survey (Class 1) ACBM
275	Equipment Storage	N/A	Rad Survey (Class 1) ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	Results ~~Confirmation~~ Analysis
277	Equipment Storage	N/A	Rad Survey (Class 1) ACBM
Area 3 - First and Second Floors			
121	Maintenance Shop	Vacuum pump oil, non-RCA circuit board w/silver & lead. RCA circuit board w/silver & lead. Lead acid batteries	Rad Survey (Class 3) ACBM
123	This is the decontamination room and likely has contamination in the process drains leading from it	RAD Contaminants	Rad Survey (Class 1) ACBM
124	This is an Radiation Control Technician (RCT) office.	N/A	Rad Survey (Class 1) ACBM
125	This room is a RCT office. Radiation sources are stored in the northeast corner of the room.	N/A	Rad Survey (Class 1) ACBM
128	This room is used for repair of radiation instruments. Radiation sources are stored in this room.	N/A	Rad Survey (Class 1) ACBM
130	Janitor Closet	N/A	Rad Survey (Class 1) ACBM
131	This was an aqueous laboratory supporting pyrochemical technology.	Pu, Am, tantalum, oils, solvents, calcium, calcium chloride, magnesium, gallium, zinc, tin, aluminum, and dicesium hexachloro-plutonate. Vacuum pump oil	Rad Survey (Class 1) ACBM
132	Source Check Lab	N/A	Rad Survey (Class 1) ACBM
133	Residue Storage	RAD Contaminants Oxide reduction	Rad Survey (Class 1)
134	There are three flammable chemical storage cabinets in this room.	Flammables	[illegible]
135	Supply Storage	N/A	Rad Survey (Class 1) ACBM
136	Chemical Technician Office	N/A	Rad Survey (Class 1) ACBM
137	Peroxide Precipitation Pu Oxide Dissolution Residue Recovery Extraction	Oxide residue, Pu Nitrate, spent resin $H_{2S}0_4$, Pu Oxide, leached metal, leached equipment	Rad Survey (Class 1) ACBM
138	Storage	N/A	Rad Survey (Class 2) ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	Results ~~Confirmation Analysis~~
139	Ferrite Actinide Removal	Ferrite material, acid wash, treated material	Rad Survey (Class 1) ACBM
140	Metal Preparation Laboratory	Depleted U, Be	Rad Survey (Class 1) ACBM
140A	Scanning Electron Support Room	RAD Contaminants	Rad Survey (Class 1) ACBM
140B	Scanning Electron Microscope (SEM)	RAD Contaminants	Rad Survey (Class 1) ACBM
141	ESCA	RAD Contaminants	Rad Survey (Class 1) ACBM
141A	Metallurgy Laboratory. Salt Crete Analysis	RAD Contaminants	Rad Survey (Class 1) ACBM
141B	This room has a scanning electron microscope. This system is uncontaminated.	Depleted U, Be, titanium, diamond paste, inorganic and organics acids, methylene chloride, acetone, methyl ethyl ketone, alcohols, oils, solvents, freon, and isopropanol	Rad Survey (Class 1) ACBM
141C	This room contains an uncontaminated metallograph and an uncontaminated optical reduction equipment. This equipment was used to photograph samples.	Depleted U, Be, titanium, diamond paste, inorganic and organics acids, methylene chloride, acetone, methyl ethyl ketone, alcohols, oils, solvents, freon, and isopropanol	Rad Survey (Class 1) ACBM
113	Assembly Technology Machine Shop	Machine turnings WD-40 Methyl alcohol Light metal	Rad Survey (Class 1) ACBM
171 & 172	These two rooms are active SNM storage vaults. A chainveyor vault is located in Rooms 172 and 171 and has Benelex-shielded cubicles. It is not known of any instances of prior contamination; however, it is assumed unlikely.	N/A	Rad Survey (Class 1)
173	Utility Area, Mechanical Room	N/A	[illegible]
270	Room 270 was part of Product Physical Chemistry which performed research and development studies for production support, product material surveillance, material research, and material compatibility studies. In the SE corner is a uncontaminated ESCA used for surface analysis. Glovebox 2115 is uncontaminated. Gloveboxes 972 and 973 are contaminated and were used for Pu and hydrogen studies.	Pu, U, oils solvents, inks, trichloroethane, methanol, freon TF, and ethanol.	Rad [illegible] ACBM Be [illegible]

