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CCP-AK-ORNL-001

Central Characterization Project
Acceptable Knowledge Summary Report
For

Nuclear Fuel Services
Contact-Handled Transuranic Waste
Stored at Oak Ridge National Laboratory

Waste Stream:
OR-NFS-CH-HET

REVISION 1

November 30, 2007

D. K. Ploetz
Printed Name

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RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	09/25/2007	Initial issue.
1	11/30/2007	1. Throughout: Added discussions related to early-1990s decommissioning waste, including Building 110 and associated underground storage tank. 2. Section 4.2: Added more detail to mission as it relates to Southwest Experimental Fast Oxide Reactor (SEFOR) and Savannah River Site (SRS) projects. 3. Section 4.2: Indicated that waste from U-233 facility in Building 234 is not included in this waste stream. 4. Section 4.4.1: Added new section with details of historical Mixed Oxide (MOX) production process operations. 5. Section 4.6: Included general discussion of transuranic (TRU) waste management. 6. Sections 4.6.1 & 5.2: Updated waste stream volumes and generation dates. 7. Section 5.4.2.2: Revised discussion on assay of waste from final decommissioning phase. 8. Tables 5-1 & 5-4: Updated waste material parameter and radiological percentages based on drum additions. 9. Sections 5.4.3 & 5.4.3.2: Added Environmental Protection Agency (EPA) hazardous waste number D006 (cadmium) and D011 (silver), and included more discussion on mercury. 10. Section 7.0: Added numerous new source documents.

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LIST OF ACRONYMS AND ABBREVIATIONS

AK	Acceptable Knowledge
BBA	Box Breakdown Area
CCP	Central Characterization Project
CFR	Code of Federal Regulations
CH	Contact-handled
D_2O	Deuterium Oxide (heavy water)
DOE	Department of Energy
DOT	Department of Transportation
DVRF	Decontamination and Volume Reduction Facility
EPA	Environmental Protection Agency
GE	General Electric
HEPA	High Efficiency Particulate Air
HLW	High-level waste
in.	inch
IPAN	Imaging Passive Active Neutron
kg	Kilogram
mg/L	milligrams per liter
MOX	Mixed Oxide
MSDS	Material Safety Data Sheet
nCi/g	nanocuries per gram
NFS	Nuclear Fuel Services, Inc.
NWPA	Nuclear Waste Policy Act of 1982
ORNL	Oak Ridge National Laboratory
PCBs	Polychlorinated biphenyls
ppm	parts-per-million
PRQL	Program Required Quantitation Limit
RCRA	Resource Conservation and Recovery Act
RTR	Real-Time Radiography
SEFOR	Southwest Experimental Fast Oxide Reactor
SEG	Scientific Ecology Group, Inc.
SGS	Segmented Gamma Scanner
SRS	Savannah River Site
TCLP	Toxicity Characteristic Leaching Procedure
TRU	Transuranic
TRUCON	TRUPACT-II Content Code
TSCA	Toxic Substances Control Act
TWBIR	Transuranic Waste Baseline Inventory Report
TWPC	Transuranic Waste Processing Center
USAEC	U.S. Atomic Energy Commission
VAGAS	Versatile Automated Gamma Assay System
VE	Visual Examination
WEAF	Waste Examination and Assay Facility
WIPP	Waste Isolation Pilot Plant
WIPP-WAC	WIPP Waste Acceptance Criteria
WIPP-WAP	WIPP Hazardous Waste Facility Permit Waste Analysis Plan

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1.0 EXECUTIVE SUMMARY

This Acceptable Knowledge (AK) Summary Report addresses the AK requirements of the NM4890139088-TSDF, *Waste Isolation Pilot Plant Hazardous Waste Facility Permit, Waste Analysis Plan,* (WIPP-WAP) (Reference 2) and DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (WIPP-WAC) (Reference 5).

This report has been prepared for the Central Characterization Project (CCP) for contact-handled (CH) transuranic (TRU) waste generated at Nuclear Fuel Services, Inc. (NFS) in Erwin, Tennessee and stored at the Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. The waste described in this report was generated primarily by the decommissioning of Building 234 at NFS, but also includes Building 110 (and associated underground storage tank) (References C099, P218, P248, P283, U054).

This AK Summary Report includes information relating to the mission and process operations in Buildings 234 and 110, waste identification and categorization, and waste management. This report also includes information regarding the physical form, radiological characteristics, and chemical contaminants of the waste, as well as prohibited items and packaging configuration.

This AK summary report currently includes only debris waste stream OR-NFS-CH-HET. NFS decommissioning also generated CH-TRU homogeneous solids and soil waste streams in storage at ORNL that will be evaluated for possible inclusion to this report at a future date.

This report, along with referenced supporting documents, provide a defensible and auditable record of AK for the designated NFS waste streams. The source documents listed at the end of this AK Summary Report and cited throughout the report are identified by alphanumeric designations (i.e., C001, I001, M001, P001, U001, DR001) corresponding to the Source Document Tracking Number using the following convention:

- C – Correspondence
- I – Internal Procedures and Notes
- M – Miscellaneous data
- P – Published documents
- U – Unpublished documents
- DR – Discrepancy resolutions

The CCP is tasked with certification of CH-TRU waste for transportation to and disposal at the Waste Isolation Pilot Plant (WIPP). The procedure CCP-TP-005, *CCP Acceptable Knowledge Documentation* (Reference 1), describes how AK is initially compiled by the CCP and how AK is updated using data generated by CCP characterization activities. The CCP is responsible for AK development in accordance with CCP procedures and will review, approve, and maintain this AK Summary Report

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and supporting AK source documentation as CCP Quality Assurance records. The CCP maintains responsibility for all referenced documentation, which will be stored at the CCP Records Center, Carlsbad, New Mexico.

2.0 WASTE STREAM IDENTIFICATION SUMMARY

Site Where TRU Waste Was Generated and Stored

Generation Location:
Nuclear Fuel Services, Inc.
1205 Banner Hill Road
Erwin, TN 37650
EPA ID TND003095635

Storage Location:
Oak Ridge National Laboratory (ORNL)
1 Bethel Valley Road
Oak Ridge, TN 37831
EPA ID TN1890090003

Facility Where TRU Waste Was Generated

Building 234 and Building 110 at NFS in Erwin, Tennessee.

Facility Mission:

The Building 234 facility at NFS performed fuel fabrication work under subcontracts to two U.S. Government contracts administered by the U.S. Atomic Energy Commission (USAEC), and two smaller commercial contracts. The largest of the two government sponsored orders was to manufacture fuel rods for the Southwest Experimental Fast Oxide Reactor (SEFOR) in Arkansas. The other government sponsored order was from the U.S. Department of Energy (DOE) Savannah River Site (SRS). The majority of the plutonium processed by NFS resulted from the two U.S. Government contracts. The other plutonium processed at NFS supported commercial contracts for the Halden reactor and Consumers Power Company. Building 110 housed wet chemistry and spectrographic laboratories that provided analytical support to Building 234 (refer to Section 4.2).

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Waste Streams

2.1 Waste Stream OR-NFS-CH-HET

Summary Category Group: S5000

Waste Matrix Code Group: Heterogeneous Debris

Waste Matrix Code: S5400, Heterogeneous Debris

TRUPACT-II Content Code (TRUCON): OR 125/225, SQ 154

Maximum Layers of Confinement: Maximum of Four

Waste Stream Description: Waste stream OR-NFS-CH-HET is comprised primarily of numerous organic and inorganic debris waste items and generally consists of cellulosics, plastic, rubber, concrete, glass, and metal. Some of the specific waste items include aluminum sheeting and tubing, angle iron, steel framing, metal fittings, hardware (e.g., bolts, nuts, screws), pipe, saw blades, sheet metal, copper tubing, inorganic absorbent, concrete, glassware, glass Raschig rings, rags, paper suits, tape, wipes, wood, plastic bags and sheeting, bottles, flex hose, hoods, strippable coating, tubing, rubber gaskets, rubber gloves, shoe covers, electric motors, electrical equipment (e.g., drills, saws, and vacuums), and High Efficiency Particulate Air (HEPA) filters. Small quantities of floor sweepings, absorbed oil, and cemented aqueous solutions may also be present. A detailed list of items in this waste stream is provided in Section 5.4.1.

The two most prevalent radionuclides by mass in this waste stream are U-238 and Pu-239 (Refer to Section 5.4.2).

The Environmental Protection Agency (EPA) hazardous waste numbers assigned to this waste stream are D006, D008, D009, and D011 (Refer to Section 5.4.3).

The only prohibited items identified in this waste stream were sealed containers greater than four liters. These few drums have already been repackaged where the lids were removed from the inner container so they are no longer sealed. In addition, some of the waste processed through the Transuranic Waste Processing Center (TWPC) may have a stainless steel band wrapped around the twisted section of the liner bag that was tightened with a banding tool which is considered an unacceptable supplemental sealing device (Refer to Section 5.4.4).

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3.0 ACCEPTABLE KNOWLEDGE DATA AND INFORMATION

TRU waste destined for disposal at the Waste Isolation Pilot Plant (WIPP) must be characterized prior to shipment. The WIPP-WAP permits use of knowledge of the materials and processes that generate and control the waste, provided a clear and convincing argument about the characteristics of the waste is achieved (Reference 2). The WIPP-WAC requires generator sites to use AK to determine if the TRU waste streams to be disposed at the WIPP meet the definition of TRU “defense” waste, and to provide information concerning the radiological composition of a waste stream (Reference 5).

The AK characterization documented herein complies with the AK requirements in the WIPP-WAP and WIPP-WAC. This AK Summary Report was developed in accordance with the applicable requirements of CCP-PO-001, *CCP TRU Waste Characterization Quality Assurance Project Plan* (Reference 3), CCP-PO-002, *CCP Transuranic Waste Certification Plan* (Reference 8), and CCP-TP-005, *CCP Acceptable Knowledge Documentation*” (Reference 1).

This AK summary report currently includes only debris waste stream OR-NFS-CH-HET. NFS also generated CH-TRU homogeneous solids (cemented fines) and soil waste streams that are currently in storage at ORNL. This waste will be evaluated for possible inclusion to this report at a later date.

This waste was characterized using AK from a variety of sources, including operating procedures, work requests, waste management and packaging procedures, decommissioning plans and reports, waste packaging and shipping forms, site databases, previous waste characterization data (e.g., radiography), analytical data, and various correspondence.

The Transuranic Waste Baseline Inventory Report (TWBIR) waste stream that applies to waste stream OR-NFS-CH-HET is OR-W202. This TWBIR waste stream is for ORNL TRU waste, but the description in the TWBIR indicates that it includes waste containers from NFS (Reference 9).

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4.0 REQUIRED PROGRAM INFORMATION

This section provides the waste management program information required by Section B4 of the WIPP-WAP (Reference 2). Included are a brief history of the NFS site and TRU waste generating facilities, a summary of its missions, a discussion of the operations associated with the generation of TRU waste, and a description of the TRU waste management program. Attachment 1 for each waste stream (created in accordance with procedure CCP-TP-005) provides a list of TRU waste management program information required to be developed as part of the AK record (Reference 1). This document satisfies those requirements.

4.1 Facility Location and Description

NFS is located in eastern Tennessee in the city of Erwin less than ten miles from the western North Carolina border. The NFS waste originated primarily from decommissioning of Building 234. Building 234 contained a plutonium/uranium mixed oxide (MOX) fuel fabrication facility and a uranium-233 purification process facility. Decommissioning also included the cleanout of the Building 110 process laboratory and an underground waste tank. Building 234 is located in the northeast section of the NFS plant (References C099, P218, P248, P283, U038, U054). A map showing the location of NFS is included as Figure 1 at the end of this report (Reference 10). A map and photograph showing the location of Buildings 234 and 110 are shown in Figures 2a and 2b (References M050, P248, P283).

