# Building JN-1 Hot Cell Laboratory

## Acceptable Knowledge Document

August 2001

TCP-98-03

*Prepared for:*
Battelle Columbus Laboratories
Decommissioning Project (BCLDP)
Columbus, Ohio

*Prepared by:*

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## PLAN APPROVAL PAGE

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*Wastren, Inc.*

This plan, TCP-98-03, *Building JN-1 Hot Cell Laboratory Acceptable Knowledge Document,* has been reviewed and approved by the following.

**Approved By:**

____________________________________ _______________

*J. Eide* *Date*
*Project Manager, TRU Waste Program*

# EXECUTIVE SUMMARY

In April 1943, Battelle Memorial Institute (BMI), a private research and development corporation, entered into a contract with the Manhattan Engineering District to perform atomic energy research and development activities. Since that time, a majority of the work performed has been in support of research programs for the U.S. Department of Energy (DOE) and its predecessors. BMI supported research for the nuclear power industry and performed projects for other government agencies including the U.S. Navy, U.S. Army, and U.S. Air Force. As a result of BMI's participation in this atomic energy research, portions of 15 buildings became radioactively contaminated. These buildings and grounds are to be decontaminated and decommissioned under the Battelle Columbus Laboratories Decommissioning Project (BCLDP). The BCLDP is being overseen by the DOE-Columbus Environmental Management Project (DOE-CEMP).

Three of the affected facilities are located at the Battelle Columbus Laboratories West Jefferson North site, including the Hot Cell Laboratory (Building JN-1). This facility was constructed in 1955 primarily to support the emerging nuclear power industry. The primary mission of the facility was the examination of nuclear reactor fuels and reactor structural materials for the DOE. During the history of the Hot Cell Laboratory, ongoing defense research supporting the development of nuclear reactors was conducted primarily for the U.S. Navy. Defense-related work was also conducted for the U.S. Air Force and U.S. Army.

The purpose of this document and supporting documentation is to present the TRU waste management acceptable knowledge available for suspect transuranic (TRU) waste generated from the Hot Cell Laboratory. Acceptable knowledge refers to information that can be used for waste characterization in lieu of or in conjunction with waste sampling and analysis. The primary objective is to provide a consistent, defensible, and auditable record of information to be used during the certification of waste destined for disposal at the Waste Isolation Pilot Plant (WIPP). The materials characterized in this document consist of suspect TRU waste that may be generated based on existing documentation. These wastes will be processed and packaged for disposal at WIPP and do not represent the final waste stream.

Several hundred sources of information were reviewed during the development of this document. Relevant documentation sources were incorporated into a data management system. These references are identified in Appendix A and are grouped into four categories: published documents, unpublished data, correspondence, and discrepancy reports. These categories correspond to the "P," "U," "C," and "D" superscripts used throughout this document (e.g., [P001]). These superscript identifiers can be used to link the information in this document to the source.

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AK | Acceptable Knowledge |
| APPR | Army Package Power Reactor |
| BCL | Battelle Columbus Laboratories |
| BCLDP | Battelle Columbus Laboratories Decommissioning Project |
| BMI | Battelle Memorial Institute |
| °C | degrees centigrade |
| CAA | Controlled Access Area |
| CAO | Carlsbad Area Office (now Carlsbad Field Office) |
| CBFO | Carlsbad Field Office |
| CEMP | Columbus Environmental Management Project |
| CFR | *Code of Federal Regulations* |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| HEC | High Energy Cell |
| HEPA | High Efficiency Particulate Air |
| HLC | High Level Cell |
| INEEL | Idaho National Engineering and Environmental Laboratory |
| JN-1 | West Jefferson North Hot Cell Laboratory (Building JN-1) |
| JN-2 | West Jefferson North Critical Assembly Laboratory (Building JN-2) |
| JN-3 | West Jefferson North Research Reactor Building (Building JN-3) |
| JN-4 | West Jefferson North Plutonium Laboratory (Building JN-4) |
| Mev | mega electron volts |
| MTC | Mechanical Test Cell |
| NRC | Nuclear Regulatory Commission |
| PCBs | polychlorinated biphenyls |
| QAPD | Quality Assurance Program Document |
| QAPjP | Quality Assurance Project Plan |
| RAL | Radioanalytical Laboratory |
| RCRA | Resource Conservation and Recovery Act |
| RH | remote-handled |
| SNF | spent nuclear fuel |
| TBD | to be determined |
| TMI | Three Mile Island |
| TRU | transuranic |
| TSCA | Toxic Substances Control Act |
| WAC | Waste Acceptance Criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP-WAP | Waste Analysis Plan for the Waste Isolation Pilot Plant, Attachment B of the WIPP Hazardous Waste Permit |

# 1.0 INTRODUCTION

Transuranic (TRU) waste generated by the Battelle Columbus Laboratories Decommissioning Project (BCLDP) will be characterized to address the objectives of the U.S. Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) TRU Waste Characterization Program. Program requirements for TRU waste characterization are provided in the WIPP Hazardous Waste Permit, Attachment B, Waste Analysis Plan (WIPP-WAP).[(1)] Implementation of these requirements is described in the Transuranic Waste Characterization Quality Assurance Project Plan for the BCLDP TRU Waste Certification Program (QAPjP).[(2)] The WIPP-WAP and QAPjP require that a consistent, defensible, and auditable record of characterization information is collected, reviewed, and managed.

The WIPP-WAP requires sites certifying TRU waste for disposal at WIPP to compile and maintain an acceptable knowledge (AK) record relating site history, mission, and waste management. In addition, waste stream specific data describing the physical and chemical composition of the waste and the originating process are required for certification. The method used to collect, review, and manage the AK documentation required by the WIPP-WAP and the BCLDP QAPjP is performed in accordance with procedure TC-AP-03.1, Collection, Review, and Management of Acceptable Knowledge Documentation.[(3)] Implementation of this procedure generates three primary sources of published AK documentation:

**TRU Waste Management Documentation**—Summarizes the required TRU waste management information required by the WIPP-WAP, including the preliminary characterization of waste materials that represent the inputs to the BCLDP TRU waste packaging processes. This document, TCP-98-03, Building JN-1 Hot Cell Laboratory Acceptable Knowledge Document, presents the program level and preliminary characterization information.

**TRU Waste Process Descriptions**—Summarizes the TRU waste stream information required by the WIPP-WAP for each process generating TRU waste streams. These reports are prepared prior to TRU waste processing to describe the waste inventory to be processed, process inputs, and TRU waste streams that will be certified for disposal at WIPP by the BCLDP program.

**TRU Waste Confirmation Reports**—Verifies AK by identifying any process deviations, resolving discrepancies, and ensuring that the Project Data Quality Objectives have been achieved based on the inspection and confirmation analyses of each TRU waste container.

The primary purpose of this document is to present the required TRU waste management AK associated with the potentially TRU waste historically generated in the Hot Cell Laboratory (Building JN-1) at the West Jefferson North site, including

- Maps of the West Jefferson North site and Building JN-1
- Summaries of the history and mission for the site and laboratory

- Descriptions of the historical laboratory operations and waste management practices
- Type and quantity of potentially TRU waste contained in JN-1.

During the AK review process, potentially TRU waste materials contained in Building JN-1 were identified and grouped into categories based primarily on the matrix of the waste (Sections 4 through 12). The waste was then characterized as it exists in the building, with the knowledge that many of the materials (hydraulic oil, liquids, etc.) will require further processing to be eligible for disposal at WIPP. In addition, non-waste materials (i.e., light bulbs, leaded glass, and lead shielding) were characterized in advance of remediation. These waste materials represent the inputs to the BCLDP operations that will process TRU waste streams. This materials assessment and the supporting AK source documentation will be used as the basis for subsequent TRU waste stream segregation and characterization activities. Waste populations identified in Sections 4 through 12 will be grouped into waste streams, described in the TRU Waste Process Descriptions, based on chemical characterization and physical composition. This document also provides the basis for the following:

- Defense waste justification
- Spent nuclear fuel and high level waste discussions
- JN-1 Hot Cell Laboratory standard facility radionuclide distribution.

The primary sources of AK were collected from historical files maintained in file cabinets in Building JN-2 at the West Jefferson site. Other sources include personal files, the Columbus Environmental Management Project (CEMP), the King Avenue Records Management Office records, the DOE Chicago Operations Office Safeguards and Security Division classified files, and personal interviews.

As defined in TC-AP-03.1, the AK record consists of information from published documents, unpublished data, correspondence, and discrepancy reports, which correspond to the "P," "U," "C," and "D" superscripts used throughout this document (e.g., [P001]).

**Published Documentation**—In general, published documents represent the most reliable, reviewed, and controlled sources of information. Published documentation includes, but is not limited to, controlled documents and databases, previously controlled documents and databases, procedures, reports, and studies. Published sources are referenced by the "P" superscripts in this document.

**Unpublished Data**—Unpublished data consist of information that typically has not received peer review and may not have been formally controlled. In many cases, this will consist of the raw data used during the development of published documentation. This AK will be used primarily to supplement and verify published information. Unpublished data include, but are not limited to, draft documents, forms, analytical data packages, log books, notes, and inventory lists, in addition to internal reports, studies, and databases. Unpublished sources are referenced by the "U" superscripts in this document.

**Correspondence**—Correspondence consists of communication records relating to specific TRU waste streams or TRU waste management. Typically, this information consists of uncontrolled records of internal and external communications. Correspondence will be used primarily to supplement and clarify the acceptable knowledge. Correspondence includes, but is not limited to, internal and external letters, memos, directives, telecommunication records, meeting minutes, and personal interview summaries. Correspondence sources are referenced by the "C" superscripts in this document.

**Discrepancy Reports**—This report is the documented resolution of discrepancies identified between AK sources or between AK sources and confirmation data. In general, this will consist of a letter to the AK record that will be referenced in the affected document location. Discrepancy reports are referenced by the "D" superscripts in this document.

Several hundred sources were reviewed during the development of this document. Approximately 75 sources were determined to be relevant to the scope of the AK and were incorporated into a data management system. When possible, discrepancies between sources were resolved by contacting cognizant personnel or collecting additional information. If the inconsistency was not resolved, the most conservative information was incorporated into the document. Appendix A, Acceptable Knowledge Inventory, lists the data sources used in compiling the AK document.

# 2.0 REQUIREMENTS

This section lists the requirements, guidance documents, and procedures that dictate or direct waste characterization and certification activities associated with this the BCLDP AK program.

- ***TRU Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (WIPP WAC), DOE/WIPP-069**

The WIPP WAC defines the requirements for safe handling, transportation, and disposal of TRU waste at the WIPP.(4) The WIPP WAC requires the preparation of certification plans and associated quality assurance plans describing site-specific TRU waste certification programs for submittal to the DOE Carlsbad Field Office (CBFO) for review and approval before a site can be granted authority to ship waste to WIPP.

- **40 CFR Parts 260 through 265, 268, and 270 (Implemented by Ohio Administrative Code, Rule 3745)**

Title 40 of the *Code of Federal Regulations* (CFR) describes the federal hazardous waste regulations codified to protect the environment, including the Resource Conservation and Recovery Act (RCRA).(5) The regulations define the requirements for making a hazardous waste determination, obtaining hazardous waste permits, and controlling the land disposal of hazardous wastes. Also included are standards for waste generators; transporters; and treatment, storage, and disposal facilities.

- ***Waste Isolation Pilot Plant Hazardous Waste Permit, Waste Analysis Plan* (WIPP-WAP), EPA No. NM4890139088**

The WIPP-WAP provides a detailed description of the quality assurance and quality control requirements for the TRU waste characterization program.(1) The plan establishes the characterization parameters that must be addressed during the characterization of TRU waste. For each parameter, the WIPP-WAP provides requirements for waste characterization, including the use of AK, visual examination, and sampling and analysis.

- ***Quality Assurance Program Document* (QAPD), DOE/CAO-94-1012**

The QAPD identifies federal, state, and industry quality requirements applicable to the CBFO quality assurance program.(6) The QAPD also establishes the minimum requirements for CBFO personnel and guidance for the development and implementation of quality assurance programs by all program participants.

- ***Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes; A Guidance Manual,* EPA-530-R-94-024**

This U.S. Environmental Protection Agency (EPA) manual provides general waste analysis guidance for facilities that generate or manage hazardous wastes.(7) Specifically, the document promotes the use of AK characterization under certain circumstances as an alternative to or in conjunction with sampling and laboratory analysis.

- ***Transuranic Waste Characterization Quality Assurance Project Plan* (QAPjP) *for the BCLDP Transuranic Waste Certification Program,* TCP-98-02**

The QAPjP specifies the quality of data necessary and the characterization techniques including the use of acceptable knowledge employed by BCLDP to meet the requirements of the WIPP-WAP for TRU wastes generated at the BCL West Jefferson North facility.(2)

- ***Collection, Review, and Management of Acceptable Knowledge Documentation,* TC-AP-03.1**

This procedure outlines the method for collecting, reviewing, compiling, managing, and confirming AK documentation.(3) This procedure was implemented during the preparation of this document to ensure that a consistent, defensible, and auditable record is created. This acceptable knowledge document (TCP-98-03) is the result of the implementation of TC-AP-03.1.

# 3.0 WASTE GENERATING OPERATIONS

On April 16, 1943, Battelle Memorial Institute (BMI) entered into a contract with the Manhattan Engineering District to support atomic energy research and development programs. BMI was selected as one of the original participants in this program because of its metallurgical expertise.[P026, P027] Nuclear reactor development activities, especially materials development, constituted the major portion of BMI's participation in the atomic energy program.[P026]

During World War II, BMI played an important role in the development of reactors for plutonium production. Studies involving the extrusion and degassing of uranium were among the company's most significant contributions. During the war, the United States was largely dependent on foreign sources of uranium. BMI was responsible for developing methods to recover uranium and thorium from domestic supplies of minerals containing relatively small amounts of source materials.[P026]

The first large-scale application of nuclear power was nuclear submarine propulsion reactors. BMI was involved with this effort from its inception. When the program began, no material was available that provided adequate corrosion resistance to hot water with a low absorption cross section. BMI invented and developed Zircaloy, a zirconium corrosion-resistant alloy used in fuel elements and assemblies.[P023] Other major accomplishments included the design and fabrication of the original reference fuel for the Nautilus program and the development of the Hot Isostatic Pressure and Picture Frame bonding technologies used to fabricate nuclear submarine cores.[P026] Additionally, BMI pioneered the design, development, and testing of radioactive material shipping containers.[P030]

As a result of BMI's participation in this atomic energy research for the DOE and its predecessor agencies, portions of 15 BCL buildings and associated grounds became contaminated with varying amounts of radioactive materials.[P038] These buildings and grounds are to be decontaminated and decommissioned under the BCLDP. The BCLDP is being overseen by the DOE-CEMP.

Nine of the buildings are located at the BCL King Avenue facility in the west central portion of the city of Columbus, Ohio. The nuclear research performed in these buildings included processing and machining of enriched, natural, and depleted uranium and thorium; fuel fabrication; radiotracer studies; radiochemical analyses; and powder metallurgy studies.[P034] Remediation of known areas of contamination in these buildings was completed in 1998. Wastes from these facilities are not addressed in this document.

The remaining six buildings are located at the BCL West Jefferson site located approximately 15 miles west of the King Avenue facility, near the city of West Jefferson, Ohio. Research was performed at two areas at the site. Three of the buildings located at the southeast portion of the site were used for fuel element fabrication and ballistic studies. This engineering area is known as West Jefferson South; cleanup of minor contamination at this site was completed in 1990. The other three buildings are located in the northern portion of the site and have been known as the Nuclear Sciences Area, the Nuclear Research Center, and currently as West Jefferson North.[P034]

## 3.1 West Jefferson North History and Mission

The Nuclear Research Center located near West Jefferson, Ohio, was constructed by BMI in 1954 and 1955 to support the ongoing nuclear research programs. Experiments were originally performed at the site in three main buildings: JN-1 (Hot Cell Laboratory), JN-2 (Critical Assembly Laboratory), and JN-3 (Research Reactor Building).[P034] Building JN-4 (Plutonium Laboratory) was built in 1960 to support plutonium research and processing programs.[P033] Figure 3-1, an aerial photograph of the site currently known as West Jefferson North, identifies these buildings.

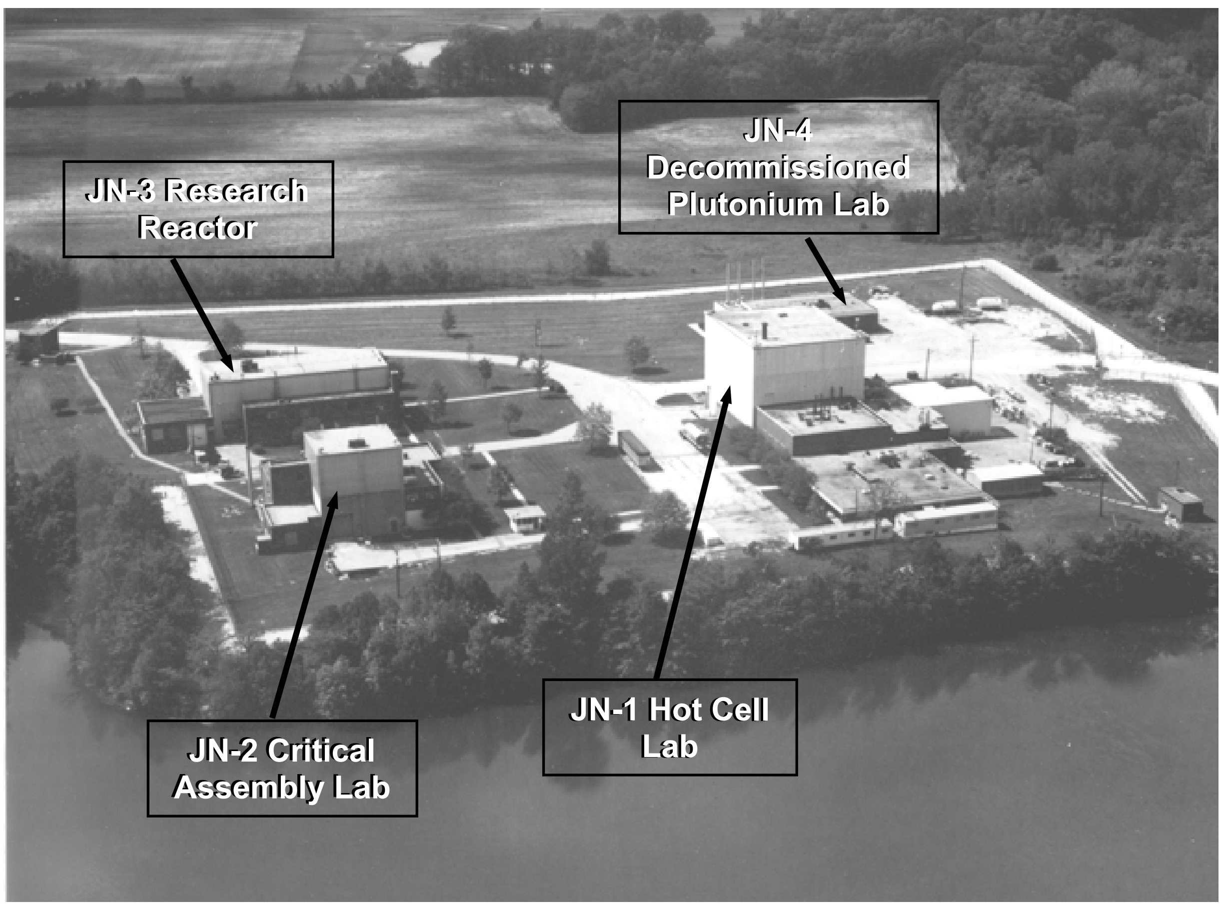



**Figure 3-1.** West Jefferson North Site.

The oldest and most contaminated building at the West Jefferson North facility is the Hot Cell Laboratory (Building JN-1). Building JN-1 operations began in 1955 to support nuclear research projects such as the examination of power and research reactor fuels; post irradiation examination of fissile, control rod, source, and structural reactor materials; and examination of irradiation surveillance capsules. Building JN-1 operations are described in more detail in Section 3.2.[P034]