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	Results ~~Confirmation~~ Analysis
	In the northwest corner were two X-ray units which were removed, placed into crates, and now are being stored in Room 157 (these were partially contaminated). There is a satellite storage area (Room #7792238) for polymer development. B-box 270-N is empty, but is contaminated; however, contamination is U-235. Glovebox 3072 is contaminated and has some tools remaining. This glovebox also has U-235 contamination.		
271	Room 271 has low-level mixed waste storage cabinets for treatability studies where samples were being stored by the Polymer Development Team. These are also being used for storage of archived low-level mixed waste samples.	RAD Contaminants	Rad Survey (Class 1) ACBM
272	This was a testing laboratory. The center Glovebox 6620 is uncontaminated. Glovebox 6621 is Pu contaminated. Class C explosives were stored in the file cabinet.	RAD Contaminants	Rad Survey (Class 1)
273, 274, 275, & 277	Office Areas	N/A	Rad Survey (Class 1) ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	Results ~~Confirmation~~ Analysis
Area 4-Areas Of The Building Not Known to be Radiologically Contaminated			
Various Office / Admin. Areas	This area of the building consists of the offices and work areas on the east side of the building that are not contained within the MAA and are considered uncontaminated. There are cold machine shops (Rooms 113, 121, & 162), showers and locker rooms (Rooms 103 & 167), an emergency generator (Room 117), a control room for building operations (Room 122), and various offices on both the first and second floor. It is anticipated that there will be minimal hazards associated with this area of the building.	N/A	Rad Survey (Class 3) ACBM
Area 5 - Rooms 001, 126, 127, and 142			
001	Basement Sumps	RAD Contaminants Chromium	Rad Survey (Class 1) ACBM
126	This is a utility area and should not contain appreciable amounts of Pu other than what might be in process piping. There are gloveboxes for house vacuum and batteries for uninterrupted emergency power supply. In Room 126, there is a helium tank system and scrubber on the west wall for a helium inert glovebox in Room 133. It was abandoned in the late 1970s or early 1980s. The system never went hot. There is an abandoned water still for producing distilled water from sanitary water. The cooling water from this system went into T-5. The still should be uncontaminated. The sub-basement (Room 001) below has all process piping for the T-5 tank (i.e., holding tank for all B779 process drains including all lab sinks). This was a RCRA tank, but it has been flushed, triple rinsed, and now receives only sanitary and eyewash liquids. It is closed as a RCRA site. This tank can also receive low-level solutions, as needed. The liquid in the tank now is water from chillers, condensate water, and water from eye wash and safety showers.	RAD Contaminants Asbestos Chromium	Rad Survey (Class 1) ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	Results ~~Confirmation Analysis~~
	The room above the T-5 tank houses pumps and two cooling water system tanks. There are two other pits in addition to the one containing the T-5 tank that are accessed from the pump room. These pits are labeled as contaminated. There are asbestos-lined pipes (condensate steam lines) overhead in this pump room. There are two old concrete pump bases from which pumps have been removed and never replaced. These have been painted over. It is possible that there is contamination underneath the paint.		
127	This is a utility room containing chillers and part of the building's original ventilation system. The filter plenum is contaminated and there is asbestos in the room. The chillers are considered uncontaminated.	RAD Contaminants Asbestos	Rad Survey (Class 1) ACBM
142	This is a utility room containing part of the building's original ventilation system. This room was used as a RCRA storage unit for waste oil.	Oils	Rad Survey (Class 1) ACBM
Area 6 - Support Buildings 727, 729, 780, 780A, 782, 783, and Associated Cooling Towers			
B727	Building 727 houses a 500-kilowatt generator which provides emergency power to Building 782. The building is approximately 380 ft^2 and is constructed of concrete block and reinforced concrete. There is a fire protection system with antifreeze solution and an electric space heater also in the building.	RAD Contaminants Asbestos	Rad Survey (Class 3)
143	Airlock to Annex	N/A	Rad Survey (Class 1)
120	Old Change Room	N/A	Rad Survey (Class 1)
B729	This plenum building is approximate 3,000 ft^2 and is a one-story concrete block building with a small penthouse on the roof. This building is located south of Building 779 and provides zone one and room air ventilation to the storage vaults and the rooms directly above the storage vaults on the south side of Building 779. Buildings 779 and 729 are connected by an overhead tunnel containing exhaust ductwork.	RAD Contaminants Asbestos	Rad Survey (Class 1) ACBM