Building 234 was comprised of three areas designated as Buildings 234A, 234B, and 234C. Building 234A was constructed in about 1962 and contained the conversion, pellet fabrication, and scrap recovery processes. An annex was built on the south end of 234A in about 1965. The annex was used for an office, a utility room, showers, and change rooms. Buildings 234B and 234C were also added about 1965. Building 234B, which was built on the west side of 234A, contained the U-233 purification process. Building 234C, which was added on the north end of 234A, was used to fabricate and inspect fuel rods. Later on, 234C contained the Decontamination and Volume Reduction Facility (DVRF) used during decommissioning operations (References C099, P248).

Building 110 housed wet chemistry and spectrographic laboratories. Piping connected the laboratory drains to a small underground storage tank that was also included in the decommissioning of the facility (References C210, P283, P323, U043, U054).

The NFS TRU waste described in this report is currently stored at ORNL. As shown in Figure 3, ORNL is located in eastern Tennessee approximately 8 miles southwest of the city of Oak Ridge (References M007, P014). ORNL is approximately 150 miles west of the NFS site. CH-TRU waste from NFS is currently stored in Buildings 7574, 7879, 7880, and 7883 (References M012, M013, P272). Figure 4 is a map denoting the locations of the TRU waste storage buildings (References P256, P272).

The TWPC is located in Building 7880 within an approximate 5-acre area in the Melton Valley area of ORNL. Processing of CH-TRU waste is limited to characterization, sorting, segregation, size reduction and repackaging as required to produce waste suitable for disposal at WIPP (Reference P256). The location of Building 7880 is shown in Figure 4 (References P256, P272).

4.2 Facility Mission

The Building 234 facility performed MOX fuel fabrication work under subcontracts to two U.S. Government contracts administered by the USAEC, and two smaller commercial contracts. The vast majority of the plutonium processed by NFS resulted from the two U.S. Government contracts. Other plutonium processed at NFS supported commercial contracts for the Halden reactor and Consumers Power Company (References C099, C100).

The largest of the two government-sponsored orders was to manufacture fuel rods for the SEFOR, a test facility for liquid metal breeder reactor fuel located at the University of Arkansas. General Electric (GE) was contracted by the USAEC to design, build, and operate the SEFOR, and GE contracted NFS to fabricate the fuel rods for the reactor. The plutonium utilized was supplied by the USAEC. The other government sponsored order was from the DOE-SRS. The fuel that NFS fabricated for DOE-SRS was used in experiments that were part of a cooperative research and development program between the USAEC and Atomic Energy of Canada Limited on deuterium oxide (D_2O)-moderated power reactors. These experiments were undertaken to determine the basic changes in lattice physics parameters that accompany plutonium buildup at high fuel burn-ups in natural uranium-fueled D_2O-moderated power reactors. The wet chemistry and spectrographic laboratories in Building 110 provided analytical support to Building 234. In early years, this lab also supported the Light Water Breeder Reactor program (References C099, C100, C145, C210, P212, P273, P323, U038, U044).

A portion of Building 234 contained a uranium-233 purification facility. This area of the building was decommissioned in 1983, several years before decommissioning of the MOX facility began. Waste from the decommissioning of the uranium-233 facility is not included in this waste stream (References C210, I053, P248, P283).

4.3 Defense Waste, Spent Nuclear Fuel, and High-Level Waste

4.3.1 Defense Waste Assessment

The WIPP-WAC (Reference 5) requires generator sites to use AK to determine if the TRU waste streams to be disposed at WIPP meet the definition of TRU “defense” waste. Based on guidance from the DOE, a TRU waste is eligible for disposal at WIPP if it has been generated in whole or part by one of the *atomic energy defense activities* listed in section 10101(3) of the *Nuclear Waste Policy Act of 1982* (NWPA) (References 5, 6, and 7).

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The two larger contracts described in Section 4.2 were placed pursuant to prime contracts with the USAEC and were both national defense rated orders which were designated DO-E2 certified for national defense use under DMS (Defense Material System) Regulation 1. The established defense and commercial activities utilized the same process equipment so the source of contamination is indistinguishable. Therefore, the TRU wastes from decommissioning are linked primarily to defense nuclear materials production (References C099, C100, M021).

4.3.2 Spent Nuclear Fuel and High-Level Waste Assessment

The WIPP Land Withdrawal Act bans the disposal of spent nuclear fuel and high-level waste (HLW), as defined by the NWPA, 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.” “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 NFS facilities that generated this waste did not have a reactor, and the waste does not contain irradiated fuel elements withdrawn from a reactor. Therefore, the waste is not a spent nuclear fuel or HLW and is eligible for disposal at WIPP (References 6 and 7).

4.4 Description of Waste Generating Operations

The Building 234 facility operated from 1965 to 1973. The process capabilities of the facility included dissolution of plutonium and uranium metals and oxides, co-precipitation of plutonium and uranium, wet or dry blending of MOX powders, pellet and rod fabrication, rod loading, and scrap recovery. Production operations in Building 234 ceased and were placed on standby in 1973. As described below, NFS TRU waste stored at ORNL is from decommissioning operations, not production (References C099, P248, P273).

4.4.1 Production Operations

<u>Pellet Production</u>

Solutions containing a mixture of plutonium nitrate and uranyl nitrate hexahydrate were transferred from the master mix tank to precipitation units. Plutonium and uranium were precipitated as ammonium diuranate and plutonium hydroxide, and ammonium hydroxide was used as a precipitant. During the Consumer Powers project, the feed solution contained plutonium nitrate only, and the plutonium was precipitated using oxalic acid, nitric acid, and hydrogen peroxide (References C145, P273).

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Supernate was decanted from the ammonium diuranate or oxalate slurry and the remaining precipitate was filtered to remove liquids. Supernate/filtrate from the ammonium diuranate or oxalate slurry was polished and stored in two glass columns. Filtrate from the column box was evaporated producing ammonium nitrate concentrate and ammonium hydroxide condensate. During SEFOR production, ammonium hydroxide condensate was used to wash ammonium diuranate cake. Wet ammonium diuranate or oxalate cake was dried in a furnace and then loaded in another furnace and heated in a nitrogen and hydrogen gas atmosphere. The resultant oxide solids (MOX or plutonium oxide) from the conversion furnace were passed through a twin shell blender. Sub-blended oxide was ball-milled, screened, and weighed. After weighing, oxide was packaged in two liter bottles and placed into storage (References C145, P273).

One cross-blend was performed per five days during SEFOR production; each cross-blend was comprised of five sub-blends. During the Consumer Powers project, plutonium oxide cross-blending was followed by the addition of uranium oxide solids. The mixture of plutonium oxide and uranium oxide was sub-blended and cross-blended. Blended oxide was granulated using an oscillating device and stainless steel screen. Binder was added to cross-blends during granulation. Granulated oxide was transferred to a pellet press. Pellets were measured for density then loaded into the sintering furnace and heated in an atmosphere of hydrogen gas, nitrogen gas, carbon dioxide, and argon. The sintered pellets were then allowed to off-gas (References C145, P273).

Sintered pellets were machined to finished size using grinders. Recycled water from the pellet wash was used as coolant. Grinder sludge and damaged pellets were sent to scrap recovery. Machined pellets were cleaned with isopropyl alcohol or in an ultrasonic wash using distilled water and then air dried. Pellets were visually inspected and diametrically gauged. A percentage of pellets were sampled for destructive analyses and measured for density and dimensional attributes. Reject pellets and sample residues were sent to scrap recovery. Finished pellets were weighed and loaded in tubes that were capped and sent to rod assembly and fabrication stations (References C145, M008, P273).

Scrap Dissolution and Recovery

Oxide scrap was ball-milled to reduce particle size. Ball-milled oxide scrap was transferred to the dissolution station and heated with nitric acid in one of two dissolvers. Nitrate solutions were pumped from the dissolver to the evaporator (References C145, P273).

Non-combustible items containing recoverable material (e.g., bottles, plastics, screens, gloves, etc.) were unloaded from drums and passed to the scrap preparation station for manual cutting and shredding. Shredded materials were leached in a nitric acid bath to recover plutonium. Leachate was pumped to the evaporator, and solids were bagged-out and packaged for disposal (References C145, P273).

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Plutonium nitrate solutions were transferred from the evaporator to glass storage columns. Solutions were circulated, sampled, and pumped to the adjacent load-out station. Plastic cylinders were placed in a holding rack and filled with solutions from the columns. Loaded cylinders were packaged for shipment (References C145, P273).

4.4.2 Decommissioning Operations

The Building 234 MOX facility remained inactive from the time production operations ceased in 1973 until decommissioning started in the early 1990's. Between 1990 and 1993, process equipment, gloveboxes, piping, utilities, and ancillary materials were removed from Building 234 and processed through the DVRF. During this same time, the concrete floor was removed from the Building 234 Wet Cell and soil was excavated from beneath the floor. The soil was blended with less contaminated soil to meet ORNL waste acceptance criteria (References C099, P248, P323).

The final phase of Building 234 decommissioning began in about 2000 and included removing the remaining equipment and utilities, decontaminating the walls, floors, and other exposed surfaces, excavating contaminated soil, dismantling the building, and disposing of the waste. Essentially all processing equipment and interior furnishings were previously dispositioned with the exception of the DVRF. Plutonium remaining in the facility was in the form of residual contamination primarily contained in the block walls, concrete floors, the DVRF, and soil beneath areas of the building (References C099, P248).

A more detailed description of the decommissioning waste generating activities is provided in Section 5.3.1.

4.5 Waste Identification and Categorization

The NFS TRU wastes were categorized into two general classifications, CH-TRU and MOX waste. CH-TRU waste includes general glovebox, equipment, and other miscellaneous waste (References P218, P268). Waste segregation practices were as follows:

- Some of the material recovered during decommissioning is in the form of MOX fuel pellets and powder. This fuel material was packaged separate from other waste (Reference P218). The MOX fuel waste is currently not included in this AK report.

- Poly bottles were used to collect higher activity waste. The contents of these bottles were heated to remove any moisture. The materials were screened to remove fines less than 200 microns, and the fines were solidified with cement in 2-liter bottles. The bottles of solidified fines are packaged into 55-gallons drums separate from other waste (Reference P218). The solidified fines waste is currently not included in this AK report.

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- Contaminated soils were excavated, dewatered, and packaged into drums (Reference P218). The soil waste is currently not included in this AK report.

- The bulk of the material removed during decommissioning was processed through the DVRF. Gloveboxes and equipment were loaded into a shear/baler where they were cut and compacted into blocks and placed into 40-gallon drums. The 40-gallon drums were sent to Scientific Ecology Group, Inc. (SEG) in Oak Ridge where they were further compacted. Three compacted 40-gallon drums were placed into a 55-gallon drum (Reference P218). The compacted waste is currently not included in this AK report.

Not all of the debris waste was processed through the DVRF. Concrete, glass, and other miscellaneous debris wastes (including dismantlement of the DVRF) were packaged into drums and boxes (References M003, M012). This waste is included in waste stream OR-NFS-CH-HET.

4.6 TRU Waste Management

In April 1986 NFS secured a contract with the DOE Idaho Operations Office for acceptance and storage of TRU waste. Subsequently, the governor of Idaho banned out-of-state waste shipments before NFS wastes could be received. To honor its contract with NFS, the DOE proposed that the TRU waste (>100 nCi/g) be stored at ORNL. In late 1989, DOE and the State of Tennessee agreed to utilize the facilities at ORNL for the storage of the NFS waste, and the DOE contract was modified in April 1992 (References C099, C145, P218, U050, U052).

The NFS wastes were categorized into two general classifications, CH-TRU waste and MOX waste (fuel pellets and oxide powder). The CH-TRU waste and MOX waste were certified to ORNL waste acceptance criteria developed specifically for receipt of the NFS waste. These criteria specified the acceptable chemical, physical, and radiological properties as well as packaging and documentation. ORNL then independently verified conformance to the applicable criteria for each waste package through a combination of program/procedure review, on-site observation of active waste processing, and direct measurement in the ORNL Waste Examination and Assay Facility (WEAF) (References P218, P267, P268, P269).

4.6.1 Types and Quantity of TRU Waste Generation

The waste stream described by this report is characterized as TRU mixed waste under the Resource Conservation and Recovery Act (RCRA). The specific containers in this waste stream are provided in the *Waste Containers List* which is maintained as a quality record as required by procedure CCP-TP-005 (Reference 1). The number of containers in each waste stream is provided in Table 4-1, Waste Stream Volumes.

