Controlled Copy

SAND2019-1831R

CCP-AK-SNL-500

Central Characterization Program Acceptable Knowledge Summary Report For

SANDIA NATIONAL LABORATORIES/NEW MEXICO

REMOTE HANDLED HOT CELL FACILITY AND OTHER RESEARCH TRANSURANIC WASTE (DEBRIS)

Waste Stream:

SNL-HCF-S5400-RH

Revision 9

Month XX, 2019

____
Printed Name

APPROVED FOR USE

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S.Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.
SAND No. 20XX-XXXX.

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	11/23/2010	Initial issue.
1	03/04/2011	Revised to incorporate *Waste Isolation Pilot Plant Hazardous Waste Facility Permit,* Attachments C-C6, *Waste Analysis Plan* (WIPP-WAP) changes, added New Mexico Administrative Code (NMAC) references, and updated the "Vacuum pump oil" entry in Table 7, Hot Cell Facility Chemical Identification.
2	07/06/2011	Revised to address comments from inspectors during U.S. Environmental Protection Agency (EPA) Baseline Inspection EPA-SNL-CCP-RH-06.11-8 (June 6-8).
3	11/29/2011	Revised to correct the assignment of U.S. Environmental Protection Agency (EPA) hazardous waste numbers (HWNs).
4	11/30/2011	Revised to change the TRUCON codes.
5	01/22/2014	Revised to include additional containers of Hot Cell Facility (HCF) fuel examination waste previously managed as SNM; to format the report consistently with CCP-TP-005, *CCP Acceptable Knowledge Documentation*; to incorporate Nuclear Waste Partnership (NWP) transition changes; and incorporate current procedures and waste processing acceptable knowledge (AK).
6	06/13/2014	Revised to include additional source documents; to change maximum layers of confinement from zero to one; and to make minor corrections throughout the report.
7	11/04/2014	Revised to address comments from inspectors during the 6/23/2104 U.S. Environmental Protection Agency (EPA) Inspection, and the 8/5/2014 Carlsbad Field Office (CBFO) audit; added acceptable knowledge (AK) for two small casks containing fuel pieces used as source material for classified research performed at TA-1; added AK for two additional containers of waste associated with the Hot Cell Facility (HCF).

RECORD OF REVISION (Continued)

Revision Number	Date Approved	Description of Revision
8	04/17/2015	Revised to include process generated waste (PGW) as a result of cleanup of the Auxiliary Hot Cell Facility (AHCF) at the conclusion of the remote-handled (RH) transuranic (TRU) repackaging campaigns; added final packaging configuration may include a 55-gallon drum without a 30-gallon inner drum to accommodate large items; updated *Annual Transuranic Waste Inventory Report* (ATWIR) information and waste stream volume.
9	XX/XX/2019	Added changes based on Carlsbad Field Office (CBFO) August 2015 and 2016 recertification audit comments. Added discussion about Chemical Compatibility Evaluation Memorandum (CCEM). Removed the chemical table from the Acceptable Knowledge Summary Report and added direction to the CCEM for information on chemical content. Made other editorial changes and corrections as applicable.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ACRR	Annular Core Research Reactor
AHCF	Auxiliary Hot Cell Facility
AK	acceptable knowledge
ANL-W	Argonne National Laboratory - West
ATWIR	*Annual Transuranic Waste Inventory Report*
BR3	Belgian Reactor 3
BWR	boiling water reactor
CCEM	Chemical Compatibility Evaluation Memorandum
CCP	Central Characterization Program
CFR	Code of Federal Regulations
CH	contact-handled
Ci	curie
cm^2	square centimeters
CO_2	carbon dioxide
DF	Damaged Fuel
DFR	Damaged Fuel Relocation
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
dpm	disintegration per minute
DQO	data quality objective
DR	Radioactive or Mixed Waste Disposal Request Form
EBR-II	Experimental Breeder Reactor-II
EEOS	Effective Equation of State
EPA	U.S. Environmental Protection Agency
FALCON	Fission Activated Laser Concept
FCI	Fuel-coolant Interactions
FEW	fuel examination waste
FD	Fuel Disruption (also referred to as Fuel Dynamics)
FFTF	Fast Flux Test Facility
GBs	gloveboxes
GBL	Glovebox Laboratory
HCF	Hot Cell Facility
HEPA	High-Efficiency Particulate Air
HWN	hazardous waste number
INL	Idaho National Laboratory

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

LANL	Los Alamos National Laboratory
lbs	pounds
LMFBR	liquid metal fast breeder reactor
LOF	loss of flow
LWA	*The Waste Isolation Pilot Plant Land Withdrawal Act*
LWR	light water reactor
MARS	Materials Accounting Records System
MC&A	Materials Control and Accountability
MDL	Microelectronics Development Laboratory
MELCOR	Methods for Estimation of Leakages and Consequences of Releases
MSDS	material safety data sheet
MP	Melt Progression
mrem/hr	milliroentgen equivalent man per hour
nCi/g	nanocuries per gram
NDC	nondestructive cleaning unit
NMAC	New Mexico Administrative Code
NPR	New Production Reactor
NWPA	*Nuclear Waste Policy Act*
PCB	polychlorinated biphenyl
PHS	Primary Hazard Screening
PGW	process generated waste
PKE	process knowledge evaluations
PPE	personal protective equipment
PWR	pressurized water reactor
QA	quality assurance
QAO	quality assurance objective
RCRA	Resource Conservation and Recovery Act
Rem/hr	roentgen equivalent man per hour
RH	remote-handled
RH-TRUCON	Remote-Handled Transuranic Waste Content Code
RMWMF	Radioactive and Mixed Waste Management Facility
RTR	real-time radiography
RWNMDD	Regulated Waste/Nuclear Material Disposition Department
R&D	research and development
SCB	Steel Containment Box
SDIO	Strategic Defense Initiative Organization
SNL/NM	Sandia National Laboratories/New Mexico
SNM	Special Nuclear Material
SPR	Sandia Pulsed Reactor
SRS	Savannah River Site

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

ST	Source Term
STAR	Sandia Transient Axial Relocation
TA	Technical Area
TDU	Tool Decontamination Unit
TMI	Three Mile Island
TRU	transuranic
TSCA	Toxic Substance Control Act
VE	visual examination
WCPIP	*Waste Characterization Program Implementation Plan*
WIPP	Waste Isolation Pilot Plant
WIPP-WAC	*Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*
WIPP-WAP	*Waste Isolation Pilot Plant Hazardous Waste Facility Permit, Waste Analysis Plan*
WMP	Waste Material Parameter
wt%	weight percent

1.0 EXECUTIVE SUMMARY

This acceptable knowledge (AK) Summary Report has been prepared for the Central Characterization Program (CCP) for remote-handled (RH) transuranic (TRU) waste generated and managed by Sandia National Laboratories/New Mexico (SNL/NM) in Albuquerque, New Mexico. The waste described in this report was predominately generated in the SNL/NM Hot Cell Facility (HCF) during the removal and packaging of experimental material and decontamination operations in Building 6580 at Technical Area (TA)-V. The waste stream also includes a very small amount of waste (estimated at less than 1 gram of fuel similar to that used for research at the HCF) originating from classified research at TA-I. In addition, the waste also includes secondary waste termed by SNL/NM as process generated waste (PGW), created during repackaging operations for this waste at the Auxiliary Hot Cell Facility (AHCF). The waste has been stored at the Sandia Pulsed Reactor (SPR) Dense Pack Storage Facility within TA-V or the Manzano Bunkers located at Manzano Base within Kirtland Air Force Base. All of the waste is being repackaged at the AHCF. This report was prepared in accordance with CCP-TP-005, *CCP Acceptable Knowledge Documentation* (Reference 1), to implement the AK requirements of DOE/WIPP-02-3214, *Remote Handled TRU Waste Characterization Program Implementation Plan* (WCPIP) (Reference 2); *Waste Isolation Pilot Plant Hazardous Waste Facility Permit*, *Waste Analysis Plan* (WIPP-WAP) (Reference 3); and DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (WIPP-WAC) (Reference 4).

The WIPP-WAP AK requirements are addressed in CCP-PO-001, *CCP Transuranic Waste Characterization Quality Assurance Project Plan* (Reference 5). The WIPP-WAC AK requirements are addressed in CCP-PO-002, *CCP Transuranic Waste Certification Plan* (Reference 6). Additionally, this report provides the AK information required by CCP-PO-505, *CCP Remote-Handled Transuranic Waste Authorized Methods for Payload Control (CCP RH-TRAMPAC)* (Reference 7).

The CCP is tasked with certification of TRU waste for transportation to and disposal at the Waste Isolation Pilot Plant (WIPP). This report was developed in accordance with CCP-TP-005 (Reference 1) and describes how AK is collected, reviewed, and managed by the CCP. The CCP is responsible for collection, review, and management of AK documentation in accordance CCP-TP-005 and reviews and approves this AK Summary Report. CCP maintains responsibility for this AK Summary Report and all CCP-TP-005 generated forms and records as quality assurance (QA) records. In addition, CCP maintains a copy of the “historical source documents” as non-QA records.

Waste stream SNL-HCF-S5400-RH originally consisted of thirty-two (32) parcels, packaged within twenty-seven (27) 55-gallon shielded drums or casks, and two non-shielded drums. Revision 5 of this report identifies 37 additional containers, currently packaged in either assembly packages, casks, or shielded boxes, that were initially identified as accountable material. The original and newly identified waste originated from pre- and post-test processes associated with reactor fuel studies conducted in the gloveboxes, Steel Containment Boxes (SCBs), and Zone 2A of the HCF. Revision 7 adds a very small amount of waste (estimated at less than 1 gram of fuel) originating from classified research at TA-I. These containers are being repacked in a remote-handling facility in the AHCF, so the final volume and number of containers may change. Revision 8 describes PGW resulting from the cleanup of the hot cell at the conclusion of the RH repackaging campaigns, and expands the final packaging configuration to include a 55-gallon drum without an inner 30-gallon drum. The corresponding contact-handled (CH) debris waste stream ID-SNL-HCF-S5400 is described in CCP-AK-INL-021, *Central Characterization Project Acceptable Knowledge Summary Report For Idaho National Laboratory, Sandia National Laboratories/New Mexico Hot Cell Facility Contact Handled Transuranic Waste (Debris), Waste Stream: ID-SNL-HCF-S5400* (Reference 8).

This AK Summary Report, along with the referenced supporting documentation, provides a defensible and auditable record of AK for the designated waste stream from the Sandia Hot Cell Facility. The references and AK source documents used to prepare this report are listed in Sections 8.0 and 9.0, respectively. The source documents cited throughout this report are identified by alphanumeric designations corresponding to a unique Source Document Tracking Number (i.e., C1001, CCE001, DR1001, I1001, M1001, P1001, and U1001).

This AK report includes information relating to the facility's history, mission, process operations, waste identification, characterization, and waste management practices. Information contained in this report was obtained from numerous sources, including facility safety basis documentation, historical document archives, generator and storage facility waste records and documents, and interviews with cognizant personnel.

This report and supporting source documentation provide the mandatory waste program and waste stream-specific information required by the WIPP-WAP (Reference 3). This report also compiles data relevant to the applicable U.S. Environmental Protection Agency (EPA) requirements and presents the documentation necessary to satisfy each WCPIP data quality objective (DQO) and quality assurance objective (QAO) for RH TRU waste streams (Reference 2).

2.0 WASTE STREAM IDENTIFICATION SUMMARY

Site Where TRU Waste Was Generated and Stored:

Sandia National Laboratories/New Mexico
1515 Eubank S.E.
Albuquerque, New Mexico 87123
EPA ID NM5890110518

Facility Where RH TRU Waste Was Generated:

Building 6580 Hot Cell Facility, TA-V
TA-I (classified research)

Facility Mission:

Historically, the mission of SNL/NM has been to develop technological solutions to support national security and to counter national and international threats. SNL/NM's mission is to meet national needs in the following areas:

- Nuclear weapons
- Nonproliferation and assessments
- Military technologies and applications
- Energy and infrastructure assurance
- Homeland security

The HCF in the basement of Building 6580 has been providing essential support for the reactor and other radiation facilities within TA-V since the early 1960s. In 1984, a major modification was conducted to provide additional hot cell facilities and systems in Building 6580 and to increase the capabilities of the existing HCF. As described in Section 4.7, the materials in waste stream SNL-HCF-S5400-RH were generated during the removal and packaging of experimental material and decontamination activities in the HCF where pre- and post-test processes associated with reactor fuel studies were conducted. These studies primarily involved the preparation of light water reactor (LWR) and liquid metal fast breeder reactor (LMFBR) experimental assemblies to be irradiated in the SNL/NM reactors to simulate severe accident scenarios. Following irradiation, the HCF capabilities allowed for post-irradiation examination of these assemblies. Additionally, this waste stream includes a small quantity of irradiated LWR fuel pieces (less than 1 gram of fuel) used in classified fuel identification research conducted at TA-I during the late 1980's to early 1990's.

Waste Stream SNL-HCF-S5400-RH (Heterogeneous Debris)

Summary Category Group: S5000

Waste Matrix Code Group: Heterogeneous Debris Waste

Waste Matrix Code: S5400

RH TRU Waste Content Code (RH-TRUCON): 321

Annual Transuranic Waste Inventory Report (ATWIR) Identification Number: SA-W135

Waste Stream Description:

Waste stream SNL-HCF-S5400-RH consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the HCF, and includes personal protective equipment (PPE) and plastic from HCF decontamination and waste repackaging activities. The waste stream also includes fuel examination waste (FEW) including test residues (i.e., kerf), test materials, hardware and the resultant test fragments from the fuel pin test specimens, including irradiated pin fragments. In addition, the repackaging of RH waste at the AHCF will produce what SNL personnel have termed PGW from the cleanup of the AHCF at the conclusion of repackaging campaigns, including contaminated items such as manipulator components, High-Efficiency Particulate Air (HEPA) filters, and sampling materials (included in material list below). The waste associated with the fuel pieces from TA-I does not include other materials, but may include the inner containers (small plastic and steel vials) the fuel pieces are currently contained in. This waste stream may contain the following materials (see Section 5.4):

- **Cellulosic items:** including paper, paper wipes, Herculite cloth, cardboard, cotton coveralls, hoods, and gloves, HEPA filter media and frames, pre-filter frames, swipes, masslin cloth, and vacuum cleaner bags and parts, absorbent pads, and wood chips.

- **Plastic materials:** including PPE, bottles, jars, buckets, dishes, pipettes, tygon tubing, pipe, bags, filter cartridges, sheeting, vials, tape, synthetic mop head, and epoxy residue.

- **Rubber items:** including non-leaded glovebox gloves, nitrile and latex gloves, gloves and booties, tubing, foam rubber, wire/cord insulation, O-rings, and gaskets.

- **Other inorganic items:** including glass jars, light bulbs, mirrors, windows, vials, lens, and other lab glassware.

- **Metal items (ferrous materials):** including stainless steel hardware, steel cans, buckets, vials, foils, plates, trays, equipment, machinery, and electronics with steel parts, filters, tubing, fittings, rods, tools, experimental assembly parts, and fuel rod pieces.

- **Non-ferrous metals:** including aluminum, brass, copper, lead, and silver. Items include foils, tools, wire, rods, tubing, fittings, gaskets, gauges, plates, machine parts, experimental assembly parts, and fuel rod pieces.

In addition to the debris materials described above, waste stream SNL-HCF-S5400-RH will also contain lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents including Aquaset, Petroset, and other inorganic absorbents are used during the immobilization and solidification of liquids. An organic based absorbent, Quik Solid was also used. The EPA hazardous waste numbers (HWNs) assigned to this waste stream are D004, D005, D006, D007, D008, D009, D011, D019, D022, D028, F002, and F005. Refer to Section 5.4.3 for the waste stream chemical content evaluation.

Prohibited items that were originally present in this waste stream identified during repackaging of the CH waste (SNL-HCF-S5400) or potentially present based on historic documentation, include unpunctured aerosol cans, prohibited liquids, and sealed containers greater than four liters. Waste packages containing prohibited items identified during characterization activities will be segregated, then dispositioned appropriately and/or repackaged to remove the items prior to shipment. Historic container paperwork did not indicate any containers with contact dose rates greater than 1000 roentgen equivalent man per hour (Rem/hr). Refer to Section 5.4.4 for detailed waste stream prohibited items information.

RH parcels previously repackaged and sent to WIPP prior to Revision 5 of this report were stored in several types of lead lined casks, 55-gallon drums with a concrete liner, and unshielded 55-gallon or 30-gallon drums. The waste added in Revision 5 and 7 of this report was or is currently stored in assembly packages, casks, or shielded boxes before repackaging. RH waste is repackaged at the AHCF in accordance with operating procedures written for each RH container (Refer to Section 5.5).

Waste stream SNL-HCF-S5400-RH meets the WIPP-WAP and the WCPIP waste stream definitions. The waste was generated during research and development operations associated with the preparation and examination of pre- and post-irradiated materials. The waste is similar in material, physical form, hazardous constituents, and radiological properties (Refer to Section 4.6.2).

3.0 ACCEPTABLE KNOWLEDGE DATA AND INFORMATION

TRU waste destined for disposal at the WIPP must be characterized prior to shipment. Development of knowledge of the waste materials and processes that generate and control the waste is required to provide a clear and convincing argument about the characteristics of each waste stream. The AK characterization documented herein complies with the requirements of the WIPP-WAP (Reference 3) and the WCPIP (Reference 2) and was developed in accordance with CCP-PO-001 (Reference 5), and CCP-TP-005 (Reference 1).