Room No.	Process Information	Radioactive And/Or Hazardous Substances Known To Have Been In Area	~~Confirmation Analysis~~ results
	Building 729 contain two filter banks, a four stage and a two stage, glovebox and room air respectively. There is a control room and a 150 kilowatt emergency generator. There are two pits located in the building to collect fire sprinkler waste water. The fire protection system for the building consists of wet-pipe sprinkler system with heat detectors and manual and automatic sprays in the plenum.		
B780	Building 780 is a corrugated metal shed attached to the northeast corner of Building 779. It has been used to store paint, solvents, miscellaneous equipment, and other material.	Paints And Solvents	Rad Survey (Class 3) ACISm
B780A	Building 780A is another storage facility located east of Building 779 which is constructed of corrugated steel. There are no utilities or fire protection associated with this facility.	N/A	Rad Survey (Class 3) ACISm
B782	This plenum building is approximate 6,200 ft^2 and is a one-story precast, reinforced concrete building. It is located east of Building 779 and provides Zone 1 and room air ventilation to the rest of Building 779. Buildings 779 and 782 are connected by an underground tunnel containing exhaust ductwork. Building 782 contains three exhaust plenums for Buildings 779 and 782 and a supply air plenum for Building 782. There is a fire water collection tank and a sump pit on the west side of the building. The fire protection system for the building consists of wet-pipe sprinkler system with heat detectors and manual and automatic sprays in the plenum.	Asbestos	Rad Survey (Class 1) ACISm
B783 & Cooling Towers	Building 783 provides cooling water to Building 779. It is constructed of aluminum, steel, and reinforced concrete. There is no fire protection system associated with this facility. The cooling towers themselves are constructed of metal and will require minimal deactivation effort.	Asbestos	Rad Survey (Class 3) ACISm

Table Notes (Footnotes to be added)