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Table 4-1. Waste Stream Volumes

Waste Stream	Number of 55-Gallon Drums	Volume (m^3)
OR-NFS-CH-HET	275	57.2

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

The WIPP-WAP defines a waste stream as waste material generated from a single process or from an activity that is similar in material, physical form, and hazardous constituents. Three CH-TRU waste streams have been delineated for the NFS waste according to this definition. The waste streams are designated OR-NFS-CH-HET, heterogeneous debris waste, OR-NFS-CH-SOIL, contaminated soil, OR-NFS-CH-HOM, cemented fines. The basis and rationale for delineating these waste streams is as follows:

- The activity at NFS that generated all three waste streams was facility decommissioning (refer to Section 4.4).
- Debris waste, soil waste, and cemented fines were packaged separately from one another (refer to Section 4.5). Waste streams OR-NFS-CH-SOIL and OR-NFS-CH-HOM are currently not included in this AK report.
- The debris waste was characterized by NFS as non-mixed waste with the exception of one drum (References M003, M012). However, review of waste item descriptions for the non-mixed drums identified batteries and electronic equipment containing circuit boards which are common hazardous waste items. Also, RCRA-regulated metals were identified in analytical data relevant to this waste stream. Therefore, the debris waste is conservatively characterized as RCRA-hazardous waste under Title 40 of the Code of Federal Regulations (CFR) Part 261, Subpart C (refer to Section 5.4.3 for details on the specific hazardous constituents).

Further evaluation of the MOX fuel waste is needed before it can be included in a CH-TRU waste stream.

4.7 Waste Certification Procedures

In the CCP program under which the subject waste stream will be certified for shipment to WIPP, CCP-TP-005 (Reference 1), directs compilation of AK. CCP certifies TRU waste under the program described in CCP-PO-002, *CCP Transuranic Waste Certification Plan* (Reference 8).

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5.0 REQUIRED WASTE STREAM INFORMATION: OR-NFS-CH-HET

This section presents the mandatory AK for waste stream OR-NFS-CH-HET required by Section B4 of the WIPP-WAP (Reference 2). Attachment 1 for waste stream OR-NFS-CH-HET (created in accordance with procedure CCP-TP-005) provides a list of TRU waste stream information required to be developed as part of the AK record (Reference 1).

5.1 Area and Building of Generation

Waste stream OR-NFS-CH-HET originated primarily from decommissioning of the Building 234 MOX fuel fabrication facility. This waste stream was also generated from the removal of the Building 110 laboratory underground waste tank (References C099, C210, M003, P248, U055).

5.2 Waste Stream Volume and Period of Generation

Waste stream OR-NFS-CH-HET includes 275 55-gallon drums, some of which are the result of size reduction and repackaging of boxed waste. The wastes from the initial phase of decommissioning were packaged at NFS from August 1993 to May 1994 (Reference M003, M012). The wastes from the final phase of decommissioning were packaged at NFS from April 2001 to September 2003, and size reduction and repackaging at the TWPC (at ORNL) occurred from December 2005 to May 2007 (References M003, M012, M013, M016, M019). The specific container numbers are provided in the *Waste Containers List* which is maintained as a quality record as required by procedure CCP-TP-005 (Reference 1).

There are 131 drums of NFS machine-compacted debris waste in storage at ORNL that are currently excluded from this waste stream but will be evaluated at a later date for possible inclusion in this waste stream (References M003, M012). In addition, there are nine B-25 boxes (96 cubic feet each) that after repackaging into 55-gallon drums at the TWPC may be identified as TRU waste (Reference M003), at which time they will also be evaluated for possible inclusion in this waste stream.

5.3 Waste Generating Activities

Waste stream OR-NFS-CH-HET originated from decommissioning of the Building 234 MOX fuel fabrication facility and the removal of Raschig rings from the Building 110 laboratory underground waste tank. Building 234 production operations ceased in 1973. TRU waste stored at ORNL is not from production operations but from the decommissioning operations described below (References C099, C210, M003, P248, P273, U055). A portion of the NFS waste required size reduction and repackaging at the TWPC (Reference P256).

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5.3.1 Decommissioning

Between 1990 and 1993, process equipment, gloveboxes, piping, utilities, and ancillary materials were removed from Building 234 and Building 110 (References C099, P248). The bulk of the material was processed through the DVRF which involved high-pressure water decontamination, shearing, and compaction of the material. The compacted waste was then sent to SEG where it was further compacted and then shipped to ORNL (Reference P218). The machine-compacted debris is currently excluded from this waste stream.

Some materials were packaged directly for shipment to ORNL and not processed through the DVRF. The activities that generated the non-compacted debris waste in this waste stream included:

- Removal of the contaminated concrete floor and footers from the Building 234 Wet Chemistry Cell. Prior to removal, an aqueous-based fixative may have been applied to the floor (References C210, M011, M052, P323).

- Removal of Raschig rings from process tanks in Building 234 and the underground tank that serviced the Building 110 laboratory. The Building 234 rings were visually clean, but the Building 110 rings were visibly contaminated with a sludge material and were cleaned in the DVRF to the extent possible (References C210, M052, U038, U055).

- Removal and packaging of miscellaneous wastes, including metal press parts and waste contaminated with asbestos (References C210, M003, M052, P304, P317).

The final decommissioning of Building 234 began in about 2000. Essentially all processing equipment and interior furnishings were previously dispositioned in the 1990s with the exception of the DVRF. In addition to the DVRF, other plutonium remaining in the facility was in the form of residual contamination contained primarily in block walls and concrete floors (References C099, P248). The decommissioning activities that generated this waste stream included:

- Removal and size-reduction of contaminated piping, vacuum lines, and ductwork (References C119, C120, C129, I068).

- Cleaning of the DVRF shear/baler with Pipe X-Metal X cleaner (References C125, M011).

- Cleanout of DVRF gloveboxes, including the neutralization of acid solutions and cementation of the neutralized solution, and sweeping up material for placement into poly bottles (References C130, I061).

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- Removal and dismantlement of the DVRF gloveboxes. The glovebox surfaces were sprayed with a fixative. Saws were lubricated with Nozzle Dip and Aqua Cut cutting fluids (References C121, C127, C130, I061, M011).

- Cleanout, removal, and dismantlement of the DVRF Decon Cell Perma-Con Structure, including wiping down interior surfaces and spraying the surfaces with a fixative (References C126, I056, I058, I059, M011).

5.3.2 Solid Waste Processing

The waste generated from the final phase of decommissioning was shipped to ORNL in 2005 (References M003, M012). A portion of the NFS waste population from final phase decommissioning has subsequently been processed at the TWPC (References M013, M016, M019).

Drums containing CH-TRU waste are moved individually to the TWPC glovebox airlock. Once inside the glovebox airlock, the drum is moved to the drum tipper where the drum lid is removed and the drum contents are emptied into sorting trays. The waste articles are manually sorted and segregated via glove ports to remove prohibited items and repackaged at one of the four load-out stations along the glovebox. Currently, repackaging of containers with liquid greater than one percent of container volume, pressurized gases, explosives, or pyrophorics are not allowed (References P254, P255, P256). Secondary wastes created during waste processing, such as rubber glovebox gloves, tools, and damp rags from cleaning internal glovebox walls, are placed into TRU waste drums (References P252, P253).

Boxes containing CH-TRU waste are moved into the box breakdown area (BBA) via airlocks. Within the BBA, the box lid is removed. The waste is inspected, removed, size reduced, and sorted manually within the BBA, and either packaged into new drums directly from the BBA or processed through the glovebox as described above. A process flow diagram for the TWPC is shown in Figure 5 (References P251, P256).

5.4 Type 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, and hazardous waste determinations for waste stream OR-NFS-CH-HET.

5.4.1 Materials Related to Physical Form

Waste stream OR-NFS-CH-HET is comprised primarily of numerous organic and inorganic debris waste items. Descriptions of the physical form of the waste are provided on the NFS TRU Waste Data Package form, NFS Radwaste Package Certification Record and NFS Drum Content Log (Reference M003). Waste item descriptions were also obtained from Real-Time Radiography (RTR) conducted at the

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WEAF and RTR and Visual Examination (VE) performed at the TWPC. The TWPC RTR and VE is considered AK because it was performed prior to implementation of the CCP TRU waste certification program at ORNL (References M018, M019, M065, M068). Specific waste items present in this waste stream are as follows (References C210, M003, M018, M019, M052, U055).

- Aluminum metal items such as channel, ductwork, foil, glove portal inserts, ladders (cut up), pipe, plates, respirator filter cartridges, sheeting, strips, and tubing
- Iron-based metal items including angle iron, banding, batteries (e.g., AA), beams, bracing, chain, clamps, conduit, containers, ductwork, filters, filter housing, fittings, flanges, framing, gauges, hand tools, hardware (clips, bolts, hose clamps, nails, nuts, screws, springs, washers), lids, panels, pipe, plate, rebar, rings, rods, saw blades, sheet metal, sleeves, strapping, wire, and wire mesh
- Other metals such as copper tubing, copper fittings, and copper wiring
- Other inorganic materials including absorbent, asbestos, charcoal filters, cinder block, concrete chunks, concrete chips and dust, glassware, Raschig rings (borosilicate glass rings 1.5-inches (in.) tall, 1.5-in. outside diameter, and 1-in. inside diameter) insulation, and mirrors
- Cellulosic items such as absorbent pads, cardboard, cartons, cheesecloth, cloth, cotton gauze, cotton glove liners, cotton wound filters, dollies, fabric, fiberboard, leather gloves, mop heads, padding, paint brushes and rollers, paper, rags, suits, swipes, tape, towels, vacuum bags, wipes, and wood
- Plastic items including bags, bottles, clips, containers, cord, ductwork, fiberglass, filters, fittings, flex hose, foam, hoods, Kevlar® gloves, latex gloves, lids, mesh, nylon rope, plexiglass, pipe, sheeting, strapping, strippable coating, suits, tape, ties, tile, and tubing
- Rubber items such as bungee cord, electrical cord, gaskets, gloves, hose, mats, o-rings, shoe covers, and wheels
- Equipment including electrical devices containing circuit boards, electronic control panels, halogen light fixtures, jacks, motors, metal press parts, power drills, pumps, reciprocating saws, and vacuums with HEPA filter and bag
- Metal-framed HEPA filters and large wood-framed HEPA filters (cut up)
- Small amounts of floor sweepings, absorbed liquid (e.g., oil), cemented aqueous solutions, and soil samples

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5.4.1.1 Waste Matrix Code

As shown in the previous section, waste stream OR-NFS-CH-HET is comprised primarily of numerous organic and inorganic debris waste items and generally consists of cellulosics (e.g., paper, cloth, wood), plastic, rubber, concrete, glass, and metal. The waste matrix code was assigned to this waste stream based on the evaluation of AK information relating to the physical form of the waste recorded on waste disposal forms, RTR conducted at the WEAF, and RTR and VE performed at the TWPC. Based on these data, some drums contain only concrete, glass, metal, or plastic waste, but many contain a combination of organic and inorganic material types. Some drums in this waste stream also contain small amounts of homogenous waste materials such as floor sweepings and absorbed or cemented liquids. However, individual drums contain less than 50 percent, by volume, of these homogenous materials (References M018, M019, M068).

Accordingly, Waste Matrix Code S5400, Heterogeneous Debris, is applied to this waste stream. The definition of this Waste Matrix Code is provided in the DOE Waste Treatability Group Guidance (Reference 4). This category includes waste that is at least 50 percent, by volume, debris materials that do not meet the criteria for assignment as either an Inorganic Debris (S5100) or Organic Debris (S5300). This evaluation is documented in a memorandum (included with Attachment 6 completed per CCP-TP-005) (Reference 1).