Building JN-2, the Critical Assembly Laboratory, was constructed during 1954 and 1955, and began operations in 1955. In addition to critical assembly studies, the facility conducted energy conservation experiments, nuclear materials handling, and plutonium research. Active nuclear experimentation was terminated in 1970.[P034] The Critical Assembly Laboratory was decommissioned in 1975. The decommissioned plutonium laboratory area was refurbished and currently contains the Radioanalytical Laboratory (RAL).[U004]

The RAL is designed to conduct routine radioanalyses in support of the BCLDP, including analysis of samples for radiological constituents for the Site Environmental Report. Specifically, the RAL performs gamma spectrometry; alpha spectroscopy; gross alpha and beta counting; and various isotopic analyses on water, air, soil, sediment, sludge, smear, and waste matrices. In addition, the RAL provides technical support for analytical sampling and is responsible for obtaining, monitoring, and controlling off-site analysis of samples funded by the BCLDP.[U015]

Building JN-3, the Research Reactor Building, was constructed during 1955 and 1956 to house the Battelle research reactor that operated from 1956 to 1974. The reactor was defueled and partially decommissioned in 1975, and Battelle's Nuclear Regulatory Commission (NRC) R-4 license was changed to "possession only" status.[C004] The dismantled reactor and waste generated during decommissioning operations were shipped to DOE's Idaho National Engineering and Environmental Laboratory (INEEL). The building is currently used to store suspect TRU waste generated by decontamination and decommissioning operations in Buildings JN-1 and JN-4. Building JN-3 also houses a respirator washing room and a waste management sorting, packaging, and radiological free release area.[P027, U004]

The Plutonium Laboratory (Building JN-4) was built in 1960 to support plutonium research and processing programs. Renovations were made to the facility in 1964 and 1967. These enlargements expanded the capabilities of the laboratory, including improved machining, mechanical testing, plutonium processing, and analytical capabilities.[P033] With the termination of the Advanced Fuel Program in March 1977, the decision was made to decontaminate and decommission the building for unrestricted use. Decontamination of the building began in January 1978 and continued through 1982. Cleanup of contaminated soil in areas around the building is pending.[P033] Wastes from Buildings JN-2, JN-3, and JN-4 are not addressed in this document.

Most of the transuranic waste generated during decontamination of Building JN-4 was shipped to either the DOE Hanford or INEEL sites for storage.[P033] Three gloveboxes and a small inventory of waste (291 cubic ft.) from the decontamination of Building JN-4 were stored in Building JN-3.[D001] These wastes are not within the scope of this document.

## 3.2 Hot Cell Laboratory (Building JN-1)

Due to the nature of the research being conducted by BMI in the early 1950s, it was necessary to construct a remote-handling facility to conduct experiments to support the development of nuclear fuels, control rods, reactor structural materials, and various other reactor components and instrumentation.[P026] The Hot Cell Laboratory (Building JN-1) was constructed in 1955 in anticipation of the emerging commercial nuclear power industry.[C004] Figure 3-2 provides a floor plan of the Hot Cell Laboratory that identifies the areas described in this section at the time operations ceased in the building.[U001, U018]

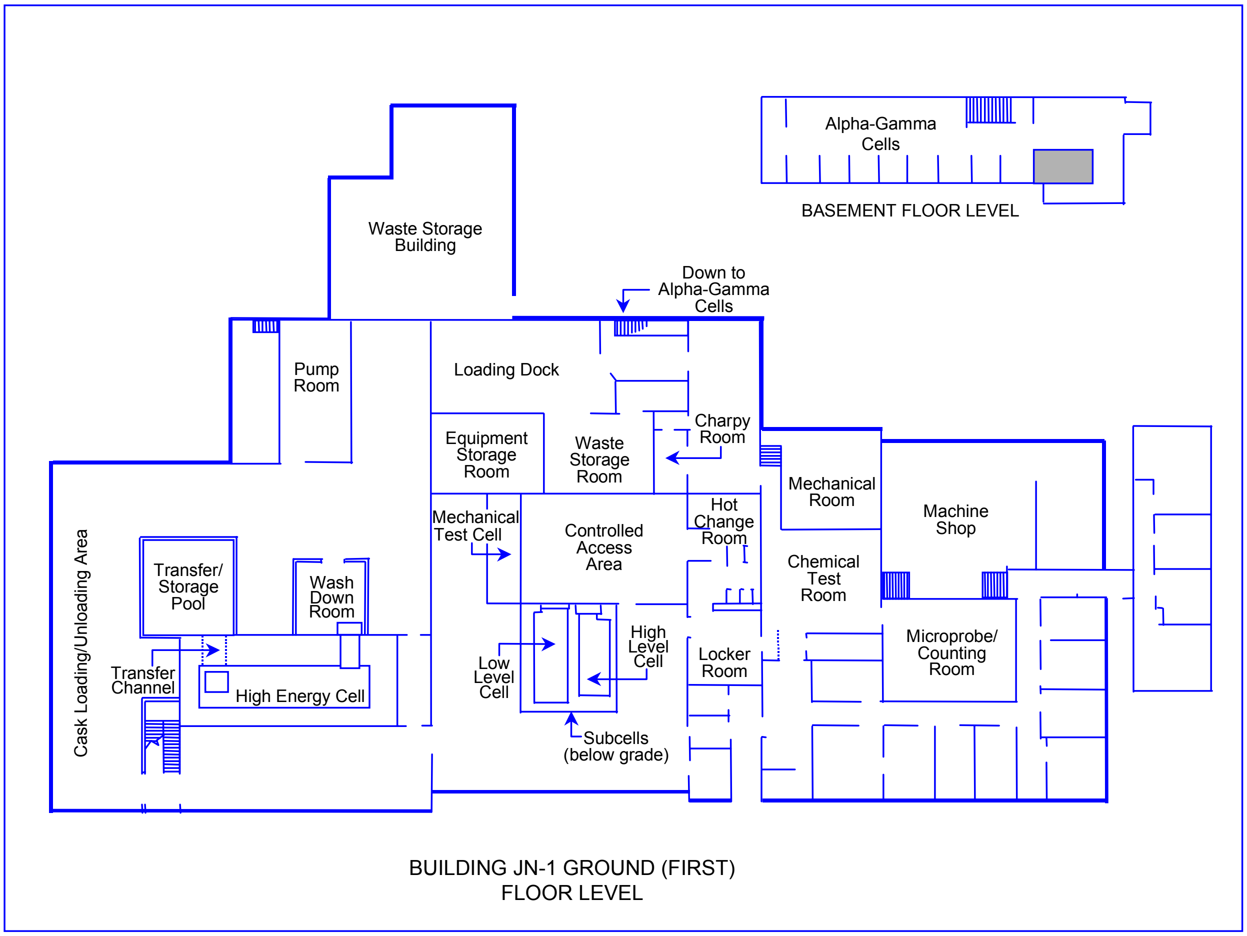



**Figure 3-2.** Building JN-1 Hot Cell Laboratory Floor Plan.

### 3.2.1 History and Mission

Since operations began in the Hot Cell Laboratory in 1955, a variety of studies relating to the radiation performance of materials were conducted in the remote-handling facilities in Building JN-1. Experiments in the Hot Cell Laboratory were largely dedicated to research supporting the DOE (including predecessor agencies) and other government agencies.[P026] The research consisted primarily of reactor fuel studies that evaluated materials such as uranium, thorium, and plutonium alloys and compounds in pellet, dispersion, and ceramic form. Control rod material studies included rare-earth absorbers such as europium titanate dispersions in stainless steel. Structural and cladding material studies evaluated stainless steels, zirconium, Zircaloy, nickel alloys, refractory metals, and pressure vessel steels.[U003] Table 3-1 provides a brief time line of major events in the history of Building JN-1. Table 3-2 summarizes the laboratory capabilities and the areas in Building JN-1 where these operations were conducted.[C006, P031]

**Table 3-1.** Building JN-1 History.

| Year | Event |
|---|---|
| 1954 – 1955 | Hot Cell Laboratory (Building JN-1) constructed (also known as JN-1A)[U004] |
| 1955 | Hot Cell operations begin[U003, U004] |
| 1955 – 1960 | Small-scale experiments on irradiated capsules[U003] |
| 1964 | Alpha-Gamma Cells added in the basement of Building JN-1[U003, P030] |
| 1967 | Mechanical Test Cell added[U003, P030] |
| 1971 – 1972 | High Energy Cell and Storage/Transfer Pool added to accept full-size fuel assemblies (JN-1B)[D001] |
| 1987 | Operations officially end with the final off-site fuel shipment[C004, U018] |
| 1989 | BCLDP begins remedial decontamination and decommissioning activities to be completed by year 2003[C008] |

Ongoing defense-related research supporting the development of nuclear reactors was conducted primarily for the U.S. Navy. In addition, defense research and development programs were performed for other Department of Defense agencies. Section 3.2.7 describes the history of atomic energy defense research conducted in the Hot Cell Laboratory.

When operations officially ceased in 1987, the Hot Cell Laboratory housed three large hot cells, ten small Alpha-Gamma Cells, a Mechanical Test Cell, and numerous support areas including a large transfer and storage pool, chemical test room, counting room, machine shop, shear testing room, and waste storage rooms.[C004, U002]

The BCLDP began remedial decontamination and decommissioning activities in 1989. The objective of the BCLDP is to decontaminate the West Jefferson buildings and associated grounds. According to the DOE-Ohio Strategic Plan, decontamination of the West Jefferson buildings is to be completed by 2006, conditioned on availability of requisite funding.

**Table 3-2.** Building JN-1 Hot Cell Capabilities.[C006]

| Capability | Area(s) of Operation |
|---|---|
| **Nondestructive Examinations of Full-Size Fuel Rods** | |
| Underwater TV viewing and videotape recording of full assemblies and fuel rods | Transfer/Storage Pool |
| In-cell visual examination | All Cells |
| Gamma scan, gross or specific isotope | High Energy and Low Level Cells |
| Profilometry | High Energy Cell |
| Rod length measurement | High Energy Cell and other cells |
| Eddy current, coil, and probe techniques | High Energy Cell |
| **Destructive Examinations** | |
| Fission gas sampling (qualitative and quantitative) | High Energy Cell<br>High Level Cell (before 1972) |
| Rod internal void volume measurement | High Energy Cell<br>High Level Cell (before 1972) |
| Rod marking and sectioning | High Energy Cell<br>High Level Cell (before 1972) |
| Fuel bulk density measurements | Mechanical Test Cell<br>Low Level Cell (before 1967) |
| Fuel burnup analysis | Mechanical Test Cell[P014] and Alpha-Gamma Cells |
| Neutron dosimetry | High Energy Cell |
| Retained or dissolved gas analysis | Mechanical Test Cell |
| Autoradiograph, alpha and beta/gamma | Alpha-Gamma and Low Level Cells |
| **Mechanical Testing and Metallurgical Examinations** | |
| Tensile and bend testing | Mechanical Test Cell and Mechanical Test Room |
| Burst testing | High Level and Mechanical Test Cells |
| Creep testing | Low Level Subcell[P016] and Mechanical Test Cell[P014] |
| Expanded mandrel testing | Mechanical Test Cell[P014] |
| Hardness and microhardness measurements | Alpha-Gamma Cells |
| Instrumented Charpy impact testing | Charpy Room and Mechanical Test Cell |
| Metallography | Alpha-Gamma Cells<br>Low Level Cell (pre-1964) |
| Radiochemistry including spectrophotometry, pH, specific resistance, titrimetry, hydrogen by inert gas-fusion, activation analysis, and alpha, beta, and gamma spectrometry | Microprobe/Counting Room<br>Mechanical Test Cell |
| Electron microprobe analysis | Microprobe/Counting Room |
| Scanning electron microscopy and energy-dispersive X-ray analysis | Microprobe/Counting Room |

**Figure 3-3.** General Flow of Materials Through Building JN-1.

## 3.2.2 JN-1 Process Operations

The Hot Cell Laboratory primarily supported experiments on small-scale irradiation capsules during the first five years of operations and over the years developed the capacity to examine complete reactor fuel assemblies.[U003] Figure 3-3 illustrates the general flow of test materials through Building JN-1 as described in Sections 3.2.2.1 through 3.2.2.7.

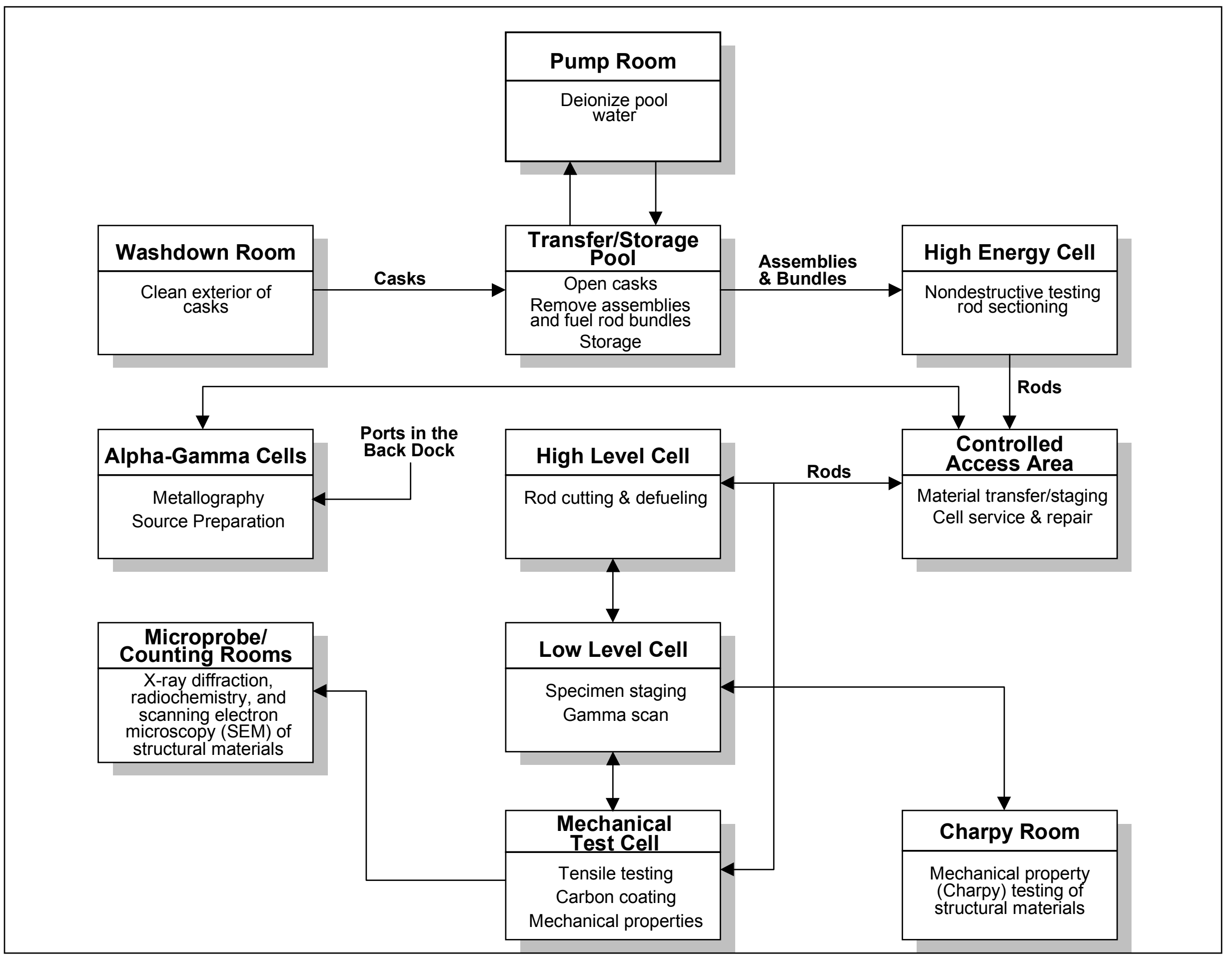



Figure 3-4 provides a process flow diagram for the Hot Cell Laboratory. The diagram identifies laboratory subprocesses, chemicals, and materials introduced during process

*Materials to be Examined*
fuel assemblies, bundles, rods, cladding, irradiated capsules, and other materials of construction

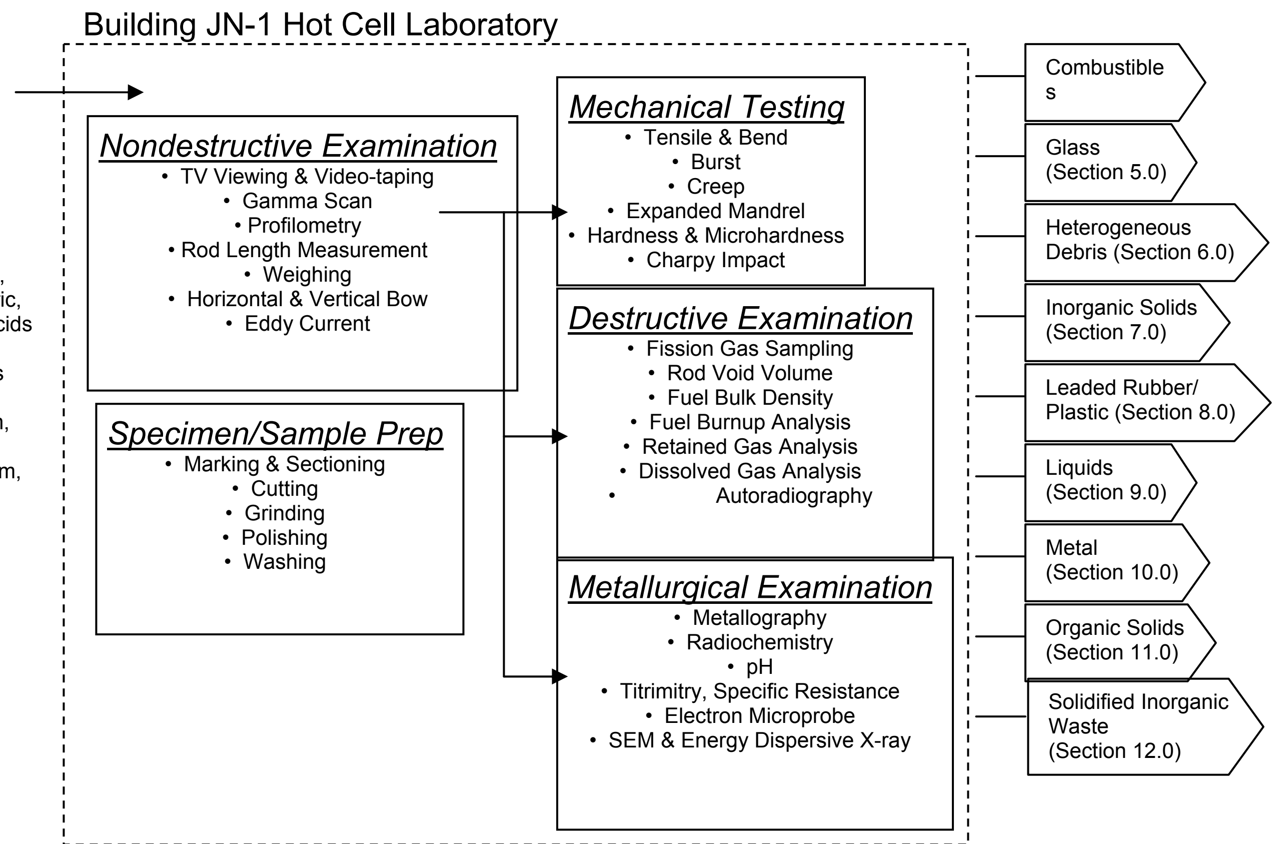
*Process Chemicals*
acetic, boric, bromic, chromic, citric, hydrochloric, hydrofluoric, lactic, nitric, oxalic, & picric acids

butyl, ethyl, & methyl alcohols

aluminum (powder), cadmium, lead (shielding), mercury, potassium, rhodium, ruthenium, and sodium metals

acetone
ammonia
ammonium nitrate
ammonium thiocyanate
barium sulfate
benzene
carbon tetrachloride
1,1,1-trichloroethane
cupric chloride
dioctylphthalate
ethylene glycol
glyceragealethant
glycerine
hydrogen peroxide
isopropyl ether
kerosene
methyl ethyl ketone
potassium dichromate
potassium ferricyanate
potassium permanganate
silver nitrate
sodium hydroxide
trichloroethylene

