Remote-Handled TRU Storage Challenges at Sandia National Laboratories/ New Mexico, 16071

B.J. Humphrey
Weston Solutions, Inc.
3840 Commons Ave. N.E., Albuquerque, NM 87109

B.P. Green, M.A. Torneby, D. Siddoway, M.T. Spoerner
Sandia National Laboratories/New Mexico
P.O. Box 5800, Albuquerque, NM 87185-1151

ABSTRACT

The events at the Waste Isolation Pilot Plant (WIPP) in February 2014 had a significant impact on the packaging, storage, and disposal options at Sandia National Laboratories/New Mexico (Sandia) as with other transuranic generator sites. In 2012, Sandia had identified accountable material for disposal, fresh and irradiated mixed oxide (MOX) and uranium oxide (UO_2), which had been used in experiments conducted in the 1970s and 1980s. During the 2012/2013 timeframe, discussions with WIPP determined the samples and experimental vessels qualified as remote-handled (RH) transuranic (TRU) waste for disposal at WIPP. Sandia began discussions with WIPP to determine the process to repackage and characterize the material for disposal at WIPP in addition to obtain funding to complete the project. By January 2014, Sandia had contracted with Nuclear Waste Partnerships, LLC (NWP) to provide Central Characterization Program (CCP) certified visual examination (VE) and dose-to-curie (DTC) support to package and certify the accountable material/waste. Work began on February 3, 2014 with the arrival of two VE operators.

On February 5, 2014, a salt truck caught fire in the underground and on February 14, 2014, the radiological release occurred at WIPP initiating a suspension of shipments. The length of the suspension was not known at the time. Sandia was only a couple of days into this long-term project, had signed a contract with NWP for support, and was still responsible for meeting earlier negotiated milestones. There were 37 parent containers which included experimental vessels from 3 to 10 feet long and unused material pieces. The original plan was to package each of the 37 parent containers separately, but several issues, including the suspension of shipments, made it imperative that a new path forward be developed. Because space is limited in the Auxiliary Hot Cell Facility (AHCF), the storage configuration for criticality safety and material-at-risk was of the highest importance. Therefore, packaging in the fewest number of containers without exceeding WIPP limits, keeping the accountable items together, and not violating any safety basis requirements was Sandia's goal.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

INTRODUCTION

In 2013 Sandia downgraded their nuclear storage bunkers to radiological facilities in an effort to reduce Sandia's nuclear footprint. The AHCF, where RH repackaging takes place, is a nuclear facility, but had not been used previously as a long-term storage facility. In addition, only one area, the high bay, is a Resource Conservation Recovery Act (RCRA) permitted facility.

The experimental vessels, excess material pieces, and kerf were tracked as accountable nuclear material and Sandia had verified Material Control and Accountability (MC&A) data on each parent container. This information was sent to the WIPP radiological engineers and based on the MC&A data, sampling and analysis was not required as it was possible to determine scaling factors for each daughter drum. However, it meant that parent containers could not be split into two daughter containers, though two or more parent containers could be combined into one daughter. Sandia prepared load plans that tentatively evaluated decay heat, fissile gram equivalent (FGE), and plutonium equivalent curies (PE-Ci) limits for each parent container and suggested daughter container to minimize the chance that these limits would be exceeded.

DISCUSSION

The materials used in the experiments were MOX and UO_2, with various burn-up rates and uranium enrichments ranging up to 11% and 93% respectively. The mass data was primarily obtained from the MC&A database of record, Materials Accounting Records System (MARS).

Each parent container was analyzed for the following parameters:

- Amount of uranium oxide
- Radionuclide quantitative composition
- Unshielded dose rates
- Hazard category fraction
- Radionuclide mass
- Criticality safety threshold mass fraction and U-235 fissile equivalent mass (FEM)
- PE-Ci, FGE, and decay heat

Initially, the 37 parent containers were re-packaged into 13 daughter containers:

- Eleven were direct loaded
- Two contained shield pots
- Ten were mixed, stored in the AHCF high bay, a RCRA permitted facility, and
- 3 were non-mixed and were stored in the mid bay.

Therefore, the goal to package in the fewest number of containers and not split the accountable items (allowing use of Material Control and Accountability (MC&A) data instead of sampling) was initially accomplished.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

RESULTS

Initial Packaging

Three campaigns were conducted on the accountable material/experimental vessels. The dose rates for a few of the daughters were higher than anticipated and a limited number of shielded casks were available. Table I lists the contact dose rates.