5.4.1.2 Waste Material Parameters

The waste material parameter weight estimates for waste stream OR-NFS-CH-HET were derived from RTR conducted at the WEAF, RTR and VE performed at the TWPC, and other information including waste disposal forms as described in Section 5.4.1. The debris waste generated from the initial phase of decommissioning includes 131 drums which underwent RTR at the WEAF. The waste generated from the final phase of decommissioning includes 82 drums (57 of which have been repackaged) plus another 62 drums produced from repackaging of boxed waste. TWPC RTR data were evaluated for all 82 drums. In addition, VE data were evaluated for the 57 repackaged drums. VE data were also evaluated for the 62 drums from box repackaging. An analysis of the RTR and VE data was performed, the results of which are presented in Table 5-1. This evaluation is documented in a memorandum (included with Attachment 6 completed per CCP-TP-005) (Reference 1).

Table 5-1. Waste Stream OR-NFS-CH-HET Waste Material Parameters

Waste Material Parameter	Weight Percent	Weight Percent Range
Aluminum-based Metal/Alloy	1.2%	0.0% – 96.6%
Iron-based Metal/Alloy	13.6%	0.0% – 99.0%
Other Metals/Alloy	1.1%	0.0% – 97.9%
Other Inorganic Materials	72.9%	0.0% –99.9%
Cellulosics	2.8%	0.0% – 99.1%
Plastics (waste materials)	7.7%	0.0% – 100%
Rubber	0.6%	0.0% – 84.6%
Organic Matrix	< 0.1%	0.0% – 4.3%
Inorganic Matrix	<0.1%	0.0% – 62.0%

5.4.2 Radiological Characterization

The Building 234 facility performed MOX fuel fabrication work under subcontracts to two U.S. Government contracts administered by the USAEC, and two smaller commercial contracts. The largest of the two government-sponsored orders was to manufacture fuel rods for the SEFOR. The other government work was sponsored by DOE-SRS. The commercial contracts were for the Halden reactor and Consumers Power Company (References C099, C100, P273). Table 5-2 shows the amount of MOX fuel processed at NFS. The isotopic composition of the MOX fuel materials is provided in Table 5-3 (References C099, C100, C122, DR001, P212, P218, P268, P269, U016, U017).

Table 5-2. Mixed Oxide Fuels Processed at NFS

Material	%Pu	%U	Pu (kg)	U (kg)	Total (kg)
SEFOR	20%	80%	746	2,984	3,730.00
Consumers	2.27%	97.9%	47	2,027	2,070.48
SRS	0.31%	99.7%	16	5,064	5,079.37
Halden	2.5%	97.5%	3	117	120.00
			812	**10,192**	**11,000**

Table 5-3. Mass Isotopic Distribution of Mixed Oxide Fuels Processed at NFS

Isotope	SEFOR		Consumers		SRS		Halden	
Pu-238	0.01%	0.04%	0.01%	0.43%	--	--	0.01%	0.29%
Pu-239	18.13%	90.63%	1.73%	76.24%	0.29%	90.94%	2.00%	79.89%
Pu-240	1.67%	8.33%	0.37%	16.34%	0.02%	7.99%	0.36%	14.51%
Pu-241	0.10%	0.48%	0.07%	2.91%	0.003%	0.99%	0.06%	2.24%
Pu-242	0.01%	0.05%	0.03%	1.17%	0.0002%	0.08%	0.02%	0.83%
Am-241	0.09%	0.47%	0.06%	2.86%	--	--	0.06%	2.20%
Total	**20.0%**	**100%**	**2.27%**	**100%**	**0.31%**	**100%**	**2.5%**	**100%**
U-234	0.12%	0.15%	0.58%	0.59%	0.001%	0.001%	3.90%	4.00%
U-235	0.28%	0.35%	2.36%	2.41%	0.30%	0.30%	4.88%	5.01%
U-238	79.60%	99.50%	94.96%	97.00%	99.40%	99.69%	88.73%	91.01%
Total	**80.0%**	**100%**	**97.9%**	**100%**	**99.7%**	**100%**	**97.5%**	**100%**

NOTE: For each of these materials, column one represents the overall mass fractions of the MOX fuel, and column 2 provides the mass fractions of the plutonium and uranium separately.

5.4.2.1 Assay of Waste from Initial Phase of Decommissioning

TRU waste generated during the initial NFS decommissioning in the early-1990s was assayed using a nondestructive assay system that consisted of five stations. Station 1 was used for determining equipment hold-up prior to decontamination, Station 2 was used to assess decontamination effectiveness, and Station 3 was used for real-time monitoring of DVRF cell hold-up. These three stations were associated only with the compacted waste which is not currently included in this waste stream. Station 4 consisted of a small size pulse active neutron differential die-away unit that was readily configured for both compacted bales and 55-gallon drums. Station 5 was a passive neutron coincidence counter for small packages (i.e., 5-gallon buckets and 2-liter bottles) containing relatively high TRU concentrations. This unit also included a hyper-pure germanium gamma-ray detector for establishing plutonium isotopics (References C210, M061, P300, P321, U054). Raschig rings (borosilicate glass) were put in 5-gallon buckets and assayed using passive neutron coincidence counting in Station 5 to measure Pu-240, but the remaining isotopes were calculated using isotopic mass fractions estimated by gamma spectroscopy of waste with higher TRU concentrations such as glovebox sweepings (References C206, M052, M058, U055).

U-235 was assigned a mass value based on normalized intensity factor ratios from gamma spectroscopy. U-234 and U-238 mass values were assigned using scaling factors derived from uranium fuel isotopics (References M003, P218, P321). U-235 values reported in NFS assay (for non-compacted debris waste) are less than 0.5 grams, and U-238 values are less than 50 grams (Reference M003).

U-233 was not reported in NFS waste assay data for the drums currently included in this waste stream. Part of Building 234 contained a uranium-233 purification facility;

however, the equipment from this portion of the building was removed several years before decommissioning of the MOX facility began. The waste from the decommissioning of the uranium-233 facility is not included in this waste stream (References C210, P248, P283). The Building 110 laboratory handled U-233, and since a small percentage of the Raschig rings in this waste stream were from the Building 110 underground storage tank, U-233 may be present in trace quantities (References C210, U055). In addition, small quantities of U-233 was identified in samples of concrete from Building 234 (Reference C122).

After receiving waste from NFS, the drums were re-assayed at the ORNL WEAF on a neutron assay system (References U017, U038). The Pu-240 mass measured by the ORNL neutron assay system was used with the same isotopic distribution used by NFS as a basis for ORNL comparisons. For this reason, even though there are differences in the isotope masses reported by the two assay systems, the calculated mass fractions will be the same (Reference M065). The assay data in the EM Waste database is from NFS assay (Reference M012).

5.4.2.2 Assay of Waste from Final Phase of Decommissioning

TRU waste generated during the final phase of decommissioning was assayed by NFS using the Versatile Automated Gamma Assay System (VAGAS). The VAGAS utilized 4 to 6 high efficiency germanium detectors to measure the contents of a 55-gallon drum (References I067, M003). After being shipped to ORNL, nearly all of this waste was re-assayed at the TWPC in 2006 using Imaging Passive Active Neutron (IPAN) and Segmented Gamma Scanner (SGS) systems. This assay is considered AK because it was performed prior to implementation of the CCP TRU waste certification program at ORNL (Reference M017).

There are several discrepancies between the NFS VAGAS data and the TWPC assay data, as well as discrepancies between TWPC assay data of the original drum and TWPC assay of the same waste after it was repackaged. The most notable is a drum (X10C0506075) that NFS assay measured over one kilogram of U-238 and the initial TWPC assay measured just under a kilogram of U-238, but the TWPC assay of the same waste after it was repackaged into X10C0501409 did not report any uranium. Further review of the assay data for X10C0501409 indicates that the SGS assay was rejected due to two segments of the assay being too dense to accurately quantify the radionuclides in those segments, and the IPAN assay could not be accurately quantify uranium due to significant gamma dead time. This may be due to re-configuration of the matrix during repackaging. Since neither the IPAN or SGS provided an acceptable measurement for X10C0501409, default isotopics were applied and uranium was not reported (Reference DR002).

The NFS VAGAS also measured U-235 (in the range of tenths of grams) and/or U-238 (in the range of hundreds of grams) in several other drums, but the TWPC assay did not detect any uranium in these drums. U-235 and U-238 have extremely long half-lives and as a result have low specific activity. The gamma ray emission rate is therefore

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very low, resulting in high detection limits and uncertainties for these isotopes when expressed in mass units. At the gram levels for U-238 and sub-gram levels for U-235, the self-attenuation of gamma rays can be significant. The U-238 has such a low gamma emission rate that the detection limits and uncertainties of hundreds of grams is not unexpected. In the same way the detection limits and uncertainties for U-235 is in tenths of grams is reasonable. Based on the detection limits for the isotopes, these discrepancies are not unexpected within the uncertainty of the measurements (Reference DR002).

Th-228 was also measured in several drums by the NFS VAGAS, but TWPC assay did not detect Th-228. NFS measured several grams of Th-232 in a drum, but TWPC assay did not detect Th-232 in any drum. It is possible that the reporting of thorium by the VAGAS may be due to spectral interference from background radiation, and it is assumed that Th-228 and Th-232 are not present in the waste stream (Reference DR002).

5.4.2.3 Radiological Characterization of Waste Stream OR-NFS-CH-HET

To determine isotopic ratios for waste stream OR-NFS-CH-HET as a whole, the total gram value for each individual 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 Wt%.” To determine the radionuclide weight percent range for individual containers, the radiological mass in each container in the waste stream 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 Wt% Range for Individual Containers.” The same process was applied to determine “Total Radionuclide Ci%” and “Radionuclide Ci% Range for Individual Containers.”

As shown in Table 5-4, Waste Stream OR-NFS-CH-HET Radiological Characterization, U-238 is the most predominant radionuclide by mass, and Pu-239 is the second most predominant radionuclide by mass based on AK. However, the two most prevalent radionuclides by mass may turn out to be Pu-239 and Pu-240 because of the issues with nondestructive assay detecting U-238 (as described above). These percentages are based on the NFS assay data (for the early-1990s waste) and the most recent TWPC assay data (for the post-2000 waste). Radioassay data indicate that the TRU alpha activity concentration in each of the drums in this waste stream is more than 100 nanocuries per gram (nCi/g) (References M003, M017). The radiological evaluation for this waste stream is documented in the NDA Memorandum as required by CCP-TP-005 (Reference 1).

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Table 5-4. Waste Stream OR-NFS-CH-HET Radiological Characterization

Isotope	Total Radionuclide Wt%[1]	Radionuclide Wt% Range for Individual Containers [2]	Total Radionuclide Ci% [3]	Radionuclide Ci% Range for Individual Containers [4]	Suspected Present (Yes/No)
Required Radionuclides					
Am-241	0.15%	0.03% - 2.86% [9]	4.97%	2.08% - 17.09%	Yes [6]
Pu-238	0.01%	0.00% - 0.43% [9]	1.81%	0.00% - 5.88%	Yes
Pu-239	23.06%	1.80% - 94.04%	13.78%	7.54% - 37.92%	Yes
Pu-240	2.74%	0.26% - 16.34% [9]	5.99%	3.30% - 17.81%	Yes
Pu-242	0.02%	0.00% - 1.17% [9]	Trace	0.00% - Trace	Yes
U-233	Trace [5]	0.00% - Trace	Trace	0.00% - Trace	Yes [7]
U-234	3.42%	0.00% - 4.00% [9]	0.21%	0.00% - 0.80%	Yes
U-238	69.94%	0.00% - 99.69% [9]	Trace	0.00% - Trace	Yes
Cs-137	Trace	0.00% - Trace	Trace	0.00% - Trace	Yes
Sr-90	Trace	0.00% - Trace	Trace	0.00% - Trace	Yes [8]
Additional Radionuclides					
Am-243	Trace	0.00% - Trace	Trace	0.00% - Trace	Yes
Np-237	Trace	0.00% - 0.05%	Trace	0.00% - Trace	Yes
Pu-241	0.07%	0.00% - 2.91% [9]	73.24%	23.56% - 83.90%	Yes
U-235	0.59%	0.00% - 5.01% [9]	Trace	0.00% - Trace	Yes

1. This listing indicates the total weight percent of each radionuclide over the entire Waste Stream.
2. 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.
3. This listing indicates the total activity (curie) percent of each radionuclide over the entire Waste Stream.
4. This listing is the curie percent range of each radionuclide on a container-by-container basis.
5. “Trace” indicates <0.01 weight percent for that radionuclide.
6. Am-241 may be present in slightly larger percentages due to the further decay of Pu-241.
7. U-233 was not reported in waste assay data for this waste stream but may be present in trace quantities.
8. Sr-90 cannot be quantified by gamma spectroscopy. Its value is calculated based on measured Cs-137 values. A Sr-90/Cs-137 scaling factor of 1.0 is used to calculate Sr-90.
9. These weight percent ranges were expanded based on plutonium and uranium isotopic distribution data (see Table 5-3).