*Decontamination Products*
Radiacwash
Shaklee Basic I
Shaklee Basic H
Zep Old Smoky
Spray Nine




*Miscellaneous Process Materials*
ion exchange resins
cartridge water filters
roughing and HEPA filters
metal, glass, & plastic cans, bottles, & bags
cloth & paper wipes, rags, towels, & vac bags
metal tools, wire, pipe, and parts
hydraulic and silicon-based oils
protective clothing, respirators, & cartridges
wood lumber, pallets, & tool parts
glass windows, labware, & apparatus
light bulbs
electronic equipment and batteries
activated charcoal (carbon)
Radsorb, Drierite, and Floor Dry absorbents
leaded gloves and aprons
lead-acid batteries

**Figure 3-4.** Building JN-1, Hot Cell Laboratory Process Flow Diagram.

operations, and potential TRU waste materials contained in the cells. The waste materials have been segregated into waste groups that are further described and characterized in Sections 4.0 through 12.0. This characterization is based on the materials and how they exist in the building prior to packaging. Specific chemical usage is summarized in Section 3.2.4 (Table 3-4). As the materials in the waste groups are packaged, Acceptable Knowledge Process Descriptions will be prepared describing the specific generating processes and TRU waste streams that will be certified for disposal at WIPP.

#### *3.2.2.1 High Energy Cell, Transfer/Storage Pool, and Supporting Areas*

In 1971 and 1972, the High Bay was constructed to house the High Energy Cell, the Transfer and Storage Pool, and support areas.[D002] The High Energy Cell and pool were specifically designed to accommodate the receipt, storage, transfer, and examination of entire fuel assemblies, which was not feasible before this time.[D001, P003, P005] Prior to the construction of this cell, shipments of radioactive materials were received at the loading dock and introduced directly into the cells.[P032]

Shipping casks containing fuel assemblies and fuel rod bundles were received at the west door of the High Bay. A 50-ton crane was used to transfer the casks to the Washdown Room where road film and dirt were removed using water and soaps including Radiacwash, Spray Nine, and other non-hazardous soaps and detergents.[C001, P025] After cleaning, the casks were backfilled with water. The displaced air and steam generated during the backfill process was vented by metal tubing to the High Energy Cell. The casks were then lowered into the Transfer and Storage Pool to be opened.[P003, P002]

The dimensions of the pool are 20 feet by 20 feet and 49 feet deep. A motorized, moveable personnel bridge running north and south across the pool was used to facilitate work in the pool. A 1-ton pool bridge crane is located on a monorail attached to the bridge. The pool contained deionized water filtered by 12 ion exchange columns in the Pump Room. The Pump Room also contained a tank of deionized water to replenish water lost due to evaporation.[P002] Draining of the Transfer and Storage Pool water began in November of 1985. Evaporation of the pool water was completed in September 1997.[C014, D004]

After the cask lid was removed under water, the fuel assemblies or bundles of rods were lifted out of the cask using the pool bridge crane and placed in storage racks in the pool. The cask was lifted out of the pool, decontaminated with deionized water and soap, reassembled, and placed back on the bed of the truck that delivered the cask. The fuel rod bundles or fuel assemblies were moved to the access lid in the floor of the High Energy Cell through a transfer canal in the west wall of the pool. The assemblies and bundles were lifted into the cell by a 5-ton crane and the access lid closed. [P002, P003] Materials and equipment also could be introduced into the cell directly through the Washdown Room by moving an 18-ton steel door, through two 6-inch drop-in ports, or through a 9x12-foot door in the ceiling of the cell.[C001, P002, P003, U002]

Once in the High Energy Cell, several nondestructive examinations were performed on the assemblies, bundles, and rods. Fuel assemblies would be weighed, dimensionally measured, temperature measured, photographed, and videotaped. Holes were then cut into the nozzle/cap of the assembly and the rods (encased by the cladding) would be removed. Each rod would be photographed, weighed, measured, and tested. The nondestructive examination included eddy current, profilometry, horizontal and vertical bow, and gamma scan. Fission gases were collected and analyzed from a hole drilled in the cladding. These examinations accounted for approximately 90 percent of the work performed in the cell. Other activities included studies and characterization of Three Mile Island (TMI) resins used to decontaminate water, effects of cobalt-60 radiation on instrumentation, and fuel rod compaction.[C001, P003, P005] Fuel rods were cut into 4-foot lengths using a tubing cutter or an abrasive wheel (non-fuel containing materials only), placed in transfer casks, and transferred to the High Level Cell for destructive testing.[C004, C006, P003, P005]

### *3.2.2.2 Controlled Access Area*

The primary purpose of the Controlled Access Area was to support operations conducted in the High Level, Low Level, Mechanical Test, and Alpha-Gamma Cells and the Charpy Room. Equipment, specimens, and other materials were moved in and out of the cells through a number of ports and doors accessible in the Controlled Access Area. A crane was used to move heavy equipment into the High Level Cell through the main cell door. In addition to material transfer and special project support capabilities, the area was used for manipulator arm service, drum compaction, and equipment and specimen decontamination.[P012]

A repair bench in the area was used to repair and service manipulators. The repair bench was accessible by four glove ports through a window for shielding. The manipulators fit through five other ports in the window and rested on a device that controlled their movement to accommodate repair. The contaminated portion of the arm was generally repaired inside the Controlled Access Area. When possible, repairs were performed through the gloves in the window to reduce personnel exposure.[P012] A portable 55-gallon drum compactor was also operated in a plastic enclosure located next to the Mechanical Test Cell door. The purpose of the enclosure was to contain airborne contamination which was vented to the Controlled Access Area high efficiency particulate air (HEPA) filter bank.[P012]

The Sabotage Program (1981 to 1983) was conducted in the Controlled Access Area and represents one of the last major projects performed in the Hot Cell Laboratory. The purpose of the program was to determine the effects of a terrorist attack on nuclear fuel shipping casks. The program involved shooting a shaped charge at a small model cask containing fuel. The solids and gases generated by the collision were collected and analyzed. The apparatus is bolted on top of a small empty pool that was used for storage of small casks prior to 1972.[P012]

During operations, the Controlled Access Area was in constant use and was repeatedly contaminated by numerous programs. Even though the area has been cleaned many times, the floors and other surfaces remain contaminated with the radionuclides from these programs.[P012]

#### *3.2.2.3 High Level and Low Level Cells*

The High Level Cell and the Low Level Cell were the original cells constructed in Building JN-1 in 1955. These cells consist of two main cells located above grade level with two subterranean cells (subcells) located directly below. The cells are situated back-to-back and form a block that is 24 feet by 24 feet. The Low Level and High Level Cells are separated by a shielding wall and were designed to provide shielding for 10,000 curies and 10 million curies of a 1-Mev gamma emitter, respectively.[P030] Entrance into each cell was gained through hydraulically operated steel doors in the Controlled Access Area. Materials were introduced through numerous access ports. Primary access into each cell was through a small access port in the hydraulic cell doors.[U002, P015] Transfer trays were used to transfer materials between the High Level, Low Level, and Mechanical Test Cells.

Nondestructive examination, destructive testing, and material preparation (marking, cutting, grinding) were conducted in the High Level and Low Level Cells before the addition of the High Energy and Mechanical Test Cells. They were the only cells available for remote manipulation of nuclear reactor materials before the addition of the Alpha-Gamma Cells in 1964.[C006, P032] Operations performed in the High Level and Low Level Cells included rod marking, sectioning, defueling, visual examination, and dimensional measuring, in addition to gamma scan, tensile, fission gas, rod void volume, fuel bulk density, autoradiography, and burst testing analyses.[C006, P017, P018] The High Level Cell is highly contaminated due to destructive cutting and grinding of fuel materials and the cobalt-60 work performed in this cell.[P018]

In 1988 and 1989, some waste materials remaining in the High Level Cell were compacted into 105 metal cans; most were transferred to the Low Level Cell where they were gamma scanned.[P017, P018]

Directly beneath the Low Level and High Level Cells are subterranean cells that were designed to support operations in the main cells and conduct operations that did not require remote manipulations.[P032] Creep testing was performed in the subcell below the Low Level Cell. The subcell below the High Level Cell was not used for project work but was used for storage of used contaminated HEPA filters.[P016]

#### *3.2.2.4 Mechanical Test Cell*

The Mechanical Test Cell was constructed in 1967 to increase the mechanical properties testing capabilities of spent fuel, irradiated cladding, and structural materials.[U002, U003] A variety of examinations were conducted in the cell including tensile, creep, vacuum fusion, burst, radial burnup, expanded mandrel, and density testing. In addition to spent fuel, other materials studied in the cell included Zircaloy, stainless steel, nickel alloys, refractory materials, and pressure vessel steels.[P030]

Specimens prepared in the High Level and Low Level Cells were placed in aluminum vials and other containers and then transferred into the Mechanical Test Cell through the tray in the Low Level Cell. Burst and tensile testing were performed on fuel cladding. In addition to the destructive mechanical testing performed in the cell, density testing of spent fuel was conducted using elemental mercury metal. The mercury used for this testing became contaminated with metal dust and fragments from the fuel specimens. Additionally, the cell was contaminated by mercury that could be observed on the floor and work surfaces.[P014]

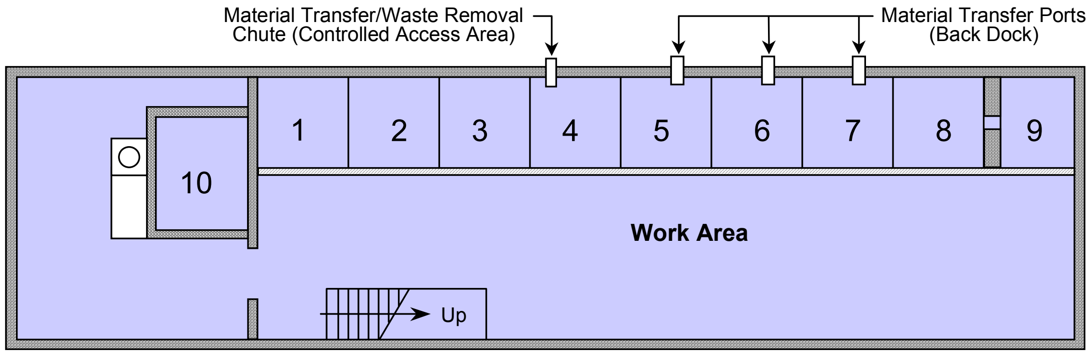
#### *3.2.2.5 Alpha-Gamma Cells*

The Alpha-Gamma Cells consist of 10 small interconnected cells located in the basement under the shipping and receiving dock. The original nine cells (Cells 1-9) were constructed in 1964 to support metallography testing of fuel rod specimens. The room adjacent to Cell 1 was constructed as an evaporator room for low level radioactive liquids. Cell 10 was added in this area in the early 1970s.[C012] Each of the cells have a window and manipulators on the front and roll out on wheels for access. Figure 3-5 illustrates the general floor plan and lists the operations performed in the Alpha-Gamma Cells.[P001, P005, P024]

Cells 1, 2, 3, and 10 were dedicated to support metallography operations. In the Low Level Cell, 1-3/4-inch-diameter specimens (Metmounts) of fuel rods were prepared by mechanical (dry) cutting and grinding techniques and transported to Cell 3 (through Cell 4). Cell 3 is considered the most contaminated cell, and the two grinders in the cell are the most contaminated equipment in the Alpha-Gamma Cells. The Metmounts were ground to the desired thickness in Cell 3; polished, washed (alcohol and water), and acid etched in Cell 2; and hardness tested and photographed using a Metallograph in Cell 1. In the early 1970s, the equipment in Cell 1 was abandoned and operations were transferred to Cell 10 where a new Metallograph was installed.[C012, P001]

The primary purpose of Cell 4 was to transport materials to and from the Controlled Access Area. Metmounts were transferred through a connecting chute in the Controlled Access Area. Pneumatic transfer tubes from the Low Level Cell were seldom used because of operational problems with this system.[C001, P017] A Macro Camera was used to photograph items in the cell. Cell 4 was not modified from its original design and was never used for project work.

Cells 5 and 6 were designed and constructed to prepare californium-252 sources. Californium wire used to produce the sources was introduced into Cell 5 through a port in the floor of the back dock. The wire was cut, weighed, and put into small containers. The containers were sealed by welding on the lids and then leak tested and washed. These sources were dropped through another port in the back dock into Cell 6 where they were placed and sealed (welded) in a larger container that was also leak tested and washed. Cell 6 should be the least contaminated cell since only sealed sources were introduced into this area.[P001] Cells 5 and 6 were not used until the mid-1970s when the californium source program was initiated, and have not been used for any other projects.[C001] Wastes generated in Cells 5 and 6 will not be TRU contaminated due to the short half-life of californium-252 (< 3 years) and low specific activity of curium-248 (daughter product).




| Cell No. | Description |
|---|---|
| 1 | Metallography; hardness testing (before 1970) |
| 2 | Metallography polishing; etching |
| 3 | Metallography mounting, grinding, polishing |
| 4 | Transfer cell |
| 5 | Californium source cutting and weighing |
| 6 | Californium source sealing and leak testing |
| 7 | Burn-out fuel dissolution and solidification |
| 8 | Thermal conductivity |
| 9 | X-Ray diffraction |
| 10 | Metallograph; hardness testing (after 1970) |

**Figure 3-5.** Alpha-Gamma Cells' Floor Plan.

Cell 7 was used primarily for dissolution and solidification of burnup fuel specimens. Fuel clad samples from burnup analysis in the High Level Cell were transferred into Cell 7 through a port in the floor of the back dock. The fuel was dissolved from the cladding, and the cladding was returned to the High Level Cell or Low Level Cell to be weighed. The fuel was dissolved with nitric acid, diluted, mixed with cement, and allowed to solidify in foam cups (referred to as *slugs*).[C012, P001, U008] Fumes from the solutions escaped the box through a faulty pipe connection and contaminated the rear area of Cells 7 and 8. The rear window in Cell 8 is severely etched from these fumes.[P001] Additional information on slugs is presented in Section 12.0.

In Cell 8, unclad fuel samples were tested for thermal conductivity. The samples were brought into the cell through pass-through ports from Cell 4 through Cells 5, 6, and 7. The test instrument consisted of a two-foot diameter plate with a small electric furnace at the center. The sample was placed in the furnace and heated. The sample was exposed to a laser beam that was directed to a detector for analysis.[P001]

X-ray diffraction testing of Metmounts was performed in Cell 9. The samples were brought into the cell through pass-through ports from Cell 4 and analyzed (crystalline structure) with an energy dispersive X-ray analysis unit and goniometer (instrument used to measure crytalline structure).[P001]

#### *3.2.2.6 Charpy Room*

Shear testing of irradiated nuclear reactor structural materials was performed in the Charpy Room. Encapsulated specimens were received in shipping casks that were opened in the Controlled Access Area. The casks were opened and the capsules containing the specimens were transferred to the High Level Cell for opening, separating, and accounting. The specimens were placed in metal cans, cleaned in an ultrasonic bath in the Controlled Access Area, then transferred to the Charpy Room for analysis.[P019]

Irradiated specimens were tested using an automated Charpy Impact Machine. Temperature-controlled oil and alcohol baths were used to heat and cool specimens, respectively. Although Charpy testing was the primary operation performed in this area, reconstituting broken specimens was also performed in this room. Milling machines operated by manipulators were used for this activity.[P019]

Storage holes (74) constructed in the floor of the Charpy Room were used to store stacked cans of specimens. These holes were originally part of the Controlled Access Area and were used to store specimens from the High Level and Low Level Cells. These 4-, 6-, and 8-inch-diameter storage holes are currently empty but are expected to contain high levels of radioactive contamination.[P019]

#### *3.2.2.7 Supporting Areas*

In addition to the activities involving irradiated and highly radioactive materials, examination and analysis of nonradioactive and low activity materials were performed in several areas in Building JN-1. The Chemistry Laboratory, Counting Room, Microprobe Room, and Machine Shop were located to the east of the main office area and south of the hot cells. Wastes generated from the cleanup of these areas were not mixed with wastes generated during hot cell operations and are not included in the suspect TRU waste inventory.[C007, P009]

### 3.2.3 Radionuclides

This section describes the methods used to identify the isotopes in radioactive waste generated in Building JN-1 that support the TRU waste determination. Since gamma rays emitted by radionuclides can be readily detected and quantified by common measurement techniques, the modeling method described in this section will chiefly use emitted gamma rays to model the quantity of isotopes in a standard waste stream. Because isotopes other than gamma emitters are known to be present from the operating history of the facility, the method combines laboratory measurements of the isotopic distribution with a computer-generated distribution to account for all isotopes.[(8), P040]

The measured isotopic distribution is based on laboratory analysis (alpha and gamma spectroscopy) of 69 smear samples taken from throughout the accessible work areas of Building JN-1.[(8), U026] Using the measured distribution as a base, the remaining isotopes are scaled according to the distribution generated by computer code that models the production and decay of fission and activation products of commercial nuclear power plants, since the majority of activities in Building JN-1 is attributable to nuclear power reactor research.[C004, (8)]

A given quantity of the combined distribution is then used as the radiation source with the computer shielding code to generate external gamma ray dose rates for various package and form weights. These dose rates are used to generate dose rate versus weight conversion equations for each package and form. These equations are then used to calculate the activity content for individual packages and waste forms.[(8)]

Because cesium-137 is the dominant isotope in the analysis of smear samples and in the computer code output, it is used as the basis for the standard mix specification. Ratios for all isotopes not present in the smear samples are based on the software calculations and then normalized to cesium-137. The source activities are further normalized to a total activity of 1 millicurie. The isotopes listed in Table 3-3 represent the isotopes indicated by the computer code calculations and the sample analysis. This distribution is considered to be the Building JN-1 standard isotope mix.[(8)] This mix should be a good approximation of the isotopes present in Building JN-1 waste. Isotopic ratios will be determined for each waste stream based on the JN-1 standard isotope mix listed in DD-98-04, *Waste Characterization, Classification, and Shipping Support Technical Basis Document*,[(8)] or by direct sampling as necessary. The ratio determination will be documented in the TRU Waste Process Description for each waste stream.