The WCPIP identifies waste characterization requirements and methods to satisfy requirements in:

- 40 Code of Federal Regulations (CFR) Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes* (Reference 9)
- 40 CFR Part 194, *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR 191 Disposal Regulations* (Reference 10)
- *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Certification* Decision (Reference 11)
- Public Law 102-579, *The Waste Isolation Pilot Plant Land Withdrawal Act* (LWA) (Reference 12)

This report presents information obtained from review of hundreds of AK sources relating to the SNL/NM HCF, process operations, and waste management practices. Examples of source documents include facility safety basis documentation, historical document archives, operational logbooks, repackaging logbooks, process work sheets, procedures for waste generation activities, interviews with cognizant personnel, results of waste characterization programs, and site mission descriptions identifying defense and non-defense operations. The references and AK sources used to prepare this report are listed in Sections 8.0 and 9.0, respectively. Only those sources cited in this report are listed. The AK sources referenced within this report by alphanumeric designations (i.e., C1001, CCE001, DR1001, I1001, M1001, P1001, and U1001) correspond to the Source Document Tracking Number using the following convention:

- C – Correspondence
- CCE – Chemical Compatibility Evaluation Memorandums
- DR – Discrepancy Reports
- I – Internal procedures
- M – Miscellaneous (e.g., controlled databases)
- P – Published plans, documents, and procedures
- U – Unpublished documents

4.0 REQUIRED PROGRAM INFORMATION

This section presents the mandatory TRU waste program information required by the WCPIP and the WIPP-WAP for waste stream SNL-HCF-S5400-RH (References 2 and 3). This section provides a description of the facility and operations associated with the generation of the SNL/NM HCF RH waste. Included is a description of the HCF and AHCF, a brief operational history of the SNL/NM site, mission summary, defense determination, waste management program information, discussions of operations associated with the generation of waste stream SNL-HCF-S5400-RH, and description of the SNL/NM waste management as it relates to this waste stream.

4.1 Facility Location

SNL/NM is located in Bernalillo County in north-central New Mexico, immediately south of Albuquerque, within the boundaries of Kirtland Air Force Base. SNL/NM is owned by the U.S. Department of Energy (DOE) and has been operated jointly by DOE and a Management and Operating contractor for over 50 years. As shown in Figure 1, Map of the Sandia National Laboratories/New Mexico, the SNL/NM site is divided into five TAs. TRU waste generated by SNL/NM is stored at the SPR Dense Pack Storage Facility within TA-V or at the Manzano Bunkers located at Manzano Base within Kirtland Air Force Base (References M2016 and P1104).

As shown in Figure 2, Map of SNL/NM Technical Area V, Building 6580 containing the HCF is located in TA-V. The SPR Dense Pack Storage Facility is located south of the HCF in TA-V. TA-V is located on a mesa bounded on the east by the Manzano Mountains, on the west by the Rio Grande, on the north by Tijeras Arroyo and Arroyo del Coyote, and on the south by Hell's Canyon Wash. Other TA-V facilities include the Annular Core Research Reactor (ACRR), the Sandia Pulsed Reactors (SPR II and SPR III), and the Gamma Irradiation Facility. Small research laboratories, a machine shop, and plant-support facilities are also located within TA-V (Reference P1104). As previously noted, a very small amount of waste originated from classified research performed at TA-I (C2005).

4.2 Facility Description

The HCF is located in the basement of Building 6580. As shown in Figure 3, HCF Basement Floor Plan, three SCBs are contained in a shielded support area (Zone 2A). They provide SNL/NM with an onsite capability of working with experiments and materials containing up to a nominal maximum of 50,000 curie (Ci) of fission products and 10,000 Ci of alpha emitters per SCB and Zone 2A. Materials, equipment, and experiment packages were moved into and out of Zone 2A through airlock doors from Room 110, and through the vertical passthrough in the roof of Zone 2A. Small items could be moved into and out of Zone 2A through the shield-wall tube. Access to SCB 1 is through a passthrough from Zone 2A. Normal access to SCBs 2 and 3 is through the passthroughs connecting the three SCBs. Small items were passed between SCB 2 and connected shielded glovebox (Blister) using a transfer tube. Items were also passed directly between Zone 2A and SCB 3 using the rear passthrough.

The Zone 2A area including the SCBs and Blister are collectively referred to as the Hot Cell in the AK record (Reference P1104).

As illustrated in Figure 4, Room 112 Glovebox Laboratory, the Glovebox Laboratory (GBL) contains a train of eight gloveboxes (GBs) connected by passthroughs. GBs 1 and 2 are shielded gloveboxes connected by a passthrough and were generally operated independently of the other boxes in the train. GBs 3 through 8 are typically accessed through an entry passthrough located between GBs 5 and 6. There are adapters on the ends of GBs 4 and 8 that permit attachment of special containers to introduce odd-sized equipment and samples into the boxes (References P1015 and P1104).

Access to GB 3 is through a passthrough to GB 4. GBs 4 and 5 have no barrier between them and function as one glovebox, sometimes referred to as GB 4/5. Similarly, GBs 6 and 7 have no barrier between them and function as one glovebox, sometimes referred to as GB 6/7. GB 8 is connected to GB 7 by a passthrough. GBs 9 and 10 are stand-alone boxes that do not directly connect to any other glovebox in the HCF. Gloveboxes may have been added to or removed from the GBL from time to time to accommodate changing customer requirements. SNL identifies that the experimental waste contained in GBs 4 through 7 consist only of low-level waste destined primarily for disposal at the Nevada Test Site. Glovebox 10 was removed prior to generation of this waste stream, and glovebox 11 shown in Figure 4 was never installed (References P1015 and P1104).

The Blister is a shielded glovebox served by both gloveports and master/slave manipulators. It connects with SCB 2 by a sample transport tube and contains sample analysis and preparation equipment (e.g., optical microscope and carbon and metal evaporator/coaters) (Reference P1104).

HCF support areas included in Zone 2 are Rooms 105, 106, 107, and 110/111/112. These rooms include the “cold” side of the Hot Cell walls and the operator areas for the hot cell. Also in these rooms are optical and scanning electron microscopes, fume hoods, leak detectors, radiation-detection equipment, and other equipment for handling radioactive and nonradioactive materials and experiments (Reference P1104).

The primary storage location for the experimental nuclear materials associated with HCF operations was Room 108. Nuclear material, largely Special Nuclear Material (SNM), was stored in Room 108 in metal cabinets, file cabinets, drums, boxes, and other closed containers. Nuclear material and SNM were also stored in other locations in and around the HCF. These locations typically included areas inside the SCBs and gloveboxes, cabinets in Rooms 105 and 112, inside Zone 2A, in drums or other containers in Rooms 110/111/112 and 106, in storage or transport containers in the monorail fenced area, and in the monorail storage hole. The 20-foot deep monorail storage tube was designed to store the larger assemblies introduced into the HCF for examination. The inventories changed frequently as materials were used for experiments and research projects (Reference P1104).

The AHCF, located in the High Bay of Building 6597 of TA-V, is the nuclear facility that has the capability to process and repackage RH TRU waste. The facility has radiological processing areas with gloveboxes for the safe handling of RH TRU waste. All of the containers currently assigned to waste stream SNL-HCF-S5400-RH will be repackaged at the AHCF to meet WIPP requirements prior to shipment. The containers have been stored at the SPR Dense Pack Storage Facility or at the Manzano Bunkers (References C1027, C2001, I1053, M1016, M2016, P1041, P1100, P1101, P2001, and P2016).

TA-I is the focus of SNL/NM's operations, housing the main administrative center and a close grouping of laboratories and offices. A majority of activities performed in TA-I are dedicated to the design, research, and development of weapon systems, the limited production of weapon system components, and energy research programs. Facilities in TA-I include the main technical library, several assembly/manufacturing areas, the Steam Plant, and various laboratories such as the Advanced Manufacturing Processes Laboratory, the Microelectronics Development Laboratory (MDL), the Neutron Generator Production Facility, the Processing and Environmental Technology Laboratory, the Joint Computational Engineering Laboratory, and the Microsystems and Engineering Sciences Applications Complex (References C2005 and P2015).

4.3 Facility Mission

Historically, the mission of SNL/NM has been to develop technological solutions to support national security and to counter national and international threats. SNL/NM's mission is to meet national needs in the following areas:

- Nuclear weapons
- Nonproliferation and assessments
- Military technologies and applications
- Energy and infrastructure assurance
- Homeland security

The HCF has been providing essential support for the reactor and other radiation facilities within TA-V since the early 1960s. In 1984, a major modification was conducted to provide additional hot cell facilities and systems in Building 6580 and to increase the capabilities of the existing HCF. As described in Section 4.7, the materials in waste stream SNL-HCF-S5400-RH were generated during the removal and packaging of historic experimental waste and associated decontamination of the process areas. The waste was generated during pre- and post- test processes associated with reactor fuel studies conducted in the GBL, SCBs, and Zone 2A of the HCF. These studies primarily involved the preparation of LWR and LMFBR experimental assemblies to be irradiated in the SNL/NM reactors to simulate severe accident scenarios. Following irradiation, the HCF capabilities allowed for post-irradiation examination of these assemblies (References P1102 and P1104).

The project performed at TA-I involved using gamma spectroscopy to develop a method for identifying the source of nuclear material (C2005).

4.4 Defense Waste Assessment

The WIPP requires generator sites to determine that TRU waste streams to be disposed of at WIPP meet the definition of TRU defense waste. 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* (NWPA) (Reference 13). Based on the review of AK there is sufficient evidence to demonstrate that TRU wastes generated by the HCF operations are contaminated with materials from atomic energy defense research activities associated primarily with projects conducted to support safety programs for reactors with defense missions (References 12 and 13).

The United States has historically operated and continues to operate reactors used for the development of nuclear energy technology. Additionally, these reactors have been utilized to produce radioisotopes for medical, industrial, and military purposes; to generate neutron environments for scientific research; and to conduct irradiation experiments in support of the government's defense, space, fusion, and advanced reactor programs. Collectively referred to as test and research reactors, these facilities have been typically operated by private contractors for the DOE. Mixed oxide, carbide, and alloy fuels for, or tests in, the DOE breeder reactor research and testing program were manufactured with plutonium obtained primarily from DOE production reactors at the Hanford site and the Savannah River Site (SRS). DOE test and research reactor facilities include the Argonne National Laboratory – West (ANL-W) Experimental Breeder Reactor-II (EBR-II) and Hanford Fast Flux Test Facility (FFTF) reactors (References C1042 and C1043).

In 1967 the U.S. Atomic Energy Commission initiated the LMFBR Program for developing and demonstrating fast breeder reactor technology for safe, reliable, and economical energy production. Critical to this demonstration program was the design, development, and construction or modification of facilities capable of manufacturing, testing, and examining these reactor materials. The ANL-W EBR-II and Hanford FFTF reactors were the most important facilities in the LMFBR Program. The FFTF was constructed to produce higher neutron flux and testing capabilities than produced by EBR-II. Even though the primary mission of the DOE test and research reactors was focused on the development of commercial energy technology, the reactors had an underlying defense mission and ongoing defense research and development experiments were conducted in these facilities. As described in Section 4.7, the HCF supported the development of the LMFBR technology by conducting experiments to simulate core disruptive accident conditions utilizing irradiated EBR-II mixed oxide reactor fuels (References C1038, C1042, C1043, and I1002).

EBR-II supported ongoing defense experiments conducted throughout the 30-year operating life of the reactor (1964-1994). In 1968 through 1969, the reactor was converted to a fast-reactor irradiation test facility. Test fuels and materials were placed in the core assemblies identical to those holding the driver fuel assemblies. In addition to supporting the LMFBR Program, numerous experiments were conducted for defense applications, including support of the Bettis Atomic Power Laboratory dedicated to supporting the Naval Nuclear Propulsion Program. Other defense program experiments conducted at EBR-II included radiation of thermionic elements and tritium production test materials. During its final year, experiments included a cooperative effort between Los Alamos National Laboratory (LANL) and Lawrence Livermore National Laboratory to demonstrate disposition of weapons plutonium in a fast reactor (References C1042 and C1043).

The EBR-II and FFTF reactors also supported the irradiation of experimental fuel pins manufactured at the LANL as part of the SP-100 Fuel Pin Irradiation Testing program during the late 1980’s and early 1990’s. This program, initiated in 1983, was jointly funded by National Aeronautics and Space Administration, DOE, and the Strategic Defense Initiative Organization (SDIO). The SDIO (better known as the “Star Wars” program) was established to pursue technology in the development of a viable and comprehensive ballistic missile defense program. The SP-100 program’s objective was to verify and validate the design of a compact, fast-spectrum nuclear reactor fuel for a broad range of national defense-related space applications. As described in Section 4.7, SNL/NM was involved in the development of SDIO technology associated with the Fission Activated Laser Concept (FALCON) project conducted in Building 6580. This program involved the development of a high-power, steady state, nuclear reactor-pumped laser concept being developed for the DOE Defense Program (References C1038, C1042, C1043, and P1019).

SNL/NM involvement with the New Production Reactor (NPR) program tests described in Section 4.7 was in support of research relating to the production of tritium for weapons production. Historically tritium was produced at the K Reactor and other reactors at the SRS. As the reactors were shut down, tritium production declined and halted altogether in 1988 when the K Reactor was shut down for safety upgrades. In the same year, DOE initiated the NPR project to develop a long term source of tritium to replace the aging K Reactor (References P1030 and P1044).

As described in Section 4.7, many of the HCF experiments were irradiated in the ACRR. The ACRR is a pool type research reactor capable of pulsed operation, steady-state operation, and a tailored transient rod withdrawal operation. The reactor was designed to produce a high yield of high-energy neutrons in the central irradiation dry cavity and other experimental facilities over a very short time-range pulse. This reactor supported DOE and U.S. Department of Defense defense experiments, including the irradiation of components for defense programs and tritium production research (References M1015, P1102, and P2001).

Based on a review of the waste management practices in the HCF, commingling of the material from the defense related projects described above would have occurred. In addition to cross contamination introduced during the storage of test materials in common storage areas in the HCF, waste materials from ongoing process operations remained in the work areas and were repackaged and moved between areas during decontamination campaigns. Additional contamination from cutting, grinding, and polishing activities would also remain in the area contaminating surfaces and equipment. This contamination would remain in the area to commingle with wastes generated during subsequent examinations. Additionally, project tooling, equipment, and instrumentation were shared between projects resulting in further cross-contamination. As a result of the waste management practices and destructive analytical nature of the operations conducted in the HCF, segregation of cross-contaminated non-defense waste from defense-related waste is not feasible. Based on a review of the AK record, there was no generator documentation indicating the intentional segregation of materials originating from defense experiments from non-defense experiments. The small amount of irradiated LWR fuel originating from Mound and used as source material at TA-I was clearly related to defense research and development (References C2005 and P2015). Therefore, waste stream SNL-HCF-S5400-RH is eligible for disposal at WIPP as a commingled defense waste stream generated "in part" by the atomic energy defense activities including defense research and development (References 12, 13, C1038, C2001, M1016, P1015, P1104, and P2001).

4.5 High-Level Waste and Spent Nuclear Fuel Assessment

The LWA (Reference 12) prohibits the disposal of spent nuclear fuel and high-level waste as defined by the NWPA (Reference 13) at WIPP. According to the NWPA, spent nuclear fuel is "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." DOE Order 435.1 *Radioactive Waste Management* (Reference 21) expands on this definition to clarify that "Test specimens of fissionable material irradiated for research and development only, and not production of power or plutonium, may be classified as waste, and managed in accordance with the requirements of this Order when it is technically infeasible, cost prohibitive, or would increase worker exposure to separate the remaining test specimens from other contaminated material." This RH waste stream contains debris contaminated during the fuel pre- and post-irradiation experiments and decontamination operations conducted in the HCF, and fuel identification research at TA-1. The waste stream also contains test residues, test materials, and the resultant test fragments from the fuel pin test specimens, including irradiated pin fragments and dispersed particulate (fines and dust). Intact irradiated fuel pin test specimens are not included in the waste stream. The accountable materials inventories and package contents were reviewed to verify the waste stream does not contain intact irradiated fuel (References C2001, C2005, M1016, and P1041).

High-level waste is defined by the NWPA as "the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation." The operations conducted in the HCF did not involve separation or reprocessing of constituent elements from reactor fuel (References 12, 13, C2001, M1016, and P1041).

4.6 RH TRU Waste Management

Historically, the wastes generated in the SCBs, Zone 2A, and the gloveboxes were all managed as radioactive or mixed waste. Radioactive and mixed wastes were collected separately and different kinds of radioactive and mixed waste (flammables, corrosives, and contaminated lead) were managed separately. Wastes were packaged, moved, handled, stored, and shipped out of TA-V in accordance with guidelines and procedures from the SNL/NM Environmental Safety and Health Manual, and HCF and TA-V procedures and policies. Prior to formal waste-processing operations in these areas, authorization was obtained from the SNL/NM waste management organizations (References P1101 and P1104).

The SNL/NM waste handlers from the Regulated Waste/Nuclear Material Disposition Department (RWNMDD) were responsible for proper waste management in the HCF. The waste handler's general responsibilities included the following (Reference P1101):

- Transporting and handling waste, materials, and samples.
- Storing, labeling, sorting, treating, and segregating waste and materials.
- Preparing waste and material for shipment to off-site facilities.
- General housekeeping in the SNL/NM facilities.
- Compiling and tracking waste inventory data and documentation.

To initiate waste generation in the HCF, the waste generators requested that waste or material be picked up for management by the RWNMDD. The request was done via a Radioactive or Mixed Waste Disposal Request Form (DR). The RWNMDD DR review process was intended to ensure that the waste accepted by the RWNMDD met the criteria for managing waste at the SNL/NM. The DR process is outlined below (Reference P1101):

The waste generator submits a DR to the RWNMDD.

- The DR is reviewed by the RWNMDD Waste Characterization Team, Radiation Protection personnel, and the Non-Nuclear Operations Supervisor for waste information and compliance with the waste acceptance criteria for the facility where the waste will be managed.

- The Non-Nuclear Operations Supervisor approves the waste for pickup and identifies the delivery or storage location for the waste at the Radioactive and Mixed Waste Management Facility (RMWMF) on the DR approval form.