ACBM = Asbestos Containing Building Material

Bu units = ug/ft^2

Appendix B

Building 779 Holdup Results

BUILDING 779 HOLDUP RESULTS

Bldg.	Room Number	Est. Cat.	Glovebox Number	Comments	Grams	(+/-2S)	Upper Bound (Grams)
779	133	C	954	furnace	104	79	183
779	154	C	1363	Inc. furnaces	464	300	764
779	154	C	1364	Inc. furnaces	572	330	902
779	154	C	1365		106	66	172
779	154	C	7248		129	66	195
779	160	C	862/3 Equip.	2 closed furnaces	255	82	337
779	160	C	865	2 closed furnaces	203	141	344
		Total Category C Plutonium Holdup (grams) =			1833		
779	126	D	126		LLD	(0,9)	9
779	127	D	Plenum 404		LLD	(0,37)	37
779	131	D	961	calciner	54	32	86
779	131	D	131C	A-Box Aqueous	LLD	(0,15)	15
779	131	D	9511		LLD	(0,18)	18
779	131	D	131A	A-Box Aqueous	LLD	(0,10)	10
779	131	D	131B	A-Box Aqueous	LLD	(0,12)	12
779	131	D	131D	A-Box Aqueous	LLD	(0,10)	10
779	131	D	131E	A-Box Aqueous	LLD	(0,9)	9
779	133	D	953	Never went hot	LLD	(0,9)	9
779	133	D	955	furnace	21	13	34
779	133	D	956	furnace	31	15	46
779	133	D	957		29	15	44
779	133	D	958		LLD	(0,17)	17
779	133	D	959	furnace	50	13	63
779	133	D	954	equipment, Pu	4	3	7
779	133	D	955	equipment	34	17	51
779	133	D	956	equipment	24	10	34
779	133	D	957	equipment	12	7	19
779	133	D	959	equipment	36	13	49
779	137	D	106-6	filter	56	28	84
779	137	D	106-2		17	9	26
779	137	D	106-1	Aqueous	22	11	33
779	137	D	106-5		8	4	12
779	137	D	1063		17	9	26
779	137	D	106-B		LLD	(0,14)	14
779	137	D	106-1-hood		LLD	(0,9)	9
779	137	D	106-2-hood		LLD	(0,6)	6
779	137	D	106-4		9	4	13
779	139	D	139-1	hood	LLD	(0,10)	10
779	139	D	139-2	hood	LLD	(0,8)	8
779	139	D	139-3	glovebox	LLD	(0,6)	6
779	139	D	139-4	glovebox	LLD	(0,8)	8
779	139	D	139-5	hood	LLD	(0,8)	8

BUILDING 779 HOLDUP RESULTS

779	142	D	PL405	return air Pl	LLD	(0.124)	124
779	150	D	box		LLD	(0.6)	6
779	150	D	N Hood		LLD	(0,12)	12
779	150	D	S Hood		LLD	(0.15)	15
779	150	D	W Hood		6	3	9
779	152	D	208		25	12	37
779	152	D	211		67	32	99
779	154	D	S Purifier		5	4	9
779	154	D	S Dif. Pump		9	5	14
779	154	D	C Dif. Pump		30	15	45
779	154	D	N Filter		LLD	(0.1)	1
779	154	D	Filter above S. airlock		LLD	(0.1)	1
779	154	D	Filter Trap		1	1	2
779	154	D	Filter above N. airlock		29	15	44
779	154	D	S end pump		LLD	(0.2)	2
779	154	D	N Purifier		10	8	18
779	154	D	2025		LLD	(0.15)	15
779	154	D	4933		40	44	84
779	154	D	Filter below GP283		66	33	99
779	155	D	155H		LLD	(0,10)	10
779	155	D	218		15	8	23
779	155	D	219		7	3	10
779	155	D	220		LLD	(0.8)	8
779	155	D	221H		LLD	(0.7)	7
779	155	D	222		42	21	63
779	155	D	223		LLD	(0.6)	6
779	155	D	224		LLD	(0.6)	6
779	155	D	225H		LLD	(0.7)	7
779	157	D	223		LLD	(0.22)	22
779	157	D	224		LLD	(0.15)	15
779	157	D	226		LLD	(0,11)	11
779	160	D	857	furnace	79	4	128
779	160	D	857	filter housing	31	6	37
779	160	D	858	salt drying	LLD	(0.10)	10
779	160	D	860	SNM storage	LLD	(0.13)	13
779	160	D	859	button breakout	55	43	98
779	160	D	862/863	continuation of 86	67	64	131
779	217	D	330-371	auger	4	10	14
779	217	D	963	misc. furnaces	8	6	14
779	217	D	964	storage/vac pumps	17	15	32
779	217	D	Hood E	vault in NW corner	LLD	(0.10)	10
779	218	D	218S	cemenatation	LLD	(0.10)	10
779	218	D	970	oxidation and storage	11	20	31
779	218	D	971	reaction vessal	25	13	38