**Table 3-3.** Isotopic Distribution for Building JN-1 Waste.

| Isotope | Isotope |
|---|---|
| Cesium-137 | Cesium-134 |
| Plutonium-241 | Plutonium-240 |
| Strontium-90 | Plutonium-239 |
| Curium-244 | Uranium-234 |
| Plutonium-238 | Uranium-238 |
| Americium-241 | Uranium-236 |
| Cobalt-60 | Uranium-235 |

### 3.2.4 Chemical Use

Chemicals historically used in Building JN-1, and how and/or where the chemicals were used, are presented in Table 3-4. This information was created during review of the source documentation describing operations in the hot cells. In addition, a list of chemicals was prepared using Material Safety Data Sheets compiled based on a chemical inventory of the building. Cognizant personnel reviewed the list to determine the chemicals used in the hot cells that may have contaminated the suspect TRU waste inventory characterized in Sections 4.0 through 12.0.[C007, C011]

**Table 3-4.** Historical Chemical Usage.

| Chemical | Use |
|---|---|
| Acetic acid | Photograph printing.[C001] |
| Acetone | Decontamination of shipping casks.[C001] |
| | Cleaning and degreasing.[C001, C011, P019] |
| | Cell and equipment decontamination.[P024, P032] |
| Acid (unspecified) | Metmount etching.[P001] |
| | Dissolving fuel specimens.[P001] |
| Alcohol (unspecified) | Metmount washing.[P001] |
| | Charpy specimen cooling.[P019] |
| | Cleaning.[P019] |
| Aluminum powder | Metmount polishing.[P001] |
| Ammonia | Unknown.[C001] |
| Ammonium nitrate | Low Level and Alpha-Gamma Cells.[C011] |
| Ammonium thiocyanate | Unknown.[C001] |
| Barium sulfate | Alpha-Gamma Cells.[C011] |
| Benzene | Laboratory operations.[C006] |
| Boric acid | Alpha-Gamma Cells.[C011] |
| Bromine or bromic acid | Alpha-Gamma Cells.[C011] |
| Butyl alcohol | Low Level and High Level Cells.[C001] |
| Cadmium | Dosimeter capsules.[C001] |
| | Shielding. |
| Carbon tetrachloride | Immersion density, Mechanical Test Cell.[C001, C011] |
| | Laboratory operations.[C006] |
| | Low Level, High Level, and Alpha-Gamma Cells.[C011] |
| | Cell and equipment decontamination.[P024, P032] |
| Chlorothene (1,1,1-trichloroethane) | Cleaning and degreasing.[C011, P019] |
| Chromic acid | Glass cleaner.[C001] |
| Citric acid | Ultrasonic cleaning.[C001] |
| Cupric chloride | Alpha-Gamma Cells.[C011] |
| Diamond paste | Metmount polishing.[C001] |
| Dioctylphthalate | Filter testing.[C001] |
| Ethanol | Decontamination of shipping casks.[C001] |
| | Cleaning and degreasing.[C001] |
| Ethylene glycol | Metmount polishing.[C001] |

**Table 3-4.** Historical Chemical Usage (Continued).

| Chemical | Use |
|---|---|
| Freon | Refrigerant.[P006] |
| Glycerigia | Metal etchant.[C001] |
| Glycerin | Unknown.[C001] |
| Hydraulic oil (Unocal Unax Rx 32)[P025] | In system for raising/lowering cell doors.[P015] |
| Hydrochloric acid | Low Level, High Level, Mechanical Test, and Alpha-Gamma Cells.[C001, C011] |
| Hydrofluoric acid | Alpha-Gamma Cells.[C001] |
| Hydrogen peroxide (30% or less) | Alpha-Gamma Cells.[C001] |
| Isopropyl ether | Low Level and High Level Cells.[C001] |
| Kerosene | Metmount polishing.[C001] |
| | Cell and equipment decontamination.[P024, P032] |
| Lactic acid | Alpha-Gamma Cells.[C001] |
| Mercury | Immersion density in Mechanical Test Cell.[C001, C011] |
| | In inventory in the Controlled Access Area, High Level, Low Level, and High Energy Cells.[C011] |
| Methanol | High Level Cell.[C001, C011] |
| Methyl ethyl ketone | Low Level, High Level, and Alpha-Gamma Cells.[C011] |
| Nitric acid | Low Level, High Level, Mechanical Test, and Alpha-Gamma Cells.[C011] |
| Oxalic acid | Alpha-Gamma Cells.[C011] |
| Picric acid | Unknown.[C001] |
| Potassium | Low Level and High Level Cells.[C001] |
| Potassium dichromate | Low Level and Alpha-Gamma Cells.[C011] |
| Potassium ferricyanate | Unknown.[C001] |
| Potassium permanganate | Alpha-Gamma Cells.[C014] |
| | Metal etching.[C014] |
| Radiacwash[P025] | Decontamination of shipping casks.[C001] |
| | Ultrasonic cleaning.[C001] |
| | Cell and equipment decontamination.[P024, P032] |
| Rhodium | Alpha-Gamma Cells.[C011] |
| Ruthenium | Alpha-Gamma Cells.[C011] |
| Shaklee Basic I and Basic H[P025] | Decontamination of shipping casks.[C001] |
| Silicon-based oil | Hot oil baths in Charpy Room.[P006] |
| Silver nitrate | Ultrasonic cleaning.[C001] |
| | Low Level and High Level Cells.[C011] |
| Sodium | Low Level and High Level Cells.[C001] |

**Table 3-4.** Historical Chemical Usage (Continued).

| Chemical | Use |
|---|---|
| Sodium hydroxide | Low Level, High Level, Mechanical Test, and Alpha-Gamma Cells.[C001, C011] |
| Spray Nine[P025] | Decontamination of shipping casks.[C001, P003] |
| | Cleaning of surfaces in Charpy Room.[P019] |
| Sulfuric acid | Low Level, High Level, and Alpha-Gamma Cells.[C011] |
| Trichloroethylene | Cleaning and degreasing.[C001, C011] |
| UCAR phenolic resins[P025] | Metmount material in Low Level and Alpha-Gamma Cells.[C001, C011] |
| Water | Metmount washing.[C001, P001] |
| | Cell and equipment decontamination.[P024, P032] |
| Zep Old Smoky[P025] | Cleaning of surfaces in all areas.[P019] |

### 3.2.5 Waste Characterization

During the review of acceptable knowledge, suspect TRU waste materials were identified as they exist in the building and assigned waste matrix codes. Similar waste materials are combined to create the "waste groups." Table 3-5 summarizes the waste assessed for the development of this document, including the waste matrix code, waste description, and EPA Hazardous Waste Numbers. Waste matrix codes and EPA Hazardous Waste Numbers are assigned in accordance with TC-AP-03.1, *Collection, Review, and Management of Acceptable Knowledge Documentation*.(3) The characterization for each waste group is discussed in Sections 4.0 through 12.0.

The acronym TBD for "to be determined" was used in Table 3-5 when existing acceptable knowledge was insufficient to assign EPA Hazardous Waste Numbers. The appropriate numbers will be assigned using additional analysis or evaluation of these wastes as they are processed. This supplemental information will be incorporated into the acceptable knowledge record as it is developed per procedure TC-AP-03.1.(3)

**Table 3-5.** Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers | Section Reference |
|---|---|---|---|
| S5319 | Plastic/Rubber | None | 4.0 |
| S5390 | Combustibles | D005, D007, D008, D009, D011, F001, F002, and F005 | |
| S5122a | Glass | None | 5.0 |
| S5122b | Leaded Glass | D005, D008 | |
| S5122c | Lightbulbs | D008, D009 | |
| S5410 | Composite Filter Debris | TBD | 6.0 |
| S5460 | Electronic Equipment | D008, D011 | |
| S5490 | Fixtures and Equipment | D009 | |
| S3114 | Absorbed Oil | TBD | 7.0 |
| S3118 | Activated Carbon | None | |
| S5119a | Inorganic Particulate Materials (Spent) | TBD | |
| S3119b | Inorganic Particulate Materials (Unused) | None | |
| S5121 | Concrete | None | |
| S5123 | Ceramic/Brick | D005, D007, D008, D009, D011, F001, F002, and F005 | |
| S5129 | Insulation | None | |
| S5311 | Leaded Rubber | D008 | 8.0 |
| X7410 | Lead Acid Batteries | D008 | |
| L1110 | Acidic Wastewaters | D002 | 9.0 |
| X7100 | Elemental Mercury | D009 | |
| L2120 | Aqueous/Nonhalogenated Organic Liquids | TBD | |
| L2220a | Nonhalogenated Organic Liquids | None | |
| L2220b | Nonhalogenated Organic Liquids | D001, F003 | |
| L9000 | Unknown Liquids | TBD | |
| S5111 | Metal Debris | None | 10.0 |
| S5112 | Metal Debris with Lead | D008 | |
| X7211 | Elemental Lead | D008 | |
| X7220 | Elemental Cadmium | D006 | |
| X7510 | Bulk Reactive Metals | D003 | |
| X7530 | Pyrophoric Metals | D001 | |
| S3211 | Organic Resin | None | 11.0 |
| S3150 | Slugs | TBD | 12.0 |

### 3.2.6 Waste Management

With the exception of gloveboxes and a small inventory of containers generated during the decontamination of the Plutonium Laboratory (Building JN-4), all suspect TRU waste stored at the site was generated in Building JN-1. These materials consist of process-related waste, equipment, furniture, and other items remaining in the cells, and the equipment and waste materials that have been removed from the cells and stored in various locations in Buildings JN-1 and JN-3.[U007, P006, P007, P008, D001]

Due to the radiological research nature of operations in the Hot Cell Laboratory, care was taken to minimize cross contamination of test materials; however, there was extremely limited consideration for waste segregation. Based on the research performed to date and verified by personnel who worked in the area, most of the wastes generated by different programs were mixed together and would be indistinguishable. Additionally, due to the numerous projects conducted in these areas and the movement of materials between the cells, equipment and materials still contained in the cells could be cross-contaminated with radionuclides from almost any project. Historically, the only waste segregation performed was the separation of compactible waste for volume reduction purposes.[C004, P012, P027] During historical operations, no waste materials were transferred between buildings at the site; therefore, Building JN-1 wastes would not be mixed with wastes from other buildings (JN-2, JN-3, or JN-4).[C001]

Containers (drums and hoppers) of waste in storage at the site were removed from the cells during campaigns to clean out the cells. This waste was not mixed with low level wastes from the supporting areas in Building JN-1. For this reason, all containers of suspect TRU waste will have originated from hot cell operations or clean-up operations and will not be contaminated with compounds used exclusively outside of the cells.[C007]

Suspect TRU waste is/was contained in the hot cells and stored in other locations in Building JN-1, including the Low Level Subcell, High Level Subcell, Waste Storage Area, Equipment Storage Room, Pump Room, Washdown Room, High Energy Cell Mezzanine, and Waste Storage Shed. In addition, hoppers and drums of Building JN-1 waste were stored in the empty pools in Building JN-3.[U007, P004, P007, P008] After this waste has been segregated, decontaminated, and packaged, an estimated 880 cubic feet of predominantly remote-handled (RH-) TRU waste will remain to be certified for disposal at WIPP.[C008]

### 3.2.7 Defense Operations

A variety of defense-related research was conducted in the Hot Cell Laboratory. Based on the review of available documentation, most of the defense research was conducted for the U.S. Navy (both directly and through DOE's Naval Reactors Program), although defense research and development also were performed for the U.S. Air Force and U.S. Army. Based on review of shipping logbooks/forms, project questionnaires, correspondence, research reports, and personnel interviews, defense work was conducted in Building JN-1 starting no later than 1958 and continuing until at least 1984.[C001, C002, C004, C005, C009, C025, U005, U010, U014, U016, P028, P029]

The first large-scale application of nuclear power was submarine propulsion. BMI was heavily involved in the Naval Reactor Program from its inception. BMI invented and developed Zircaloy, a zirconium corrosion-resistant alloy used in fuel elements and assemblies. Other major accomplishments included the design and fabrication of the original reference fuel for the Nautilus program and the development of the Hot Isostatic Pressure and Picture Frame bonding technologies used to fabricate nuclear submarine cores.[P036]

Defense research and development work performed for the U.S. Air Force included support of the Aircraft Nuclear Propulsion Program (1947-1961). In addition, reactor studies were conducted involving air-cooled, molten salt-fueled, and supercritical water-cooled reactors. Very extensive work was performed in the area of producing activated forms of oxide ceramics having a density approaching theoretical.[P036]

BMI contributed to the development of the Army Package Power Reactor (APPR) program, which began in 1954 and continued to the late 1960s. The mission of this program was to develop a portable and transportable reactor for use at the South Pole.[C001] Because the APPR was a water-cooled reactor, naval reactor technology could be utilized. BMI had considerable experience with the fuel selected for this reactor, and also contributed to the refinement of the processes used to fabricate fuel clad elements.[P036] In addition to the U.S. Army reactor research, the Hot Cell Laboratories were used in 1981 and 1982 for research on the destruction of chemical agents using high level gamma fields. The research involved irradiating capsules of chemical agents using cobalt-60 sources.[C002] Chemical agent capsules were not introduced into the cell; irradiation occurred in the closed beam-type port.[C014]

Based on guidance from CBFO, a TRU waste is eligible for disposal at WIPP if it has been generated in whole or part by one of the *atomic energy defense activities* listed in section 10101(3) of the Nuclear Waste Policy Act of 1982. By definition, this includes any activity performed in carrying out any of the following functions:[P041]

A) Naval reactors development

B) Weapons activities, including defense inertial confinement fusion

C) Verification and control technology

D) Defense nuclear materials production

E) Defense nuclear waste and materials by-products management

F) Defense nuclear materials security and safeguards and security investigations

G) Defense research and development.

Based on the review of acceptable knowledge, TRU wastes generated in the hot cell areas of Building JN-1 clearly meet the definition of defense waste in the areas of naval reactors development (A) and defense research and development (G). Even though a majority of the work performed in the hot cells was not done in support of defense programs, no attempt was made to segregate the defense-related wastes (see Section 3.2.6). Since segregation of this waste is no longer feasible, by definition this waste is eligible for disposal at the WIPP facility.

### 3.2.8 Spent Nuclear Fuel and High Level Waste

Several criteria determine if a material is spent nuclear fuel or high level waste. A material is spent nuclear fuel if all of the following are true:

1) The material is fuel withdrawn from a nuclear reactor after irradiation.
2) The constituent elements have not been separated by reprocessing.
3) Test specimens of developmental reactor fuels were not irradiated solely for research and development purposes.

A material is high level waste if any of the following are true:

1) The waste is from first cycle separation.
2) The material is test specimens of fissionable material not irradiated solely for research and development purposes.
3) The material is derived from fuel withdrawn from a nuclear reactor after irradiation where the constituent elements have been separated by reprocessing.

As previously described, Building JN-1 was used for research and development testing of spent fuel withdrawn from nuclear reactors after irradiation. The types of testing did not involve separation of constituent elements from the fuel. The spent fuel inventory does not include specimens of developmental reactor fuels, and was not generated from first cycle separation.[U008] Therefore, the materials examined in Building JN-1 were spent nuclear fuel, not high level waste.[C033, P041] Spent nuclear fuel is not eligible for disposal at the WIPP site and will be segregated from other wastes.[P041]

Waste materials generated from examination of spent nuclear fuel should be managed as RH-TRU waste. Based on DOE guidance, irradiated fuel materials that are RH-TRU waste:

> …include irradiated fuel test residues, test materials, and/or any resultant fragments upon which tests were performed and resultant waste generated from experiments and/or examinations, such as polishing residue, cutting fluids, adsorbents, metal fines. These may also include irradiated fuel pin fragments and dispersed particulate that cannot be readily retrieved and packaged with the fuel assemblies and intact pins.

The radioactive waste inventory generated in Building JN-1 consists of fuel test materials such as wipes, glass, and metal contaminated with fuel test residues, as well as resultant test fragments (see Sections 4.0 through 12.0). Therefore, these materials are RH-TRU waste and eligible for disposal at WIPP.[C033, P041]

# 4.0 COMBUSTIBLES

This waste group consists of combustible wastes generated by the research and development activities conducted in Building JN-1. A description of the combustible wastes and associated waste matrix codes are provided in Section 4.1. The RCRA characterization of the combustible wastes is presented in Section 4.2.

## 4.1 Waste Description

***Waste Matrix Code S5319, Plastic/Rubber:*** This waste consists of plastic or rubber debris materials including polyethylene, polyvinyl chloride, nylon, styrofoam, Tygon, Plexiglas, and neoprene. Waste items may include sheeting, rope, tape, empty bottles and bags, booties, hose/tubing, lids from spray cans, cups, packing material, respirators, gloves, boots, rain suits, O-rings, electrical cords, safety glasses, and vials.[P004, P006, U009] Plexiglas panels may also be included.[P001, P006]

***Waste Matrix Code S5390, Combustibles:*** This waste consists of paper, cloth, and wood debris materials, including canvas, leather, and other porous materials. Waste items may include wipes, rags, towels, tissues, blotter paper, mop heads, empty vacuum bags, paper filters, card-board, sandpaper, smear paper, masking tape, notebook paper, documents, and protective clothing (e.g., gloves, booties, suits, safety shoes/boots), lumber, plywood, pallets, and tool handles.[P004, P006, P008, U009]

## 4.2 Waste Characterization

Combustible wastes are characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous waste determination for combustible wastes. EPA Hazardous Waste Numbers applicable to the combustible waste group are presented by waste matrix code in Table 4-1. These conclusions are supported by the evaluation in Sections 4.2.1 and 4.2.2.

**Table 4-1.** Combustible Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| S5319 | Plastic/Rubber | None |
| S5390 | Combustibles | D005, D007, D008, D009, D011, F001, F002, and F005 |

### 4.2.1 Characteristic Waste

The materials in this waste group may exhibit a characteristic of hazardous waste as defined in 40 CFR 261, Subpart C, as a toxic waste (metals only). Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristics of ignitability (40 CFR 261.21), corrosivity (40 CFR 261.22), reactivity (40 CFR 261.23), or toxicity for organics (40 CFR 261.24).

***Ignitability***: The materials in this waste group do not meet the definition of ignitability as defined in 40 CFR 261.21. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. In addition, absorbents are added to wastes having the potential of generating free liquids (e.g., wet wipes). The materials are not capable of causing fire through friction or absorption of moisture. Cellulose-based materials such as wipes are visually examined to verify the absence of visible nitrocellulose contamination. The materials in this waste group are therefore not ignitable wastes (D001).