- The DR Custodian tracks the DR through the DR review process and places the DR in the “Ready for Pickup” file box for the Waste Handlers when the waste is approved for pickup.

- The Waste Handlers pick up the waste and deliver it to a predetermined staging area at the RMWMF.

- The Waste Handlers unload and weigh the individual waste containers/parcels. Parcels are assigned identification numbers beginning with P and containers or drums are assigned C or SNL/NM prefixes.

- Waste labels are generated and attached to the container and/or parcel and the following information is verified:

  - Information on the radioactive waste labels includes the start date, the physical form of the waste (solid or liquid), and the DR number(s).

  - Information of the mixed waste labels include the start date, Resource Conservation and Recovery Act (RCRA) codes and hazardous constituents, characteristics of the waste (toxic, corrosive, etc.), the physical form of the waste, and DR number.

Following the initial management of parcels received at the RMWMF from HCF decontamination operations described in Section 4.7, the CH drums in waste stream SNL-HCF-S5400 containing the parcels from this operation were packaged during 2007 and 2008. During the CH repackaging effort, several parcels were determined to be RH. Several objectives for the repackaging effort were identified in the TRU Waste Repackaging Plan (Reference I1053), including:

- Repackage TRU waste into WIPP compliant packaging configurations.

- Repackage waste to meet weight, fissile gram equivalent, and decay heat limits for the packaging configurations.

- Document the repackaging activities.

- Remove and/or remediate prohibited items.

- Identify packages that are below the 100 nanocuries per gram (nCi/g) limits and reclassify as necessary.

- Segregate mixed waste items from non-mixed, if possible.

- Consolidate TRU waste into fewer containers.

- Prepare a Documented Safety Analysis to move the high activity/high dose TRU waste from storage to a facility at TA-V for repackaging.

The waste generated during the HCF decontamination consists of a combination of historic experimental waste and decontamination waste. Experimental waste was defined by the generator as those items present in the areas prior to the implementation of the decontamination program and included experimental debris (i.e., paper, chemicals) and equipment items that cannot be decontaminated to be reused. These experimental waste items are heterogeneous in nature and have varying radioactivity levels. Decontamination waste was defined as the materials generated during the decontamination of experimental items and/or the containment structures. Special handling of the high activity potentially RH waste generated as a result of experiment assembly or disassembly or post experiment examination was required for these materials and was the responsibility of the experimenter. The waste was collected and the experimenter was responsible for ultimate disposal. This waste may have been stored in the facility until disposal or may have been moved to another location (References I1030, P1015, P1102, and P1104).

Waste stream SNL-HCF-S5400-RH also includes containers of FEW added in Revision 5 of this report. These containers have been managed by SNL as accountable material, and the content of these containers is based on Materials Control and Accountability (MC&A) records and accountable material data recorded in the MC&A Materials Accounting Records System (MARS) database. The FEW material was stored in the HCF after it was examined, containerized and stored outside the HCF in Building 6580, and then transferred to the Manzano bunkers or the SPR Dense Repack Facility for long term storage (References C2006, C2008, M2025, M2029, M2030, and M2031). The containers of FEW material will be repackaged in the AHCF prior to shipment to WIPP (References C2001, M2029, P2002, P2003, P2005, and P2016). The small amount of irradiated LWR fuel originating from TA-I was originally stored at the Manzano Bunkers, before being transferred to the RMWMF to await repackaging at the AHCF (References C2005, C2007, and M2028).

4.6.1 Types and Quantity of TRU Waste Generated

Waste stream SNL-HCF-S5400-RH is mixed heterogeneous debris originally packaged during HCF decontamination activities conducted from 1995 to 1998. Waste stream SNL-HCF-S5400-RH originally consisted of 32 parcels inside 27 shielded casks or 55-gallon drums with concrete liners, and two non-shielded drums. These parcels have been repackaged at the AHCF and shipped to WIPP. An additional 40 containers, previously managed as accountable material anticipated to be shipped to the Idaho National Laboratory (INL), have been determined to be FEW eligible for disposal at WIPP. These containers have been added to the SNL-HCF-S5400-RH waste stream (Reference C2001). These added containers will also require repackaging at the AHCF prior to shipment to WIPP. The additional 40 containers were also generated in the SNL/NM HCF during the removal and packaging of experimental material and decontamination operations in Building 6580. The materials in these containers consist of reactor fuel sections, fragments, samples, residues, and related hardware associated with the examination of reactor fuel specimens. The small amount of irradiated LWR fuel originating from TA-I consists of a total of approximately 1 gram of fuel currently packed inside two lead casks (Reference M2028). In addition, the waste also includes PGW, created during repackaging operations for this waste at the AHCF. An inventory of drums verified to be eligible for shipment to WIPP will be included in the AK Waste Containers List for waste stream SNL-HCF-S5400-RH, and will be updated to reflect the repackaging campaigns (References C2001, C2004, C2005, C2008, C2009, C2010, M1016, M1019, M2003, M2010, M2021, M2028, M2030, M2031, P1105, P2002, P2005, and P2014).

4.6.2 Correlation of Waste Streams Generated from the Same Building and Process

The WIPP-WAP defines a waste stream as waste materials that have common physical form, that contain similar hazardous constituents, and that are generated from a single process or activity. The WCPIP definition also includes that the materials in a waste stream must have similar radiological properties. Based on a review of the AK record and SNL/NM waste management practices, TRU debris waste from HCF decontamination operations was segregated to be managed as RH and CH waste. One CH TRU debris waste stream (SNL-HCF-S5400) and one RH debris waste stream (SNL-HCF-S5400-RH) have been delineated based on the WIPP-WAP and WCPIP waste stream definitions. Additionally low-level waste was generated by this program is not addressed in this report (References 2, 3, 21, C2008, DR1001, DR1003, M1016, M2002, M2004, M2010, M2021, M2028, M2030, P1015, and P2001).

The basis and rationale for delineating this waste stream is as follows:

- Waste stream SNL-HCF-S5400-RH was generated by HCF research operations associated with pre- and post-irradiation examination experiments and the associated decontamination waste from the areas performing these experiments, and from research outside the HCF involving non-destructive assay of similar fuels.

- Based on the review of the container documentation, the waste materials in waste stream SNL-HCF-S5400-RH consist of predominantly of organic and inorganic debris materials with lesser amounts homogeneous solids (vermiculite, Quik Solid, and Aquaset). Though the composition (e.g., cellulosics, plastic, metal) of the individual debris waste items vary between containers the materials are similar in physical form as delineated in this report (Refer to Section 5.4.1).

- Waste stream SNL-HCF-S5400-RH consists of the RH portion of the TRU waste inventory generated during the HCF decontamination process and has been characterized and delineated consistently with CH waste stream ID-SNL-HCF-S5400.

- Nuclear material storage, historic process operations, waste management, decontamination operations and subsequent waste management and repackaging operations resulted in the RH and CH TRU waste materials to be contaminated with similar radiological and chemical constituents. These containers have been segregated from the CH stream, solely due to elevated radiological content of these materials. Based on review of the AK record, the following resulted in comingling of chemical and radiological contamination in the TRU waste materials including FEW. (References C1038, C2001, C2008, C2009, M1016, M2021, M2028, M2030, P1015, P1102, and P1104):

  - Storage and frequent movement of the nuclear test materials in common HCF storage areas;

  - Transfer of materials, specimens, equipment, and waste between research areas;

  - Contamination from previous destructive experiments on research area surfaces and from waste from previous experiments stored in the area;

  - Historic sharing of equipment between areas;

  - Fume hood operations involving the preparation of experimental chemicals and the decontamination of equipment for HCF areas;

  - Combination of RH waste parcels originating from CH repackaging operations conducted in the RMWMF;

  - The nature of the HCF decontamination program segregation of low-level, CH, and RH waste materials resulted in this RH waste stream containing predominantly post-irradiated experimental materials and contamination; and Cross contamination introduced during the final packaging of RH waste parcels in the same area in the AHCF.

Based on the rational above, waste stream SNL-HCF-S5400-RH meets the WIPP-WAP and the WCPIP waste stream definitions.

The DOE/TRU-18-3425, *Annual Transuranic Waste Inventory Report – 2018* (ATWIR) (Reference 14), identifies one RH TRU waste stream from SNL/NM, SA-W135 categorized as research and development (R&D)/R&D Laboratory Waste. Previous versions of the ATWIR identified three RH TRU waste streams from SNL/NM, SA-W134-B, SA-W135, and SA-W135-C. The 2013 version of the ATWIR identified one RH debris waste stream from the SNL/NM Hot Cell Facility, SA-W135-A. The 2014 ATWIR crosswalks SA-W135 to SA-W135-A. The two additional waste streams SA-W134-B and SA-W135-C are associated with PGW and the very small amount of irradiated LWR fuel used as a source material at TA-I, respectively. All three of these waste streams are included in SNL-HCF-S5400-RH. Previous ATWIRs identified two other CH waste streams from the HCF decontamination project, SA-W134 and SA-W134M. These streams were combined into waste stream SNL-HCF-S5400 as described in CCP-PK-SNL-002, *Central Characterization Project Process Knowledge Summary Report For Sandia National Laboratories/New Mexico Hot Cell Facility Contact Handled Transuranic Waste (Debris) Waste Stream: SNL-HCF-S5400* (Reference 23), and were shipped to INL for shipment to WIPP.

4.6.3 Waste Stream Identification, Categorization, and Delineation

This SNL/NM waste stream has been characterized based on knowledge of the material, knowledge of the processes generating the waste, and historical container documentation. Section 5.4.1 provides information on the container documentation used to determine the waste matrix codes assigned to these waste streams (References C2008, M1016, M1019, M2003, M2021, M2028, M2030, M2031, and P2001).

Once the containers are repackaged to meet WIPP requirements, they will be assigned new waste container identification numbers. The drums are given an identifier beginning with the letters SNL/NM or SNL, followed by a unique 6-digit number that is linked to the individual parcel identification numbers recorded on the DRs, or to the parent container number (References I1042, I1053, M1016, M2021 and P1101).

4.7 Description of Waste Generating Processes

4.7.1 Historic HCF Project Descriptions

The HCF in the basement of Building 6580 has been providing essential support for the reactor and other radiation facilities within TA-V since the early 1960s. In 1984, a major modification was conducted to provide additional hot cell facilities and systems in Building 6580 and to increase the capabilities of the existing HCF. The materials in waste stream SNL-HCF-S5400-RH were generated during historic experimental activities and waste operations associated with the decontamination of the HCF process areas. Contamination was the result of pre- and post-test processes associated with reactor fuel studies conducted in the GBL, SCBs, and Zone 2A of the HCF during the late 1970s to mid-1990s. These studies primarily involved the preparation of LWR and LMFBR experimental assemblies to be irradiated in the SNL/NM reactors to simulate severe accident scenarios. Following irradiation, the HCF capabilities allowed for post-irradiation examination of these assemblies. The data generated from many of these experiments was used by SNL/NM in the development of the Methods for Estimation of Leakages and Consequences of Releases (MELCOR) computer software that models the complex physical phenomena that occur in a nuclear power plant accident. Work began on MELCOR in 1982, with the first widely distributed release of the software in 1989 (References P1048, P1051, P1102, and P1104).

Details of HCF operations depend on specific experiment and project requirements. All involve either radioactive materials, fissile materials, or both. Types of post-irradiation examination operations conducted in the SCBs, Zone 2A, and the gloveboxes included packaging and unpackaging materials; loading materials into experiment packages; disassembly of irradiated and unirradiated packages and experiments containing radioactive or fissile materials; cutting, sectioning, coring, potting, mounting, grinding, polishing, and coating samples and materials for microscopic and other analytical examination; photography of samples; gamma counting and other radiation-emission analytical examinations; “wet” chemical and other chemical operations; and physical properties measurements (Reference P1102). Due to the research and development nature of the projects conducted in the HCF, development of a comprehensive process flow diagram was not feasible; however, the physical, chemical, and radiological properties of waste items was assessed to ensure that these items were consistent with the activities that were determined to generate TRU waste materials. The AK record was reviewed to compile a comprehensive list of chemicals and materials used during historic operations that may be contained in the waste stream. See Section 5.4 for a summary of the physical, chemical, and radiological characterization of waste stream SNL-HCF-S5400-RH.

Review of the AK record identified the primary research programs conducted in the SCBs, Zone 2A, and GBL described below. Waste from the SCBs and Zone 2A of the HCF primarily resulted from four experiments conducted from 1986 to 1993. These four experiments were: Melt Progression (MP) experiments, the Source Term (ST) experiments, the Damaged Fuel (DF) experiment, and the NPR experiments (Reference P1102). The Fuel Disruption (FD), Effective Equation of State (EEOS), Sandia Transient Axial Relocation (STAR), and FALCON programs were primarily conducted in the GBL and adjacent supporting areas. Table 1, HCF Project Areas, identifies the primary locations in the HCF where these projects were conducted (References C1004, P1015, and P1102).

Table 1. HCF Project Areas

Area	Project
SCBs/Zone 2A	Source Term (ST) Damaged Fuel-4 (DF-4) New Production Reactor (NPR)(irradiated) Melt Progression (MP)
Glovebox 1/2	Fuel Disruption (FD) Sandia Transit Axial Relocation (STAR) Effective Equation of State (EEOS) Source Term (ST)
Glovebox 3	Source Term (ST) (Ion Chromatograph)
Glovebox 4/5	Melt Progression (MP)
Glovebox 6/7	Melt Progression (MP) New Production reactor (NPR) (non-irradiated)
Glovebox 8	Melt Progression (MP)
Glovebox 9	New Production Reactor (NPR) (non-irradiated) Fission Activated Laser Concept (FALCON) Effective Equation of State (EEOS)
Fume Hood	Melt Progression (1&2) Fission Activated Laser Concept (FALCON) Supported chemical preparation and equipment decontamination for SCBs, Zone 2A, and GBL
Blister (Zone 2A)	Supported SCB and Zone 2A sample preparation and analysis

Melt Progression

The MP program included two experiments irradiated in the ACRR. MP-I was irradiated in 1989, and MP-2 was irradiated in 1992. These experiments were designed to investigate the successive melting and solidification of core materials found in a LWR during a severe accident. The initial geometry of the test section was built to simulate a partially degraded core based on the findings of the post-accident examination of Three Mile Island (TMI), Unit II core.

The MP project included the insertion of the test section into the experiment package, which was then subjected to a neutron field in the ACRR. The experiment simulated the continuation of a severe accident beyond the end stage of the TMI accident. Fission heating in the experiment simulated the fission product decay heating of a severe accident. The experiment was allowed to proceed until preset temperature limits on the supporting structures were reached or a preset fraction of the test section material had relocated due to damage. Waste materials from the MP work include post-test preparation for metallurgical examination materials (References M1016, P1045, and P1102).

Source Term

The focus of the ST program was on the investigation of fission product release under severe accident conditions. Four short rods of non-irradiated fuel and four short rods of previously irradiated fuel were placed in a test section and neutronically heated 2,400 Kelvin to observe fission product release. The non-irradiated fuel rods were fabricated at Battelle Pacific Northwest Laboratories. The previously irradiated fuel was obtained from the Belgian Reactor 3 (BR3) in Mol, Belgium, and was reworked in the HCF shielded glovebox. Several sample tubes with filters were sequentially opened and closed during the experiment to collect samples of the released substances. There were two tests run under this program, ST-l performed on April 28, 1987, and ST-2 performed on November 19, 1987. The materials from this program are those generated from the post irradiation examination. This examination for ST used the SCBs more extensively than any other program and included both a metallurgical examination and a chemical analysis of the filters from the sample tubes core (References C1011, I1010, I1011, I1016, I1023, I1024, I1025, I1026, I1033, I1034, I1035, I1036, I1039, M1016, P1025, P1046, P1102, U1004, U1011, and U1012).

Damaged Fuel

In general, the purpose of the DF program was to investigate the initial reaction of intact fuel rods during a severe accident sequence, specifically, a station blackout sequence. There were four tests in the DF experimental program. Of the four tests, only DF-4 included work in the SCBs or Zone 2A. In addition, DF-4 differed from the previous tests done in this series because the geometry of the test section was based on the boiling water reactor (BWR) geometry rather than the pressurized water reactor (PWR) geometry. The DF assembly included non-irradiated fuel enriched to 10 percent U-235 in zircaloy clad rods. The DF-4 experiment was irradiated on November 21, 1987, subjected to a neutron flux field in the ACRR for a period of approximately two hours. Waste included in this waste stream are those generated from the post-test preparation for metallurgical examination (References C1009, C1014, C1015, C1016, C1017, I1004, I1005, I1017, I1018, I1020, I1021, I1028, I1031, I1032, M1016, P1007, P1011, P1022, P1045, P1102, U1009, and U1014).

New Production Reactor

The primary goal of the NPR program tests was to assess the behavior of the fuel under transient, fuel melting conditions. The fuel was a uranium-aluminum alloy and produced significantly less particulate when cutting or polishing than the ceramic fuels. Four tests were conducted under this program, including one without radioactive materials to calibrate the thermal response of using a flooded ACRR cavity. Of the three remaining experiments, one was conducted with non-irradiated fuel and two with high burnup fuel.

All fuel used in the NPR experiments came from the SRS and was sectioned in HCF to generate samples for performing experiments in the ACRR. The non-irradiated fuel test was irradiated in the ACRR during November 1991, and the two tests using high-burnup fuel occurred between November 1991, and April 1992. Additional fuel cutting and repackaging was performed in the first quarter of 1996. This additional work generated some contaminated equipment, lay-down material and fuel cuttings (References I1040, M1016, P1044, P1047, and P1102).

