This paper describes objective technical results and analysis. Any subjective views or opinions that might be expressed in the paper do not necessarily represent the views of the U.S. Department of Energy or the United States Government.

WM2019 Conference, March 3—7, 2019, Phoenix, Arizona, USA.

SAND2018-12732C

Alternate Packaging Options for Remote-Handled Transuranic Waste Disposal at WIPP-19093

B. Humphrey
Weston Solutions, Inc.
M. Spoerner, B. Green, T. Erenstein, D. Siddoway, and M. Torneby
Sandia National Laboratories/New Mexico

ABSTRACT

Sandia National Laboratories/New Mexico (Sandia) began a remote-handled (RH) transuranic (TRU) repackaging campaign two weeks before the Waste Isolation Pilot Plant (WIPP) shutdown in February 2014. Since a contract with Nuclear Waste Partnerships (NWP), the WIPP Management and Operation (M&O) contractor, was already in place for certified visual examination (VE) and dose-to-curie (DTC) support, repackaging continued and was completed in October 2015. Twenty-five 55-gallon drums of RH TRU waste were packaged, awaiting certification and shipment to WIPP. However, in February 2017 at the National TRU Program (NTP) Corporate Board meeting, Sandia learned that RH TRU waste normally transported in removable lid canisters (RLCs) and 72-B casks was not being accepted for disposal when WIPP re-opened after the shutdown. One option, shielded container assemblies (SCAs), was available and approved for RH TRU waste disposal at the WIPP. Sandia made the decision to pursue the use of SCAs. The use of SCAs allow RH TRU waste to be shipped as contact-handled (CH) in HalfPACTs, emplaced on the floor of the WIPP instead of in boreholes in the walls, if the dose rate is less than 200 millirem/hour on contact. The RH TRU waste remains on the WIPP inventory as RH.

INTRODUCTION

A radiological release at the Waste Isolation Pilot Plant (WIPP) in February 2014 initiated a shutdown of disposal operations which continued for nearly three years. TRU waste generator sites were significantly impacted, and each site began evaluating their characterization schedules and storage capacities for continued mission support. When WIPP reopened in early FY17, only CH TRU waste was accepted for disposal. Contamination issues prevented RH TRU waste from being emplaced in RLCs. Therefore, generator sites with RH TRU waste formed an RH Working Group (RHWG), chartered by the Carlsbad Field Office (CBFO), and began discussions to determine alternative options for disposal. Near-term (< 3 years) and long-term (> 3 years) options included various means to emplace RLCs and the use of several shielded container designs.

The RHWG was comprised of representatives of TRU waste generator sites with RH TRU waste inventory and NWP. Several conference calls were conducted as well as face-to-face meetings. A meeting held at the Idaho National Laboratory included a tour of characterization and storage facilities, with emphasis on handling and storage of RH TRU waste. Every option suggested was discussed in detail including the mechanics of the operation, pros and cons, challenges, and needs. Most of the options would require a WIPP Hazardous Waste Permit modification, Documented Safety Analysis (DSA) revision, significant capital costs, and were considered long-term.

Removable Lid Canisters

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

The RHWG considered the continued emplacement of RLCs in Panel 7 boreholes, even though Panel 7 and the emplacement equipment were contaminated during the radiological release, and additional alternatives for RLC emplacement were suggested and evaluated. Table I provides examples of the alternative options, a description of each, and a few of the challenges.

TABLE I. Examples of Alternative for RLC Emplacement [1]

Option	Description	Challenges/Needs
Emplace RLCs in trenches	Trenches dug out of the floor in a disposal room, covered with mined out salt	• Long term options • Permit modification • DSA evaluation and revision • Possible technology development • Design and approval of new equipment • May require use of hot cell at WIPP
Emplace RLCs in overpack containers (ROPs) or Interim Storage Containers (ISC)	RLCs loaded in ROPs or ISCs at WIPP, transferred to underground	
Emplace in shielded racks	RLC array in horizontal frame assembly in disposal room	
Store above ground temporarily until underground available	Storage in ROPs, ISCs, and IWTU storage vault	

Shielded Container Assemblies

The shielded container concept was discussed in 2008 at the Waste Management Symposia [2] with a few containers fabricated and eventually approved for disposal of RH TRU at the WIPP. Argonne National Laboratory (ANL) shipped RH TRU waste to WIPP using the initial SCAs, but the cost to procure additional ones was prohibitive since at that time, RLCs could still be used. Shielded containers allow RH TRU waste to be shipped as contact-handled (CH) as long as the contact dose rate is < 200 mrem/hour on contact. Only the SC-30G1 is currently approved for use, therefore, the RHWG proposed four new designs that are being fabricated, tested, with an anticipated approval in 2021. Table II lists approved and proposed shielded containers with associated data.