***Corrosivity***: The materials in this waste group do not meet the definition of corrosivity as defined in 40 CFR 261.22. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. In addition, absorbents are added to wastes having the potential of generating free liquids (e.g., wet wipes). The materials in this waste group are therefore not corrosive wastes (D002).

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23. The materials are stable and will not undergo violent chemical change. The materials will not react violently with water; form potentially explosive mixtures with water; or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials in this waste group are therefore not reactive wastes (D003).

***Toxicity***: The materials in this waste group meet the definition of toxicity as defined in 40 CFR 261.24. The toxicity characteristic contaminants fall into one of two categories: metals and organics. Organic compounds include halogenated and nonhalogenated solvents, pesticides, herbicides, and other toxic compounds. This waste group does not exhibit the characteristic of toxicity for organics. This waste group may exhibit the characteristic of toxicity for metals including barium, chromium, lead, mercury, and silver metals.

Barium sulfate, chromic acid, potassium dichromate, mercury, and silver nitrate were used in various processes in Building JN-1 (see Table 3-4). Lead shielding materials were also used (see Section 8.0). The combustible waste (S5390) is potentially contaminated with these materials. Therefore, waste S5390 is assigned EPA Hazardous Waste Numbers D005, D007, D008, D009, and D011 since a representative sample of this waste cannot be obtained for verification purposes.

Benzene, carbon tetrachloride, methyl ethyl ketone, and trichloroethylene were used in Building JN-1. These compounds were typically used as solvents. Therefore, waste S5390 is regulated as a listed hazardous waste and not a characteristic waste since these compounds are specifically addressed in the treatment standards for listed hazardous waste.

Plastic/rubber waste (S5319) is visually examined prior to or during packaging to ensure no residue is present, or this waste meets the definition of empty container (40 CFR 261.7). Therefore, waste S5319 does not exhibit the characteristic of toxicity (D004-D043).

### 4.2.2 Listed Hazardous Waste

The materials in this waste group are listed hazardous waste because they were mixed with spent solvents listed in 40 CFR 261, Subpart D. Based on the acceptable knowledge documentation reviewed, the materials are not, nor were they mixed with, hazardous waste from specific sources (40 CFR 261.32), or discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Carbon tetrachloride, 1,1,1-trichloroethane, trichloroethylene, benzene, and methyl ethyl ketone were used in laboratory operations and for cleaning/degreasing (see Table 3-4). The combustible waste (S5390) is potentially contaminated with these spent solvents. Therefore, waste S5390 is assigned EPA Hazardous Waste Numbers F001, F002, and F005.

Plastic/rubber waste (S5319) is visually examined prior to or during packaging to ensure no residue is present, or this waste meets the definition of empty container (40 CFR 261.7). Any contact with listed solvents is considered incidental. Therefore, waste S5319 is not a listed hazardous waste.

This waste may be contaminated with spent acetone and methanol used for cleaning and degreasing. However, this waste is not assigned F003 because it does not exhibit the characteristic of ignitability (F003-listed solvents are listed solely for ignitability).

F004-listed solvents were not used in the areas or processes generating combustible wastes. Therefore, this waste group is not an F004-listed hazardous waste.

# 5.0 GLASS

This waste group consists of glass wastes generated by the research and development activities conducted in Building JN-1. A description of the glass wastes and associated waste matrix codes are provided in Section 5.1. The RCRA characterization of the glass wastes is presented in Section 5.2.

## 5.1 Waste Description

***Waste Matrix Code S5122a, Glass:*** This waste consists of glass debris, including laboratory glassware, windows, and various glass apparatus.[P001, P006]

***Waste Matrix Code S5122b, Leaded Glass:*** This waste consists of leaded glass windows.[P001]

***Waste Matrix Code S5122c, Lightbulbs:*** This waste includes various lightbulbs such as fluorescent, incandescent, and mercury vapor lightbulbs.[P001, P006]

## 5.2 Waste Characterization

Glass wastes are characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous waste determination for glass wastes. EPA Hazardous Waste Numbers applicable to the glass waste group are presented by waste matrix code in Table 5-1. These conclusions are supported by the evaluation in Sections 5.2.1 and 5.2.2.

**Table 5-1.** Glass Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| S5122a | Glass | None |
| S5122b | Leaded Glass | D005, D008 |
| S5122c | Lightbulbs | D008, D009 |

### 5.2.1 Characteristic Waste

The materials in this waste group may exhibit a characteristic of hazardous waste as defined in 40 CFR 261, Subpart C, as a toxic waste (metals only). Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristics of ignitability (40 CFR 261.21), corrosivity (40 CFR 261.22), reactivity (40 CFR 261.23), or toxicity for organics (40 CFR 261.24).

***Ignitability***: The materials in this waste group do not meet the definition of ignitability as defined in 40 CFR 261.21. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials in this waste group are therefore not ignitable wastes (D001).

***Corrosivity***: The materials in this waste group do not meet the definition of corrosivity as defined in 40 CFR 261.22. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials in this waste group are therefore not corrosive wastes (D002).

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23. The materials are stable and will not undergo violent chemical change. The materials will not react violently with water; form potentially explosive mixtures with water; or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials in this waste group are therefore not reactive wastes (D003).

***Toxicity***: The materials in this waste group meet the definition of toxicity as defined in 40 CFR 261.24. The toxicity characteristic contaminants fall into one of two categories: metals and organics. Organic compounds include halogenated and nonhalogenated solvents, pesticides, herbicides, and other toxic compounds. This waste group does not exhibit the characteristic of toxicity for organics. This waste group may exhibit the characteristic of toxicity for barium, lead, and mercury metals.

Glass wastes (S5122a) are visually examined prior to or during packaging to ensure no residue is present, or these wastes meet the definition of empty container (40 CFR 261.7). Therefore, waste S5122a does not exhibit the characteristic of toxicity (D004-D043).

Analytical data for leaded glass windows indicate lead and barium leach above the toxicity characteristic level.[C013, U021] Therefore, waste S5122b is assigned EPA Hazardous Waste Numbers D005 and D008.

Fluorescent and mercury vapor lightbulbs may exhibit the characteristic of toxicity for mercury, and incandescent lightbulbs may exhibit the characteristic of toxicity for lead (solder). Therefore, waste S5122c is assigned EPA Hazardous Waste Numbers D008 and D009.[C051]

### 5.2.2 Listed Hazardous Waste

The materials in this waste group are not, nor were they mixed with, waste listed in 40 CFR 261, Subpart D, as hazardous waste from non-specific sources (40 CFR 261.31); as hazardous waste from specific sources (40 CFR 261.32); or as discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Glass wastes are visually examined prior to or during packaging to ensure no residue is present, or these wastes meet the definition of empty container (40 CFR 261.7). Any contact with listed solvents is considered incidental. Therefore, this waste group is not a listed hazardous waste.

# 6.0 HETEROGENEOUS DEBRIS

This waste group consists of heterogeneous debris wastes generated by the research and development activities conducted in Building JN-1. A description of the heterogeneous debris wastes and associated waste matrix codes are provided in Section 6.1. The RCRA characterization of the heterogeneous debris wastes is presented in Section 6.2.

## 6.1 Waste Description

***Waste Matrix Code S5410, Composite Filter Debris:*** This waste consists of filters constructed of more than one material type (e.g., metal, inorganic nonmetal, and organic materials). Filters include air intake and exhaust filters such as roughing filters (prefilters) and HEPA filters, as well as Tri-Nuc cartridge filters used to filter the Transfer/Storage Pool water.[P002, P003, P004, P006, U009]

***Waste Matrix Code S5460, Electronic Equipment:*** This waste consists of electronic equipment constructed of more than one material type (e.g., metal, inorganic nonmetal, and organic materials). Waste items may include electric panels (ultrasonic cleaners).[P001]

***Waste Matrix Code S5490, Fixtures and Equipment:*** This waste consists of debris materials that are a combination of both organic and inorganic compositions. Waste items may include contaminated fixtures and equipment such as vacuum cleaners and thermostats.[P006, P011]

## 6.2 Waste Characterization

Heterogeneous debris wastes are characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous waste determination for heterogeneous debris wastes. EPA Hazardous Waste Numbers applicable to the heterogeneous debris waste group are presented by waste matrix code in Table 6-1. These conclusions are supported by the evaluation in Sections 6.2.1 and 6.2.2.

**Table 6-1.** Heterogeneous Debris Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| S5410 | Composite Filter Debris | TBD |
| S5460 | Electronic Equipment | D008, D011 |
| S5490 | Fixtures and Equipment | D009 |

### 6.2.1 Characteristic Waste

The materials in this waste group may exhibit a characteristic of hazardous waste as defined in 40 CFR 261, Subpart C, as a toxic waste (metals only). Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristics of ignitability (40 CFR 261.21), corrosivity (40 CFR 261.22), or reactivity (40 CFR 261.23).

***Ignitability***: The materials in this waste group do not meet the definition of ignitability as defined in 40 CFR 261.21. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials are not capable of causing fire through friction or absorption of moisture. Air exhaust filters are visually examined to verify the absence of visible nitrocellulose contamination. The materials in this waste group are therefore not ignitable wastes (D001).

***Corrosivity***: The materials in this waste group do not meet the definition of corrosivity as defined in 40 CFR 261.22. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials in this waste group are therefore not corrosive wastes (D002).

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23. The materials are stable and will not undergo violent chemical change. The materials will not react violently with water; form potentially explosive mixtures with water; or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials in this waste group are therefore not reactive wastes (D003).

***Toxicity***: The materials in this waste group meet the definition of toxicity as defined in 40 CFR 261.24. The toxicity characteristic contaminants fall into one of two categories: metals and organics. Organic compounds include halogenated and nonhalogenated solvents, pesticides, herbicides, and other toxic compounds. This waste group does not exhibit the characteristic of toxicity for organics. This waste group may exhibit the characteristic of toxicity for lead, mercury, and silver metals.

Air intake filters (S5410) have not come in contact with toxicity characteristic compounds, and therefore are not toxic wastes (D004-D043).

Air exhaust filters (S5410) may be contaminated with dust and particulate material from cutting and grinding fuel specimens. Additional research is necessary to determine if these filters exhibit the characteristic of toxicity due to the metal impurities in fuel. If air exhaust filters are determined to be hazardous waste, they will be segregated from air intake filters.

Tri-Nuc and pool water cartridge filters (S5410) may contain metals dissolved in the Transfer/Storage Pool water. Additional research is necessary to determine if these filters exhibit the toxicity due to metal impurities in the Transfer/Storage Pool water.

Electronic equipment (S5460) may contain lead or silver above the toxicity characteristic level due to the presence of solder on circuit boards. Therefore, waste S5460 is assigned EPA Hazardous Waste Numbers D008 and D011.

Contaminated fixtures and equipment (S5490) such as vacuum cleaners and thermostats may exhibit the characteristic of toxicity for mercury.[P006, P011] Therefore, waste S5490 is assigned EPA Hazardous Waste Number D009.

Benzene, carbon tetrachloride, methyl ethyl ketone, and trichloroethylene were used in Building JN-1 (see Table 3-4). However, air exhaust filters (S5410) are designed to entrap dust and particulate material and will not retain toxicity characteristic levels of these compounds. In addition, filters are visually examined to verify the absence of visible contamination. Therefore, waste S5410 does not exhibit the characteristic of toxicity for organics (D012-D043).

### 6.2.2 Listed Hazardous Waste

The materials in this waste group are not, nor were they mixed with, waste listed in 40 CFR 261, Subpart D, as hazardous waste from non-specific sources (40 CFR 261.31); as hazardous waste from specific sources (40 CFR 261.32); or as discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Tri-Nuc and Transfer/Storage Pool filter cartridges (S5410) did not come in contact with F-listed solvents.

Air exhaust filters (S5410) may have come in contact with solvent vapors. However, vapors do not meet the definition of a solid waste. Filters are visually examined prior to or during packaging to ensure no visible contamination is present. Therefore, waste S5410 is not a listed hazardous waste.

Electronic equipment (S5460) and other contaminated fixtures and equipment (S5490) are visually examined prior to or during packaging to ensure no residue is present. Any contact with listed solvents is considered incidental. Therefore, wastes S5460 and S5490 are not listed hazardous wastes.

### 6.2.3 TSCA Waste Determination

The materials in this waste group are not TSCA-regulated waste as defined in 40 CFR 761. The source of the oil that was absorbed (S3114) is believed to be from the hydraulic cylinders used to open and close the doors to the High Level Cell and Low Level Cell.[P006] This hydraulic oil does not contain polychlorinated biphenyls (PCBs).[C006] Therefore, waste S3114 is not a TSCA-regulated waste. A representative sample of this waste will be obtained for verification purposes.

# 7.0 INORGANIC SOLIDS

This waste group consists of inorganic solid wastes generated by the research and development activities conducted in Building JN-1. A description of the inorganic solid wastes and associated waste matrix codes are provided in Section 7.1. The RCRA characterization of the inorganic solid wastes is presented in Section 7.2.

## 7.1 Waste Description

***Waste Matrix Code S3114, Absorbed Oil:*** This waste consists of oils mixed with an inorganic absorbent material such as Drierite or Floor Dry.[P006, P025]

***Waste Matrix Code S3118, Activated Carbon:*** This waste consists of unused charcoal contained in the filter bed of the fan unit in the Mezzanine above the High Energy Cell.[P003, P006]

***Waste Matrix Code S5119, Inorganic Particulate Materials (spent):*** This waste may include floor sweepings and vacuum cleaner contents.[U009, P001, P004, P006] Inorganic particulate material consists of particulate matter resulting from mechanical treatment and destructive testing operations. Consequently, particle size is frequently less than 2.36 inches (60 millimeters); however, summary category group S5000 applies because the waste material predominantly consists of manufactured objects (metal and glass pieces) that are not particles of S3000 or S4000 material.

***Waste Matrix Code S3119b, Inorganic Particulate Materials (unused):*** This waste may include soda ash and cement that has not been used.[U009, P001, P004, P006]

***Waste Matrix Code S5121, Concrete:*** This waste consists of concrete debris such as concrete blocks used for radiation shielding (does not include construction materials).[P001, P004, P006]

***Waste Matrix Code S5123, Ceramic/Brick:*** This waste may include ceramic refractory material (firebrick).[U009]

***Waste Matrix Code S5129, Insulation:*** This waste consists of pipe insulation.[U009]

## 7.2 Waste Characterization

Inorganic solid wastes are characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous and Toxic Substances Control Act (TSCA) waste determination for inorganic solid wastes. EPA Hazardous Waste Numbers applicable to the inorganic solid waste group are presented by waste matrix code in Table 7-1. These conclusions are supported by the evaluation in Sections 7.2.1, 7.2.2, and 7.2.3.

**Table 7-1.** Inorganic Solid Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| S3114 | Absorbed Oil | TBD |
| S3118 | Activated Carbon | None |
| S5119a | Inorganic Particulate Materials (spent) | TBD |
| S3119b | Inorganic Particulate Materials (unused) | None |
| S5121 | Concrete | None |
| S5123 | Ceramic/Brick | D005, D007, D008, D009, D011, F001, F002, and F005 |
| S5129 | Insulation | None |

### 7.2.1 Characteristic Waste

The materials in this waste group may exhibit a characteristic of hazardous waste as defined in 40 CFR 261, Subpart C, as a toxic waste (metals only). Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristics of ignitability (40 CFR 261.21), corrosivity (40 CFR 261.22), or reactivity (40 CFR 261.23).

***Ignitability***: The materials in this waste group do not meet the definition of ignitability as defined in 40 CFR 261.21. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. In addition, absorbents are added to wastes having the potential of generating free liquids. The materials in this waste group are therefore not ignitable wastes (D001).

***Corrosivity***: The materials in this waste group do not meet the definition of corrosivity as defined in 40 CFR 261.22. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. In addition, absorbents are added to wastes having the potential of generating free liquids. The materials in this waste group are therefore not corrosive wastes (D002).

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23. The materials are stable and will not undergo violent chemical change. The materials will not react violently with water; form potentially explosive mixtures with water; or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials in this waste group are therefore not reactive wastes (D003).

***Toxicity***: The materials in this waste group meet the definition of toxicity as defined in 40 CFR 261.24. The toxicity characteristic contaminants fall into one of two categories: metals and organics. Organic compounds include halogenated and nonhalogenated solvents, pesticides, herbicides, and other toxic compounds. This group does not exhibit the characteristic of toxicity for organics. This waste group may exhibit the characteristic of toxicity for barium, chromium, lead, mercury, and silver metals.

Absorbed oil (S3114) and spent inorganic particulate materials (S5119) may be contaminated with toxic metals or organics depending on how the oil was used. Additional research is necessary to determine if these wastes exhibit the characteristic of toxicity (D004-D043). Representative samples of wastes S3114 and S5119 will be obtained for verification purposes.

Activated carbon (S3118) is unused charcoal contained in a filter bed of a fan unit. Inorganic particulate materials (S3119b) are also unused. Since these materials were not used, they will not exhibit the characteristic of toxicity (D004-D043). Representative samples of wastes S3118 and S3119b will be obtained for verification purposes.

Concrete blocks (S5121) and pipe insulation (S5129) are visually examined prior to or during packaging to ensure no residue is present. Therefore, wastes S5121 and S5129 do not exhibit the characteristic of toxicity (D004-D043).

Firebrick (S5123) was removed from an incinerator in Building JN-1. The incinerator was used to burn combustible materials generated in the building. It is assumed the firebrick is contaminated with the same constituents as the combustibles (see Section 4.0). Therefore, waste S5123 is assigned EPA Hazardous Waste Numbers D005, D007, D008, D009, and D011 since a representative sample of this waste cannot be obtained for verification purposes.

### 7.2.2 Listed Hazardous Waste

The materials in this waste group are listed hazardous waste because they were mixed with, or derived from the treatment of, spent solvents listed in 40 CFR 261, Subpart D. Based on the acceptable knowledge documentation reviewed, the materials are not, nor were they mixed with, hazardous waste from specific sources (40 CFR 261.32), or discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Activated carbon (S3118) is unused charcoal contained in a filter bed of a fan unit. Inorganic particulate materials (S3119b) are also unused. Since these materials were not used, they are not listed hazardous wastes.

Concrete blocks (S5121) and pipe insulation (S5129) are visually examined prior to or during packaging to ensure no residue is present. Any contact with listed solvents is considered incidental. Therefore, wastes S5121 and S5129 are not listed hazardous wastes.

Firebrick (S5123) was removed from an incinerator in Building JN-1. The incinerator was used to burn combustible materials generated in the building. It is assumed the firebrick is contaminated with the same constituents as the combustibles (see Section 4.0). Therefore, waste S5123 is assigned EPA Hazardous Waste Numbers F001, F002, and F005.

### 7.2.3 TSCA Waste Determination

The materials in this waste group are not TSCA-regulated waste as defined in 40 CFR 761. The source of the oil that was absorbed (S3114) is believed to be from the hydraulic cylinders used to open and close the doors to the High Level Cell and Low Level Cell.[P006] This hydraulic oil does not contain polychlorinated biphenyls (PCBs).[C006] Therefore, waste S3114 is not a TSCA-regulated waste. A representative sample of this waste will be obtained for verification purposes.

# 8.0 LEADED RUBBER/PLASTIC

This waste group consists of leaded rubber/plastic wastes generated by the research and development activities conducted in Building JN-1. A description of the leaded rubber/plastic wastes and associated waste matrix codes are provided in Section 8.1. The RCRA characterization of the leaded rubber/plastic wastes is presented in Section 8.2.