5.4.3 Chemical Content Identification – Hazardous Constituents

EPA hazardous waste numbers were assigned to waste stream OR-NFS-CH-HET based on a review of available AK documentation to identify chemical usage and potentially hazardous materials that may have been introduced into the waste stream. Table 5-5 lists the EPA hazardous waste numbers assigned to waste stream OR-NFS-CH-HET. Material Safety Data Sheet (MSDS) information has been compiled for commercial products used during decommissioning (Reference M011).

Table 5-5. OR-NFS-CH-HET EPA Hazardous Waste Numbers

EPA Hazardous Waste Number	Constituent
D006	Cadmium
D008	Lead
D009	Mercury
D011	Silver

5.4.3.1 F-Listed Constituents

Waste stream OR-NFS-CH-HET is not an F-listed hazardous waste because the debris wastes were not mixed with hazardous wastes from non-specific sources as listed in 40 CFR Part 261, Subpart D (40 CFR 261.31).

As part of MOX fuel production, blended oxide was granulated using an oscillating device and stainless steel screen. Binder was added to cross-blends during granulation. One of the binders used was Oxylene M-6 which contained 81 percent methylene chloride and 19 percent trichlorotrifluoroethane, both of which are F002-listed solvents. Use of this binder does not constitute a listed hazardous waste because these constituents were used as reactants or ingredients in the formulation of a commercial product. The State of Tennessee concurred with this determination (References C142, P273). Therefore, waste stream OR-NFS-CH-HET is not an F002-listed waste.

Several F-listed solvents were detected in TWPC headspace gas samples. The only constituents detected above the Program Required Quantitation Limit (PRQL) were methanol and toluene. Several samples contained methanol above the PRQL, but only one of 78 drums sampled contained toluene above the PRQL at 20 parts-per-million (ppm) (Reference M020). Methanol, an F003-listed solvent, was not identified as being used by NFS. F003-listed solvents are listed solely for ignitability, and this waste stream does not exhibit the characteristic of ignitability because the solvent is not in liquid form. Toluene, an F005-listed solvent, was not identified as being used by NFS. A single sample containing toluene is not sufficient to cause this waste stream to be hazardous. Therefore, waste stream OR-NFS-CH-HET is not an F003- or F005-listed waste.

5.4.3.2 Toxicity Characteristic Metals

Waste stream OR-NFS-CH-HET exhibits the characteristic of toxicity for metal compounds as defined in 40 CFR Part 261, Subpart C (40 CFR 261.24). The following sources for metals have been identified:

- Review of physical form descriptions provided by NFS as well as RTR and VE data identified equipment containing circuit boards and batteries (References M003, M018, M019). The manufacturing of printed circuit boards involves dipping the

boards in molten tin/lead solder (Reference C146). Electrical components are sometimes attached to the circuit borad using solder containing lead and silver (Reference 12). Household dry-cell batteries contain mercury (Reference C147).

- Waste was also generated from the cleanup of mercury from the bottom of a glovebox. The mercury was from a regulator gauge located inside a glovebox (References C204, C210).
- Three samples of the Building 110 tank contents were collected and analyzed for metals by TCLP. Mercury was detected above regulatory limit in one of the samples (Reference U043).
- One composite paint sample was collected from the exterior of the shear/baler and analyzed for TCLP metals. Cadmium was detected at a concentration of 4.0 milligrams per liter (mg/L) which is above the regulatory limit (Reference I052).
- Cadmium-coated hand tools may also be present in the waste (References C210, U043).

Since analytical data from sampling of this waste stream are not available that demonstrate the concentrations of cadmium, lead, mercury, and silver are less than the toxicity characteristic regulatory level, EPA hazardous waste numbers D006, D008, D009, and D011 are conservatively assigned to this waste stream (Reference DR002).

Toxicity characteristic metals constituents were not identified in the MOX fuel production process (Reference P273). Products used during decommissioning did not contain toxicity characteristic metals constituents (Reference M011).

Four concrete, three cinder block, three paint, and one floor tile composite samples were collected from Building 234 and analyzed for metals by the TCLP. No metals were detected above regulatory limits in any of the samples (Reference C122). Approximately 16 liters of fines were removed from the shear/baler prior to dismantlement. Three samples of fines were analyzed for metals by TCLP, and no metals were detected above regulatory limits.

5.4.3.3 Toxicity Characteristic Organics

Waste stream OR-NFS-CH-HET does not meet the definition of toxicity for organic compounds as defined in 40 CFR Part 261, Subpart C (40 CFR 261.24). Toxicity characteristic organic compounds were not identified in the MOX fuel production process (Reference P273). Products used during decommissioning did not contain toxicity characteristic organic compounds (Reference M011).

Four concrete, three cinder block, three paint, and one floor tile composite samples were collected from Building 234 and analyzed for volatile organics, semivolatile organics, herbicides, and pesticides by TCLP. None of the organic constituents were

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detected above regulatory limits in any of the samples (Reference C122). About 16 liters of fines were removed from the shear/baler prior to dismantlement. Three samples of fines were analyzed for volatile and semivolatile organics by TCLP, and no organics were detected above regulatory limits (Reference I052).

Three samples of the Building 110 tank contents were collected and analyzed for organics by TCLP. None of the organic constituents analyzed were detected above regulatory limits in any of the samples (References M064, U043).

5.4.3.4 U- and P- Listed Wastes

Waste stream OR-NFS-CH-HET does not contain a discarded commercial chemical product, an off-specification commercial chemical product, or a container residue or spill residue thereof (40 CFR 261.33). Based on the AK documentation reviewed, U- and P-listed compounds were not used during MOX production or facility decommissioning (References M011, P273). Therefore, U-and P-listed EPA hazardous waste numbers, including U134, are not assigned to this waste stream.

Based on the AK documentation reviewed, beryllium was not used by NFS (Reference C210). Therefore, this waste stream is not a P015-listed waste, and beryllium will not be present in amounts greater than one percent by weight of the waste in each drum and will be less than 18.14 kilograms (kg) in any payload container.

5.4.3.5 Ignitables, Corrosives, and Reactives

<u>Ignitability</u>

TRU waste generated at NFS was packaged in accordance with waste certification plans to meet ORNL waste acceptance criteria developed specifically for NFS TRU waste. Efforts were made to minimize liquids in the waste, and any liquids encountered were immobilized (e.g., Waste Lock® 770 polymer absorbent) (References C125, C126, I059, M003, M011, P268, P269, P273, P317). Pyrophorics have not been identified in NFS TRU waste. Compressed gas cylinders, if identified, were rendered safe (References M003, P268, P269, P273, P317).

The debris materials in waste stream OR-NFS-CH-HET do not meet the definition of ignitability as defined in 40 CFR 261.21. The waste is not an oxidizer, and it is not capable of causing fire through friction, absorption of moisture, or spontaneous chemical change. However, small quantities of liquids have been identified in a few drums. Prior to WIPP disposal, prohibited quantities of liquids will be removed or immobilized (see Section 5.4.4). Waste stream OR-NFS-CH-HET is therefore not ignitable (D001).

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Corrosivity

TRU waste generated at NFS was packaged in accordance with waste certification plans to meet ORNL waste acceptance criteria developed specifically for NFS TRU waste. Efforts were made to minimize liquids in the waste, and any liquids encountered were immobilized (e.g., Waste Lock® 770 polymer absorbent) (References C125, C126, I059, M003, M011, P268, P269, P273, P317).

The debris materials in waste stream OR-NFS-CH-HET do not meet the definition of corrosivity as defined in 40 CFR 261.22. However, small quantities of liquids have been identified in a few drums. Prior to WIPP disposal, prohibited quantities of liquids will be removed or immobilized (see Section 5.4.4). Waste stream OR-NFS-CH-HET is therefore not corrosive (D002).

Reactivity

TRU waste generated at NFS was packaged in accordance with waste certification plans to meet ORNL waste acceptance criteria developed specifically for NFS TRU waste. Explosives, reactive metals, reactive cyanides, or reactive sulfides were not identified in the AK documentation reviewed (References M003, P268, P269, P273, P317). NFS Radwaste Package Certification Records indicate that the waste is not readily capable of detonation, explosive decomposition, reaction at normal pressures and temperatures, or an explosive reaction with water (Reference M003).

The debris materials in waste stream OR-NFS-CH-HET do not meet the definition of reactivity as defined in 40 CFR 261.23. The waste is stable and will not undergo violent chemical change. The waste will not react violently with water, form potentially explosive mixtures with water, or generate toxic gases, vapors, or fumes when mixed with water. The waste does not contain reactive cyanide or sulfide compounds. There is no indication that the waste contains explosive materials, and it is not capable of detonation or explosive reaction. Waste stream OR-NFS-CH-HET is therefore not reactive (D003).

5.4.3.6 Polychlorinated Biphenyls

This waste stream does not contain polychlorinated biphenyls (PCBs) greater than 50 ppm, and therefore, is not regulated as a Toxic Substance Control Act (TSCA) waste under 40 CFR 761.

Four concrete, three cinder block, and one floor tile composite samples were collected from Building 234 and analyzed for total PCBs (Reference C122). One composite paint sample was collected from the exterior of the shear/baler and analyzed for total PCBs (Reference I052). Two samples of the Building 110 tank contents were collected and analyzed for PCBs. Also, gasket material from typical glovebox applications was analyzed for PCBs (References C205, M062, M063, M064, P273, U043). PCB compounds were not detected above 50 ppm in any of the above samples.

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Approximately 16 liters of fines were removed from the shear/baler prior to dismantlement. Three samples of fines were analyzed for total PCBs. Two of the fines samples contained the PCB compound Aroclor-1242 at 190 and 280 ppm (References C099, I052, U040). The PCB waste is packaged in drums inside box X10C0506146. This box is not included in the waste stream and has not been processed at the TWPC.

5.4.4 Prohibited Items

For the waste generated in the early-1990s, RTR was conducted by ORNL in 1993 and 1994. Liquids and compressed gases were not observed in any of the drums currently in this waste stream (Reference M065).

RTR conducted at the TWPC has identified prohibited items in only a few of the post-2000 decommissioning drums in this waste stream. The only prohibited items identified were sealed containers greater than four liters. These few drums have already been repackaged where the lids were removed from the inner container so they are no longer sealed. RTR also identified a few drums with liquid; however, the amount of liquid did not exceed WIPP-WAC limits (References M018, M019).

Some of the NFS waste processed at the TWPC may have a stainless steel band wrapped around the twisted section of the liner bag that was tightened with a banding tool (Reference P253). This closure method is considered a supplemental sealing device that is unacceptable (References 11, P276).

Certified RTR and/or VE are performed by CCP to ensure the waste does not contain prohibited items in accordance with the WIPP-WAC and WIPP-WAP.

5.5 Waste Packaging

TRU waste generated during the initial phase of NFS decommissioning in the early-1990s is packaged in Department of Transportation (DOT) specification 17H or 17C drums. Each drum contains a 90-mil high-density polyethylene rigid liner with a liner lid, and the lid contains a 3/8-inch vent hole. A polyethylene drum liner bag was placed inside the rigid liner. An absorbent pad was added between the bottom of the drum and the liner, and at the bottom of the liner. Absorbent (e.g., RADSORB polymer absorbent) may have also been added to the drum. When the drum was full of waste, the polyethylene bag drum liner was twisted and taped closed (References C200, C210, M003, M011, M052, P268, P269, P317).