BUILDING 779 HOLDUP RESULTS

779	220	D	463	muffle furnace	60	30	90
779	220	D	220SE	storage	LLD	(0,11)	11
779	220	D	220C	gas experiments	LLD	(0,17)	17
779	220	D	220S	muffle furnace	LLD	(0.19)	19
779	220	D	462	furnace and hot pt	70	29	99
779	220	D	974	gas reaction	82	54	136
779	222	D	17		LLD	(0,10)	10
779	222	D	105	muffle furnace	35	17	52
779	222	D	106	B box	LLD	(0,9)	9
779	222	D	222NC	Hood/U	LLD	(0.12)	12
779	222	D	230	Blanked	LLD	(0.16)	16
779	222	D	330-371	Sol Calor.	LLD	(0.9)	9
779	222	D	555	Hood	LLD	(0,12)	12
779	222	D	460	gas reactions	LLD	(0.12)	12
779	222	D	976	vacuum furnace	17	7	24
779	222	D	980	nitrogen	LLD	(0.14)	14
779	222	D	981	B box	LLD	(0,7)	7
779	222	D	982	muffle furnace	LLD	(0,7)	7
779	222	D	983	cold	LLD	(0,11)	11
779	222	D	985		LLD	(0.19)	19
779	222	D	989	2 tube furnaces	14	10	24
779	222	D	991	SNM storage	LLD	(0.21)	21
779	222	D	992	tumbler/press	21	24	45
779	222	D	975	compat. studies	62	13	75
779	223	D	223-1	hood	LLD	(0.11)	11
779	228	D	45		LLD	(0.27)	27
779	228	D	468	sputtering coate	LLD	(0,19)	19
779	228	D	191	B box	LLD	(0.10)	10
779	228	D	192		16	7	23
779	228	D	198	vac furnace	LLD	(0,9)	9
779	228	D	200	tube furnace	LLD	(0.14)	14
779	228	D	201	microbalance	LLD	(0.8)	8
779	228	D	202	temp bath	11	10	21
779	228	D	202H	hood	LLD	(0,21)	21
779	228	D	203	polishing/vac system	31	24	55
779	228	D	468	sputtering coate	11	5	16
779	228	D	199	bottle of graphite	200	195	395
779	228	D	199	Pu polishing	154	58	212
779	234	D	205	sample prep	42	60	102
779	234	D	205A	ultrasonic	21	17	38
779	234	D	205B		16	16	32
779	234	D	205C		40	14	54
779	234	D	205D		LLD	(0.7)	7
779	270	D	972		9	5	14
779	270	D	973		LLD	(0.6)	6

BUILDING 779 HOLDUP RESULTS

779	270	D	3072	has B box inc.	LLD	(0,16)	16
779	270	D	2115		LLD	(0,6)	6
779	272	D	6620	boost testing	LLD	(0,7)	7
779	all	D	duct	G9 exhaust system	490	224	714
			Total Grams (d) Plutonium Holdup =		2280	2-sigma upper bound	4610
			Total Grams(c)+(d) Plutonium Holdup =		4113	2-sigma upper bound	7507
				^{241}Americium Holdup			
779	133	D	955	equipment. Am	3	1	4
779	133	D	956	equipment. Am	2	1	3
779	133	D	957	equipment. Am	1	1	2
779	133	D	959	equipment, Am	1	1	2
779	133	D	all gbs	Am	62	25	87
			Total Grams ^{241}Americium Holdup =		69	2-sigma upper bound	94

Plutonium Holdup Measurements associated with but not in Building 779

782	PL401	D		Glovebox exhaust	13	17	30
782	PL402	D		Glovebox exhaust	27	58	85
729	P1408	D	PLENUM		LLD	(0,146)	146
728	P1409	D	PLENUM		LLD	(0,71)	71
729	D409	D	DEMISTER		LLD	(0,23)	23