## 8.1 Waste Description

***Waste Matrix Code S5311, Leaded Rubber:*** This waste consists of leaded gloves and aprons.

***Waste Matrix Code X7410, Lead Acid Batteries:*** This waste consists of lead acid battery casings that have been drained of their electrolyte.

## 8.2 Waste Characterization

Leaded rubber/plastic wastes are characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous waste determination for leaded rubber/plastic wastes. EPA Hazardous Waste Numbers applicable to the leaded rubber/plastic waste group are presented by waste matrix code in Table 8-1. These conclusions are supported by the evaluation in Sections 8.2.1 and 8.2.2.

**Table 8-1.** Leaded Rubber/Plastic Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| S5311 | Leaded Rubber | D008 |
| X7410 | Lead Acid Batteries | D008 |

### 8.2.1 Characteristic Waste

The materials in this waste group may exhibit a characteristic of hazardous waste as defined in 40 CFR 261, Subpart C, as a toxic waste (metals only). Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristics of ignitability (40 CFR 261.21), corrosivity (40 CFR 261.22), reactivity (40 CFR 261.23), or toxicity for organics (40 CFR 261.24).

***Ignitability***: The materials in this waste group do not meet the definition of ignitability as defined in 40 CFR 261.21. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials in this waste group are therefore not ignitable wastes (D001).

***Corrosivity***: The materials in this waste group do not meet the definition of corrosivity as defined in 40 CFR 261.22. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials in this waste group are therefore not corrosive wastes (D002).

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23. The materials are stable and will not undergo violent chemical change. The materials will not react violently with water; form potentially explosive mixtures with water; or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials in this waste group are therefore not reactive wastes (D003).

***Toxicity***: The materials in this waste group meet the definition of toxicity as defined in 40 CFR 261.24. The toxicity characteristic contaminants fall into one of two categories: metals and organics. Organic compounds include halogenated and nonhalogenated solvents, pesticides, herbicides, and other toxic compounds. This waste group does not exhibit the characteristic of toxicity for organics. This waste group may exhibit the characteristic of toxicity for lead metal.

Leaded rubber (S5311) and lead acid batteries (X7410) contain lead above the toxicity characteristic level.[C013] These wastes are visually examined prior to or during packaging to ensure no residue is present. Therefore, wastes S5311 and X7410 are assigned EPA Hazardous Waste Number D008.

### 8.2.2 Listed Hazardous Waste

The materials in this waste group are not, nor were they mixed with, waste listed in 40 CFR 261, Subpart D, as hazardous waste from non-specific sources (40 CFR 261.31); as hazardous waste from specific sources (40 CFR 261.32); or as discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Leaded rubber (S5311) and lead acid batteries (X7410) are visually examined prior to or during packaging to ensure no residue is present. Any contact with listed solvents is considered incidental. Therefore, wastes S5311 and X7410 are not listed hazardous wastes.

# 9.0 LIQUIDS

This waste group consists of liquid wastes generated by the research and development activities conducted in Building JN-1. A description of the liquid wastes and associated waste matrix codes are provided in Section 9.1. The RCRA characterization of the liquid wastes is presented in Section 9.2.

## 9.1 Waste Description

### 9.1.1 Inorganic Liquids

***Waste Matrix Code L1110, Acidic Wastewaters:*** This waste consists of various acids and acid solutions including nitric acid.[P001, P006]

***Waste Matrix Code X7100, Elemental Mercury:*** This waste consists of liquid elemental mercury (mercury contaminated equipment is not included in this waste).[P006]

### 9.1.2 Organic Liquids

***Waste Matrix Code L2120, Aqueous/Nonhalogenated Organic Liquids:*** This waste consists of hydraulic oil (Unocal Unax RX 32), wash water, and a sludge of sand and mixed fission products (dust, small fragments) located on the floor of the Hydraulic Door Room beneath the Controlled Access Area.[C006, P006, P015] Small items such as tools may also be present in this waste.[P006] Over the years, the oil leaked from hydraulic cylinders used to open and close the doors to the High Level Cell and Low Level Cell. The floor of the Controlled Access Area has been washed many times with water and detergent, and some of the wash water drained into the opening between the door and Controlled Access Area floor.[P015, P037]

***Waste Matrix Code L2220a, Nonhalogenated Organic Liquids:*** This waste consists of nonhalogenated organic liquids with a flash point greater than or equal to 60°C, such as glycols and oils.[P001, P006]

***Waste Matrix Code L2220b, Nonhalogenated Organic Liquids:*** This waste consists of nonhalogenated organic liquids with a flash point less than 60°C, such as alcohols.[P001, P006]

### 9.1.3 Unknown Liquids

***Waste Matrix Code L9000, Unknown Liquids:*** This waste consists of unmarked bottles of liquids contained inside the various cells.[P001]

## 9.2 Waste Characterization

Liquid wastes are characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous and TSCA waste determination for liquid wastes. EPA Hazardous Waste Numbers applicable to the liquid waste group are presented by waste matrix code in Table 9-1. These conclusions are supported by the evaluation in Sections 9.2.1, 9.2.2, 9.2.3.

**Table 9-1.** Liquid Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| L1110 | Acidic Wastewaters | D002 |
| X7100 | Elemental Mercury | D009 |
| L2120 | Aqueous/Nonhalogenated Organic Liquids | TBD |
| L2220a | Nonhalogenated Organic Liquids | None |
| L2220b | Nonhalogenated Organic Liquids | D001, F003, F005 |
| L9000 | Unknown Liquids | TBD |

### 9.2.1 Characteristic Waste

The materials in this waste group may exhibit a characteristic of hazardous waste as defined in 40 CFR 261, Subpart C, as an ignitable waste (40 CFR 261.21), a corrosive waste (40 CFR 261.22), and a toxic waste (metals only). Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristic of reactivity (40 CFR 261.23).

***Ignitability***: Nonhalogenated organic liquids (L2220b) meet the definition of ignitability as defined in 40 CFR 261.21(a)(1), and therefore are assigned EPA Hazardous Waste Number D001.

***Corrosivity***: Acidic wastewaters (L1110) meet the definition of corrosivity as defined in 40 CFR 261.22, and therefore are assigned EPA Hazardous Waste Number D002.

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23. The materials are stable and will not undergo violent chemical change. The materials will not react violently with water; form potentially explosive mixtures with water; or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials in this waste group are therefore not reactive wastes (D003).

***Toxicity***: The materials in this waste group meet the definition of toxicity as defined in 40 CFR 261.24. The toxicity characteristic contaminants fall into one of two categories: metals and organics. Organic compounds include halogenated and nonhalogenated solvents, pesticides, herbicides, and other toxic compounds. This waste group does not exhibit the characteristic of toxicity for organics. This waste group may exhibit the characteristic of toxicity for mercury metal.

Elemental mercury (X7100) waste exhibits the characteristic of toxicity for mercury and is therefore assigned EPA Hazardous Waste Number D009.

Aqueous/nonhalogenated organic liquids (L2120) may be contaminated with toxic metals or organics depending on the contamination from the Controlled Access Area washed into the hydraulic door room below. Additional research is necessary to determine if this waste exhibits the characteristic of toxicity (D004-D043). A representative sample of the treated waste will be obtained for verification purposes.

Nonhalogenated organic liquids (L2220a) do not exhibit the characteristic of toxicity (D004-D043). A representative sample of the treated waste will be obtained for verification purposes.

Unknown liquids (L9000), acidic wastewaters (L1110), and nonhalogenated organic liquids (L2220b) may exhibit the characteristic of toxicity and will be characterized on a case-by-case basis. Representative samples of the treated wastes will be obtained for verification purposes.

### 9.2.2 Listed Hazardous Waste

The materials in this waste group are listed hazardous waste because they are spent solvents or were mixed with spent solvents listed in 40 CFR 261, Subpart D. Based on the acceptable knowledge documentation reviewed, the materials were not, nor were they mixed with, hazardous waste from specific sources (40 CFR 261.32), or discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Nonhalogenated organic liquids (L2220a) were not mixed with spent solvents. Therefore, waste L2220a is not a listed hazardous waste.

Nonhalogenated organic liquids (L2220b) may include spent solvents such as methanol, acetone, benzene, or methyl ethyl ketone. Therefore, waste L2220b is an F003- and F005-listed hazardous waste.

Unknown liquids (L9000) may be listed spent solvents or mixed with listed spent solvents and will be characterized on a case-by-case basis.

### 9.2.3 TSCA Waste Determination

The materials in this waste group are not TSCA-regulated wastes as defined in 40 CFR 761. The source of the oil (L2120) is the hydraulic cylinders used to open and close the doors to the High Level Cell and Low Level Cell.[P006] This hydraulic oil does not contain PCBs.[C006] Waste L2220a does not contain PCBs. Therefore, wastes L2120 and L2220a are not TSCA-regulated wastes. Representative samples of these wastes will be obtained for verification purposes, as applicable.

# 10.0 METAL

This waste group consists of metal wastes generated by the research and development activities conducted in Building JN-1. A description of the metal wastes and associated waste matrix codes are provided in Section 10.1. The RCRA characterization of the metal wastes is presented in Section 10.2.

## 10.1 Waste Description

***Waste Matrix Code S5111, Metal Debris:*** This waste consists of metal debris including stainless steel, aluminum, iron, copper, and zirconium (Zircaloy).[P023] Waste items may include cable, wire, planchets, signs, respirator filters, valves, piping, strapping, tools, foil, sheeting, fixtures, ballasts, equipment (e.g., pumps, motors, etc.), hardware (e.g., nuts, bolts, brackets, etc.), empty cans, specimen vials, fuel rod cladding, Metmounts, and empty tackle boxes.[U009, P001, P003, P004, P006, P008] Aerosol cans that have been punctured and emptied of their contents are also included.[P001]

***Waste Matrix Code S5112, Metal Debris with Lead:*** This waste consists of metal items containing lead as part of the matrix. Waste items may include lead-lined tubing.[P006]

***Waste Matrix Code X7211, Elemental Lead:*** This waste consists of pure lead materials used primarily as radiation shielding. Waste items may include lead wool, shot, bricks, containers (e.g., pigs, casks), sheeting, and disks.[P001, P003, P006]

***Waste Matrix Code X7220, Elemental Cadmium:*** This waste consists of cadmium wire.[P019] The cadmium was possibly used to make covers for dosimeter capsules to increase the efficiency of dosimetry measurements.[C001]

***Waste Matrix Code X7510, Bulk Reactive Metals:*** This waste includes metals that may react violently with water, such as sodium and potassium.[C001]

***Waste Matrix Code X7530, Pyrophoric Metals:*** This waste includes metals that may spontaneously ignite in air, such as aluminum powder.[C001, P001]

## 10.2 Waste Characterization

Metal wastes are characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous waste determination for metal wastes. EPA Hazardous Waste Numbers applicable to the metal waste group are presented by waste matrix code in Table 10-1. These conclusions are supported by the evaluation in Sections 10.2.1 and 10.2.2.

**Table 10-1.** Metal Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| S5111 | Metal Debris | None |
| S5112 | Metal Debris with Lead | D008 |
| X7211 | Elemental Lead | D008 |
| X7220 | Elemental Cadmium | D006 |
| X7510 | Bulk Reactive Metals | D003 |
| X7530 | Pyrophoric Metals | D001 |

### 10.2.1 Characteristic Waste

The materials in this waste group may exhibit a characteristic of hazardous waste as defined in 40 CFR 261, Subpart C, as an ignitable waste (40 CFR 261.21), reactive waste (40 CFR 261.23), and a toxic waste (metals only). Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristics of corrosivity (40 CFR 261.22) or toxicity for organics (40 CFR 261.24).

***Ignitability***: The materials in this waste group meet the definition of ignitability as defined in 40 CFR 261.21(a)(2). The materials are liquid, but visual examination is performed to ensure free liquids are not added to containers during packaging. Pyrophoric metals (X7530) will spontaneously ignite in air and therefore are assigned EPA Hazardous Waste Number D001. Pyrophoric metals (X7530) will be segregated from TRU waste during packaging.

***Corrosivity***: The materials in this waste group do not meet the definition of corrosivity as defined in 40 CFR 261.22. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials in this waste group are therefore not corrosive wastes (D002).

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23(a)(2). The materials are stable and will not undergo violent chemical change. The materials will not form potentially explosive mixtures with water or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. Bulk reactive metals (X7510) will react violently with water and are therefore assigned EPA Hazardous Waste Number D003. Reactive metals (X7510) will be segregated from TRU waste during packaging.

***Toxicity***: The materials in this waste group meet the definition of toxicity as defined in 40 CFR 261.24. The toxicity characteristic contaminants fall into one of two categories: metals and organics. Organic compounds include halogenated and nonhalogenated solvents, pesticides, herbicides, and other toxic compounds. This waste group does not exhibit the characteristic of toxicity for organics. This waste group may exhibit the characteristic of toxicity for cadmium and lead metals.

Metal debris wastes (S5111) are visually examined prior to or during packaging to ensure no residue is present, or these wastes meet the definition of empty container (40 CFR 261.7). Visual examination will also verify the absence of toxicity characteristic metals (e.g., lead bricks). Therefore, waste S5111 does not exhibit the characteristic of toxicity (D004-D043) as long as all surfaces of the metal can be examined to verify the absence of surface contamination.

Metal debris with lead (S5112) and elemental lead (X7211) exhibit the characteristic of toxicity for lead. Therefore, wastes S5112 and X7211 are assigned EPA Hazardous Waste Number D008. The waste stream will not exhibit the characteristic of toxicity for any other constituent as long as all surfaces of the lead can be examined to verify the absence of surface contamination.

Elemental cadmium (X7220) exhibits the characteristic of toxicity for cadmium. Therefore, waste X7220 is assigned EPA Hazardous Waste Number D006.

### 10.2.2 Listed Hazardous Waste

The materials in this waste group are not, nor were they mixed with, waste listed in 40 CFR 261, Subpart D, as hazardous waste from non-specific sources (40 CFR 261.31); as hazardous waste from specific sources (40 CFR 261.32); or as discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Metal wastes are visually examined prior to or during packaging to ensure no residue is present, or these wastes meet the definition of empty container (40 CFR 261.7). Any contact with listed solvents is considered incidental. Therefore, this waste group is not a listed hazardous waste.

# 11.0 ORGANIC SOLIDS

This waste group consists of organic solid waste generated by the research and development activities conducted in Building JN-1. A description of the organic solid waste and associated waste matrix code are provided in Section 11.1. The RCRA characterization of the organic solid waste is presented in Section 11.2.

## 11.1 Waste Description

***Waste Matrix Code S3211, Organic Resin:*** This waste consists of ion-exchange resin contained in bags used for deionizing the Transfer and Storage Pool water.[U009, P002, P004] CM-2 Regenerated Mixed Bed Resin was used.[P025] The containers of resin likely have free liquids.[C001] Also included is TMI resin that was sampled, analyzed, and packaged; no other testing was conducted.[C001, P003, P006]

## 11.2 Waste Characterization

Organic solid waste is characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous waste determination for organic solid waste. No EPA Hazardous Waste Numbers are applicable to the organic solid waste group presented by waste matrix code in Table 11-1. These conclusions are supported by the evaluation in Sections 11.2.1 and 11.2.2.

**Table 11-1.** Organic Solid Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| S3211 | Organic Resin | None |

### 11.2.1 Characteristic Waste

Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristics of ignitability (40 CFR 261.21), corrosivity (40 CFR 261.22), reactivity (40 CFR 261.23), or toxicity (40 CFR 261.24).

***Ignitability***: The materials in this waste group do not meet the definition of ignitability as defined in 40 CFR 261.21. The materials are not liquid, and visual examination is performed to ensure free liquids are not present nor added to containers during packaging. In addition, absorbents are added to waste containing free liquids or having the potential of generating free liquids. The materials in this waste group are therefore not ignitable wastes (D001).

***Corrosivity***: The materials in this waste group do not meet the definition of corrosivity as defined in 40 CFR 261.22. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. In addition, absorbents are added to waste having the potential of generating free liquids. The materials in this waste group are therefore not corrosive wastes (D002).

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23. The materials are stable and will not undergo violent chemical change. The materials will not react violently with water; form potentially explosive mixtures with water; or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials in this waste group are therefore not reactive wastes (D003).

***Toxicity***: The materials in this waste group do not meet the definition of toxicity as defined in 40 CFR 261.24. No source for toxic compounds has been identified for organic resin (S3211), and therefore does not exhibit the characteristic of toxicity (D004-D043). A representative sample of waste S3211 will be obtained for verification purposes.

### 11.2.2 Listed Hazardous Waste

The materials in this waste group are not, nor were they mixed with, waste listed in 40 CFR 261, Subpart D, as hazardous waste from non-specific sources (40 CFR 261.31); as hazardous waste from specific sources (40 CFR 261.32); or as discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Organic resin (S3211) did not come in contact with listed solvents. Therefore, this waste group is not a listed hazardous waste.

# 12.0 SOLIDIFIED INORGANIC WASTE

This waste group consists of solidified inorganic waste generated by the research and development activities conducted in Building JN-1. A description of the solidified inorganic waste and associated waste matrix code are provided in Section 12.1. The RCRA characterization of the solidified inorganic waste is presented in Section 12.2.

## 12.1 Waste Description

***Waste Matrix Code S3150, Slugs:*** Slugs were produced from dissolving fuel specimens in an acid solution which was then diluted several times and mixed with cement and water and allowed to solidify in foam cups.[P001] The slugs will contain limited amounts of radionuclides from fuel because of this dilution.[C006]

## 12.2 Waste Characterization

Solidified inorganic waste is characterized based on knowledge of the material, knowledge of the processes generating the waste, and visual examination. This section provides an RCRA hazardous waste determination for solidified inorganic waste. EPA Hazardous Waste Numbers applicable to the solidified inorganic waste group are presented by waste matrix code in Table 12-1. These conclusions are supported by the evaluation in Sections 12.2.1 and 12.2.2.

**Table 12-1.** Solidified Inorganic Waste Characterization.

| Waste Matrix Code | Waste Description | EPA Hazardous Waste Numbers |
|---|---|---|
| S3150 | Slugs | TBD |

### 12.2.1 Characteristic Waste

Based on the acceptable knowledge documentation reviewed, the materials do not exhibit the characteristics of ignitability (40 CFR 261.21), corrosivity (40 CFR 261.22), or reactivity (40 CFR 261.23). Additional research is necessary to determine if the waste exhibits the characteristic of toxicity (40 CFR 261.24).

***Ignitability***: The materials in this waste group do not meet the definition of ignitability as defined in 40 CFR 261.21. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials in this waste group are therefore not ignitable wastes (D001).

***Corrosivity***: The materials in this waste group do not meet the definition of corrosivity as defined in 40 CFR 261.22. The materials are not liquid, and visual examination is performed to ensure free liquids are not added to containers during packaging. The materials in this waste group are therefore not corrosive wastes (D002).

***Reactivity***: The materials in this waste group do not meet the definition of reactivity as defined in 40 CFR 261.23. The materials are stable and will not undergo violent chemical change. The materials will not react violently with water; form potentially explosive mixtures with water; or generate toxic gases, vapors, or fumes when mixed with water. The materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials in this waste group are therefore not reactive wastes (D003).