TRU waste generated during the final phase of NFS decommissioning is packaged in DOT specification UN1A2/Y400/S 55-gallon drums (Reference M003). The majority of the drums are lined with a polyethylene bag drum liner, although a few of the drums also contain 90-mil high-density polyethylene liners with no liner lids (Reference M018). Prior to adding waste to the drum, NFS added absorbent (e.g., Waste Lock® 770 polymer absorbent) to the bottom of the drum liner (References C125, C126, I059, M011). Waste was packaged in plastic bags that were sealed with tape. Waste may

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have also been packaged in 2-liter plastic bottles and 5-gallon buckets (References I058, I061). When the drum was full, the polyethylene bag drum liner was twisted and taped closed (Reference M018).

DOT specification 7A Type A 55-gallon drums are used for waste packaging (and repackaging) at the TWPC (Reference P256). Drums were lined with a cardboard liner and a 6-mil poly liner bag; rigid liners were not used (Reference M019). When a drum was ready to be closed, the liner bag was twisted, and a stainless steel band or cable tie wrap was wrapped around the twisted section and tightened using a banding tool. Additional tape was then wrapped around the twisted section (References P251, P252, P253, P254). Hydrogen diffusion rate testing of cable tie wraps indicates that they are an acceptable closure method. However, a stainless steel band tightened with a banding tool is an unacceptable supplemental sealing device (References 11, P276).

5.5.1 Prohibited Items

NFS TRU waste drums are fitted with approved filter vents (References C201, M003, P253).

5.5.2 Layers of Confinement

TRU waste generated during the initial phase of NFS decommissioning in the early-1990s has one layer of confinement (drum liner bag) (References C210). TRU waste generated during the final phase of NFS decommissioning has between one and four layers of confinement (Reference M018). The TWPC typically limits containers to 4 layers of confinement, including a filtered drum liner (References M019, P254).

6.0 CONTAINER SPECIFIC INFORMATION

For the decommissioning waste generated in the early-1990s, several forms were filled out, including the NFS TRU Waste Data Package Form and the ORNL UCN-2822 form. For the waste generated after 2000, NFS completed a Radwaste Package Certification Record, a Drum Content Log, and anCH-TRU ORNL UCN-2109 form. The types of information included on these forms is as follows:

<u>NFS TRU Waste Data Package Form</u>

- Container number
- Date packaged
- Gross and tare weights
- Physical description
- Iron content & Organic content
- Radiological data (fissile gram equivalents, plutonium equivalent curies)
- Hazardous constituents

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ORNL Form UCN-2822

- Container number
- Origin of waste
- Brief description of waste (e.g., concrete)
- Date
- Container type

NFS Radwaste Package Certification Record

- Container number
- Generation location
- Container type
- Package date
- Waste description code (e.g., M = metals, P = plastics)
- Prohibited materials
- Hazardous waste listing

NFS Drum Content Log

- Item number
- Waste description (for each item in drum)
- Date

ORNL Form UCN-2109

- Container number
- Generator
- Waste description
- Origin date
- Prohibited items
- Radiological data

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7.0 REFERENCES

References

1. CCP-TP-005, *CCP Acceptable Knowledge Documentation*.

2. *Waste Isolation Pilot Plant Hazardous Waste Facility Permit, Waste Analysis Plan,* NM4890139088-TSDF, New Mexico Environment Department, Santa Fe, New Mexico.

3. CCP-PO-001, *CCP TRU Waste Characterization Quality Assurance Project Plan*.

4. DOE/LLW-217, *DOE Waste Treatability Group Guidance*, Idaho Falls, Idaho, INEL-Lockheed Idaho Technologies.

5. DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Carlsbad, New Mexico, U.S. Department of Energy.

6. *Waste Isolation Pilot Plant Land Withdrawal Act* (as amended), Public Law 102-579.

7. 42 U.S.C 10141, *Nuclear Waste Policy Act*.

8. CCP-PO-002, *CCP Transuranic Waste Certification Plan.*

9. DOE/TRU-2006-3344, *Transuranic Waste Baseline Inventory Report – 2004*.

10. Environmental Protection Agency EnviroMapper for Envirofacts, URL: http://134.67.99.122/enviro/emef.asp. Last updated on October 31, 2005. Retrieved August 28, 2007.

11. CH-TRU Payload Appendices, Waste Isolation Pilot Plant.

12. CCP-AK-ORNL-002, *Central Characterization Project Acceptable Knowledge Summary Report for Oak Ridge National Laboratory Radiochemical Engineering Development Center Contact-Handled Transuranic Waste, Waste Stream: OR-REDC-CH-HET.*

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8.0 AK SOURCE DOCUMENTS

Tracking Number	Title	Document Number	Date
C099	Letter to Harold Johnson, CBFO DOE re: KAPL-NFS Transuranic Waste Background Information		5/3/2005
C100	Interview With Richard Booth And Faxed Defense And Waste Information For NFS, Erwin, TN TRU Waste		2/24/2005
C119	Removal of Contaminated Pipe, Building 234 Area B, Memo to Ron Mitchell, Letter of Authorization	LOA-7000-018	3/20/2000
C120	Removal of Contaminated Piping, Building 234, Memo to Larry Burleson, Letter of Authorization	LOA-7000-011	3/2/2000
C121	DVRF Bale Packaging Glovebox Removal, Memo to Ron Mitchell	LOA-7000-034	2/15/2001
C122	Building 234 Characterization Results, Memo to Heather Little	DCM-03-18, 44T-99-0436, GPC-99-013	9/30/1999
C125	Cleaning and Surveying the DVRF Shear Baler for PCBs, Memo to Building 234 Supervision	SWI-02-035	10/3/2002
C126	Waste Packaging of the DVRF Decon Cell Perma-Con Structure, Memo to Richard A. Moore	SWI-02-001	2/18/2002
C127	Size Reduction of the NDA Station 2 Glovebox In the DVRF Decontamination Cell, Memo to Ron Mitchell and Rick Leitner	SWI-01-018	4/16/2001
C129	Size Reduction Process Ductwork Within the Decontamination Cell, DVRF, Memo to Ron Mitchell and Rick Leitner	SWI-01-015	3/15/2001
C130	Cleanout of DVRF Bale Packaging Glovebox, Memo to Ron Mitchell and Rick Leitner	SWI-01-013	3/7/2001
C142	Legal Analysis regarding Solvent Binder Used to Make Fuel		11/28/1990
C145	Internal Correspondence from D. W. Turner. Nuclear Fuel Services (NFS) Background Information.		2/7/1992
C146	Waste Minimization Assessment for a Manufacturer Producing Printed Circuit Boards		2/6/1996
C147	Environmental Protection Agency Consumer Product Links for Mercury		8/7/2007

Tracking Number	Title	Document Number	Date
C200	Internal Correspondence from J. A. Chapman. Subject: On the Use of Rad-Sorb in NFS TRU Waste Drums.		5/26/1993
C201	Letter from Terry Wickland, NFT Incorporated, to Mr. Bill Reynolds, EcoTek		4/8/1993
C204	Letter from Michael L. West, Nuclear Fuel Services, Inc., to Martin W. Tull, Martin Marietta Energy Systems.		9/3/1992
C205	Internal Correspondence from Martin W. Tull. Minutes of November 5, 1991 Meeting with NFS Regarding Process-Line Samples		11/11/1991
C206	NFS Decommissioning Oversight Reports.		1/9/1991 – 8/28/1992
C210	Record of Communication. Subject: NFS TRU Waste Shipped to Oak Ridge National Laboratory.		9/12/2007
DR001	Attachment 11 - Acceptable Knowledge Source Document Discrepancy Resolution (Radionuclide Determination), Revision 1		11/29/2007
DR002	Attachment 11 - Acceptable Knowledge Source Document Discrepancy Resolution (EPA Hazardous Waste Number Assignment), Revision 1		11/29/2007
I052	Memorandum; Building 234 Shear Baler Characterization Samples	DC-03-18, 44T-02-0633, GPC-02-013	9/11/2002
I053	KAPL-TN Waste Profile for NFS Building 234 Soil	44G-03-1050, WST-20, JWP-03-009	9/11/2003
I056	Removal of Building 234 Wet Cell Permacon Containment Enclosure	DC-SWI-03-041	6/20/2003
I058	Dismantlement of the West Wet Cell Wall in Building 234	DC-SWI-02-030	9/30/2002
I059	Waste Packaging of Wet Cell Wall in Building 234	WST-SWI-02-002, Rev. 1	9/19/2002
I061	Size Reduction of the DVRS Glovebox	DC-SWI-01-020	5/24/2001
I067	Procedure for the Operation of the Versatile Automated Gamma Assay System (VAGAS)	NFS-ACC-104, Rev. 0	5/8/2000
I068	Size Reduction of 4-inch Diameter Duct Section in Area C	DC-SWI-02-004, Rev. 0	1/25/2002
M003	ORNL UCN-2109 and UCN-2822 Forms for NFS TRU Waste and Related Paperwork		Various

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Tracking Number	Title	Document Number	Date
M007	Finding of No Significant Impact, Receipt and Storage at Oak Ridge National Laboratory of Transuranic Waste, Mixed Transuranic Waste, and Mixed Oxide Waste from Nuclear Fuel Services, Inc.	Ltr.# ER-NEPA/92-05	11/9/1996
M008	Fax from John E. Kirkpatrick to Robert C. Mason. Pu02 + U02 (Mixed Oxide) Fuel Production Flow Chart for Pellet Production, Rod/Assembly Fabrication, Scrap Dissolution/Recovery		11/16/1991
M011	Material Safety Data Sheets for Products Used at NFS		Various
M012	EM Waste Database Query		8/9/2007
M013	EM Waste Database Query - NFS Box Daughter and Repack Drums		8/23/2007, 8/29/2007
M016	Incoming Container Travelers for NFS Waste		Various
M017	Foster Wheeler Nondestructive Assay (NDA) Data for NFS TRU Waste		Various
M018	Foster Wheeler Nondestructive Examination (NDE) Data for NFS TRU Waste		Various
M019	Foster Wheeler Visual Examination (VE) Data for NFS TRU Waste		Various
M020	Foster Wheeler Headspace Gas (HSG) Data for NFS TRU Waste		Various
M021	Defense Determination Approval Form, Waste Stream ORNL/NFS-HD-001		5/13/2005
M050	Aerial Photographs of Nuclear Fuel Services, Inc.		Undated
M052	Logbook for the Decommissioning and Volume Reduction Facility		12/6/1990 – 6/2/1994
M058	EcoTek, Inc. Information on Assay Methods		Undated
M061	An Evaluation of NFS Isotopic Estimates Determined by Gamma-ray and Alpha-particle Spectroscopy		8/24/1992
M062	NFS Data Set No. 2, PCB Reanalysis of Gasket and K1 Samples. Analytical Chemistry Division, Oak Ridge National Laboratory.		12/30/1991

Tracking Number	Title	Document Number	Date
M063	NFS Data Set No. 3, PCB Analysis of Fresh Gasket and Pall Filter Samples and Cadmium in Pall Filter TCLP Leachate. Analytical Chemistry Division, Oak Ridge National Laboratory.		1/22/1992
M064	Analytical Chemistry Data Package for NFS Sample Set No. 3.		10/9/1991
M065	WEAF Waste Acceptance Reports, NFS Waste Storage Project.		Various
M068	Review of WEAF RTR Video Tapes		11/27/2007
P014	Inventory of ORNL Remedial Action Sites: 11. Research Laboratories		6/30/1986
P212	Lattice Experiments with Simulated Burned-Up Fuel for D_2O Power Reactors	DP-1122	2/1968
P218	Oak Ridge National Laboratory/Nuclear Fuel Services, Inc. NFS Waste Parameter Verification Program		10/29/1992
P248	Structural Assessment of Building 234	DCM-03-18, 44T-99-0450, SS-99-002	11/1999
P251	Box Breakdown Area Operations	CH-P-OP-003, Rev. 7	3/13/2007
P252	Glove Box Operations	CH-P-OP-004, Rev. 8	3/13/2007
P253	Drum Bag In/Bag Out and Glove Ports	CH-P-OP-011, Rev. 10	5/2/2007
P254	Contact Handled Waste Repackaging	CH-P-OP-013, Rev. 6	4/30/2007
P255	Contact handled Waste Acceptance Criteria	T-CH-FW-X-AD-001, Rev. 5	10/19/2006
P256	TRU/Alpha Low Level Waste (LLW) Treatment Project Documented Safety Analysis	T-CM-FW-R-AD-001, Rev. 13	3/1/2007
P267	Nuclear Fuel Services Waste Acceptance and Storage Procedure	WM-SWO-501.18, Revs. 0 and 1	3/5/1991 7/12/1991
P268	ORNL WAC for Contact Handled Transuranic and Mixed Oxide Wastes from Nuclear Fuel Services, Inc.	WMRA-WMPC-106	10/16/1992
P269	ORNL WAC for Contact Handled Transuranic and Mixed Oxide Wastes from Nuclear Fuel Services, Inc.	WM-WMCO-202, Revs. 0 and 1	3/20/1991 4/7/1992
P272	Oak Ridge National Laboratory Waste Management Plan	ORNL/TM-11433, Revs. 1, 2, 3	12/1991 12/1992 12/1993

