

## **The Direct Path To WIPP - 12471**

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### **ABSTRACT**

Sandia National Laboratories/New Mexico (SNL/NM), designated as a small quantity site (SQS) by the National TRU Program (NTP), generated contact-handled (CH) and remote-handled (RH) transuranic (TRU) waste primarily from the decontamination and cleanout of glove boxes at the Hot Cell Facility (HCF) at Technical Area (TA) V. All of the waste required repackaging, with the CH TRU waste being repackaged from late 2007 through 2011. Three shipments of CH were completed in October 2011, which de-inventoried SNL/NM's legacy TRU waste.

In FY11, RH TRU waste was repackaged at the Auxiliary Hot Cell Facility (AHCF) located in TA-V with the support of the Central Characterization Project (CCP). The waste was originally packaged in SNL/NM fabricated casks, cement or lead-lined 55-gallon drums, or 30-gallon drums. The AHCF is a small hot cell, with access only through a roof port which presented challenges for inserting and removing waste from the hot cell. The CCP provided visual examination operators (VEOs) to observe and document each waste item repackaged, removal of prohibited items, and radiological sampling. Dose-to-Curie measurements were calculated by CCP after a radiological report was prepared using scaling factors determined by the analysis of swipe samples. Finally, headspace gas samples were taken and sent to the Advanced Mixed Waste Treatment Project (AMWTP) for analysis. Despite the challenges, the RH waste is on track to be shipped to WIPP in early FY12.

The processes used and procedures developed to conduct the repackaging operations, the issues identified and mitigated were challenging but the cooperation between SNL/NM and the Central Characterization Program (CCP) enabled SNL/NM to complete the repackaging and support the characterization and shipment. An inventory list, identification of the campaigns, discussion of the challenges and mitigations, and the final loading of the RH 72-B casks at TA-V for direct shipment to the Waste Isolation Pilot Plant (WIPP) will be discussed.

### **INTRODUCTION**

The mission of SNL/NM is to develop technological solutions to support national security and counter national and international threats to meet the national needs in the following areas:

- Nuclear Weapons
- Energy, Climate, & Infrastructure Security
- Nonproliferation
- Defense Systems & Assessments
- Homeland security
- Science, Technology, & Engineering

The hot cell facility (HCF) is located in the basement of Building 6580 at Technical Area (TA) V and was equipped with steel confinement boxes, a glovebox laboratory, ancillary analytical equipment, support areas, and fissile-and radioactive-material storage areas. It provided support for the reactor and other radiation facilities within TA-V since the early 1960s. In 1984, a modification was performed that provided additional hot cell facilities and systems to increase the capabilities of the HCF. The waste was generated during the decontamination of the HCF and included contact-handled (CH) and remote-handled (RH) transuranic (TRU) waste. The CH waste has been repackaged and shipped to the Advanced Mixed Waste Treatment Plant (AMWTP) for final certification and shipment to the Waste Isolation Pilot Plant (WIPP) for disposal.

## **BACKGROUND**

Eight projects were conducted in the HCF that generated TRU waste. They were part of the Severe Accident Research Program, initiated after Three-Mile Island. These studies involved the preparation of reactor experimental assemblies that were to be irradiated in the reactors to simulate the accident scenarios, followed by post-irradiation examination and evaluation. The TRU waste generated from these programs are from post irradiation examination processes and does not include any fuel rods.

- The Melt Progression (MP) experiments investigated the successive melting and solidification of core materials. The test section was subjected to a neutron field in the Annular Core Research Reactor (ACRR) with fission heating simulating the fission product decay heating of a severe accident.
- The Source Term (ST) program studied the fission product release under severe accident conditions. Non-irradiated and irradiated fuel comprised the test package and heated to 2,400 degrees Kelvin to study the release of fission products.
- Damaged Fuel (DF) investigated the initial reaction of intact fuel rods during a severe accident sequence.
- The goal of the New Production Reactor (NPR) experiments was to study the behavior of the fuel under transient, fuel melting conditions.
- The Fuel Disruption (FD) studies determined breeder reactor fuel behavior under disruption models such as cracking and breakup of solid fuel, liquid state frothing, and radial spray from molten fuel. These were observed with a high speed camera.
- Effective Equation of State (EEOS) experiments determined the effective vapor pressure from irradiated and un-irradiated mixed-oxide reactor fuels heated in a closed volume at a very high temperature.
- The Sandia Transient Axial Relocation (STAR) program studied the transient cladding and fuel relocation during the beginning phase of a hypothetical accident.
- The Fission Activated Laser Concept (FALCON) examined the feasibility using the energy from a nuclear reactor to pump high power systems.

In 1994, decontamination of the HCF was initiated which included dismantling and decontamination of equipment, removal of waste such as hand tools, filters, small parts, fixtures, laboratory glass and plastic ware, larger pieces of equipment, and loose surface contamination. Wastes were packaged and disposal requests prepared and approved. The waste was picked up by waste handlers from the Regulated Waste/Nuclear Material Disposition Department (RWNNDD) for storage in the Manzano Bunkers. Several containers were used to package the RH waste. Figures 1 and 2 are examples of casks and shielded 55-gallon drums containing the RH waste.



**Fig. 1. RH Casks**



**Fig. 2 PACO Casks**

## **INVENTORY**

The waste stream consists of organic and inorganic debris including metal hardware, glass vials and lab ware, glove box gloves, tubing, plastic bottles, PPE, and various cellulosic materials. There were a total of 30 original containers requiring repackaging including 15 casks, 8 55-gallon drums, and 2 30-gallon drums. They were a mix of Hazard Category 3 and less than

Hazard Category 3. All had to be repackaged in the Auxiliary Hot Cell Facility (AHCF) at TA-V. Figure 3 is the AHCF and shield wall.