***Toxicity***: The materials in this waste group may meet the definition of toxicity as defined in 40 CFR 261.24. The toxicity characteristic contaminants fall into one of two categories: metals and organics. Organic compounds include halogenated and nonhalogenated solvents, pesticides, herbicides, and other toxic compounds. This waste group does not exhibit the characteristic of toxicity for organics. The toxicity characteristic of metal contaminants in this waste group are to be determined.

Slugs (S3150) may exhibit the characteristic of toxicity depending on the leachability of metal fuel impurities in this waste. Additional research is necessary to determine if this waste exhibits the characteristic of toxicity (D004-D011). A representative sample of waste S3150 will be obtained for verification purposes.

### 12.2.2 Listed Hazardous Waste

The materials in this waste group are not, nor were they mixed with, waste listed in 40 CFR 261, Subpart D, as hazardous waste from non-specific sources (40 CFR 261.31); as hazardous waste from specific sources (40 CFR 261.32); or as discarded commercial chemical products, off-specification species, container residues, or spill residues thereof (40 CFR 261.33).

Listed solvents were not used in the process that generated slugs. Therefore, this waste group is not a listed hazardous waste.

# 13.0 REFERENCES

1. NMED. 1999. Waste Isolation Pilot Plant (WIPP) Hazardous Waste Permit, New Mexico Environment Department, #NM4890139088, State of New Mexico.

2. TCP-98-02, *Transuranic Waste Characterization Quality Assurance Project Plan for the Battelle Columbus Laboratories Decommissioning Project Transuranic Waste Certification Program,* Battelle Columbus Laboratories Decommissioning Project.

3. TC-AP-03.1, *Collection, Review, and Management of Acceptable Knowledge Documentation,* Battelle Columbus Laboratories Decommissioning Project.

4. DOE/WIPP. 1999. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant.* DOE/WIPP-069, Revision 7.

5. *Code of Federal Regulations,* Title 40, Parts 260-265, 268, and 270, U.S. Environmental Protection Agency.

6. DOE-CAO. 1999. *Quality Assurance Program Document.* DOE/CAO-94-1012, Revision 3, Carlsbad, New Mexico, Carlsbad Area Office, U.S. Department of Energy.

7. EPA. 1994. *Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes: A Guidance Manual,* EPA-530-R-94-024, U.S. Environmental Protection Agency.

8. DD-98-04, *Waste Characterization, Classification, and Shipping Support Technical Basis Document,* Battelle Columbus Laboratories Decommissioning Project.

# ACCEPTABLE KNOWLEDGE INVENTORY

Appendix A to Building JN-1 Hot Cell Laboratory
Acceptable Knowledge Document

| Ref No. | Title / Author | Summary | Date |
|---|---|---|---|
| C001 | Group Interview Record of Eugene Sands, Larry Stickel, Harley Toy, Max Berchtold, Mike Failey, and George Kirsch, BCL, conducted by Kevin Peters/Jeff Harrison.<br>WASTREN, Inc. | Interview summary of group interview with Eugene Sands, Larry Stickel, Harley Toy, Max Berchtold, Mike Failey, and George Kirsch. Includes notes taken from a very general discussion of operations in JN-1 including chemical use, flow of materials, general operations by area, radionuclides, waste management, and defense-related projects. The information collected was general and used to focus subsequent AK research. | 1998.<br>May 13. |
| C002 | Miscellaneous Internal Correspondence for the U.S. Army Project (Project Number G8109).<br>Battelle Columbus Laboratory. | The correspondence includes descriptions of a program conducted for the Army to examine the destruction/ immobilization of toxic substances using intense gamma irradiation from Co-60 source in JN-1. Demonstrates that defense related materials from the Army were introduced into JN-1 in 1970. | November 1992 – January 1983. |
| C003 | Internal Correspondence from Michael P. Failey to Louis B. Myers. "Characterization of the JN-1 Hot Cell Waste Drums."<br>Battelle Columbus Laboratory. | The correspondence provides isotopic characterization data for 15 drums of Hot Cell waste materials assayed by a gamma-ray scanning system in 1985 and 1986. Isotopes include only gamma-ray emitting radionuclides and does not quantify any transuranics (Pu, Am). | 1997.<br>May 1. |
| C004 | Interview Record of Harley Toy and George Kirsch, BCL, conducted by Kevin Peters.<br>WASTREN, Inc. | Interview summary of interview with Harley Toy and George Kirsch. Includes summary of discussions of waste management, shutdown of JN-1, operation history, chemical use and defense-related work. Includes identification of defense projects from a list of projects (U014) and documentation linking Shippingport work to naval research in JN-1. In the interview, Harley and George verify that highly enriched uranium (greater than 93%) could be attributed only to naval reactor fuel. | 1998.<br>July 13. |
| C005 | Interview Record of Scott Kitts, BCL, conducted by Kevin Peters.<br>WASTREN, Inc. | Interview summary of interview with Scott Kitts. Documents that Mr. Kitts identified N-Reactor fuel cladding from a dual purpose Hanford reactor in the Low Level cell. This verifies defense related materials were being tested in JN-1 during the early 1980s. | 1998.<br>July 16. |
| C006 | Interview Record of Max Berchtold, BCL, conducted by Kevin Peters.<br>WASTREN, Inc. | Interview summary of interview with Max Berchtold. Documents in which areas operations identified in the 1970s brochure (P031) were performed, in addition to how materials were introduced into the cells. The composition of the hydraulic oil used to lift the Low Level Cell (LLC) and High Level Cell (HLC) doors (no PCBs) was discussed (MSDS attached). Verifies carbon tetrachloride and benzene used in early operations. | 1998.<br>July 15. |
| C007 | Interview Record of Scott Kitts, BCL, conducted by Kevin Peters.<br>WASTREN, Inc. | Interview summary of interview with Scott Kitts. Documents that all suspect JN-1 TRU waste in inventory (hoppers and drums) stored at the site was generated in the cells and not mixed with waste or chemicals from the area supporting the cells. | 1998.<br>July 22. |
| C008 | Memorandum from Thomas A. Baillieul to Mike Brown, DOE/CAO. "Certification Strategy for Transuranic Waste Generated from the Battelle Columbus Laboratories Decommissioning Project."<br>DOE Ohio Field Office. | This memorandum summarizes the certification strategy for TRU waste generated during the BCLDP. The memo summarizes BCLDP and provides an estimate of RH and contact-handled waste to be generated by the program. Attachment includes the TRU Waste Certification Program Integrated Schedule (including assumptions and commitments), Certification Strategy, and a memo requesting a small quantity site certification audit. | 1998.<br>June 25. |

# ACCEPTABLE KNOWLEDGE INVENTORY

Appendix A to Building JN-1 Hot Cell Laboratory
Acceptable Knowledge Document

| Ref No. | Title / Author | Summary | Date |
|---|---|---|---|
| C009 | Miscellaneous BMI correspondence.<br>Various Authors. | Miscellaneous correspondence documenting the initial communications associated with naval reactor research (February 1956) and descriptions of navy research conducted in 1966–1968.<br>Documents: (1) External correspondence from R. W. Dayton to W. H. Wilson, 2/9/56; (2) Memorandum from R. F. Dickerson to R. W. Dayton, 8/27/56; (3) Memorandum from J. B. Brown to J. W. Ray, 3/22/66; (4) Memorandum from J. B. Brown to J. W. Ray, 9/15/66; (5) Memorandum from J. W. Ray to R. W. Dayton, 10/27/67; (6) Memorandum from J. W. Ray to R. W. Dayton, 10/27/67; (7) Memorandum from D. C. Minton, Jr. to S. J. Paprocki, 10/29/68. | February 1956 – October 1968. |
| C010 | Miscellaneous DOE and Battelle Columbus Correspondence.<br>Various Authors. | Miscellaneous correspondence relating to discussions of the amount of government research performed by Battelle laboratories, in addition to identifying the responsibility for the cost and management of the decontamination and decommissioning (D&D) operations. Several of the correspondence include attachments estimating the amount of work performed by the DOE, industry, and other government agencies (Department of Defense, Army, Navy, Air Force, NRC). Limited information on where research was performed.<br>Documents: (1) External correspondence from David A. Zorich to Pete Greenwalt, 12/27/95; (2) External Correspondence from J. O. Neff to William Daily, 11/6/91; (3) External correspondence from Jerome R. Bahlmann to Martin A. Langsam, 6/22/87; (4) Memorandum from James W. Vaughan, Jr. to Troy Wade, 8/12/87; (5) DOE Memorandum of Understanding under Contract No. W-7405-Eng-92-M. | November 1985 – December 1995. |
| C011 | JN-1 Chemical Use Lists.<br>Battelle Columbus Laboratories. | This list of chemicals was compiled by reviewing files containing MSDSs for chemicals found in JN-1. The list of chemicals was reviewed by Max Berchtold and Eugene Sands to identify those chemicals used in hot cells. | 1998.<br>July 24. |
| C012 | Interview Record of George Kirsch, BCL, conducted by Kevin Peters.<br>WASTREN, Inc. | Interview identifies the transfer of metallography operations from Alpha-Gamma Cell 1 to Cell 10, and identifies the acid used to dissolve burnout fuel in the Alpha-Gamma cells. | 1998.<br>July 28. |
| C013 | Internal correspondence from D. L. Kidd to A. A. Church. "Status of TCLP Analysis on Leaded Gloves and Leaded Glovebox Windows."<br>EG&G Rocky Flats, Inc. | Analytical data for leachable metals in leaded gloves and leaded glass windows. | 1991.<br>March 13. |
| C014 | Group Interview Record of Eugene Sands and George Kirsch, BCL, conducted by Kevin Peters.<br>WASTREN, Inc. | Interview summary of group interview with Eugene Sands and George Kirsch. This interview was conducted to answer specific questions raised during the first review of the AK document. Interview verified that cyanide will be contained in negligible amounts in the waste, that the Transfer/Storage Pool evaporator was completed in 1989, and that Army chemical agents will not be present in the TRU waste streams. | 1998.<br>October 22. |

# ACCEPTABLE KNOWLEDGE INVENTORY

Appendix A to Building JN-1 Hot Cell Laboratory
Acceptable Knowledge Document

| Ref No. | Title / Author | Summary | Date |
|---|---|---|---|
| C025 | Letter to James H. Eide, BMI, authored by Kevin Peters, WASTREN, Inc. | Letter summarizing historical research performed at West Jefferson during the 1970s and 1980s for Hanford. Based on the review of existing AK (C005, P035, P043, P044, U006), defense research includes N-reactor and LOCI programs performed in JN-1. | 1999<br>October 30 |
| C026 | Internal Correspondence from Jim Sarge to James H. Eide | Review of Benchmark Environmental assay data for waste boxes comparing BCLDP JN Standard and Pool waste stream models with ORIGEN2 output. | 1999.<br>April 30. |
| C033 | Letter from Elizabeth Sellers, DOE Richland Operations Office, to Contractors, Richland, Washington.<br>DOE Richland Operations Office. | Letter requesting Hanford Site contractors take action to maintain documentation and records necessary for the disposition of spent nuclear fuel (SNF). Attached to this letter is a DOE memorandum providing guidance on defining RH-TRU waste versus SNF. RH-TRU definition includes irradiated fuel test residues, test materials, and resultant fragments upon which tests are performed. Also included are resultant waste from examinations, and fuel pin fragments and dispersed particulate that cannot be readily retrieved and packaged with fuel assemblies and intact pins. This Attachment is also referenced in the determination for RH-TRU waste provided in *Interim Guidance on Ensuring That Waste Qualifies for Disposal at the Waste Isolation Pilot Plant* (P041). | 1996.<br>March 14. |
| C051 | Letter to AK Record authored by Scott Smith. | Letter describing analysis results for incandescent, fluorescent, and mercury vapor lightbulbs. Sampling and analysis were conducted at Rocky Flats Environmental Technology Site. Indicates incandescent lightbulbs contain lead over the regulatory limit and fluorescent and mercury bulbs contain mercury over the regulatory limit. Sample results are attached. | 2001.<br>July 6. |
| D001 | Telephone Interview Record of Scott Kitts and George Kirsch, conducted by Kevin Peters. "Discussions about JN-4 Waste Stored in JN-3."<br>WASTREN, Inc. | This interview verifies that there is a small inventory of plutonium-contaminated waste from D&D of the Plutonium Laboratory (JN-4). Previously, it had been assumed that the only waste remaining was gloveboxes that would not be disposed of at WIPP. Includes miscellaneous inventory information sent by George Kirsch. | 1998.<br>July 22. |
| D002 | Interview Record of George Kirsch, BCL, conducted by Kevin Peters.<br>WASTREN, Inc. | Interview summary with George Kirsch discussing the actual date that the High Energy Cell (HEC) and transfer pool were constructed and operational in JN-1. The AK record identifies 1972 and 1975 as the start date. | 1998.<br>July 28. |
| D004 | Telephone Interview Record of Cidney Voth, BCL, conducted by Kevin Peters.<br>WASTREN, Inc. | This interview was conducted to describe the operations involved with the draining of the JN-1 Transfer/Storage Pool water and to resolve a disrepancy relating to the date when this activity was completed. In an interview with Gene Sands and George Kirsch (C014) the interviewer was informed that the evaporation of the pool water was completed in 1989. Based on review of subsequent AK documentation it was determined that this activity was not completed until the mid-1990s. Cidney Voth was inter-viewed and documentation provided that the operation was performed between 1995 and 1997. | 1999.<br>April 27. |

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|---|---|---|---|
| P001 | Alpha-Gamma Cells JN-1A. Decontamination and Decommissioning Operation.<br>Louis B. Myers, Eugene Sands, Paul A. Tomlin, and William E. Bruce. | This report describes general operations in the 10 Alpha Gamma Cells in the basement of JN-1A, including a description of the cells' construction, cell access, and equipment and waste contained in each cell. Operations include metal specimen (Metmounts) grinding, washing, polishing, and metallography analysis; production of californium sources; preparation of fuel samples for disposal; thermal conductivity testing; and X-ray diffraction. Attachments include miscellaneous photos, drawings, and narrative (unknown source), in addition to hand-written inventory lists, 1996 update, and a supplement to Battelle's procedure manual for the cells (1964). Limited information relating to specific projects and dates. | 1994. August. |
| P002 | Fuel Storage Pool, Pump Room and Washdown Room JN-1B. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, and James L. Stickel. | This report describes general operations and configuration of the fuel storage pool, pump room, and washdown room in JN-1B. Operations include fuel storage (assemblies, strongbacks, rod bundles, rod holders and tools), deionization of pool water, and washing of casks. Attachments include 1996 update, miscellaneous drawings/photos, and health physics survey reports and data (including isotopics). | 1995. January. |
| P003 | High Energy Cell, Mezzanine, and Top of HEC JN-1B. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, Paul D. Faust, and Paul A. Tomlin. | This report describes general operations and configuration of the mezzanine, high bay, HEC, and area above the HEC in the JN-1B. Operations described include receipt and transfer of fuel assemblies into the HEC and transfer of cutup rods to the High Level Cell. Nondestructive examination, including weighing, dimension measuring, visual examination, photography, and gamma scan. Attachments include a 1996 update, miscellaneous drawings/photos, and health physics survey reports and data (including isotopics). Specific projects are not identified or described. | 1994. December. |
| P004 | Waste Storage Shed JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers and Max B. Berchtold. | This report describes the contents of the Waste Storage Shed (WSS) behind Building JN-1A. The inventory includes numerous drums and hoppers of waste from the HEC, HLC, and Alpha-Gamma Cell; resin bags from the pool deionizing tanks; and other miscellaneous contaminated items. Attachments include drawings of the WSS, waste location maps, and inventory lists. | 1995. June. |
| P005 | Hot Cell Purposes and Activities. Decontamination and Decommissioning Operations.<br>Battelle Columbus Laboratories. | Very brief and general report (2 pages) describing operations in the High Energy Cell, High Level Cell, Low Level Cell, Mechanical Test Cell, Charpy Room, and Alpha-Gamma Cells. | 1997. September 22. |
| P006 | Contents of the West Jefferson North Hot Cells and Storage Areas.<br>Louis B. Myers, Max B. Berchtold, and Eugene H. Sands. | This report describes the equipment, wastes, supplies, and other contaminated materials contained in the High Energy Cell, High Level Cell, Low Level Cell, Hydraulic Room, Pump Room, Mechanical Test Cell, Charpy Room, and Alpha Gamma Cells. | 1995. May. |
| P007 | Reactor Pool, Thermal Column, and Contractor Pool in JN-3. Decontamination and Decommissioning Operations.<br>Louis B. Myers and James L. Stickel. | This report provides a physical and functional description of the concrete structure that houses the remains of the retired research reactor including Reactor Pool, the Thermal Column, and the Contractor (GE) Pool. Describes waste stored in the area. Attachments include photos of the reactor. Specific projects and dates are not identified. | 1995. September. |

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|---|---|---|---|
| P008 | West Jefferson North Hopper Location and Contents. Decontamination and Decommissioning Operations.<br>Louis B. Myers and Max B. Berchtold. | This report describes the contents of 24 waste hoppers stored in JN-3, JN-1B (High Bay), and the Waste Storage Shed. Attachments include logbook entries of specific materials placed into certain hoppers. | 1995.<br>June. |
| P009 | Chemistry Laboratory, Counting Room and Microprobe Room. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, Paul A. Tomlin, and Michael P. Failey. | This report describes the operations and configuration of the Chemistry Laboratory, Counting Room, and Microprobe Room. Operations described include X-ray diffraction, gamma spec, alpha spec, gross alpha/beta, and isotopic analysis. Attachments include a 1996 update and photo-graphs of these areas. Specific projects and dates are not identified. | 1994.<br>December. |
| P010 | Evaporator Room JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, and Paul A. Tomlin. | This report describes the purpose and configuration of the Evaporator Room adjacent to the Charpy Room in JN-1A. Operations include an evaporator tank that produced sludge evaporated from liquids from the Radiological Analytical Laboratory, Hot Sump, hot drain sump (behind the Machine Shop), and drains from the Controlled Access Area (CAA) and OBD. Attachments include a 1996 update, health physics survey reports and data, and a certificate of analysis for TCLP of the sludge (1993). | 1994.<br>November. |
| P011 | Controlled Access Area Storage Rooms JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, Paul D. Faust, and Paul A. Tomlin. | This report describes the contents of the two storage rooms located to the east of the Controlled Access Area. Attachments include a health physics survey report and data, and a hand-written report of the contents of the rooms. | 1994.<br>October. |
| P012 | Controlled Access Area JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, Paul D. Faust, and Paul A. Tomlin. West Jefferson North historical files. | This report describes the CAA that provided support to the High Level Cell, Low Level Cell, and Mechanical Test Cell. Operations included staging and transferring materials between cells, servicing and repairing manipulators, and performing special projects. The Sabotage Program performed in this area (1981-1983) is also described. Attachments include a 1996 update and health physics survey reports and data. | 1994.<br>September. |
| P013 | Mezzanines JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers and Max B. Berchtold. | This report describes the mezzanine areas above the High Level Cell, Low Level Cell, and Mechanical Test Cell. These areas contain the ventilation and filtering systems for these cells. Attachments include a 1996 update. | 1994.<br>September. |
| P014 | Mechanical Test Cell JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Carl A. Redd, Sr., and Max B. Berchtold. | This report describes the purpose and background of the Mechanical Test Cell (MTC) used primarily for tensile testing. Other analyses performed in this cell include creep, vacuum fusion, burst, radial burnup, density, and expanding mandrel testing. Attachments include a 1996 update, photographs, hand-written calculations of isotope content (Co-60 and Sb-125), and waste can volume. | 1994.<br>July. |
| P015 | High Level Cell and Low Level Cell Hydraulic Doors and Hydraulic Door Room JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers and Max B. Berchtold. | This report describes the configuration and operation of the High Level and Low Level hydraulic doors, in addition to the hydraulic fluid and contamination on the floor of the Hydraulic Room below the doors. Attachments include drawings and diagrams of the area and a health physics survey report and data. | 1994.<br>September. |