Fuel Disruption (also referred to as Fuel Dynamics)

The purpose of the FD experiments was to determine breeder reactor fuel behavior under a number of disruption models, such as cracking and breakup of solid fuel, liquid state frothing, and radial spray from molten fuel. Between 1977 and 1983, over 30 in-pile experiments were performed in the ACRR to investigate fuel disruption behavior for LMFBR loss of flow (LOF) accidents. In all experiments the timing and mode of the fuel disruption were observed with a high speed camera, enabling detailed comparisons with a fuel pin code, SANDPIN. The project involved the cutting of irradiated breeder reactor fuel. Most of the fuel was irradiated in the late 1960s and early 1970s in the EBR-II. Cutting of the fuel occurred in GB2 in an inert atmosphere, and was performed dry. Glovebox 1 was used to load the fuel pin segments into the test apparatus, prior to irradiation in the ACRR (References C1004, C1006, C1013, I1006, I1007, I1009, M1016, P1010, P1012, P1034, P1035, P1036, P1037, P1038, P1039, P1040, and P1102).

Effective Equation of State

The EEOS program consisted of a series of experiments designed to determine the effective vapor pressure from irradiated mixed-oxide reactor fuels heated in closed volume to a very high temperature, simulating LMFBR core disruptive accident conditions. A series of similar EEOS experiments involving unirradiated fuel were conducted in the GBL during 1982 and 1983. Planning of the irradiated fuel experiments began in 1986 and they were completed by 1993.

The experiments involved two separate assemblies containing a pressure cell and calorimeter. Assembly and fueling was done in HCF prior to irradiation at the ACRR. Fueling was performed in shielded glovebox GB9, with each experiment using 0.9 to 1.5 grams of fuel from an EBR-II irradiated pin. After irradiation, the assemblies were returned to HCF for disassembly and examination. Leak testing was conducted using a bell jar and mass spectrographic technique (References C1008, C1038, I1001, I1002, I1003, I1015, I1019, I1022, M1016, P1001, P1002, P1003, P1004, P1005, P1006, P1008, P1009, P1014, P1026, and P1027).

Sandia Transient Axial Relocation

The STAR program was a series of seven in-pile experiments conducted between 1983 and 1985. The objective of the STAR experiment program was to study the transient cladding and fuel relocation during the initiation phase of LMFBR hypothetical accidents. The STAR program was an extension of the FD program that investigated the time and mode of fuel disruption during hypothetical LMFBR accidents.

In these experiments unprotected loss-of-flow accident conditions were simulated, and the accident-induced clad motion and fuel dispersal were recorded using high speed photography. Both unirradiated and irradiated EBR-II fuels were used in the STAR experiments. Assembly and disassembly of the test apparatuses involving single and multiple pins were done primarily in gloveboxes GB1 and GB2 in Room 112. Irradiation was performed at the ACRR (References C1038, I1012, I1013, M1016, P1016, P1033, U1001, and U1002).

Fission Activated Laser Concept

Sandia was the lead laboratory for the FALCON reactor-driven laser program from 1986 to 1995. The FALCON experiments were an SDIO defense program examining the feasibility of high power systems pumped directly by the energy from a nuclear reactor. In this concept, the highly energetic fission fragments from neutron-induced fission were used to excite a large-volume laser medium. Disassembly and reassembly of the experiment was done in the fume hood located in Room 112. Samples from the experiment were analyzed on the mass spectrometer in GB9. Fabrication of the fission foils containing enriched uranium used in the experiment were done in Room 203 and not included in this waste stream (References C1038, C1041, M1016, P1019, P1020, and P1021).

4.7.2 HCF Decontamination

During 1994, Scientific Ecology Group, Inc., prepared a Decontamination Plan for the HCF. The Decontamination Plan was intended to meet the SNL/NM requirements for decontamination, nuclear safety, As Low As Reasonably Achievable, and waste management activities, by establishing a project organizational structure, levels of authority, and lines of communication (Reference I1030).

This work was to be done as part of HCF routine operations and maintenance. The tentative acceptance criteria for the HCF were based on allowing future work in the area to be conducted with minimal protective clothing and reasonable stay-times. The tentative decontamination criteria were as follows (Reference I1030):

- Removable Alpha Contamination — <100 disintegration per minute (dpm)/100 square centimeters (cm^2)

- Removable Beta-Gamma Contamination <5,000 dpm/100 cm^2

- General Area Dose Rate <5 milliroentgen equivalent man per hour (mrem/hr)

The Scope of Work for the Decontamination Plan included remediation of the following areas: Zone 2A; Zone 2 (also referred to as Rooms 111 and 112); reactor rooms 108 and 109; and room 212A, a small room located above reactor room 109 (References C1038 and I1030). The work associated with Zone 2A included decontamination, dismantling, and removal of the SCBs followed by decontamination of the canyon surfaces. Other components in Zone 2A, including the overhead crane, crane rails, overhead components, and floor rails were scheduled to be removed, sectioned and packaged as required. Removal of the interior airlocks was also identified as part of the Zone 2A scope of work (Reference I1030).

The primary task associated with rooms 108 and 109 involved the removal of sources of radioactive waste and loose surface contamination. Special consideration was given for the removal of high activity waste to an outside storage location. Zone 2 (Rooms 111 and 112) included the removal of shielded and low activity gloveboxes. This task included the removal of all debris and equipment from within the gloveboxes (Reference I1030).

The nondestructive cleaning unit (NDC) was used sporadically during the HCF decontamination project to decontaminate equipment that was stored in the gloveboxes in Room 112, in the SCBs, and in the general HCF area. The NDC mobile decontamination facility was designed for cleaning hand tools, small parts, and larger items up to 4,000 pounds (lbs). The process could handle both metal objects and softer materials such as wood, plastics and rubber. The facility consisted of a decontamination room for cleaning larger objects, a decontamination cell (glovebox) for cleaning tools, small parts and fixtures, a count room, a liquid carbon dioxide (CO_2) storage vessel and compressor, and the ventilation/exhaust system. The decontamination room operated at a negative pressure of 1.5 inches of water vacuum to prevent airborne exhaust of radioactive materials (Reference M1016).

The unit used dry compressed air to propel CO_2 pellets (dry ice) onto the contaminated surface. The pellets shatter, flash into dry CO_2 gas and undergo roughly a ten-fold increase in volume upon impact with the surface to be decontaminated. The cleaning action results from the rapidly expanding gas penetrating the surface of the item to be cleaned. Loose particles of contamination were flushed away by expanding gas. Dislodged microscopic particles were captured on the exhaust system air filter, and larger particles that were dislodged fell to the bottom of the containment area and were vacuumed away to dry air filters (Reference M1016).

The unit's air filtration system consisted of three sets of filters in series. Ideally, the filters were replaced when the exposure rate at the external filter housing reached 25 mrem/hr, and exposure rates were not to exceed 200 mrem/hr (Reference M1016).

4.7.3 TA-I Classified Research

A research project performed In TA-I from the late 1980's to early 1990's resulted in a very small quantity of waste source material (less than 1 gram of irradiated LWR fuel). This research project involved using gamma spectroscopy to develop a method of identifying the source of nuclear material. This project was and still is classified, so little information can be provided in this report. Based on an interview with the scientist involved with this project, the material was thought to be irradiated LWR fuel from Mound, and was never removed from the steel and plastic vials that contain the material. Based on analytical data, this material appears to be very similar to the BR-3 fuel already associated with waste from the HCF. Because this material is radiologically similar to the HCF waste, this AK summary report was expanded to include it (References C2005, M2028, and P2015).

5.0 REQUIRED WASTE STREAM INFORMATION

This section presents the waste stream information required by the WIPP-WAP and the WCPIP for waste stream SNL-HCF-5400-RH (References 2 and 3). The area of generation, waste stream volume, period of generation, prohibited items, waste packaging, and the physical, chemical, and radiological composition of the waste stream are described.

5.1 Area and Building of Generation

Waste stream SNL-HCF-S5400-RH originated from research and development and decontamination processes performed at SNL/NM as described in Section 4.7 (References C2001, C2004, C2009, M1016, M1019, M2003, M2004, M2010, M2021, M2028, M2030, M2031, P2001, and P2002).

5.2 Waste Stream Volume and Period of Generation

Waste stream SNL-HCF-S5400-RH is mixed heterogeneous debris originally packaged during HCF decontamination activities conducted from 1995 to 1998. The very small amount of irradiated LWR fuel used as source material in TA-I was used during research in the late 1980's to early 1990's. Table 2, Estimated and Actual Waste Stream SNL-HCF-S5400-RH Volume, summarizes the original and current inventory of waste before and after repackaging at the ACHF (References C2001 and P2001). The volume was determined by estimating the inner volume of the shielded containers. The final volume after repackaging will vary depending upon the degree of contamination within the various experiment assemblies, and the degree of consolidation that may be possible based on final container shipping limits. The current inventory of drums verified to be eligible for shipment to WIPP will be included in the AK Waste Containers List for waste stream SNL-HCF-S5400-RH (References M1016, M1019, and P2001).

Table 2. Estimated and Actual Waste Stream SNL-HCF-S5400-RH Volume

Containers	Volume in cubic meters
Original (have been shipped to WIPP) – 32 parcels inside 29 various shielded and non-shielded casks or drums	Estimated – 2.8 Actual – 4.6 (22 55-gal drums)
Current (FEW) – 40 various sized shielded and non-shielded containers (casks, drums, boxes, and experiment assembly packages) and PGW from hot-cell cleanup	Estimated – 3.5* Actual – 5.2 (25 55-gal drums)
Current – 2 lead casks (pigs) containing irradiated LWR fuel from TA-1	Negligible**

* Based on current repackaging and visual examination (VE) data
**Added to FEW material during AHCF repackaging Campaign 14

5.3 Waste Generating Activities

Waste stream SNL-HCF-S5400-RH was generated from activities primarily associated with pre- and post-test processes associated with reactor fuel studies, as described in Section 4.7. In general, these studies involved the preparation of nuclear fuel experimental assemblies in the HCF, irradiation of the assemblies in SNL reactors to simulate various reactor conditions, and post-irradiation examination of the test assemblies in the HCF. In addition, the repackaging of RH waste at the AHCF will produce what SNL personnel have termed PGW from decontamination of the hot cell during the RH repackaging campaigns. PGW may include debris left over from repackaging RH waste, as well as materials used in the hot cell such as HEPA filters, manipulator components, and sampling materials. No additional hazardous materials were added to the waste during the generation of PGW or during cleanup of the hot cell (References 14, C2010, and P2005).

5.4 Types of Wastes Generated

This section describes the waste materials based on process inputs and outputs, waste matrix code assignment, waste material parameter weight estimates, radionuclide contaminants, hazardous waste determinations, and prohibited items for waste stream SNL-HCF-S5400-RH.

5.4.1 Materials Related to Physical Form

Waste stream SNL-HCF-S5400-RH consists predominantly of organic and inorganic debris generated during the destructive and nondestructive examinations conducted in the HCF, and includes PPE and plastic from HCF decontamination and waste repackaging activities. The waste stream also includes FEW including test residues, test materials, hardware and the resultant test fragments from the fuel pin test specimens, including irradiated pin fragments. In addition, the repackaging of RH waste at the AHCF produced what SNL personnel have termed PGW from the decontamination of the hot cell during the RH repackaging campaigns, including contaminated items such as manipulator components, HEPA filters, and sampling materials. The waste associated with the fuel pieces from TA-1 does not include other materials, but may include the inner containers (small plastic and steel vials) the fuel pieces are currently contained in. This waste stream may contain the following materials (See Section 5.4.1.2 for detailed information):

Cellulosic items: including paper, paper wipes, Herculite cloth, cardboard, cotton coveralls, hoods, and gloves, HEPA filter media and frames, pre-filter frames, swipes, masslin cloth, and vacuum cleaner bags and parts, absorbent pads, and wood chips.

Plastic materials: including PPE, bottles, jars, buckets, dishes, pipettes, tygon tubing, pipe, bags, filter cartridges, sheeting, vials, tape, synthetic mop head, and epoxy residue.

Rubber items: including non-leaded glovebox gloves, nitrile and latex gloves, gloves and booties, tubing, foam rubber, wire/cord insulation, O-rings, and gaskets.

Other inorganic items: including glass jars, light bulbs, mirrors, windows, vials, lens, and other lab glassware.

Metal items (ferrous materials): including stainless steel hardware, steel cans, buckets, vials, foils, plates, trays, fuel cuttings and pieces, equipment, machinery, and electronics with steel parts, filters, tubing, fittings, rods, tools, experimental assembly parts, and fuel rod pieces.

Non-ferrous metals: including aluminum, brass, copper, lead, and silver. Items include foils, tools, wire, rods, tubing, fittings, gaskets, gauges, plates, fuel cuttings and pieces, machine parts, experimental assembly parts, and fuel rod pieces.

In addition to the debris materials described above, waste stream SNL-HCF-S5400-RH may also contain lesser amounts (less than 50 percent in any container) of homogeneous organic and inorganic materials. Clay and vermiculite based absorbents including Aquaset, Petroset, and other inorganic absorbents are used during the immobilization, and solidification of liquids. An organic absorbent, Quik Solid, was also used (References C1039, C2001, C2005, M1007, M1016, M1019, M2003, M2004, M2010, M2021, M2028, M2030, P2001, P2002, and P2005).

5.4.1.1 Waste Matrix Code

Based on the evaluation of the materials contained in waste stream SNL-HCF-S5400-RH, it was determined that the stream is comprised of greater than 50 percent heterogeneous inorganic and organic debris. Therefore, Waste Matrix Code S5400, Heterogeneous Debris, is assigned to the waste stream. Although the waste stream, as a whole, is comprised of more than 50 percent heterogeneous debris, any drum may include a wide percentage range of the waste material parameters listed in Section 5.4.1.2, except that no individual drum will contain greater than 50 percent homogeneous solids (References C1039, C2001, C2005, C2009, M1016, M1019, M2003, M2004, M2010, M2021, M2028, M2030, M2031, P2001, and P2002).

5.4.1.2 Waste Material Parameters

Waste Material Parameter (WMP) estimates for waste stream SNL-HCF-5400-RH were based on disposal request documentation and MC&A data for TRU waste generated during decontamination of the SNL/NM HCF in Building 6580. Decontamination of the HCF occurred from 1995 to 1998. Waste generated includes materials associated with pre- and post-test processes, primarily metallurgical examination, in support of several research programs conducted between the late 1970s and mid-1990s. This waste stream is greater than 50 percent by volume material that meets the criteria for heterogeneous debris (References C1039, C2001, C2005, C2009, M1016, M1019, M2003, M2004, M2010, M2021, M2028, M2030, M2031, P2001, and P2002).

The WMP weight percentages for this waste stream were estimated by reviewing the container paperwork. Since container paperwork did not always indicate weights for individual items placed in a parcel or drum, these weights were estimated based on the waste description. For most parcels, the net weights were taken from the SNL Radioactive Waste/Nuclear Material Disposition Department Radiological Form included in the DR documentation. A few parcels had other DR documentation that was viewed as more accurate so that was used (References C1039, M1016, and M1019). The FEW waste, because it had been previously managed as accountable material, does not have standard DRs so content descriptions are based on MC&A records and radiological characterization forms, which are less detailed from the WMP perspective. In addition, many of the FEW containers have the original experimental assemblies, which may or may not have been entirely contaminated if the fuels remained intact during irradiation in ACRR. If the fuels remained intact they could potentially be removed from the assemblies during repackaging (References P2002 and P2005), substantially reducing the volume of waste material. For the FEW containers the following assumptions were made to estimate relative WMP weights:

1) Net weight of a container was taken from the Radiological Characterization Summary Form (Reference M2021). If a Summary form was not available the net weight is based on SNL's estimate of the average experimental assembly weight of 60 lbs., regardless of the type of container it is currently stored in (Reference P2002).

2) The current outer containers (i.e., shielded casks, drums, assembly packages, and boxes) will be disposed as low-level waste and will not become part of the waste stream.

3) The net weight of each container was estimated to contain 85 percent iron-based metal (experimental assembly parts, inner packaging [e.g., steel paint cans], fuel cladding, hardware), 10 percent aluminum-based metals (experimental assembly parts), and 5 percent other metals (experimental assembly parts, fuel specimens, and cladding).

4) The weight of other inorganic materials, cellulosics, rubber, and plastic, prior to repackaging is negligible to the weight of metal.

The WMP estimate for waste stream SNL-HCF-S5400-RH is presented in Table 3, Waste Material Parameter Estimates for SNL-HCF-S5400-RH. These calculations conclude that the average weight percentages for inorganic and organic waste materials for waste stream SNL-HCF-S5400-RH are 90.6 percent and 9.4 percent, respectively, with the predominant WMP being iron based metal alloys. The minimum and maximum weight percentages per drum included in Table 3 represents the lowest and highest estimated non-zero amounts of these materials prior to repackaging. The final packaging of these materials will result in drums that do not include all of these waste material parameters. The estimates in Table 3 take into account the entire waste stream, including the portion of this waste stream that has been shipped to WIPP. The waste material parameters and weight percent estimates were not recalculated for the addition of the very small amount of material added to the FEW inventory during revision 7 of this report. This small quantity of material is bounded by or would not significantly change the values presented in Table 3 (References C2008, M2028, M2030, and M2031).