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Tracking Number	Title	Document Number	Date
P273	Nuclear Fuel Services, Inc., Waste Certification Plan for Transuranic Waste	28G-91-001, Rev. 0 DCM-03-05, Revs. 0, 1	7/1991 2/1992 11/1992
P276	Determination of H_2 Diffusion Rates through Various Closures on TRU Waste Bag-Out Bags	LA-13616-MS	6/1999
P283	Plutonium Facilities Decommissioning Project Plan Condition Addendum	SNM-124, Chapter 7, Appendix B, Rev. 2	4/28/1989
P300	Operation of the Decontamination and Volume Reduction Facility.	DCM-08	1990 – 1992
P304	Removal of Asbestos-Bearing Materials	DCM-PR-13	6/20/1990
P317	Packaging for Shipment to Processing, Storage, or Burial	DCM-03, Rev. 6	7/15/1993
P321	Determination of Plutonium Isotopics for Buildings 110 and 234.		4/28/1992
P323	Status of Former Mixed Oxide Fuel Fabrication Facilities at Nuclear Fuel Services' Erwin, TN Site	28T-94-003	1/10/1994
U016	A Graphical Workbook for Estimating Important Quantities of NFS Radioactive Waste Constituents		3/1/1992
U017	The Inter-comparison of NDA Measurements on CH-TRU Waste Between Nuclear Fuel Services, Inc. and Oak Ridge National Laboratory		10/24/1995
U038	ORNL TRU Waste Historical Survey; Volumes 1, 2, and 3. Draft	BJC/OR-395	9/2001
U040	NFS Response to "Transuranic Waste Baseline Inventory Report Questionnaire"	N/A	1/1996
U043	Final Report - Waste Characterization of Wastes Generated from D&D Activity; Buildings 110 and 234 on the NFS Site in Erwin, Tennessee		1/31/1992
U044	Acceptable Knowledge Summary Report for Oak Ridge National Laboratory Contact-Handled TRU Debris Waste Facility Maintenance Operations.	AK-ORNL-001, Revs. 3A and 4	5/24/2006, 6/19/2006
U050	Action Description Memorandum for Disposition of Transuranic Waste and Plutonium Scrap from Nuclear Fuel Services, Inc.		12/19/1990 (Fax Date)

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Tracking Number	Title	Document Number	Date
U052	Excerpt from Decommissioning Strategy in Today's Environments. Section 7. Decontamination and Decommissioning of a Uranium Oxide and Plutonium Oxide Fuel Fabrication Facility		Undated
U054	Decontamination and Decommissioning of a Plutonium Fabrication Facility. EcoTek, Inc. NFS Plutonium Facilities Decommissioning Project.		Undated
U055	Calibration Schemes and Measurement Techniques for the Assay of Raschig-Rings and Soils		Undated

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Figure 1. Nuclear Fuel Services, Inc.

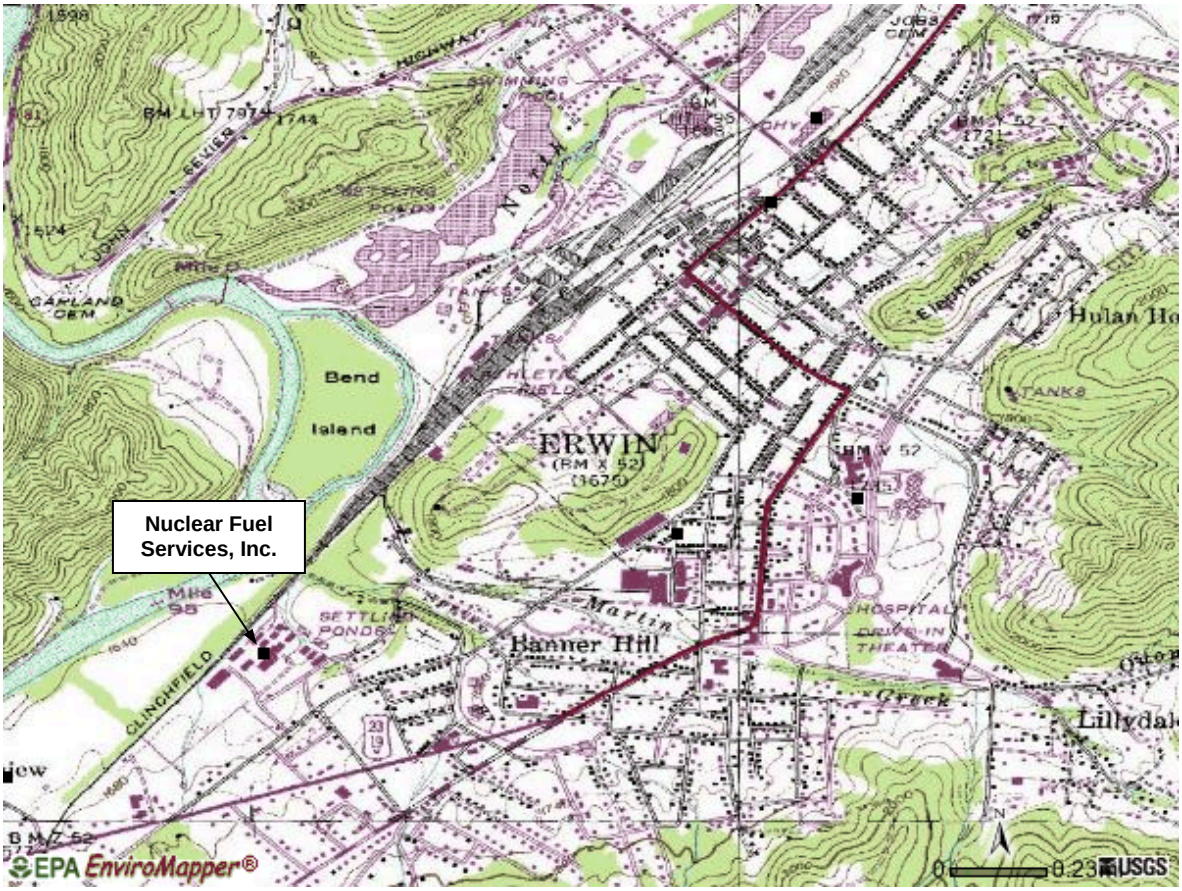

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Figure 2a. Buildings 234 and 110 at Nuclear Fuel Services, Inc.

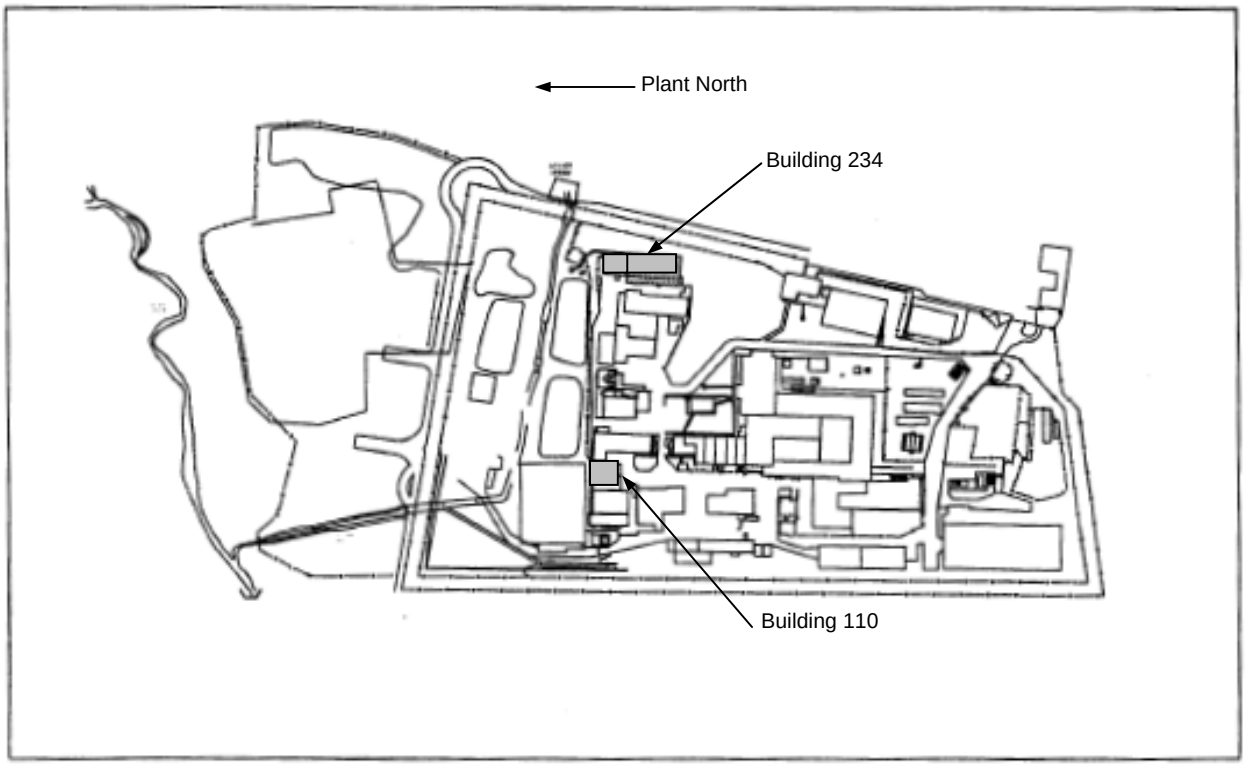

Figure 2b. Photograph of Nuclear Fuel Services, Inc.