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| Ref No. | Title / Author | Summary | Date |
|---|---|---|---|
| P016 | Subcells of the High Level and Low Level Cells in JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, and Paul A. Tomlin. | This report describes the subcells below the High Level and Low Level Cells. The subcells are used for storage of used HEPA filters and were used historically for creep testing. Attachments include a 1996 update, drawings and diagrams of the area, and a health physics survey report and data, in addition to a drawing showing hydraulic oil seeping into the area from the Hydraulic Room. | 1994.<br>November. |
| P017 | Low Level Cell JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, Thomas A. Beddick, Paul D. Faust, and Paul A. Tomlin. | This report describes the operations and configuration of the LLC in JN-1A. Projects included fuel cutting, grinding, tensile tests of cobalt samples, and gamma scanning of waste containers filled in the HLC. Attachments include a 1996 update, logbook pages describing the packaging of approximately 100 waste (berry) cans (December 1988 to February 1989), logbook pages of a study verifying the contents of the containers (July 1991), and radioassay results. Limited information relating to projects and dates. | 1994.<br>August. |
| P018 | High Level Cell JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Max B. Berchtold, Paul D. Faust, and Paul A. Tomlin. | This report describes the operations and configuration of the HLC in JN-1A. Operations described include cutting irradiated fuel sections and defueling fuel rod sections. Attachments include a 1996 update, lists of materials and equipment stored in the cell, and a letter discussing material lost during the Sabotage Program. Limited information relating to projects and dates. | 1994.<br>August. |
| P019 | Charpy Room JN-1A. Decontamination and Decommissioning Operations.<br>Louis B. Myers, Carl A. Redd, Sr., Max B. Berchtold. | This report describes operations and materials stored in the Charpy Room in JN-1A. Operations described include sheer testing of irradiated specimens and cleaning of samples. Attachments include a 1996 update, drawings and diagrams of the area, and a health physics survey report and data. Limited information relating to projects and dates. | 1994.<br>June. |
| P020 | Curie Content Determination and Package Classification of Low-Level Waste at Battelle's Hot Cell.<br>Failey, Michael P. | This report describes the procedures and methods used to determine the curie content and classification of low-level waste packages generated at Battelle's hot cell, including the identification of gamma-emitting radioisotopes. | 1986.<br>June 11. |
| P021 | Draft Report on the Characterization of Remote Handled TRU Waste Packages by Gamma-Ray Spectroscopy.<br>Failey, Michael P., Ph.D. | Gamma-ray spectroscopy was used to measure the amount of gamma-ray emitting radioisotopes present in waste generated in the hot cells and combined with ratios obtained from a computer code to calculate the amount of TRU radionuclides present in the waste packages. Also included are a general hot cell facility description; year operations ceased; how the wastes were packaged during cleanup activities; instrumentation used to measure the radioactive contamination; and system calibration, validation, and verification. | 1992.<br>October 5. |
| P022 | Appendices for the Intensive Audit Report for the Hot Cell.<br>Author Unknown. | Applications for radioisotopic procurement and/or use for items transferred from the Research Reactor (JN-3) to JN-1. The document describes movement of capsules and other reactor materials from JN-3 to JN-1 during the 1967-1969 time frame. | 1969.<br>August. |
| P023 | Course 7: Metals for Nuclear Power. Lesson Ten: Structural Materials.<br>Metals Engineering Institute. | One of a series of correspondence course pamphlets relating to metals used for the nuclear power industry. Useful as a reference for the structural metals used in nuclear reactors, especially zirconium. | Copyright 1958. |

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| Ref No. | Title / Author | Summary | Date |
|---|---|---|---|
| P024 | Procedures Manual for Battelle's Radioisotope, Gamma, and Hot-Cell Laboratories.<br>Sunderson, Duane N., and John E. Gates. | Document describing Battelle's radioisotopes, gamma, and hot-cell laboratory operations and West Jefferson and King Avenue. Provides maps and floor plans of the facilities and brief descriptions of operations in JN-1 in 1965. | 1965.<br>November 24. |
| P025 | Miscellaneous Material Safety Data Sheets (MSDSs).<br>Authored by Manufacturers. | Miscellaneous MSDSs collected from numerous sources during AK research at the West Jefferson site. | |
| P026 | The U.S. Government and Battelle, Partners in Nuclear Research, 1943 – Present.<br>Battelle Columbus Laboratories. | Document prepared primarily from thousands of questionnaires sent to Battelle Memorial Institute employees in 1985. The document describes the involvement of BMI in atomic research and development at several facilities. Includes a history of Battelle's involvement and the scope of operations performed in JN-1 and the amount of work performed for the DOE and other customers. The report does not specifically identify work performed for defense-related government work and focuses on special nuclear material projects. | 1985. |
| P027 | Battelle Columbus Laboratories Decommissioning Project. West Jefferson Category 1 and 3 Low-Level Waste Summary.<br>Battelle Columbus Laboratories. | Summary of decommissioning project at West Jefferson including an historical overview and physical and radiological characterization of compactible and noncompactible waste from JN-1, JN-2, and JN-3. The report focuses on low-level waste and does not distinguish between wastes generated from JN-1, JN-2, and JN-3. | 1997.<br>July 25. |
| P028 | Shipping/Receiving Records for U.S. Air Force Project (Project Number G7656-3).<br>Battelle Columbus Laboratory. | Radioactive Material Receipt documents receipt of reactor material from Sundance Air Force Station to JN-1. Demonstrates that defense-related materials from the Air Force were introduced into JN-1 in 1967. The document gives no details relating to the scope of the project. | 1967.<br>October. |
| P029 | Shipping/Receiving Records for U.S. Army Project.<br>Battelle Columbus Laboratory. | Radioactive Shipment and Receipt form and other documents that show the receipt of reactor material from the Army MH-1A reactor to JN-1. Demonstrates that defense-related materials from the Army were introduced into JN-1 in 1970. | 1970.<br>November/ December. |
| P030 | Hot-Laboratory Facility and Summary of Capabilities.<br>Battelle Memorial Institute. | Brochure describing capabilities of the JN-1 Hot Cell Laboratory, published before 1975 because HEC capabilities are not included. Includes descriptions of the facility and projects and methods used in the hot cells. | Date Unknown. |
| P031 | Battelle Hot Cell Laboratory Brochure.<br>Battelle Columbus Laboratory. | Brochure describing capabilities of the JN-1 Hot Cell Laboratory published after 1975, because HEC capabilities are described. Includes description of the facility, projects and methods used in the hot cells. Does not identify where the different methods are performed. | Date Unknown. |
| P032 | Procedures Manual for Battelle's Radioisotope, Gamma, and Hot-Cell Laboratories.<br>Sunderson, Duane N., and John E. Gates. | Document describing Battelle's radioisotopes, gamma, and hot-cell laboratory operations and West Jefferson and King Avenue. Provides maps and floor plans of the facilities and brief descriptions of operations in JN-1 in 1962 before the construction of the Alpha-Gamma cells. The procedure also describes a Waste Disposal Area that was never constructed in the basement of JN-1. | 1962.<br>February 20. |

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| P033 | Decontamination of Battelle Columbus' Plutonium Facility. Final Report to U.S. DOE Chicago.<br>Rudolph, Ann, George Kirsch, and Harley L. Toy. | This report summarizes the D&D of the Plutonium Laboratory. The report includes a historical description of the facility and operations. In addition, the report documents that all waste generated by the program was shipped off site. | 1984.<br>November 12. |
| P034 | Finding of No Significant Impact and Environmental Assessment. Battelle Columbus Laboratories Decommissioning Project.<br>U.S. DOE Chicago Operations Office. | This FONSI includes the Environmental Assessment and describes the proposed actions and DOE responsibility for the D&D of 15 Battelle Columbus Laboratories. Provides brief descriptions of West Jefferson North operations. | 1990.<br>June. |
| P035 | Representative Battelle-Columbus Projects with the Department of Energy, 1980–Present.<br>Battelle Columbus Laboratories. | This report provides a list and brief descriptions of nuclear, materials/process, fossil fuel, biomass/solar, and environmental studies performed for the DOE by Battelle from 1980 to 1985. The report does not identify the specific facilities supporting the projects. | 1985. |
| P036 | Battelle-Columbus 40 Years of Energy Research for the U.S. Government.<br>Battelle Columbus Laboratories. | This report provides an overview of operations and the historical missions of Battelle-Columbus. Provides a brief description of JN-1 operations and describes defense related Army, Navy, and Air Force Programs. General overview that does not identify the facility where the research was conducted. | 1985. |
| P037 | Decontamination Work Plan for Building JN-1 (partial document).<br>Battelle Columbus Laboratories. | This portion of the work plan describes the hydraulic oil leak in the Hydraulic Room below the Low Level and High Level Cells and provides an elevation drawing of the cell doors in these cells. | 1990.<br>November. |
| P038 | Battelle Columbus Laboratories Decommissioning Project Baseline.<br>Battelle Columbus Laboratories. | This portion of this document provides a brief history of Battelle Columbus Laboratories and a history of special nuclear material flow for the 15 buildings to be decontaminated and decommissioned. Information is extremely brief. | 1992.<br>November. |
| P039 | SCS-300 Operating Manual.<br>Bartlett Services, Inc. | This operating manual describes the operations of the SCS-300 Sonatol cleaning system equipment. The manual also provides a summary of the theory of the system's operations. | 1998. |
| P040 | Waste Characterization, Classification and Shipping Support Technical Basis Document for the Battelle Columbus Laboratories Decommissioning Project (BCLDP) West Jefferson North Facility.<br>Battelle Columbus Laboratories. | This report describes the methods used to identify and quantify the isotopes present in waste generated in JN-1. The report provides a radioisotope distribution based on smear samples taken from surface contamination in the CAA. Since the CAA historically supported operations in all the cells, samples of contamination should be very representative of the general distribution of isotopes in JN-1 (see C004). | 1998.<br>May. |
| P041 | Interim Guidance on Ensuring that Waste Qualifies for Disposal at the Waste Isolation Pilot Plant.<br>U.S. DOE Carlsbad Area Office. | This interim guidance was developed to assist the TRU waste sites in establishing and demonstrating that only TRU waste generated by atomic energy defense activities is certified for disposal at WIPP. | 1997.<br>February 13. |
| U001 | Miscellaneous Maps of Battelle Columbus West Jefferson Facility.<br>Battelle Columbus Laboratories. | Maps provide a layout of the West Jefferson site and the JN-1, JN-2, and JN-3 facilities. The map of JN-1 includes the HEC, pool, and High Bay. | Date Unknown. |

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|---|---|---|---|
| U002 | Description of the Battelle Hot Cell Laboratory.<br>Battelle Columbus Laboratories. | Summary of operations in the JN-1 hot cells including the HEC, LLC, HLC, MTC, and Alpha-Gamma Cells, including a three-dimensional diagram of the cells. The source of the document is unknown and provides no historical operational information. | Date Unknown. |
| U003 | Battelle-Columbus Hot Cell Laboratory - Capability Summary.<br>Battelle Columbus Laboratories. | Summary of JN-1 capabilities and operational history. The source of this document is unknown and must have been written after 1972, but before 1975, because it does not include a description of the HEC capabilities. | Date Unknown. |
| U004 | Buildings JN-1, JN-2, and JN-3 Summaries.<br>Battelle Columbus Laboratories. | Historical dates and brief history bullets for JN-1, JN-2, and JN-3. Dates are useful for creating a chronology of the history of operations at the site. Limited information relating to specific operations. | Date Unknown. |
| U005 | DOE Contract Log. | Logbook documents transfers of materials from Battelle relating to various defense-related Army and Air Force projects. There is no way to determine if any of these materials originated from JN-1; however, the enriched uranium project for Babcock and Wilcox Company, Naval Nuclear Fuel Division, was likely conducted in JN-1 based on conversations with Harley Toy. | 1975 – 1987. |
| U006 | ENG-92 Contract Projects Database 1 Printout. | Printout of the database created for the reference *The U.S. Government and Battelle, Partners in Nuclear Research* (P026). The printout provides a list of DOE, other government, and industrial contracts supported by Battelle from 1943 through 1985. Includes project number, date, funding, principal investigator, and scope. This list does not directly identify where the research project was conducted. | 1985.<br>Query Date May 20. |
| U007 | Volume Estimates for Potential TRU Contents at WJN.<br>Battelle Columbus Laboratories. | This table estimates the volume and type of potentially TRU waste contained in JN-1 cells, and other areas in JN-1 and JN-3. The volumes are rough estimates based only on visual observations and do not identify all materials that are included. | Date Unknown. |
| U008 | Nuclear Fuel Inventory at West Jefferson North.<br>Battelle Columbus Laboratories. | Inventory of nuclear fuel material located in JN-1 and JN-3, including cemented slugs of burn-up solution cemented in Alpha/Gamma Box 7. Information verifies that the cement slugs are primarily power reactor material. | Date Unknown. |
| U009 | Miscellaneous JN-1 Waste Inventory Data.<br>Battelle Columbus Laboratories. | This source consists of a number of inventory lists and Waste Package Loading Records describing the materials in drums and berry cans, including pool resins (with MSDS) and filters. Includes radiochemistry results for Tri-Nuc filters used to filter JN-1 pool water and an internal memo describing the method used to analyze the filters. This source contains information that can be used to describe the materials that may be contained in the TRU waste streams. | 1988 – 1997. |
| U010 | Hot Cell Receipts and Shipments Logbook.<br>Battelle Columbus Laboratories. | This JN-1 logbook documents receipt and shipment of irradiated materials. The logbook identifies numerous shipments of highly enriched uranium (navy reactor) fuel (see C004) into and out of the Hot Cell Laboratory from 1960 through 1969. | March 21, 1960 – May 14, 1973. |

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| U011 | Battelle Memorial Institute Laboratory Record Book of BMI Reports, No. 13561.<br>Battelle Columbus Laboratories. | This Battelle Memorial Institute Logbook records the identification numbers assigned to BMI research reports, in addition to the authors, report dates, and distribution (1957-1960). The log documents that a majority of the reports and drafts were destroyed and unavailable. The log lists ongoing naval reactor research; however, it does not identify where the research was conducted. | June 1957 – December 1960. |
| U012 | Battelle Memorial Institute Laboratory Record Book of BMI Reports, No. 18423.<br>Battelle Columbus Laboratories. | This Battelle Memorial Institute Logbook records the identification numbers assigned to BMI research reports, in addition to the authors, report dates, and distribution (1959-1968). The log documents that a majority of the reports and drafts were destroyed and unavailable. The log lists ongoing naval reactor research; however, it does not identify where the research was conducted. | July 1959 – June 1968. |
| U013 | Battelle Memorial Institute Laboratory Record Book of BMI Reports, No. 13117.<br>Battelle Columbus Laboratories. | This Battelle Memorial Institute Logbook records the identification numbers assigned to BMI research reports, in addition to the authors, report dates, and distribution (1960-1965). The log documents that a majority of the reports and drafts were destroyed and unavailable. The log lists ongoing naval reactor research; however, it does not identify where the research was conducted. | December 1960 – August 1965. |
| U014 | ENG-92 Contract Projects Database 2 Printout.<br>Battelle Columbus Laboratories. | Printout of the database created for the reference *The U.S. Government and Battelle, Partners in Nuclear Research* (P026). The printout provides a list of DOE, other government, and industrial contracts supported by Battelle from 1943 through 1985. Includes project number, dates, scope, and nuclear material type. Also includes group notes prepared by Harley Toy describing assumptions made for this database. Unlike U006, this reference identifies the building where the research was conducted and specifically identifies naval reactor research being conducted in JN-1 (see C004). | 1986.<br>Query Date October 17. |
| U015 | Miscellaneous Documentation describing Radioanalytical Laboratory Operations.<br>Battelle Columbus Laboratories. | Miscellaneous sources of information describing the mission and operations in the RAL in JN-2, including a list of procedures, pages from the RAL Administrative Operating procedure, and a RAL quality assurance discussion from the 1996 BCLDP Site Environmental Report. | 1997 – 1998. |
| U016 | Nuclear Materials Questionnaires.<br>Battelle Columbus Laboratories. | These Nuclear Materials Questionnaires were distributed during research conducted for *The U.S. Government and Battelle, Partners in Nuclear Research* (P026) and identify defense-related programs conducted in JN-1. This information was compiled in the database queried for reference U014. These forms document ongoing naval reactor research; however, they provide very limited project information. | 1985. |

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| U017 | Summary Report of Battelle 741 Reports.<br>Battelle Columbus Laboratories. | Available reports were compiled by Kathy Hall (CEMP) and Craig Jensen during review of 741 shipping reports stored in classified files in DOE Chicago. Information includes shipment numbers, shippers, receivers, material types/descriptions, dates, weights, project numbers, and other miscellaneous information. The information in the reports was reviewed for classification and was cleared for uncontrolled distribution. Based on a review performed by George Kirsch, none of the material could be linked to operations in JN-1. | 1998.<br>March/June |
| U018 | Battelle Columbus Laboratories Decommissioning Project (BCLDP); BCLDP Hot Cell Facility Presentation.<br>Battelle Columbus Laboratories. | 1995 presentation describing the BCLDP program associated with the JN-1 Hot Cell Laboratory. Provides a summary of the program history, JN-1 history and map, and brief summaries and drawings of the cells. | 1995.<br>July. |
| U019 | Miscellaneous JN-1 Construction Detail Reports.<br>Battelle Columbus Laboratories. | Construction detail reports for the High Energy Cell, Hydraulic Door Room, Low Level Subcell, Mechanical Test Cell, Low Level Cell, High Level Cell, and the JN-1 Pool and Sumps. Most of this information is duplicated in references P002, P003, P014, P015, P016, P017, and P018. No operations or waste information is contained in these reports. | 1997. |
| U020 | DOE/Battelle Cost Share – Scope July, 1997.<br>Battelle Columbus Laboratories. | This document describes the history and responsibilities of Battelle, NRC, and DOE for the D&D of Battelle Laboratories. | 1997. |
| U021 | TCLP metals data for leaded glass.<br>Rocky Flats Environmental Technology Site. | Analytical data for TCLP leachable metals in glass windows. Demonstrate leaded glass leaches at regulated levels for lead. | 1998.<br>July. |
| U026 | 69 Sample Basis of DD-98-04 Technical Basis Document.<br>Battelle Columbus Laboratories. | Analytical data for 69 radiological samples taken throughout Building JN-1. The data are the analytical basis for the JN-1 standard isotopic mixture documented in DD-98-04, *Waste Characterization, Classification, and Shipping Support Technical Basis Document*. Analysis limited to radionuclide isotopic concentrations. | 2001.<br>May 25. |