Table 3. Waste Material Parameter Estimates for SNL-HCF-S5400-RH

Waste Material Parameter	Average Weight Percent (Wt%)	Wt% Range[1]
Iron-based Metals/Alloys	71.0%	3.0% - 95.0%
Aluminum-based Metals/Alloys	10.1%	1.0% - 100.0%
Other Metals	4.3%	1.0% - 80.0%
Other Inorganic Materials	4.7%	0.1% - 100.0%
Cellulosics	3.4%	0.5% - 50.0%
Rubber	0.9%	0.5% - 11.1%
Plastic (waste materials)	5.1%	0.5% - 50.0%
Inorganic Matrix	0.5%	3.3% - 10.0%
Organic Matrix	0.0%	0.0% - 0.0%
Soils/Gravel	0.0%	0.0% - 0.0%
Total Inorganic Waste Average	**90.6%**	
Total Organic Waste Average	**9.4%**	

1. Range includes lowest non-zero estimated values for parcels prior to repackaging.

5.4.2 Radiological Characterization

5.4.2.1 Radiological Characterization of the Original Inventory

As described in Section 4.0, waste stream SNL-HCF-S5400-RH consists of debris waste generated during decontamination of the HCF from 1995 to 1998. The waste is contaminated with radiological material associated with the HCF activities conducted between the late 1970s and the mid-1990s. Based on waste management practices and categorization schemes, containers in this waste stream have surface dose rates exceeding 200 mrem/hr and contain more than 100 nCi/g of alpha emitting TRU isotopes with half lives greater than 20 years. The radionuclides of principle interest that contaminate the waste include Sr-90, U-235, U-238, mixed-fission products, Cs-134, Cs-137, and small amounts of transuranic radionuclides, primarily Pu-238, Pu-239, and Am-241. The approach implemented by CCP to fully characterize this waste stream is documented in CCP-AK-SNL-501, *Central Characterization Program Remote-Handled Transuranic Radiological Characterization Technical Report For Sandia National Laboratory/New Mexico Hot Cell Facility Remote-Handled Transuranic Debris Waste, Waste Stream: SNL-HCF-S5400-RH* (References 15, M1016, and M1019).

The waste stream originally consisted of approximately 32 parcels contained in 27 shielded and two non-shielded storage containers. For the original inventory of radioactive waste, SNL/NM personnel generally characterized each parcel using quantitative gamma spectroscopy analysis, either the laboratory Q2 system or a portable system, in conjunction with activity ratios for radionuclides not detected or undetectable by gamma spectroscopy. If gamma spectroscopy was not performed, exposure rate surveys were used in conjunction with MICROSHIELD modeling to estimate the Cs-137 activity. The activity ratios that were used to predict the activity concentration of additional fission products and TRU radionuclides are documented in process knowledge evaluations (PKEs). Special considerations or additional information influencing the reported radiological characterization was documented in the DR forms for each parcel (References M1016, M1019, M1020, and M1021). High dose rate RH containers were initially characterized using only the portable gamma spectroscopy system, because of Q2 system dose limits.

Radiological characterization of original population of HCF decontamination waste was established by the SNL/NM waste handlers from the RWNMDD who were responsible for proper management of waste following generation and initial packaging of the waste in the HCF (refer to Section 4.6). Because of different fuel types involved in the areas and gloveboxes and because of the different experiments conducted in these areas, there is potential that the radionuclide distributions exhibited on the waste from these different areas may differ. RWNMDD personnel developed and used the PKEs to establish radiological characterization of each parcel based on information provided on the DRs which identified the location and/or project that generated the waste. For waste parcels included in the original population of waste stream SNL-HCF-S5400-RH, the three PKEs used were:

Document Number	Waste Generation Source
PKE00044	SCBs and Zone 2A
PKE00047	Gloveboxes 1 and 2
PKE00027/54	Glovebox 3

PKE00044 and PKE00047 were initially established based on limited sampling and analytical modeling (ORIGEN analysis). During 2004, swipe samples were collected and analyzed by gamma spectroscopy and radiochemical analysis to verify and update the radionuclide activity ratios previously reported in PKE00044 and PKE00047. Although the evaluation of the swipe sample identified differences between the expected and measured ratios, the measurements indicated that the process knowledge in PKE00044 and PKE00047 was reasonably accurate and allowed for differentiation of low-level radioactive waste from transuranic waste. Table 4, PKE00044 Radionuclide Activity Ratio Comparison, and Table 5, PKE00047 Radionuclide Activity Ratio Comparison, summarize the results of the comparison (References M1016, M1020, and M1021).

Table 4. PKE00044 Radionuclide Activity Ratio Comparison

Radionuclide	Measured Activity Ratio to Cs-137	PKE00044 Activity Ratio to Cs-137	Measured Activity Ratio to Am-241	PKE00044 Activity Ratio to Am-241
Am-241	1.95E-03	6.94E-04	1.00E+00	1.00E+00
Pu-238	1.31E-02	7.17E-03	6.73E+00	1.03E+01
Pu-239/240	1.29E-03	2.00E-03	6.64E-01	2.89E+00
Sr-90	2.95E-01	9.41E-01	NA	NA
Pm-147	2.50E-02	6.42E-02	NA	NA
Pu-241	2.79E-02	1.75E-02	1.43E+01	2.52E+01
TRU alpha	1.63E-02	9.86E-03	8.39E+00	1.42E+01

NA: Not applicable since the radionuclide is not transuranic.

Table 5. PKE00047 Radionuclide Activity Ratio Comparison

Radionuclide	Measured Activity Ratio to Cs-137	PKE00047 Activity Ratio to Cs-137	Measured Activity Ratio to Am-241	PKE00047 Activity Ratio to Am-241
Am-241	4.09E-02	1.00E+00	1.00E+00	1.00E+00
Pu-238	2.56E-02	3.50E-03	6.27E-01	3.50E-02
Pu-239/240	4.01E-02	1.30E-02	9.80E-01	1.30E-01
Sr-90	6.85E-01	1.00E+00	NA	NA
Pm-147	2.13E-02	---	NA	NA
Pu-241	3.97E-01	---	9.71E+00	---
TRU alpha	1.07E-01	1.17E-01	2.61E+00	1.17E+00

NA: Not applicable since the radionuclide is not transuranic.

The activity ratios associated with HCF glovebox 3 decontamination waste were initially established in 1997, however errors were discovered in the calculations and other problems were identified with methods used to establish these ratios. Due to insufficient radionuclide activity inventory documentation, additional sampling and analysis was performed to determine representative radionuclide activity ratios. The new ratios were established and documented in the memorandum dated June 12, 2008, *Evaluation of Radionuclide Activity Ratios for Hot Cell Facility Glove Box 3 Decontamination Waste, PKE00027 and PKE000054.* Table 6, Radionuclide Activity Ratios for PKE00027/54, presents a summary of the 2008 revised ratios use for HCF waste determined to be generated from glovebox 3 (Reference M1016).

Table 6. Radionuclide Activity Ratios for PKE00027/54

Radionuclide	Measured Activity Ratio to Cs-137	Measured Activity Ratio to Am-241
Am-241	8.99E-05	1.00E+00
Am-243	3.05E-06	3.39E-02
Pu-238	1.41E-05	1.56E-01
Pu-239	4.91E-05	5.46E-01
Pu-242	1.41E-06	1.57E-02
Sr-90	3.05E-02	NA
Cs-137	1.00E+00	NA
Pm-147	5.63E-05	NA
Pu-241	2.67E-04	NA
TRU Alpha	1.58E-04	1.75E+00

To compile a summary of generator reported radionuclide data for original inventory of waste stream SNL-HCF-S5400-RH, DR forms were reviewed for 32 waste parcels originally presented to comprise the waste stream. The total gram value for each individual reported radionuclide was divided by the total mass of all radioactive constituents in the waste stream and converted to a percentage. This result is listed as "Total Radionuclide Weight%." In Table 7, Summary of Generator Reported Radionuclides for the Original Inventory of Waste Stream SNL-HCF-S5400-RH. To determine the radionuclide weight percent range for individual parcels, the radiological mass in each parcel in the waste stream was summed. The mass of each individual radionuclide in a parcel was divided by the total radiological mass for that parcel and converted to a percentage. The minimum and maximum results are listed as "Radionuclide Weight% Range for Individual Parcels." The same process was applied to determine "Total Radionuclide Curie%" and "Radionuclide Ci% Range for Individual Parcels" (References M1016, M1019, M1020, and M1021).

Table 7. Summary of Generator Reported Radionuclides for the Original Inventory of Waste Stream SNL-HCF-S5400-RH

Radio-nuclide	Number of Parcels with Report-ed Radio-nuclide	Total Radio-nuclide Weight %[1,5]	Total Radio-nuclide Curie %[2,5]	Radionuclide Wt% Range for Individual Parcels[3,5]	Radionuclide Ci% Range for Individual Parcels[4,5]	Average Ci/Parcel	Expected Present
WIPP Required Radionuclides							
Am-241	32	0.85%	1.24%	0.20 - 3.87%	Trace[5] - 4.72%	6.03E-02	Yes
Pu-238	31	0.07%	0.50%	0 - 4.57%	0 - 1.28%	2.45E-02	Yes
Pu-239	32	17.66%	0.47%	4.73 - 95.31%	Trace - 2.09%	2.27E-02	Yes
Pu-240	18	0.18%	0.02%	0 - 8.75%	0 - 0.05%	8.47E-04	Yes
Pu-242	4	0.02%	Trace	0 - 29.33%	0 - 0.04%	1.31E-06	Yes
U-233	Not Reported						No
U-234	4	0.12%	Trace	0 - 0.14%	0 - Trace	1.51E-05	Yes
U-238	4	54.25%	Trace	0 - 64.76%	0 - Trace	3.78E-07	Yes
Cs-137	32	1.59%	59.25%	0.26 - 88.85%	44.57 - 96.97%	2.87E+00	Yes
Sr-90	32	0.38%	21.94%	0.05 - 7.28%	1.36 - 47.24%	1.06E+00	Yes
Additional Radionuclides							
U-235	4	24.78%	Trace	0 - 29.57%	0 - Trace	1.11E-06	Yes
Am-243	2	Trace	Trace	0 - 1.25%	0 - 0.10%	1.92E-06	Yes
Co-60	22	0.03%	12.90%	0 - 7.67%	0 - 54.02%	6.26E-01	Yes
Th-234	2	Trace	Trace	0 - Trace	0 - Trace	3.11E-07	Yes
Cs-134	27	Trace	0.02%	0 - Trace	0 - 0.45%	8.84E-04	Yes

1. This listing indicates the total weight percent of each radionuclide over the entire waste stream.
2. This listing indicates the total activity (curie) percent of each radionuclide over the entire waste stream.
3. This listing is the weight percent range of each radionuclide on a container-by-container basis. Some containers with "0" listed as the lower range, will not contain the specified radionuclide.
4. This listing is the curie percent range of each radionuclide on a container-by-container basis.
5. "Trace" indicates <0.01 weight percent or activity percent for that radionuclide.

5.4.2.2 Radiological Characterization of FEW Waste

As described in Section 4.6.1, waste stream SNL-HCF-S5400-RH includes 37 containers previously managed as accountable material anticipated to be shipped to the INL. These containers have been determined to be FEW eligible for disposal at WIPP and have been added to waste stream SNL-HCF-S5400-RH in Revision 5 of this report. The SNL MC&A organization has maintained the accountable material record for the contents of each container of the FEW population of this waste stream (with the exception of one container of kerf, described separately below). Since the MC&A record identifies both the specific fuel and the quantity of the fuel in each container, the MC&A data has been used by SNL to establish the nuclear properties of each container on a container-by-container bases. Note that the approach described in this section is not the approach implemented by CCP. The approach implemented by CCP to fully characterize the FEW portion of this waste stream for certification and disposal at WIPP is documented in CCP-AK-SNL-501 (Reference 15). The information presented in this section is intended only to provide background information related to data that may be found on container records and repackaging campaign planning documents (References M2007, P2001, and P2003).

The document describing the SNL radiological characterization of the FEW portion of waste stream SNL-HCF-S5400-RH is the Analysis of Materials to be Processed in the AHCF (Reference P2003). The purpose of the SNL analysis was to determine and document radiological conditions that are expected during processing of container contents at AHCF, and to calculate the quantities that are compared to the facility's technical safety requirements. SNL used a combination of existing analysis of radionuclide data found in SAND99-0182, *Preliminary Characterization of Materials in Manzano Storage Bunker 37055* (Reference P2001), mass data obtained from the MC&A MARS database which provides definitive mass values for major isotopes of uranium and plutonium for accountability purposes, and additional analysis and calculations to determine the various nuclear properties of interest (References M2007, P2001, and P2003).

The MARS data for one container (C00218134) of kerf (cuttings) indicated only fresh uranium oxide fuel, and this container was not expected to be classified as TRU or RH waste. However, sampling and analysis of the kerf indicated the kerf contained BR3 fuel from the ST experiment. The activity of Cs-137 determined from the analysis was used to establish the BR3 oxide mass contamination in the kerf for container C00218134 (References M2001, M2004, M2007, and P2003).

To summarize the SNL reported radionuclides for the FEW portion of waste stream SNL-HCF-S5400-RH, the total gram value for each individual reported radionuclide was divided by the total mass of all radioactive constituents and converted to a percentage. This result is listed as "Total Radionuclide Weight%" in Table 8, Summary of Generator Reported Radionuclides for the FEW Portion of Waste Stream SNL-HCF-S5400-RH. To determine the radionuclide weight percent range for individual containers, the radiological mass in each container was summed. The mass of each individual radionuclide in a container was divided by the total radiological mass for that container and converted to a percentage. The minimum and maximum results are listed as "Radionuclide Weight% Range for Individual Containers." The same process was applied to determine "Total Radionuclide Curie%" and "Radionuclide Ci% Range for Individual Containers" (Reference M2007). Table 8 was not recalculated for the addition of the very small amount of material added to the FEW inventory during revision 7 of this report. The generator reported radionuclide data for this small quantity of material were determined to be bounded by or would not significantly change the values presented in Table 8 (References M2028, M2030, and M2032).

Table 8. Summary of Generator Reported Radionuclides for the FEW Portion of Waste Stream SNL-HCF-S5400-RH

Radio-nuclide	Containers with Reported Radio-nuclide	Total Radio-nuclide Weight %[1,5]	Total Radio-Nuclide Curie %[2,5]	Radionuclide Wt% Range for Individual Containers[3,5]	Radionuclide Ci% Range for Individual Containers[4,5]	Expected Present
WIPP Required Radionuclides						
Am-241	37	0.22%	3.91%	<0.01% - 2.58%	1.92% - 26.07%	Yes
Pu-238	37	0.02%	1.56%	<0.01% - 0.30%	0.52% - 4.15%	Yes
Pu-239	37	4.50%	1.45%	<0.01% - 76.81%	0.24% - 23.74%	Yes
Pu-240	37	1.03%	1.22%	<0.01% - 20.41%	0.20% - 11.53%	Yes
Pu-242	37	0.06%	<0.01%	<0.01% - 0.53%	<0.01% - <0.01%	Yes
U-233	37	<0.01%	<0.01%	<0.01% - <0.01%	<0.01% - <0.01%	Yes
U-234	37	0.10%	<0.01%	<0.01% - 1.01%	<0.01% - 0.04%	Yes
U-238	37	76.56%	<0.01%	<0.01% - 98.48%	<0.01% - <0.01%	Yes
Cs-137	36	0.07%	31.27%	0 - 0.85%	0 - 61.78%	Yes
Sr-90	35	0.03%	23.43%	0 - 0.27%	0 - 27.86%	Yes
Additional Radionuclides[6]						
Am-242	34	<0.01%	0.08%	0 - <0.01%	0 - 6.33%	Yes
Am-242m	34	<0.01%	0.08%	0 - 0.05%	0 - 6.36%	Yes
Am-243	36	<0.01%	<0.01%	0 - 0.04%	0 - <0.01%	Yes
Cm-242	34	<0.01%	0.07%	0 - <0.01%	0 - 5.25%	Yes
Cm-245	4	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Co-60	31	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Cs-134	35	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Eu-152	15	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Eu-154	27	<0.01%	0.06%	0 - <0.01%	0 - 0.13%	Yes
Fe-55	31	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
H-3	36	<0.01%	0.04%	0 - <0.01%	0 - 0.08%	Yes
Kr-85	36	<0.01%	0.62%	0 - <0.01%	0 - <0.01%	Yes
Nb-93m	36	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Ni-59	31	<0.01%	<0.01%	0 - 0.03%	0 - <0.01%	Yes
Np-237	37	0.07%	<0.01%	<0.01% - 0.42%	<0.01% - <0.01%	Yes
Np-238	34	<0.01%	<0.01%	0 - <0.01%	0 - 0.03%	Yes
Np-239	36	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Pa-233	37	<0.01%	<0.01%	<0.01% - <0.01%	<0.01% - <0.01%	Yes
Pm-147	35	<0.01%	0.04%	0 - <0.01%	0 - 0.21%	Yes

Table 8. Summary of Generator Reported Radionuclides for the FEW Portion of Waste Stream SNL-HCF-S5400-RH (Continued)

Radio-nuclide	Containers with Reported Radio-nuclide	Total Radio-nuclide Weight %[1,5]	Total Radio-Nuclide Curie %[2,5]	Radionuclide Wt% Range for Individual Containers[3,5]	Radionuclide Ci% Range for Individual Containers[4,5]	Expected Present
Additional Radionuclides[6]						
Pu-241	37	0.02%	11.84%	<0.01% - 0.42%	6.24% - 36.19%	Yes
Ru-106	32	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Sm-147	35	<0.01%	<0.01%	0 - 0.01%	0 - <0.01%	Yes
Sm-151	36	0.01%	0.86%	0 - 0.16%	0 - 3.07%	Yes
Sn-121	35	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Sn-121m	35	<0.01%	<0.01%	0 - <0.01%	0 - <0.01%	Yes
Tc-99	36	0.12%	0.01%	0 - 1.08%	0 - 0.02%	Yes
Th-230	37	<0.01%	<0.01%	<0.01% - <0.01%	<0.01% - <0.01%	Yes
Th-231	37	<0.01%	<0.01%	<0.01% - <0.01%	<0.01% - 0.12%	Yes
Th-234	37	<0.01%	<0.01%	<0.01% - <0.01%	<0.01% - <0.01%	Yes
U-235	37	17.07%	<0.01%	<0.01% - 99.99%	<0.01% - 0.12%	Yes
U-236	37	0.06%	<0.01%	<0.01% - 0.18%	<0.01% - <0.01%	Yes
U-237	37	<0.01%	<0.01%	<0.01% - <0.01%	<0.01% - <0.01%	Yes
Y-90	35	<0.01%	23.44%	0 - <0.01%	0 - 27.87%	Yes
Zr-93	36	0.07%	<0.01%	0 - 0.55%	0 - <0.01%	Yes

1. This listing indicates the total weight percent of each radionuclide over the entire waste stream.
2. This listing indicates the total activity (curie) percent of each radionuclide over the entire waste stream.
3. This listing is the weight percent range of each radionuclide on a container-by-container basis. Some containers with "0" listed as the lower range, will not contain the specified radionuclide.
4. This listing is the curie percent range of each radionuclide on a container-by-container basis.
5. "Trace" indicates <0.01 weight percent or activity percent for that radionuclide.
6. Radionuclides reported less than 10^{-8} total relative activity or weight percent are not shown.