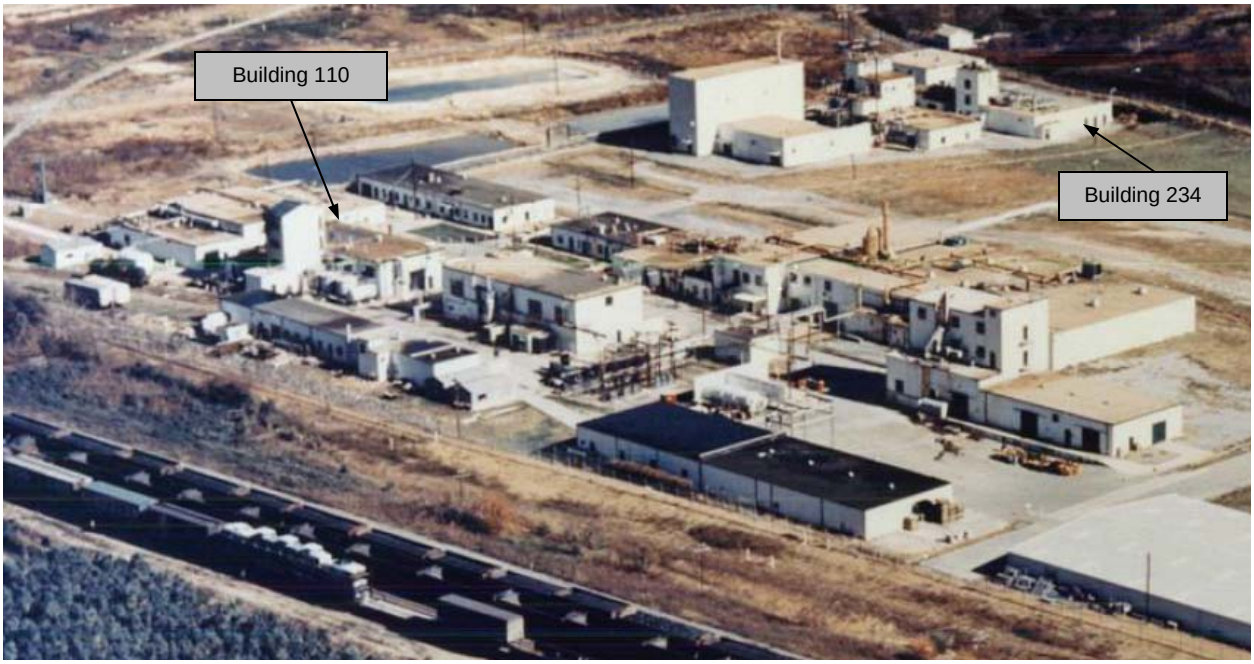

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Figure 3. Oak Ridge National Laboratory

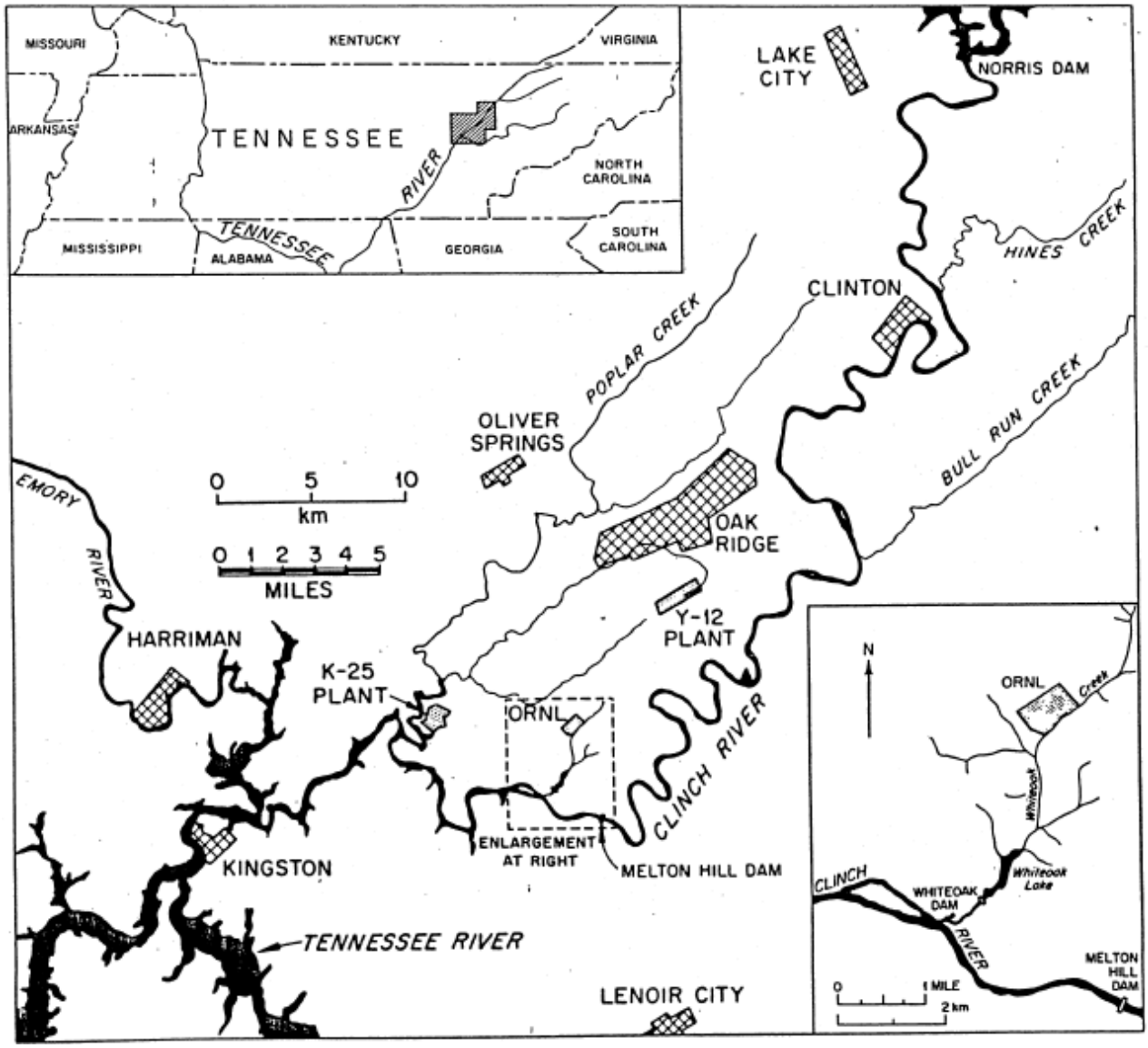

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Figure 4. Transuranic Waste Processing Center and ORNL Solid Waste Storage Areas

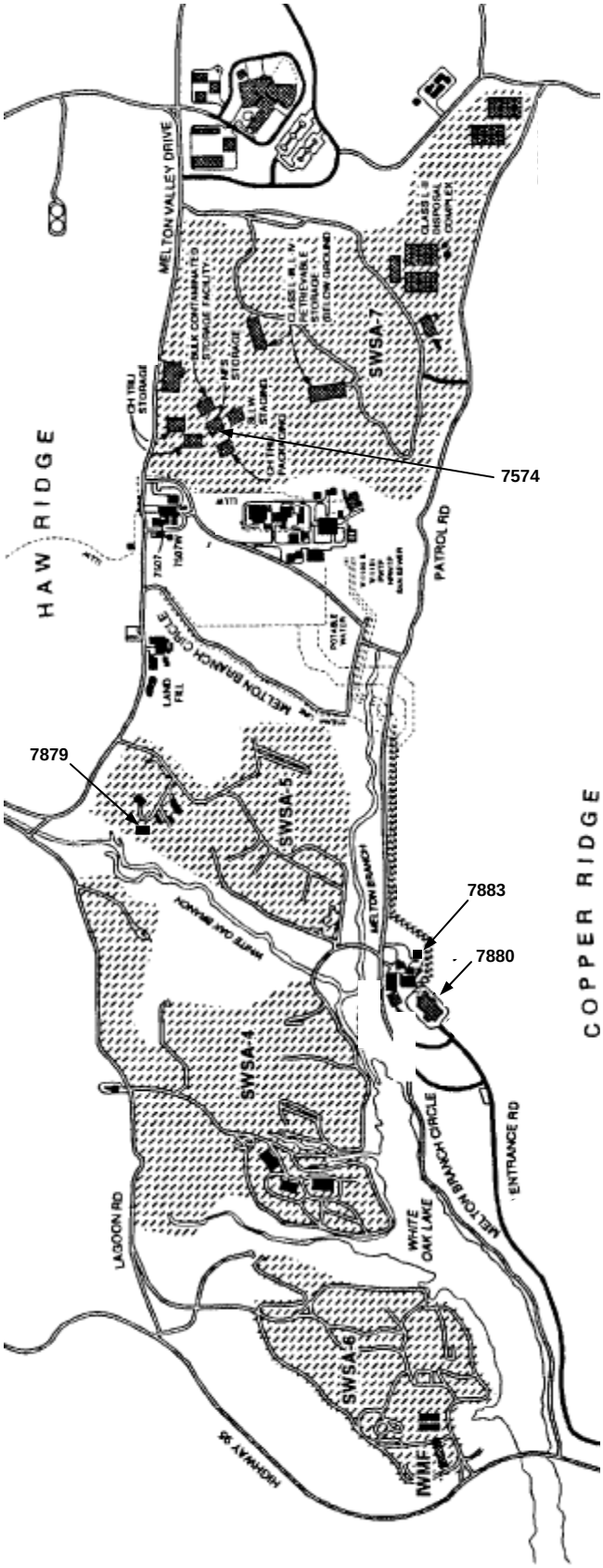
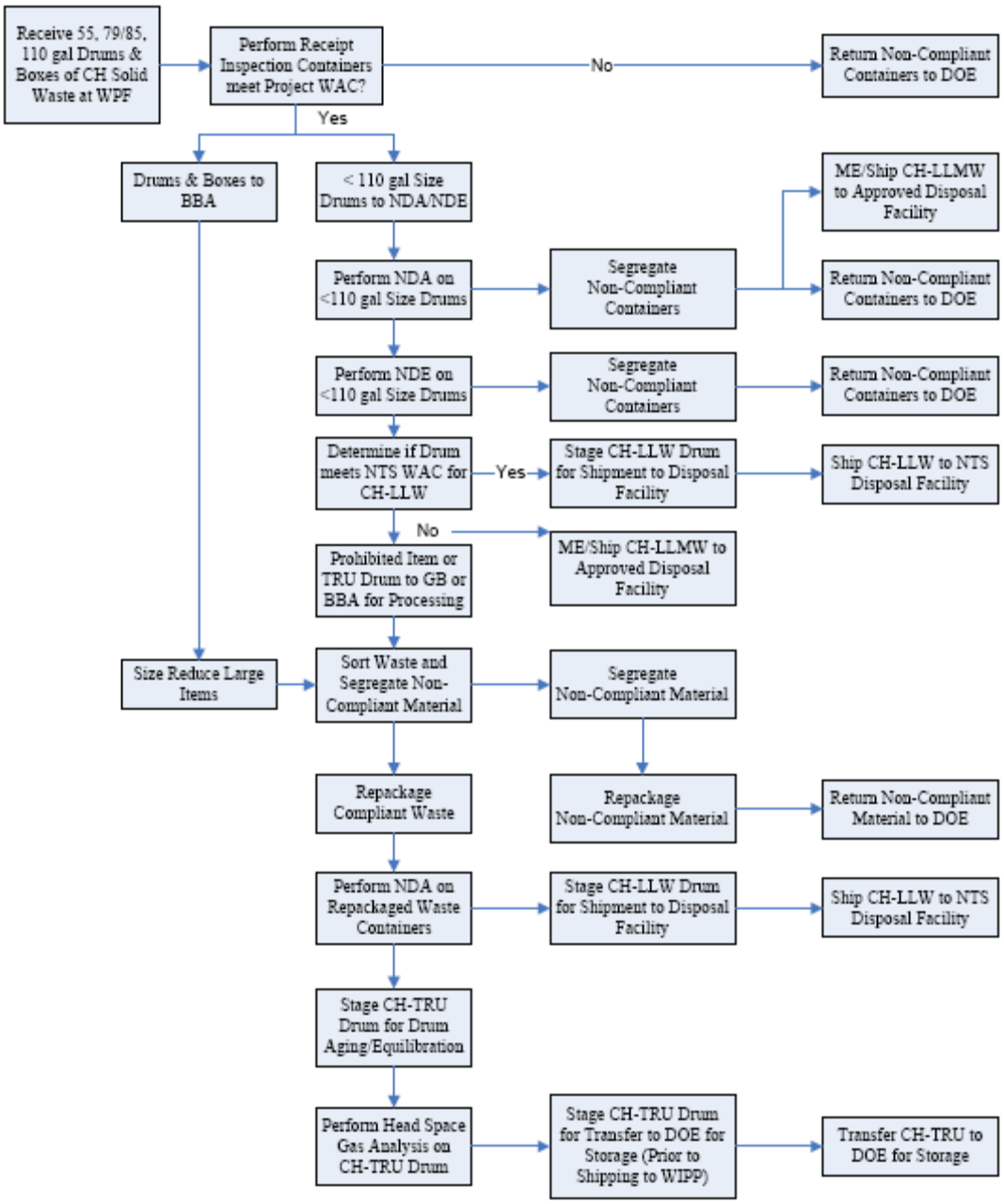
Figure 5. Transuranic Waste Processing Center CH Solid Waste Flow Diagram