*LLD (Lower Unit of Detection) = 0 grams

Appendix C

779 ACBM Summary Table

779 Cluster ACBM Summary Table

Building	Material	Location (Room #)	Amount
779A	Pipe Insulation > 4" Diameter	142	1132 ft^2 (722 l.f.)
	Pipe Insulation < 4" Diameter	142, 149, 150, 152, 153, 154, 155, 156, 157, 159, 160, 161, 162, Covered Dock.	3,228 l.f.
	Duct Insulation	142	1079 ft^2
	Tank Insulation	142	63 ft^2
	Flue Insulation	142	130 ft^2
	Pump Ins.	142	89 ft^2
	Brake shoes	144 elevator	4 each
	Cement Wallboard	150, 155 chemical hoods; Covered Dock	1020 ft^2
	Chalkboard	158	1 @ 24 ft^2
	Drywall Systems	162, 167A	1480 ft^2
	Floor tile/mastic	145, 146, 147, 149, 151, 156, 161, 163	2138 ft^2
779	Pipe Insulation > 4" Diameter	121, 122, 126, 127	1689 ft^2 (1432 l.f.)
	Pipe Insulation < 4" Diameter	001, 100, 103, 103B, 105, 106, 107, 108, 110, 110A, 111, 113, 114, 115, 116A, 116, 117, 118, 119E, 119W, 120, 121, 123, 126, 127, 130, 131, 137, 139, 140, 141, 141A-C, 201, 204, 205, 207, 208, 209, 210A, 211, 212, 212A, 213, 214, 215, 216E, 216W, 217, 218, 219, 220, 222, 223, 224, 228, 234, 234A, 779R	6069 l.f.
	Duct Insulation	126, 127, 779R	280 ft^2
	Tank Insulation	001, 127	233 ft^2
	Flue Insulation	117	32 ft^2
	Pump Ins.	127	40 ft^2
	Brake shoes	104 elevator	4 each
	Cement Wallboard	106, 107, 108, 109, 110, 110A, 111, 121, 125, 128, 132, 135, 136, 141, 141A-C, 201, 201A-B, 202, 202A, 203, 204, 207, 207A-C, 221B, 221C, 223, 225, 229, 230, 231, 232, 235	7662 ft^2
	Cement Counter	222, 223	56 ft^2
	Drywall Systems	236	150 ft^2

Building	Material	Location (Room #)	Amount
	Floor tile/mastic (carpet)	106, 107, 108, 109, 201, 201A-B, 203, 204, 204A-B, 205, 206, 207, 207A-C, 208, 213, 214	5575 ft^2
	Floor tile/mastic	110, 110A, 111, 114, 115, 116A, 118, 119E, 119W, 122, 124, 128, 132, 135, 136, 138, 140, 140A-B, 141, 141A-C, 202, 202A, 209, 210, 210!, 212, 215, 216E, 216W, 219, 221, 221A-C, 223, 229, 230, 231, 232, 233, 235, 237	11861 ft^2
	Chalkboard	110A, 119E, 128, 205, 221, 221A-C, 228, 229, 230, 231, 232	14 total @ 336 ft^2
	Duct/wall filler	113, 114, 115, 116, 117, 131, 137, 139, 141, 141A-C, 201, 202, 203, 204, 205, 207, 208, 209, 214, 215, 216E, 216W, 228	294 ft^2
	Panel glue	203	414 ft^2
779B	< 4" diam pipe insulation	173, 270, 273-275, 277	362 l.f.
	Drywall system	271	430 ft^2
	Floor tile/mastic	273-275, 277	498 ft^2
	Roofing felt/tar	South side of building	2100 ft^2
729	< 4" diam pipe insulation	throughout	384 l.f.
780	Drywall system	walls, ceiling	560 ft^2
782	4" or greater pipe insulation	throughout	456 ft^2 (279 l.f.)
	< 4" diam pipe insulation	throughout	272 l.f.