5.4.3 Chemical Content Identification – Hazardous Constituents

This section describes the characterization rationale for assignment of EPA HWNs to waste stream SNL-HCF-S5400-RH. Table 9, Waste Stream SNL-HCF-S5400-RH Hazardous Waste Characterization Summary, identifies the hazardous constituents and associated HWNs assigned to this waste stream.

Table 9. Waste Stream SNL-HCF-S5400-RH Hazardous Waste Characterization Summary

Chemical/Material	Use/Source	AK Source	EPA Hazardous Waste Number
Arsenic	Found in sample analysis of materials from Gloveboxes 4/5, 6/7 and 9, and the fume hood.	C1021	D004
Barium	Found in sample analysis of filters and materials from Gloveboxes 4/5, 6/7 and 9, and the fume hood. Fission product present in analysis o f the ST-1 and ST-2 experiments.	C1021, M1010, P1018, P1025, P1046	D005*
Cadmium	Cadmium filters and ring used in the pressure cell and the calorimeter for the EEOS experiments. Used in the HCF, possibly in the metal evaporator/coater. Found in sample analysis of filters and materials from Gloveboxes 4/5, 6/7, and 9, and the fume hood. Component of the control rod for the DF-3 experiment. Used in uranium alloy experiments. Present as tramp material in the aluminum alloys used in the New Production Reactor Program. Found above regulated levels in kerf (cuttings)	C1010, C1012, C1021, I1001, I1002, I1003, I1004, I1005, M1010, M1011, M2001, M2004 P1004, P1005, P1006, P1007, P1008, P1011, P1022, P1102, P1104	D006*
Chromium	Found in sample analysis of filters and materials from Gloveboxes 4/5, 6/7 and 9, and the fume hood. Present as tramp material in the aluminum alloys used in the New Production Reactor Program. Present in the MP-2 prefabricated construction.	C1021, M1010, P1102	D007*
Chromel/Aluminel (nickel-chromium/nickel-magnesium-aluminum)	Wires used in thermocouples for EEOS, DFR, and ST-2 experiment.	I1004, I1019, I1028, U1012	D007
Chromium oxide	Used in the EEOS experiments.	P1001	D007
Nichrome oxide	Component of mica used in the EEOS experiments.	P1001	D007
Brass	Items found during the cleanup of Gloveboxes 1, 2, and 4/5. Found during the cleanup of SCB 3. Materials present in 005940 TRU-HCF-97-06 C980391 and 005940 TRU-HCF-97-05 C980392.	M1010, M1013, P1015, P1102	D008

Table 9. Waste Stream SNL-HCF-S5400-RH Hazardous Waste Characterization Summary (Continued)

Chemical/Material	Use/Source	AK Source	EPA Hazardous Waste Number
Lead	Found in sample analysis of filters and materials from Gloveboxes 4/5, 6/7 and 9, and the fume hood. Used for shielding in the HCF and in various experiments processed through the HCF. In the form of bricks, blankets, sheets, shot, pellets, wool, pigs, etc. Used as counter weights on manipulator arms. Found in analysis of filter material (HEPAs and prefilters). Used as shielding in the containment and filter structure for the EEOS experiments. Screens and filters used when performing gamma-ray tomography. Possibly present in solder pieces and in electrical components present in waste parcels. Found above regulated levels in kerf (cuttings)	C1021, I1001, I1002, I1021, I1028, I1039, I1046, I1048, I1053, M1001, M1003, M1004, M1006, M1010, M1011, M1013, M1014, M1016, M2001, M2004 P1005, P1006, P1008, P1015, P1022, P1104, U1012	D008*
Mercury	Found in sample analysis of filters and materials from Gloveboxes 4/5, 6/7 and 9, and the fume hood. Mercury vapor lamps used in UV-ozone box in the HCF.	C1021, M1010, P1001	D009
Silver	Found in sample analysis of filters and materials from Gloveboxes 4/5, 6/7 and 9, and the fume hood. Wire and coupons used in the ST-1 and ST-2 experiments. Parts used in construction of the ST-1 and ST-2 experiments. Component of the control rod for the DF-3 experiment. Present in the solder used in electronic parts in the HCF and in thermocouples for the EEOS experiments. Present in the Melt Progression Program test section. Possibly present in solder pieces and in electrical components present in waste parcels. Wire used for silver plating present in waste parcels.	C1021, I1004, I1005, I1023, I1039, I1053, M1010, M1013, M1016, P1004, P1007, P1011, P1015, P1022, P1025, P1102, P1104	D011*
Silver chloride	Used in the calibration solution for an ion-selective electrode.	P1102	D011
Silver nitrate	Used in the HCF.	P1104	D011
Carbon tetrachloride	Found in sample analysis of filters from Glovebox 6/7. Used in the unshielded gloveboxes.	C1021, M1010, P1104	D019
Freon-11 (trichlorofluoromethane, carbon tetrachloride, chloroform)	Contains small amounts of carbon tetrachloride and chloroform, used in the HCF as a fuel stimulant (non- solvent use). Present in the HCF.	C1004, P1104	D019, D022

Table 9. Waste Stream SNL-HCF-S5400-RH Hazardous Waste Characterization Summary (Continued)

Chemical/Material	Use/Source	AK Source	EPA Hazardous Waste Number
Chloroform (trichloromethane)	Used in the HCF.	P1104	D022
1,2-dichloroethane	Found in sample analysis of filters from Glovebox 6/7.	C1021, M1010	D028
1,1,1-Trichloroethane	Found in sample analysis of filters and materials from Gloveboxes 4/5 and 6/7. Assumed solvent use. Used in the HCF.	M1010, P1104	F002
1,1,2-Trichloro-1,2, 2-trifluoroethane (Freon-113, Freon TF)	Found during sampling of the Tool Decontamination Unit (TDU) micro filter and TDU charcoal filter for Glovebox 9. Used as a solvent in the TDU. Used as a cutting lubricant in Gloveboxes 4-7 and 9. Found during the cleanup of Glovebox 4/5 and 6/7. Used as a coolant during drilling of test section from ST-1 and ST-2. Used as a lubricant for sample polishing for the Damaged Fuel Program and NPR Program.	C1021, M1010, P1015, P1102	F002
Methylene chloride	Found in sample analysis of filters and materials from Gloveboxes 4/5 and 6/7. Used in the HCF.	C1021, M1010, P1104	F002
Trichloroethylene (trichloroethene)	Found in sample analysis of filters from Glovebox 6/7. Used to ultrasonically clean EEOS components. Used in the unshielded gloveboxes.	C1021, M1010, M1011, P1001, P1004, P1008, P1104	F002
Benzene	Found in sample analysis of materials from Glovebox 4/5. Used in the HCF.	C1021, M1010, P1104	F005
Methyl ethyl ketone	Found in sample analysis of materials from Gloveboxes 4/5 and 6/7. Used in the HCF.	C1021, M1010, P1104	F005
Pyridine	Used in the HCF.	P1104	F005
Toluene	Used in the unshielded gloveboxes. Found in sample analysis of filters for Gloveboxes 6/7 and 9.	C1021, M1010, P1104	F005*

*EPA HWN also assigned by the generator to containers in this waste stream.

The assignment of these EPA HWNs was based on a review of the available AK documentation assessing chemical inputs to the hot cell operations to identify hazardous material potentially contaminating waste stream SNL-HCF-S5400-RH. In addition, material safety data sheets (MSDSs) and other manufacturer information were obtained for the commercial products to determine the presence of RCRA regulated constituents. CCE001 lists the specific chemicals identified and associated HWNs assigned to the waste stream (References DR1001, DR1003, and M1007).

Based on a review of SNL/NM historic waste management practices and characterization performed previously, the EPA HWNs assigned to HCF TRU waste containers have been maintained. The HWNs historically assigned to HCF decontamination TRU waste containers were D005 (barium), D006 (cadmium), D007 (chromium), D008 (lead), D011 (silver), and F005 (toluene). SNL/NM has historically characterized the HCF TRU debris waste on a container basis and segregated specific waste items containing or potentially mixed with hazardous constituents for on-site waste management purposes. The TRU debris waste from the HCF does consist of containers historically segregated by the generator into separate mixed and non-mixed waste streams based on the hazardous constituent identified for specific containers. However, the TRU waste materials originated from the same process and the waste population would have originally contained these items resulting in similar chemical and radiological contaminants in the TRU waste streams. For this reason, the assignment of EPA HWNs to waste stream SNL-HCF-S5400-RH considered the HWNs assigned to TRU waste generators to HCF TRU waste debris containers, in addition the review of the AK record described below. The HWN assignments have been applied on a waste stream basis; individual containers may not contain all of the hazardous materials listed for the waste stream as a whole (References 2, 3, 8, C2005, C2009, DR1001, DR1003, M1016, M2003, M2004, M2010, M2021, M2028, M2030, M2031, and P2001).

As part of the process for characterizing and certifying TRU waste for disposal at WIPP, it is necessary to consider the range of possible chemical combinations that could occur in each waste stream. Potential adverse chemical reactions that stem from combining chemicals need to be considered to support safe and compliant waste management. To expand upon this evaluation, chemical compatibility has been enhanced to require formal documentation and generation of a chemical compatibility evaluation memorandum (CCEM) for the waste stream, or sub-population of the waste stream, as needed. The CCEM evaluates the contents of a waste stream and the conclusions reached in the CCEM will demonstrate the acceptability for disposal with respect to chemical compatibility. Initially the referenced CCEM may only be a list of chemicals to be evaluated but will be revised to include complete chemical compatibility evaluation for waste stream SNL-HCF-S5400-RH (Reference CCE001).

5.4.3.1 F-Listed Constituents

Based on review of AK relative to inputs to waste stream SNL-HCF-S5400-RH may contain or be mixed with F-listed hazardous wastes from nonspecific sources listed in Title 20 of New Mexico Administrative Code (NMAC) 4.1.200, *Adoption of 40 CFR Part 261* which incorporates by reference 40 CFR 261, *Identification and Listing of Hazardous Waste, Part 261.31* (References 16 and 17). As shown in Table 9, F002 and F005 listed solvents were used in operations conducted in the HCF. F003 constituents, including acetone, butyl alcohol, ethanol, methanol, methyl isobutyl ketone, and xylene are listed solely because these solvents are ignitable in liquid form. The waste stream does not exhibit the characteristic of ignitability because it is not liquid; therefore, F003 is not assigned. Waste stream SNL-HCF-S5400-RH is assigned F-listed EPA HWN F002 for methylene chloride, 1,1,1-trichloroethane, trichloroethylene, and 1,1,2-trichloro-1,2, 2-trifluoroethane. Waste stream SNL-HCF-S5400-RH is also assigned F-listed HWN F005 for benzene, methyl ethyl ketone, pyridine, and toluene. Trichlorofluoromethane (Freon-11) was used as a fuel stimulant, not as a solvent, and therefore HWN F002 was not assigned for this chemical (References C1004, C1021, DR1001, M1010, M1011, P1001, P1004, P1008, P1015, P1102, and P1104).

5.4.3.2 Toxicity Characteristic Constituents

Based on review of AK relative to inputs to the hot cell and glovebox operations conducted in the HCF, waste stream SNL-HCF-S5400-RH is contaminated with toxicity characteristic compounds as defined in 20 NMAC 4.1.200 which incorporates by reference 40 CFR 261.24 (References 16 and 17). Where a constituent has been identified and there is no or limited quantitative data available to demonstrate that the concentration of a constituent is below regulatory threshold levels, the applicable EPA HWN is applied to the waste stream in accordance with CCP-TP-005 (Reference 1).

Heterogeneous debris waste from the HCF contains or is contaminated with toxicity characteristic metals. Based on the references identified in Table 9, EPA HWNs D004, D005, D006, D007, D008, D009, and D011 are assigned to waste stream SNL-HCF-S5400-RH (References DR1001 and DR1003).

The AK sources identified the use of organic toxicity characteristic compounds, including benzene (D018), carbon tetrachloride (D019), chloroform (D022), 1,2-dichloroethane (D028) methyl ethyl ketone (D035), pyridine (D038), and trichloroethylene (D040). Trichloroethylene is identified as an F-listed solvent and is assigned EPA HWN F002. Specific uses were not found in the AK for benzene, methyl ethyl ketone, and pyridine, therefore EPA HWN F005 was assigned for these compounds. Because the more specific F-listed EPA HWN has been assigned for these compounds, assignment of the corresponding toxicity characteristic HWNs (D018, D035, D038, and D040) is not necessary. HWNs D019, D022, and D028 are assigned to waste stream SNL-HCF-S5400-RH (References C1021, DR1001, DR1003, M1010, M1011, P1001, P1004, P1008, P1015, P1102, and P1104).

5.4.3.3 P-, U-, and K-Listed Wastes

Based on review of AK relative to inputs to the HCF process, decontamination, and waste repackaging operations, waste stream SNL-HCF-S5400-RH does not contain and is not mixed with a discarded commercial chemical product, an off-specification commercial chemical product, or a container residue or spill residue thereof as defined in 20 NMAC 4.1.200 which incorporate by reference 40 CFR 261.33. No listed chemicals were identified in the container-specific documentation. Waste stream SNL-HCF-S5400-RH is therefore not assigned a U-listed HWN (References DR1001, DR1003, I1042, I1053, M1016, and P1101).

As indicated in CCE001, beryllium was in the HCF as an oxide. The identified sources of beryllium in the AK record do not indicate that significant quantities of beryllium were utilized. Based on the identified presence and use of beryllium, the waste stream does not meet the definition of P015 (unused beryllium powder) waste and beryllium is not expected to exceed one percent in any payload container. Although hydrofluoric acid was identified as a process chemical, no source of discarded commercial chemical product or off-specification commercial chemical product was identified, therefore U134 is not assigned to the waste stream. Waste stream SNL-HCF-S5400-RH is therefore not assigned any P-listed or U-listed HWNs (References DR1001, DR1003, I1042, I1053, M1016, and P1101).

The material in this waste stream is not a hazardous waste from any of the sources specified in 20 NMAC 4.1.200 which incorporates by reference 40 CFR 261.32 (References 16 and 17).

5.4.3.4 Ignitables, Corrosives, and Reactives

Potentially ignitable, corrosive, and reactive chemicals are prohibited from disposal in RH TRU waste. The materials in this waste stream do not meet the definition of ignitability as defined in 20 NMAC 4.1.200 which incorporates by reference 40 CFR 261.21 (References 16 and 17). The materials are not liquid and liquids were not added to containers during packaging. This material will not cause fire through friction, absorption of moisture, or spontaneous chemical changes, and procedures did not allow packaging of pyrophoric materials. This material is not a compressed gas or an oxidizer. Liquids are immobilized with absorbent (i.e., Aquaset, Petroset, Quik Solid [organic], and other inorganic absorbents). The materials in this waste stream are therefore not ignitable wastes (HWN D001) (References M1016, P1015, and P1102).

The materials in this waste stream do not meet the definition of corrosivity as defined in 20 NMAC 4.1.200 which incorporates by reference 40 CFR 261.22 (References 16 and 17). The materials are not liquid and liquids were not added to containers during packaging. In addition, absorbents (i.e., Aquaset, Petroset, Quik Solid [organic], and other inorganic absorbents) were added to liquids when generated. The materials in this waste stream are therefore not corrosive wastes (HWN D002) (References P1015, M1016, and P1102).

The materials in this waste stream do not meet the definition of reactivity as defined in 20 NMAC 4.1.200 which incorporates by reference 40 CFR 261.23 (References 16 and 17). 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. As detailed in the HCF Safety Analysis Report, capsules containing sodium metal and sodium-potassium alloy were disassembled and examined in the HCF (Reference P1104). Further, sodium is also associated with the In-Pile Debris-Bed experiments (Reference P1104). However, sodium or sodium-potassium alloys and debris-bed experiments are not associated with this waste stream. Repackaging Campaign Plan 12 discusses the potential for the presence of residual sodium associated with some of the fuel pin sections, specifically on the BR-3 fuel pins (Reference P2002). However, any sodium present on the surfaces of fuel pins is assumed to have been oxidized through contact with air and will no longer be reactive (References CCE001 and P2002). In addition, as noted in CCE001, cyanide was identified as a class of hazardous material that may have been used in the HCF, however no other source documents identified cyanides used in the HCF, and no source documents indicate cyanide is present in this waste stream. Also identified in CCE001 is titanium potassium perchlorate, a type of chemical commonly used in fireworks. Source documents indicate the cartridges containing the very small amount of titanium potassium perchlorate were used to actuate valves. The charges were "fired" during the experiment and no unreacted potassium perchlorate would remain in the cartridge and valve body (References C1011, I1025, and U1012). Therefore, the materials do not contain cyanides or sulfides, and are not capable of detonation or explosive reaction. The materials are not liquid and liquids were not added to containers during packaging. The materials in this waste stream are therefore not reactive wastes (HWN D003).

Based on SNL/NM waste management practices, the materials contained in waste stream SNL-HCF-S5400-RH do not exhibit the characteristics of ignitability (D001), corrosivity (D002), or reactivity (D003) as defined in 20 NMAC 4.1.200 which incorporates by reference 40 CFR 261.21, 261.22, and 261.23, respectively (References 16 and 17). Real-time radiography (RTR) and/or VE will also be used to verify the absence of prohibited materials.