Drum Number	Dose Rate (Rem)	Drum Number	Dose Rate (Rem)	Drum Number	Dose Rate (Rem)
SNL001401	2	SNL001501	12	SNL001601	11
SNL001402	3.5	SNL001502*	4.4	SNL001602	6
SNL001403	3.3	SNL001503*	2.5	SNL001603	18
		SNL001504	5.5	SNL001604	20
				SNL001605	96

*contains shield pots

TABLE I. Contact Dose Rates for RH TRU Containers

Three cask configurations were available: four L-110 casks, six MTS casks, and three short casks (shorties). The L-110 and MTS casks accommodate 55-gallon drums, but the lids cannot be secured on the shorties if used for 55-gallon drums. Pictures of the L-110 and MTS casks are shown in Figure 1. Figure 2 shows a shorty cask.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Fig. 1 L-110 and MTS Casks

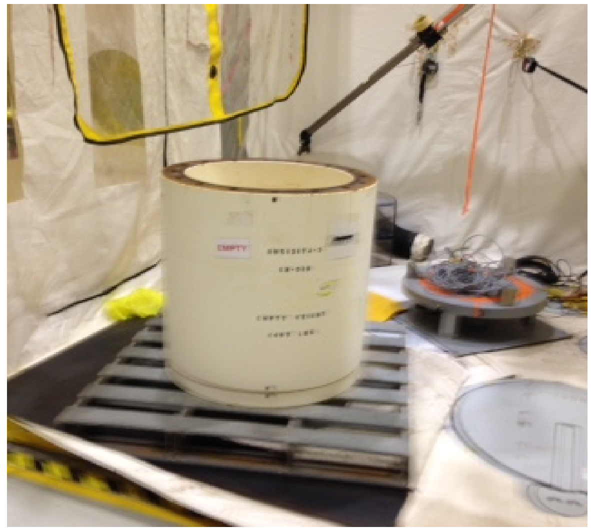

Fig. 2 Short Cask

Process Generated Waste

The next step was to decontaminate (decon) the hot cell and package the process generated waste (PGW). Eleven drums of PGW were generated during the initial decon effort, four of which were determined to be contact-handled (CH) TRU and were removed from this waste stream. Table II lists the initial PGW drums with their associated dose rate. The four CH containers are SNL001701, 1707, 1709, and 1710.

Drum Number	Dose Rate (Rem)	Drum Number	Dose Rate (Rem)	Drum Number	Dose Rate (Rem)
SNL001701*	0.16	SNL001705	0.34	SNL001709*	0.06
SNL001702	0.25	SNL001706	12.3	SNL001710*	0.12
SNL001703	0.4	SNL001707*	0.14	SNL001711	2.9
SNL001704	0.2	SNL001708	0.6		

*contact-handled

TABLE II. PGW Contact Dose Rates

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Accountable Material Issues

Dose to Curie (DTC) measurements were performed on the re-packaged containers, including the PGW. CCP evaluated the results for TRU concentration, decay heat, FGE, and PE-Ci. As expected, the PGW containers met the limits, however, three of the accountable material drums, SNL001502, SNL001503, and SNL001605, failed to meet the FGE limits and were required to be repackaged. The CCP radiological engineers suggested each drum be split into three drums. That presented another issue that had to be resolved; the accountable material would have to be split in a way to satisfy both MC&A and WIPP requirements. If the splits resulted in the accountable material being in separate containers, MC&A agreed that keeping daughter drums together in a configuration that could be TID'd was acceptable. After discussions between Sandia and CCP, the splits were made as follows:

- SNL001502, contained two shield pots, therefore was split into two new daughters, SNL001505 and SNL001506. This did not involve splitting accountable material.
- SNL001503, direct loaded, was split into three new daughters, SNL001507, SNL001508, and SNL001509. This new configuration split accountable material, and these daughter drums were placed in a silo, located next to the hot cell.
- SNL001605, direct loaded, was split into three daughters, SNL001606, SNL001607, SNL001608 and did split accountable material, so these were placed in a 744 TID'd metal box.

DTC was conducted on the additional daughter drums. The FGE limits were met for all but one, SNL001505, which was split into daughters SNL001510 and SNL001511, this time resulting in a split of accountable material, requiring storage in a 744 box to meet MC&A requirements. DTC was conducted and again, one daughter, SNL001510, exceeded the FGE limit making another split necessary. The results showed that the FGE for one daughter was very low, while the other was just slightly above the limit. It was decided not to do a new split, but to distribute some material from the high FGE daughter to the low FGE daughter. The final FGE limits were finally met for the final two daughters.

After final decon of the AHCF, two PGW drums were generated that were determined to be CH drums, 81and 178 mrem/hr and are not in this waste stream. Figure 3 illustrates the storage array and Figure 4 shows a shorty cask with a daughter drum inside and lead blankets for shielding on the top.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Fig. 3 Storage Array

Fig. 4 Shorty Cask with Shielding

CONCLUSIONS

Storage and shielding not only became an issue, but movement of containers for re-insertion into the hot cell for splitting required careful material management. All of these issues required careful planning and monitoring to ensure the final daughter containers met all of the WIPP requirements; MC&A could track and manage the material; the AHCF operators minimized their dose; safety basis requirements were met; and, the final containers were in a safe configuration until shipment to WIPP.

ACKNOWLEDGEMENTS

I want to thank the co-authors of this paper for allowing me to support this effort at Sandia. They were key participants in making this project a success. In addition, special thanks to INL and ANL for supporting Sandia's repackaging efforts by providing VE and DTC operators and to the CCP for their guidance and support.

REFERENCES

1. Radiological Survey Reports, Sandia National Laboratories/New Mexico, 2014 and 2015.

2. Visual Examination Forms, Central Characterization Program, 2014 and 2015.

3. Waste Container Dose-to-Curie Conversion Record Forms, *DRAFT,* Central Characterization Program, 2015.

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.