Appendix D

779 Cluster Beryllium Survey Sample Results

Appendix D 779 Cluster Beryllium Surface Survey Results

Room #	Sample Location & Description	Samples Results ug/ft^2
115	Cabinet #35278-00, second drawer	0.30
134	Flammable cabinet 40	<0.05
139	Desk top, beneath cabinet #1	<0.05
140	Bench #1, east side, right section of drawers, top drawer	0.11
140	Bench #1, east side, middle section of drawers, top drawer	0.58
140	Bench #1, east side, left section of drawers, second drawer	0.33
140	Bench #1, east side, left section of drawers, third drawer	<0.1
140	Bench #1, west side, right section of drawers, top drawer	<0.1
140	Bench #1, west side, middle section of drawers, top drawer	<0.1
140	Bench #1, west side, middle section of drawers, second drawer	2.88
140	Bench #1, west side, left section of drawers, top drawer	<0.1
140	Bench #1, west side, top of bench	0.06
140	Cabinet #35825-00, top drawer	0.52
140	Cabinet #35825-00, second drawer	0.32
140	Cabinet #35825-00, third drawer	0.14
140	Cabinet #5, second shelf	0.10
140	Cabinet #5, bottom shelf	0.41
140	Counter top beneath cabinet 5	<0.1
140	Cabinet 9, bottom right of cabinet	<0.1
150	Random survey inside portable tool chest	<0.1
150	Random survey inside portable tool chest	<0.1
150	Cabinet #5, top shelf	2.10
150	Cabinet #5, second shelf	2.11
150	Cabinet #1, top three shelves	0.64
150	Cabinet #1, bottom two shelves	0.78
150	Blue cabinet,north central wall, second shelf	0.24
155	Cabinet #3, top shelf	<0.1
155	Cabinet #3, second shelf	<0.1
155	File card cabinet, south east corner of room, random locations	<0.1
155	File card cabinet, south east corner of room, random locations	<0.1
155	File card cabinet, south east corner of room, random locations	<0.1
155	File card cabinet, south east corner of room, random locations	<0.1
157	Box, north west corner of room, random location	<0.1
157	Box, north west corner of room, random location	<0.1
201A	Grey file cabinet, bottom drawer, front section	<0.1
201A	Grey file cabinet, bottom drawer, back section	<0.1
201A	Cabinet #76-1250-X-16804, bottom drawer	0.29
201A	Cabinet #76-1250-X-16804, second drawer from bottom	0.20
201A	Cabinet #76-1250-X-16804, third drawer from bottom	1.24
201A	Cabinet #76-1250-X-16804, fourth drawer from bottom	<0.1
201A	Cabinet #76-1250-X-16804, fifth drawer from bottom	<0.1
201A	Tan file cabinet, top drawer	<0.1
217	Cabinet along north wall, bottom shelf	<0.1
217	Cabinet #36052-00, shelves C1710, C1711, C1706 & C1707	0.08
217	Cabinet #36052-00, shelves C1708, C1709, C1712 & C1713	<0.05
217	Cabinet #36052-00, shelves C1714, C1715, C1718 & C1719	0.08