**Fig. 3. Auxiliary Hot Cell Facility with the Shield Wall**

## **CHARACTERIZATION**

Eight repackaging AHCF campaigns were developed to accommodate sampling requirements, radiological profiles, and parent packaging configurations. Campaigns 1-6 consisted of 15 containers that were repackaged from which 18 swipe samples were collected and sent to the Idaho National Laboratory (INL) for radiochemistry. The analytical results were used to develop scaling factors for use in the dose-to-curie (DTC) calculations. The final two campaigns did not involve sampling, but only repackaging of the remaining 15 containers.

### **Repackaging**

The repackaging involved AHCF personnel and Central Characterization Project (CCP) visual examination (VE) personnel. AHCF operators opened the parent containers, sorted through the waste, and placed the items in new 30-gallon drums, all under the direction of two certified VE operators. Each item was documented and verified by the VE operators while in visual contact with the waste items through the hot cell windows. The 30-gallon drums were removed from the hot cell and placed in a 55-gallon drum. Both drums have lever-locks. The introduction and removal of items from the hot cell is through an opening on the roof and can only accommodate a 30-gallon drum or smaller. Figure 4 is an aerial view of the hot cell with a view of the opening where items are introduced and removed from the hot cell.



**Fig. 4. Aerial View of the Auxiliary Hot Cell**

### **Physical Properties**

This waste stream consisted of debris items generated during the decontamination of the original hot cell. The waste material parameters an average weight percent is in Table I.

**Table I Waste Material Parameters**

<b>Waste Material Parameter</b>	<b>Average Weight Percent (Wt %)</b>
Iron-based metals/alloys	62.1
Aluminum-based metals/alloys	10.1
Other metals	3.8
Other inorganic materials	7.7
Cellulosics	5.6
Rubber	1.6
Plastics (waste materials)	8.3
Organic matrix	0.0
Inorganic matrix	0.8
Soils/Gravels	0.0

## Radiological Properties

The waste stream was categorized usually per parcel during initial generation by surface dose rates of greater than 200 millirem/hour (mrem/hr) and containing more than 100 nanoCuries/gram (nCi/g) of alpha emitting TRU isotopes with half lives greater than 20 years. Originally, the waste was characterized using quantitative gamma spectroscopy. The activity ratios primarily used were documented in process knowledge evaluations (PKEs). Three PKEs were found to represent this waste stream, 44, 47, and 54. For sampling purposes, each PKE was sampled separately to determine the scaling factors for each PKE. A summary of the SNL/NM reported radionuclides is in Table 2.

**Table II Summary of Radionuclides and Average Curies per Parcel**

<b>Radionuclide</b>	<b>Average Ci/parcel</b>
Am-241	6.03E-02
Pu-238	2.45E-02
Pu-239	2.27E-02
Pu-240	8.47E-04
Pu-242	131E-06
U-234	1.51E-05
U-238	3.78E-07
Cs-137	2.87E+00
Sr-90	1.06E+00
U-235	1.11E-06
Am-243	1.92E-06
Co-60	6.26E-01
Th-234	3.11E-07
Cs-134	8.84E-04

DTC measurements were conducted on the final package, 55-gallon drums, behind the shield wall as illustrated in Figure 3. CCP personnel conducted the measurement with the support of the AHCF staff. The calibration of the probes was accomplished at the Gamma Irradiation Facility at TA-V.

## Headspace Gas

After the repackaging was completed, the drums were moved to the Sandia Pulse Reactor facility. The highest dose drums were placed in shielded containers, and the remaining containers were stored in a shielded room. Two campaigns of headspace gas sampling were conducted by certified CCP samplers. Samples were collected in summa canisters and shipped to INL for analysis.

## CERTIFICATION AND SHIPMENT

The certification process was challenging. Initially, the U.S. Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED) scheduled a visit to observe the repackaging, DTC, and headspace gas sampling for PKE 44. The container that was scheduled to be repackaged during the EPA visit turned out to be solid waste and not debris, resulting in a

nonconformance. The DTC and headspace gas sampling observations were acceptable. EPA returned to observe a different container several weeks later.

The baseline report for PKE 44 was submitted by EPA to the Federal Register on October 6, 2011. A 45-day public comment period is required before WIPP can certify the RH waste for shipment directly to WIPP. That period is up on November 21, 2011. Two Tier 1 reports will be prepared and approved for PKEs 47 and 54. SNL/NM anticipates shipment of the PKE 44 waste will be before the end of the calendar year, with PKE 47 and 54 being shipped the first quarter of 2012.

## LESSONS LEARNED AND CONCLUSIONS

Lessons learned from the RH campaigns are:

- Some containers that were originally identified as HC-3 have been re-evaluated and became < HC-3 due to the conservative estimates made by the original generators
- Operators at the AHCF were not accustomed to the detail required by the VE operators. However, they worked well together and the repackaging was completed ahead of schedule.
- The AK was not always accurate as was demonstrated by the solid waste found in the drum during the first visit by EPA. That waste has since been determined to be low-level.
- Two drums originally thought to be RH turned out to be CH and arrangement for RTR had to be made quickly.
- Six of the original RH repacked drums became low level.
- Lessons learned from the CH campaigns were helpful in avoiding many issues.

The RH repackaging effort has been a success due to the expertise of the AHCF operators, supervisor, and manager, the conscientious attention to detail of the CCP VE operators, the experience of the CCP DTC and headspace gas sampling staff, and the guidance and support from CCP and CBFO. Sometimes schedules had to be adjusted, processes updated, and issues discussed, but the communication between CCP and SNL/NM was good. SNL/NM hopes to have the legacy RH TRU waste shipped off-site by early 2012.

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