5.4.3.5 Polychlorinated Biphenyls (PCBs)

Although polychlorinated biphenyls (PCBs) were identified in the CH waste stream, SNL-HCF-S5400 (Reference M1016), no sources of PCBs were identified as inputs into waste stream SNL-HCF-S5400-RH. Potential sources of PCBs including light ballasts, oil-filled electrical equipment, and hydraulic oils are not identified in the RH TRU debris waste. Therefore, waste stream SNL-HCF-S5400-RH is not regulated as a Toxic Substance Control Act (TSCA) waste under 40 CFR 761, *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions* (References 18, C2008, C2009, M2003, M2004, M2010, M2021, M2028, M2030, M2031, P2001, and P2014). If PCB containing material is identified during RTR and/or VE, it will be managed in accordance with PCB disposal requirements of the WIPP-WAC (Reference 4).

5.4.4 Prohibited Items

Based on a review of AK, waste stream SNL-HCF-S5400-RH potentially could contain the following prohibited items (Reference M1016):

- Unpunctured aerosol cans

- Prohibited liquids
- Sealed containers exceeding 4 liters (buckets, bottles, and cans)

VE will be performed prior to shipment to WIPP. Waste drums with prohibited items will be treated and/or repackaged to remove the items prior to shipment. Therefore, the waste stream will not include the prohibited items identified above, unblocked or unbraced heavy/sharp objects, or U.S. Department of Transportation (DOT) Class 1 explosives, oxidizers, and forbidden materials identified in 18 NMAC 23.17 which incorporates by reference 49 CFR 173.21, *Forbidden Materials and Packages* (References 19, 20, I1042, I1053, P1101, P2002, and P2005).

5.5 Waste Packaging

Waste stream SNL-HCF-S5400-RH will be repackaged to meet WIPP transportation and disposal requirements. Waste material will be repackaged inside a 30-gallon metal drum with a WIPP compliant filter. The 30-gallon drum may contain two 7-gallon drums each containing a lead-lined shield pot (Reference M2024). Any plastic inner bags will be breeched, and the 7-gallon drums are not sealed, so there is no layer of confinement within the 30-gallon drum. The 30-gallon drum will be placed inside a WIPP compliant 55-gallon metal drum. The final package configuration will have one layer of confinement if the inner 30-gallon drum is closed and fitted with a WIPP compliant filter (References C1047, P1105, P2002, and P2005). At the conclusion of the RH packaging campaigns, the AHCF's hot cell HEPA filters will require replacement. These filters may be loaded directly into a 55-gallon drum to avoid size reduction and re-contaminating the hot cell (References P2002 and P2005). In this case there will be zero layers of confinement for the final package.

6.0 QUALIFICATION OF AK INFORMATION

Document CCP-AK-SNL-502, *Central Characterization Program RH TRU Waste Certification Plan for 40 CFR Part 194 Compliance for Sandia National Laboratory/New Mexico Remote-Handled Hot Cell Facility Transuranic Debris Waste, Waste Stream: SNL-HCF-S5400-RH* (Reference 22), describes how each DQO and QAO will be met along with the rationale for selection of the AK qualification methods used. The description of characterization approaches selected for the waste stream is presented in CCP-AK-SNL-502 (Reference 22).

Table 10, Waste Stream SNL-HCF-S5400-RH DQO Determination Summary, lists the DQOs to be addressed using AK associated with waste stream SNL-HCF-S5400-RH relating to the defense waste, radiological, and physical waste stream determinations.

Table 10. Waste Stream SNL-HCF-S5400-RH DQO Determination Summary

DQO Determinations	Summary of Characterization/Qualification Method	AK Sources
Defense Waste, High Level Waste, and Spent Nuclear Fuel	As described in the defense waste justification in Section 4.3, there is sufficient evidence to demonstrate that TRU wastes generated by HCF operations are contaminated with materials from atomic energy defense research activities associated primarily with projects conducted to support safety programs for reactors with defense missions. As described in Section 4.5, this waste stream does not contain spent nuclear fuel or high-level waste.	C1038, C1042, C1043, C2001, I1002, M1016, P1019, P1030, P1041, P1044, and P2001
TRU Waste	Evaluation of generator radionuclides demonstrates that this is a TRU waste stream. Based on generator reported radiological data, the estimated average TRU alpha concentration exceeds 100 nCi/g. **Characterization/Qualification Method**: Method described in CCP-AK-SNL-502.	M1016, M1019, M1020, M1021, and CCP-AK-SNL-501
RH Waste	Generator reported dose rates for the waste stream cans indicate the surface dose rates >200 mrem/hr. **Characterization/Qualification Method**: Method described in CCP-AK-SNL-502.	M1016, M1019, and CCP-AK-SNL-501
Activity	This DQO is specific to payload containers and will not be assessed until the final payload configuration has been established.	Not Assessed
WIPP 10 Required Radionuclides	The relative activity of the WIPP 10 required radionuclides for this waste stream is documented in CCP-AK-SNL-501. **Characterization/Qualification Method**: Method described in CCP-AK-SNL-502.	M1016, M1019, M1020, M1021, and CCP-AK-SNL-501
Physical Form	As described in Section 5.3, Waste Stream SNL-HCF-S5400-RH consists primarily of heterogeneous debris meeting the WCPIP definition for Summary Category Group S5000. Section 5.4.1.2 identifies the WMPs, including the estimated amount of each in the waste stream. **Characterization/Qualification Method**: 100 percent VE or RTR as described in CCP-AK-SNL-502.	C1039, M1016, and M1019
Liquids	As described in Sections 5.4.3.4 and 5.4.4, liquids are prohibited during the packaging of Waste Stream ID-HFEF-S5400-RH. **Characterization/Qualification Method**: 100 percent VE or RTR as described in CCP-AK-SNL-502.	I1042, I1053, and P1101

The methods used to qualify the AK information associated with waste stream SNL-HCF-S5400-RH are documented in CCP-AK-SNL-501 and CCP-AK-SNL-502 (References 15 and 22).

7.0 CONTAINER SPECIFIC INFORMATION

In accordance with procedure CCP-TP-005 (Reference 1), a CCP Waste Containers List (Attachment 8 of the procedure) is completed and maintained as a quality record for waste tracking purposes. The Container Tracking Spreadsheet identifies the drum number, internal waste container identification number, summary category group, vent date, and closure date for each drum, based on AK and the most current information from AK characterization activities, as applicable.

8.0 REFERENCES

1. CCP-TP-005, *CCP Acceptable Knowledge Documentation*, Carlsbad, New Mexico, Nuclear Waste Partnership, LLC.

2. DOE/WIPP-02-3214, *Remote-Handled TRU Waste Characterization Program Implementation Plan*, Carlsbad, New Mexico, U.S. DOE Carlsbad

3. *Waste Isolation Pilot Plant Hazardous Waste Facility Permit*, *Waste Analysis Plan*, New Mexico Environment Department, Santa Fe, New Mexico

4. DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria For the Waste Isolation Pilot Plant,* Carlsbad, New Mexico, U.S. DOE Carlsbad Field Office

5. CCP-PO-001, *CCP Transuranic Waste Characterization Quality Assurance Project Plan*, Carlsbad, New Mexico, Nuclear Waste Partnership, LLC.

6. CCP-PO-002, *CCP Transuranic Waste Certification Plan*, Carlsbad, New Mexico, Nuclear Waste Partnership, LLC.

7. CCP-PO-505, *CCP Remote-Handled Transuranic Waste Authorized Methods for Payload Control (CCP RH-TRAMPAC)*, Carlsbad, New Mexico, Nuclear Waste Partnership, LLC.

8. CCP-AK-INL-021, *Central Characterization Project Acceptable Knowledge Summary Report For Idaho National Laboratory, Sandia National Laboratories/New Mexico Hot Cell Facility Contact Handled Transuranic Waste (Debris), Waste Stream: ID-SNL-HCF-S5400,* Carlsbad, New Mexico, Nuclear Waste Partnership, LLC.

9. 40 CFR Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*, Washington, D.C., U.S. EPA, December 20, 1993

10. 40 CFR Part 194, *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations*, Washington, D.C., U.S. EPA, February 9, 1996

11. *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Certification Decision*, Washington, D.C., U.S. EPA, May 18, 1998

12. Public Law 102-579, *The Waste Isolation Pilot Plant Land Withdrawal Act*, October 30, 1992, as amended by Public Law 104-201, September 23, 1996

13. 42 U.S.C. 10101, *Nuclear Waste Policy Act of 1982*, U.S. Congress

14. DOE/TRU-18-3425, *Annual Transuranic Waste Inventory Report – 2018*, Carlsbad, New Mexico, U.S. DOE Carlsbad

15. CCP-AK-SNL-501, *Central Characterization Program Remote-Handled Transuranic Radiological Characterization Technical Report For Sandia National Laboratory/New Mexico Hot Cell Facility Remote-Handled Transuranic Debris Waste, Waste Stream: SNL-HCF-S5400-RH,* Carlsbad, New Mexico, Nuclear Waste Partnership, LLC.

16. Title 20 NMAC 4.1.200, *Adoption of 40 CFR Part 261*

17. 40 CFR Part 261, *Identification and Listing of Hazardous Waste*, U.S. EPA

18. 40 CFR, Part 761, *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and use Prohibitions*, U.S. EPA

19. Title 18 NMAC 2.3.17, *Adoption of Federal Hazardous Materials Transportation Regulations, 49 CFR Parts 107, 171, 172, 173, 177, 178, and 180*

20. 49 CFR, Part 173.21, *Forbidden Materials and Packages*, U.S. DOT

21. DOE Order 435.1, *Radioactive Waste Management*, U.S. DOE, Environmental Management

22. CCP-AK-SNL-502, *Central Characterization Program RH TRU Waste Certification Plan for 40 CFR Part 194 Compliance for Sandia National Laboratory/New Mexico Remote-Handled Hot Cell Facility Transuranic Debris Waste, Waste Stream: SNL-HCF-S5400-RH*, Carlsbad, New Mexico, Nuclear Waste Partnership, LLC.

23. CCP-PK-SNL-002, *Central Characterization Project Process Knowledge Summary Report For Sandia National Laboratories/New Mexico Hot Cell Facility Contact Handled Transuranic Waste (Debris), Waste Stream: SNL-HCF-S5400*

9.0 AK SOURCE DOCUMENTS

Tracking Number	Title or Description
C1004	Reactor Accident Experiments and Funding
C1006	Memo from F. Gonzalez and D. Fenstermacher to S. Wright re: Loading of Experiment FD4.4 and FD4.5
C1008	Memo from D.M. Haaland to R.L. Coats re: High Temperature Equation-of-State Studies of Fast Breeder Reactor Fuels: Evaluations Summary
C1009	Memo from K.T. Stacicer to Picard re: Radiometric Temperature Measurement
C1010	Memos, re: SRSC, ACRR, ACPR, RCSC, & ACPR Meeting Minutes; TRAN-GAP Fuel Loading Procedure and Approval; Fuel Loading Procedures for Exp in Bldg. 6597; Removal and Encapsulation of ST-1 Fuel Assembly; ST-1 Cutting Procedure; Handling Procedures for WLM Ex
C1011	Memo: Explosive Valves in the ST-2 Experiment
C1012	Memos: draft Section 5 and 6 of the ARSR quarterly reports
C1013	Memo: Suggested Instrumentation for the Fuel Disruption Tests.
C1014	Memos: Working Document for Preliminary DFR Test Section Design Concepts; DFR Visual Diagnostics; Preliminary Calculations for the DFR Steam System.
C1015	Memo: Hydrogen Flow in DFR-PWR Experiments
C1016	Memo: Fission Product Release Rates for Proposed DFR Pre-Irradiated Fuel Experiments
C1017	Memo: Preliminary Evaluation of Pre-Irradiated Fuel Experiments for the DFR Program
C1021	Memo from Susan Longley to File re: Characterization of waste from Glove Box 9
C1027	Memo Concerning Management Readiness Review of Pu Repackaging Project at the RMWMF
C1038	Ken Reil Interview; John Kleckner
C1039	Waste Material Parameter Memorandum for Waste Stream SNL-HCF-S5400-RH
C1041	Memos re: Modification of Hot Cell Bell Jar/Mass Spec (with supporting materials)
C1042	Memorandum to Ines Triay: Determination and Findings, Defense Origin of Nuclear Waste, Kerr-McGee Waste
C1043	Memorandum to CCP Central Records, Evaluation of Kerr-McGee Fuel Production and FFTF History
C1047	Record of Communication between John Kleckner and Tommy Mojica re: Final Packaging Configuration
C2001	Letter from S. Schafer to B. Humphrey regarding TRU Waste Currently Stored at SNL (SJS-121001), and correspondence from CBFO to NNSA concurring with the letter.
C2004	Waste Stream Container Evaluation Memorandums
C2005	Interview with Keith Marlow
C2006	Correspondence regarding management of FEW accountable material
C2007	Emails from SNL personnel regarding waste added to waste stream SNL-HCF-S5400-RH in CCP-AK-SNL-500, Rev 7
C2008	E-mail from B. Humphrey regarding contaminated tray from repackaging activities
C2009	Conference call regarding contaminated tray from repackaging activities
C2010	E-mail from B. Humphrey answering J. Kleckner's questions regarding process generated waste to be included in CCP-AK-SNL-500, Revision 8
CCE001	Chemical Compatibility Evaluation Memorandum for Waste Stream SNL-HCF-S5400-RH
DR1001	Discrepancy Resolution for the assignment of EPA Hazardous Waste Numbers
DR1003	AK Discrepancy Resolution DR1003 re: Assignment of EPA Hazardous Waste Numbers
I1001	EEOS Mass of Cadmium, Lead, and Remaining Package
I1002	Experiment Plan for Effective Equation of State (EEOS) Experiments with Irradiated Fuel
I1003	Design of EEOS Pressure Cell and In-Pile Calorimeter

Tracking Number	Title or Description
I1004	Damaged Fuel Relocation Experiment DF-2: Results and Analyses
I1005	Damaged Fuel Experiment DF-4: Test Result Report
I1006	Summary of Heating Conditions and Disruption for Each Fuel Disruption Experiment
I1007	Fuel Disruption Notes: FD1, FD2, HRR, FF and IF FF
I1009	Fuel Disruption Experiment Plan for the FD2/4 Series
I1010	ACRR Source Term Tests, Project Overview
I1011	ST-2 Operation Checklist
I1012	STAR-5 Quick Look Report
I1013	STAR-6 Very Short Quick Look Report
I1015	Effective Equation of State Experiments
I1016	ACRR Source Term Experiments, Program Overview
I1017	Annular Core Research Reactor Experiment Plan
I1018	Project/Experiment Quality Plan for Damaged Fuel Relocation (DFR)
I1019	Annual Core Pulse Reactor Experiment Plan for EEOS with Report (EEOS Experiments)
I1020	Analysis of the DF-1 Experiments using SCDAP
I1021	Damaged Fuel Relocation (DFR) Experiments Damage Fuel (DF) Series ACRR Experiment Plan
I1022	Handwritten Notes of a proposal for an Experimental Program
I1023	Catalog pages of Hardware for the Source Term Experiments
I1024	Detailed ST-2 Procedures and Gas Manifold Operations; Detailed ST-1 Procedures for Gas Manifold Operation
I1025	Project/Experiment Quality Plan for ACRR Source Term Experiments
I1026	Severe Accident Source Term Information Needs and Capabilities
I1028	Damaged Fuel Relocation (DFR) Experiments: Damaged Fuel (DF) Series DF-2 ACRR Experiment Plan
I1030	Hot Cell Facility (HCF) Decontamination Plan
I1031	DF-2 Experiment Quick Look Report
I1032	Notes describing the differences between DF-1 and DF-2 Experiments
I1033	Procedures for Gas Manifold Operation, Leak Rate Measurement (Room 107 and Hot Cell) and Back Fill Operations for ST-1.
I1034	ST-1 Procedures in Hot Cell
I1035	Hot Cell Requirements for the Source Term Experiments
I1036	Safe Operating Procedures for Source Term Outside Cask Handling Operations
I1039	ST-1 Filter Wire Analysis Procedures
I1040	HCF Procedures for the Recovery of the Fuel/Target and gas sample bottles from the NPR C Series
I1042	Work Instructions for Repackaging TRU Waste at Sandia National Laboratories/New Mexico DRAFT
I1046	Characterization of Excess Lead
I1048	Lead Characterization and Repackaging
I1053	Transuranic Waste Repackaging Plan
M1001	Sandia National Laboratories Primary Hazard Screening (PHS)
M1003	Hazards Analysis (HA): Hot Cell Facility
M1004	Radiological Survey Form for Post Job and Lead Brick Release and associated supporting data
M1006	Completed Equipment Decontamination Requests; Radiological Work Permits; Decontamination