Appendix D 779 Cluster Beryllium Surface Survey Results

Room #	Sample Location & Description	Samples Results ug/ft^2
217	Cabinet #36052-00, shelves C1716, C1717, C1720 & C1721	0.06
218	Cabinet #1, fourth shelf	<0.1
222	Cabinet #7, top of cabinet	<0.1
222	Cabinet #7, top of cabinet	<0.1
222	Cabinet #7, north drawer	<0.1
222	Cabinet #7, south drawer	<0.1
223	East bench, right top drawer	<0.1
225	Blue cabinet labeled "Caution Beryllium", top shelf	<0.1
225	Blue cabinet labeled "Caution Beryllium", second shelf	<0.1
225	Blue cabinet labeled "Caution Beryllium", third shelf	<0.1
225	Blue cabinet labeled "Caution Beryllium", fourth shelf	<0.1
225	Blue cabinet labeled "Caution Beryllium", fifth shelf	<0.1
225	Blue cabinet labeled "Caution Beryllium", sixth shelf	<0.1
225	Blue cabinet labeled "Caution Beryllium", bottom shelf	<0.1
225	Cabinet #1, left bottom shelf	<0.1
225	Grey tool box, first large drawer	0.21
225	Grey tool box, small drawer, top left side	<0.1
228	Cabinet #7, top shelf	<0.1
228	Cabinet #7, second and third shelves	<0.1
228	Cabinet #7, fourth and fifth shelves	<0.1
228	Cabinet #7, bottom shelf	<0.1
228	Cabinet #1, top shelf	<0.1
228	Cabinet #1, second shelf	0.25
228	Cabinet #1, third shelf	<0.1
228	Cabinet #1, fourth shelf	<0.1
228	Cabinet #1, fifth shelf	<0.1
228	Card file cabinet, south wall by Column C-4, first, second & third drawers	<0.1
228	Card file cabinet, south wall by Column C-4, fourth, fifth & sixth drawers	0.18
228	Cabinet #11, top shelf	<0.1
228	Cabinet #11, second shelf	<0.1
228	Cabinet #11, third shelf	0.69
228	Cabinet #11, fourth shelf	<0.1
228	Cabinet #11, fifth shelf	<0.1
228	Cabinet #11, sixth shelf	0.18
228	Cabinet #11, bottom shelf	0.35
228	File cabinet along east wall, third drawer	1.62
228	File cabinet along east wall, fourth drawer	<0.1
229	Grey file cabinet, top drawer	<0.1
229	Grey file cabinet, second drawer	<0.1
229	Grey desk, east side, middle drawer	<0.1
229	Grey desk, east side, top left drawer	<0.1
230	Orange file cabinet, top drawer	<0.1
230	Orange file cabinet, second drawer	<0.1
232	Desk, east side, top of desk	<0.05
232	Desk, east side, top left drawer	<0.1
232	Desk, east side, bottom left drawer	<0.1
232	Desk, east side, middle drawer	<0.1

Appendix D 779 Cluster Beryllium Surface Survey Results

Room #	Sample Location & Description	Samples Results ug/ft^2
232	Desk, east side, top right drawer	<0.1
232	Desk, east side, middle right drawer	<0.1
232	Desk, east side, bottom right drawer	<0.1
232	Grey file cabinet, top drawer	<0.1
232	Grey file cabinet, bottom drawer	<0.1
232	Desk, north side, top right drawer	<0.1
232	Desk, north side, bottom right drawer	<0.1
232	Desk, north side, middle drawer	<0.1
232	Desk, north side, top left drawer	<0.1
232	Desk, north side, middle left drawer	<0.1
232	Desk, north side, bottom left drawer	<0.1
233	East bookshelf, south side, top shelf	<0.1
233	East bookshelf, south side, bottom shelf	<0.1
233	Desk, east side, top of desk	<0.05
233	Desk, east side, top right desk	<0.1
233	Desk, east side, middle right drawer	<0.1
233	Desk, east side, bottom right drawer	<0.1
233	Desk, east side, middle drawer	<0.1
233	Desk, east side, top left drawer	<0.1
233	Desk, east side, bottom left drawer	<0.1
234	Desk, north west wall, top left drawer	1.16
234	Desk, north west wall, middle left drawer	<0.1
234	Desk, north west wall, bottom left drawer	<.01
234	Desk, north west wall, top right drawer	<0.1
234	Desk, north west wall, second right drawer	<0.1
234	Desk, north west wall, third right drawer	<0.1
234	Desk, north west wall, bottom right drawer	<0.1
234	Cabinet over desk along north west wall, top shelf	<0.1
234	Cabinet over desk along north west wall, second shelf	<0.1
234	Cabinet, north side second shelf	<0.1
235	Boxes in northwest corner of room	<0.1
235	Cabinet, west side, top shelf	<0.1
235	Cabinet, west side, bottom shelf	<0.1
235	Cabinet, south side, top shelf	<0.1
235	Cabinet, south side, middle shelf	<0.1
235	Cabinet, south side, bottom shelf	<0.1
237	Cabinet #1, fifth shelf	<0.1
237	Cabinet #1, bottom shelf	0.20
270	Pan next to sink, east side	<0.1
270	Bench #3, east side, top right drawer	<0.1
270	Bench 3, east side, top right drawer	<0.1
270	Bench #3, east side, second middle drawer	<0.1