Tracking Number	Title or Description
	Operations Checklists, etc. for NDC Trailer
M1007	Collection of MSDSs
M1010	Disposal Request #005934
M1011	Att 3 - Laboratory Data for Glove Box 9 Paper Towels
M1013	Review of TRU Disposal Requests: 001179, 005934, 005939, 005940, 007242, 994027, 994506, 994655, 204041, 204073, 204114, 204256, 041213, 061080
M1014	Readiness Assessment Plan for the Non-Destructive Cleaning Mobile Decontamination Unit
M1015	Miscellaneous Articles and Public Extracts
M1016	Disposal Requests from the 2007/2008 Repackaged Containers
M1019	Collection of Spreadsheets Pertaining to TRU Waste Generated at the AHCF and Other Locations on TA-V
M1020	Process Knowledge Evaluations (PKE) for radiological ratios (e.g., PKE00044 and PKE00047)
M1021	Memo to Record, re: Evaluation of Radionuclide Activity Ratios for Hot Cell Facility Wastes (PKE00044 and PKE00047); Memo to Record, re: PKE000047 Radionuclide Activity Ratios
M2001	e-mail from R. Salyer to B. Humphery regarding MP1 Kerf information in container C00218134 including analytical data and MP-1 experiment results attachments
M2002	Ref. 16 in Analysis of Materials to be Processed in the AHCF - rad analysis of container C00188425 by R. Salyers
M2003	Miscellaneous container C00188425 documentation
M2004	MP-1 Kerf Summary and attachments
M2007	Fuel Analysis By Container
M2010	Data file from the MC&A MARS Database listing Containers and Pieces
M2016	Bldg. 6588/10 Dense Pack Storage Configuration
M2021	Disposal Requests for RH waste containing spent fuel pieces
M2024	Shield Pot Design documents
M2025	MARS Database Transaction History Reports for the FEW Accountable Material Containers
M2028	DR2014060 – TA-I waste
M2029	SNL Explanation of Piece Part History
M2030	History of the Yellow Shielded Container (CS-0022) with Negligible Quantity PNL MOX fuel
M2031	Historical information of contaminated tray: Disposal Request, History Report, Photographs (PNL-3 pins)
M2032	PNL-3 Radionuclide Data
P1001	Contamination Control in Sandia Equation of State Experiments
P1002	In-Pile Calorimetry in the Joint Sandia/KfK Equation of State Experiments on Nuclear Fuel
P1003	A Model for Effective Equation of State of Irradiated Fast Reactor Fuel
P1004	Joint In-Pile Equations of State Series on Nuclear Fuels at Sandia National Laboratories
P1005	Vapor Pressure Measurements on Liquid Uranium Oxide and (U,Pu) Mixed Oxide
P1006	Measurements of the Total Pressure from Irradiated (U,Pu) Mixed Oxide
P1007	Proceedings of the International ANS/ENS Topical Meeting on Thermal Reactor Safety, Results of the ACRR-DFR Experiments
P1008	In-Pile Vapor Pressure Measurements on (U)O2 and (U,Pu)O2
P1009	Analysis of Mixed Oxide Fuel Irradiated in EBR-II Measured vs Predicted Burn-Up
P1010	In-Pile Determination of Fuel Disruption Mechanisms under LMFBR Loss of Flow Accident Conditions
P1011	The DF-4 Fuel Damage Experiment in ACRR with a BWR Control Blade and Channel Box

Tracking Number	Title or Description
P1012	Fuel-Disruption Experiments Under High-Ramp-Rate Heating Conditions
P1014	Fission Rates, Burnup, and Neutron Flux-Fluence-Spectra Characterization for Mixed Oxide Fuel Experiments in the EBR-II
P1015	Sampling and Analysis Plan for Characterization of Waste Arising From Hot Cell Facility Glovebox Decontamination
P1016	In-Pile Observation of Fuel and Clad Relocation During LMFBR Core-Disruptive Accidents
P1018	Fission Product Release and Fuel Behavior of Irradiated Light Water Reactor Fuel Under Severe Accident Conditions, The ST-1 Experiment
P1019	DOE Reactor-Pumped Laser Program
P1020	FALCON Reactor-Driven Laser Experiments Show Potential
P1021	Fission Activated Laser as Primary Power for CW Laser
P1022	Damaged Fuel Experiment DF-1
P1025	ACRR Fission Product Release Tests: ST-1 and ST-2
P1026	LMFBR Mixed Oxide Fuels Development Semi-Annual Report, July-December 1975
P1027	Fabrication, Irradiation, and Post-Irradiation Examination of Mixed Oxide Fuel Pins, PNL-3-23, 27, and 33
P1030	Plutonium, The First 50 Years
P1033	Guernsey Fast Reactor Safety Topical In-Pile Observations of Fuel and Clad Relocation During LMFBR Initiation Phase Accident Experiments, The STAR Experiments
P1034	Visual Observations of Fuel Disruption in In-Pile LMFBR Accident Experiments
P1035	Analysis of In-Pile Fuel Disruption Experiments
P1036	Visual In-Pile Fuel Disruption Experiments
P1037	First Visual In-Pile Fuel Disruption Experiments
P1038	Visual Investigation of Reactor Fuels Response to Simulated LOF Heating Conditions, First Series
P1039	Fuel Disruption Mechanisms Determined In-Pile in the ACRR
P1040	In-Core Fuel Disruption Experiments Simulating LOF Accidents for Homogeneous and Heterogeneous Core LMFBRs: FD2/4 Series
P1041	Sandia National Laboratories/New Mexico Environmental Information Document, Volume II
P1044	The Department of Energy's Tritium Production Program
P1045	LWR Severe Core Damage Phenomenology Program Plan - Volume I: Melt-Progression Phenomenology and Damaged Fuel Relocation Programs
P1046	Summary Report: Special Committee on Source Terms
P1047	NPR/FCI EXO-FITS Experiments Series Report
P1048	MELCOR 1.8.0: A Computer Code for Nuclear Reactor Severe Accident Source Term and Risk Assessment Analysis
P1051	The Global Nuclear Future, The Next Era of Nuclear Power
P1100	Programmatic Waste Acceptance Criteria
P1101	SNL/NM Waste Handling
P1102	Building 6580 Hot Cell Facility, Steel Containment Boxes and Zone 2A Process Knowledge Documentation: Isotope Production Program, Hot Cell Facility Decontamination Project
P1104	Hot Cell Facility (HCF) Safety Analysis Report, Main Report and Appendices
P1105	Series of procedures titled AHCF Campaign Operating Procedure for TRU Waste
P2001	Preliminary Characterization of Materials in Manzano Storage Bunker 37055
P2002	Auxiliary Hot Cell Facility Campaign Plans 11, 12, and 14
P2003	Analysis of Materials to be Processed in the Auxiliary Hot Cell Facility (AHCF)

Tracking Number	Title or Description
P2005	Campaign Operating Procedures for Campaigns 11, 12, 14, and 17
P2014	Reports, internal memos, and notes regarding the PNL-3 fuel pins
P2015	Various reports describing Sandia's Technical Area I (TA-I)
P2016	Material Handling, an Auxiliary Hot Cell Facility Operating Procedure (AHCF-OP-004)
U1001	STAR -1 Quick Look Report
U1002	STAR -7 Data Report
U1004	Plan for ACRR Source Term Experiments
U1009	DFR TLM Demonstration Test
U1011	Reassessment of the Technical Bases for Estimating Source Terms (Draft Report for Comment)
U1012	ST-2 Experiment Plan, Corrections, and Appendix of Instrumentation, also includes QAP and SOP
U1014	The USNRC Severe Fuel Damage Research Program

Figure 1. Map of Sandia National Laboratories/New Mexico

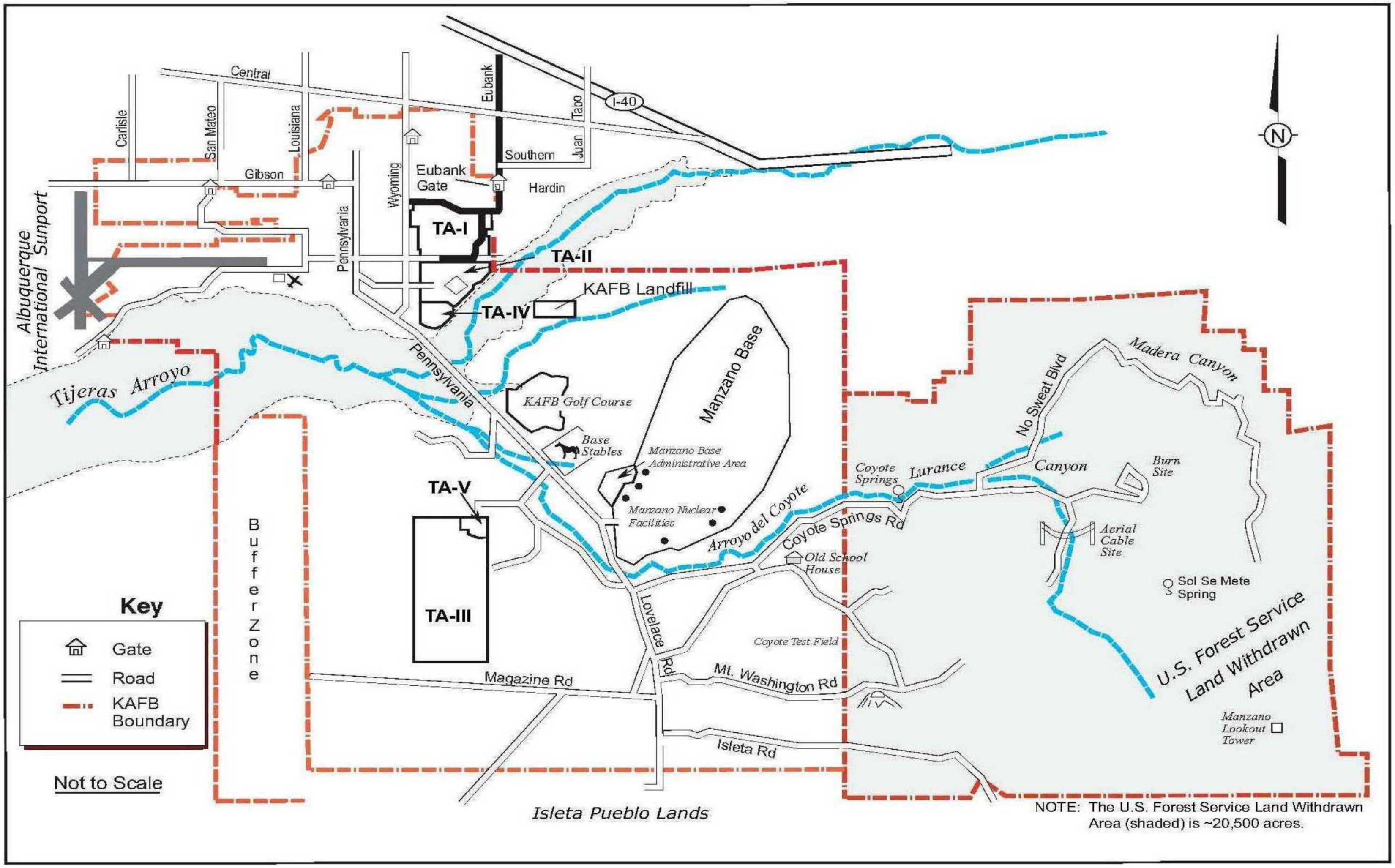

Figure 2. Map of SNL/NM Technical Area V

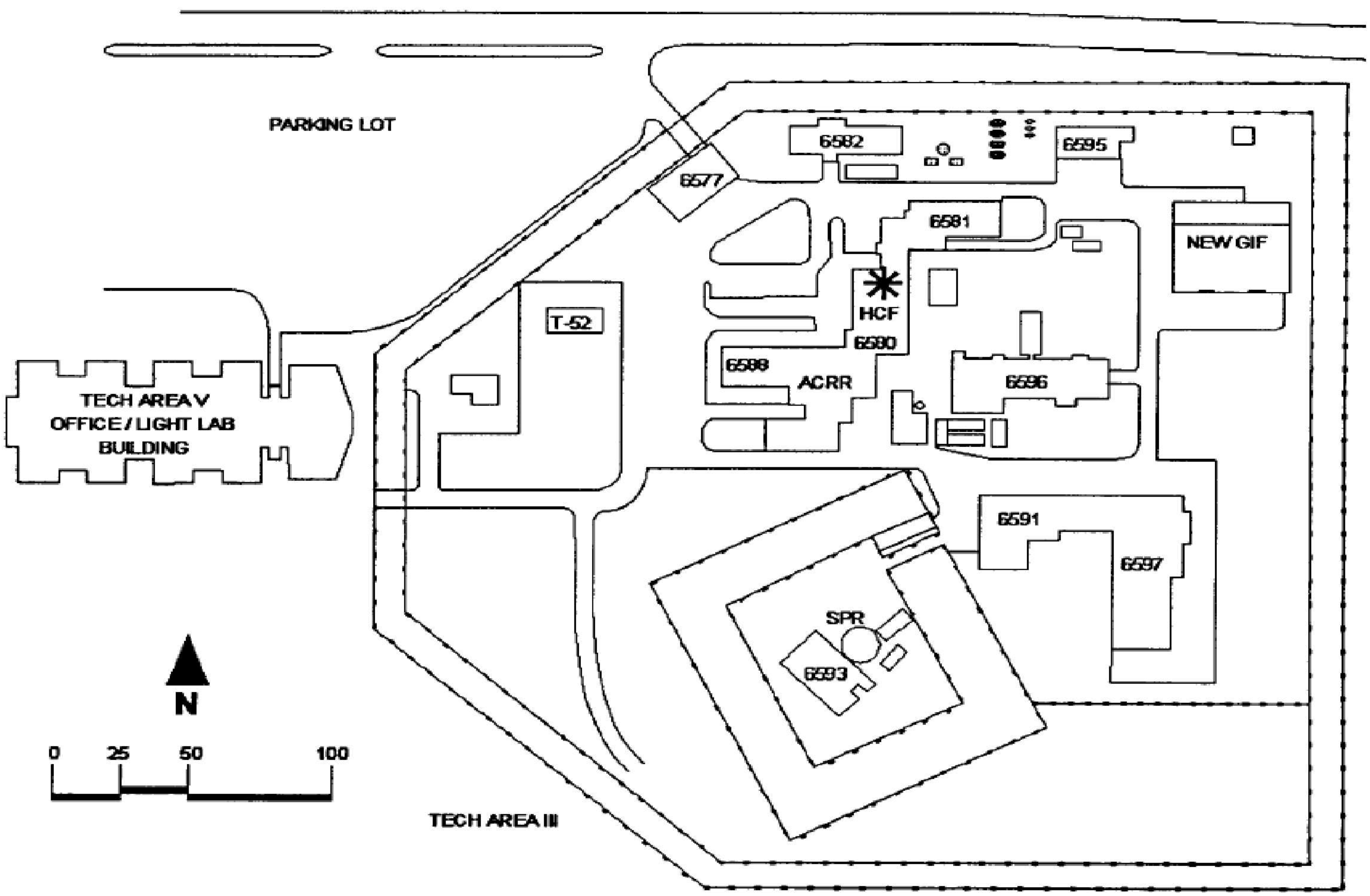

Figure 3. HCF Basement Floor Plan

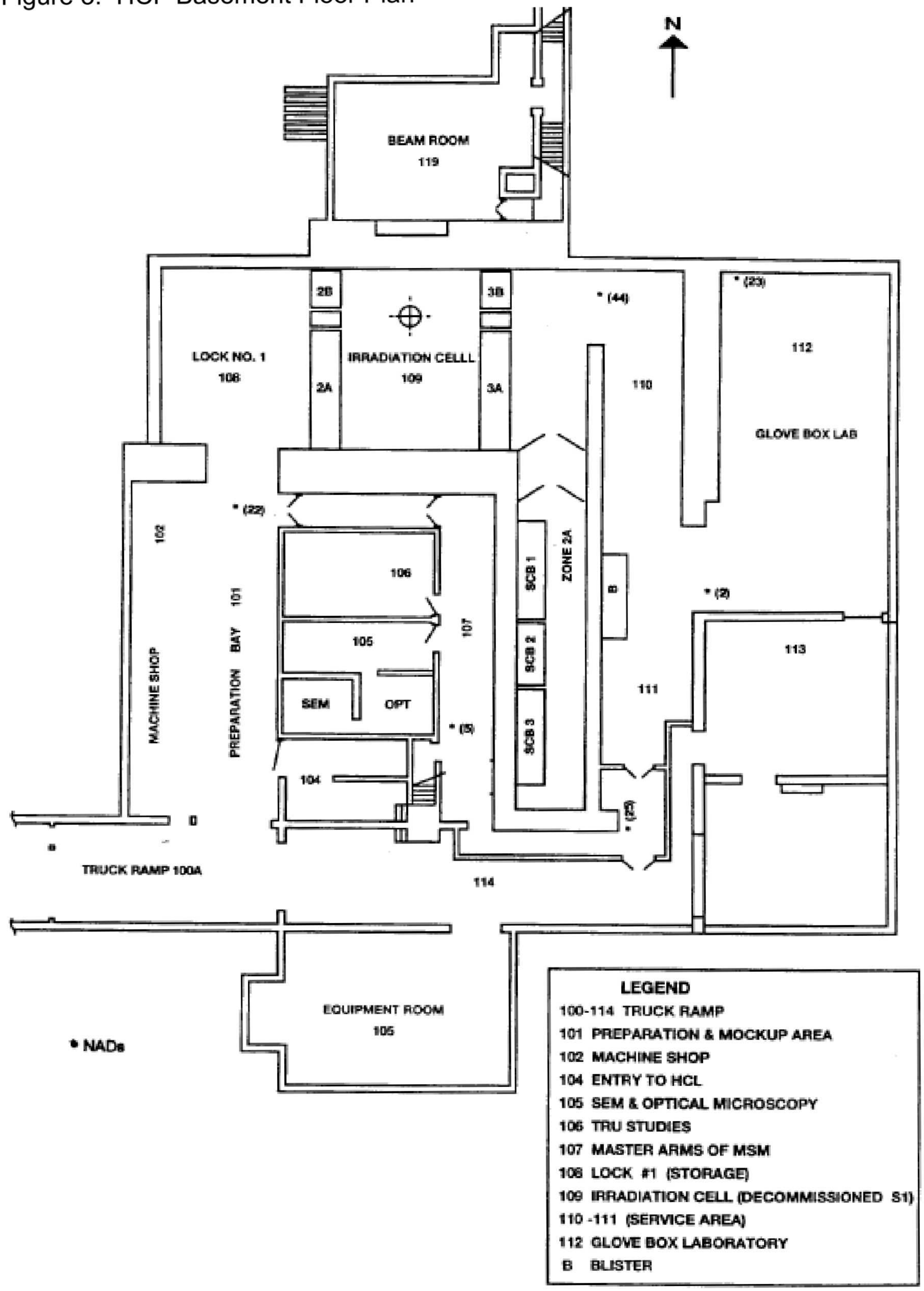

Figure 4. Room 112 Glovebox Laboratory