TABLE II. Shielded Container Designs [1]

Parameter	SC-30G1	SC-30G2	SC-30G3	SC-55G1	SC-55G2
Lead, cm (in)	2.54 (1)	4.45 (1.75)	8.26 (3.25)	2.86 (1.125)	6.35 (2.5)
Number per HalfPACT	3	2	1	2	1
Container tare weight (kg)	783	1220	2521	1206	2525
Maximum gross weight (kg)	1025	1462	2763	1448	2767
Estimated allowable drum dose rate for Cs-137 R/hr	10.1	77.8	2795	12.9	456
Estimated allowable drum dose rate for Co-60 R/hr	2.2	8.1	124	2.5	27.7
Approved Yes/No	Yes	No	No	No	No

U.S. DEPARTMENT OF ENERGY NNSA

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

Sandia National Laboratories

The SCA option became more attractive for many RH TRU waste generator sites due to the long-term timeframe for RLC emplacement and requirements for DSA revisions to include RH TRU waste. If Sandia was going to be able to ship their RH TRU waste packaged in 2014/2105 in the near future, it was imperative to begin exploring the use of SCAs.

DESCRIPTION OF SCA PROCESSING

No shielded containers had been manufactured or procured since the original ones used by ANL and the original cost was approximately $25,000 to $27,000 per unit. For this effort to be cost effective, the RHWG requested that the sites determine if they could benefit from utilizing the SCAs, and if so, how many could they procure if the cost could be reduced by purchasing in bulk by Central Procurement at WIPP. Sandia and ANL said they were interested and proceeded to determine how many they could use as well as fund. In parallel, Central Procurement issued a Request for Proposal/Quote to several vendors to determine the minimum number of SCAs required to reduce the cost while meeting the Quality Assurance/Quality Control (QA/QC) requirements for WIPP. A minimum purchase of 50 containers would reduce the cost to approximately $14,500 per unit, a significant reduction from the original cost. ANL purchased 39 and Sandia purchased 12 SCAs to reach one more than the goal of 50.

Determination of Qualifying Containers

In conjunction with the RHWG, Sandia reviewed their RH TRU inventory to determine the number of containers that could qualify for shipment in the currently approved SCA. The SC-30G1 accommodates a 30-gallon drum, the maximum allowable dose rate of a payload drum is estimated to be 10.1 R/hr, and the final dose rate after loading into the SCA must be less than 200 mrem/hr on contact. As discussed above, Sandia's waste was originally packaged in 30-gallon drums, then over-packed in 55-gallon drums, therefore, radiological engineers modeled the dose rate to determine an estimated dose rate after loading in the SCA. Initially, twelve containers were identified as meeting the requirements of the SC-30G1. Table III lists the containers and contact dose rates on the 55-gallon drums.

TABLE III. Initial Dose Rates

Container ID	Dose Rate on Contact, mrem/hr	Container ID	Dose Rate on Contact, mrem/hr
SNL001401	2000	SNL001702	300
SNL001402	3500	SNL001703	400
SNL001403	3300	SNL001704	200
SNL001509	500	SNL001705	340
SNL001513	3700	SNL001708	600
SNL001602	2800	SNL001711	1900

Procurement of SCAs

U.S. DEPARTMENT OF ENERGY NNSA

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

Sandia National Laboratories

Sandia began to secure funding which had not been previously identified for SCAs in any of Sandia's FY17 budgets. Two departments, Waste Management and Nuclear Material Management/Material Control and Accountability (NMM/M&A), provided the funding and in September 2017, a 50% down payment was transferred to Central Procurement at WIPP, in conjunction with ANL's 50% down payment, to issue the purchase order for the 51 SCAs. On July 16, 2018, Sandia's 12 SCAs were delivered to Technical Area (TA) V at Sandia National Laboratories/ New Mexico. Figure 1 is a photo of the new SCAs.

Fig. 1. New Shielded Containers

LOADING OF THE SCAs

U.S. DEPARTMENT OF ENERGY NNSA

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

Sandia National Laboratories

In the 2014/2015 WIPP certified characterization activities, the VE packaging operations were conducted in the Auxiliary Hot Cell Facility (AHCF) at Sandia's TA-V. The AHCF is located in the high bay and access to the hot cell is through an opening in the roof. Consequently, the 30-gallon drum containing the RH TRU waste is contaminated and was removed from the AHC through this roof opening and placed in a 55-gallon over-pack. The 55-gallon over-pack was surveyed clean in anticipation of loading in an RLC for shipment to WIPP after certification. With the decision to utilize the SC-30G1, the contamination of the 30-gallon drum required the loading activities be carried out inside a confinement tent, which is adjacaent to the AHC and located behind a shield wall equipped with manipulators. Figure 2 shows the AHC, shield wall and the adjacaent tent structure.

Fig. 2. Auxiliary Hot Cell and Tent

Sandia developed a campaign plan and loading procedure and met with the NWP RH manager and the mobile loading unit (MLU) staff for a facility walk down. The MLU staff was asked to review the final procedure to ensure compliance with WIPP requirements. After a short postponement of the start date, two members of the WIPP MLU team and one Vendor Project Manager (VPM) arrived at Sandia to begin SCA loading operations with the Sandia AHCF operators.

U.S. DEPARTMENT OF ENERGY NNSA

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

Sandia National Laboratories

As stated previously, Sandia's RH TRU waste was packaged in contaminated 30-gallon drums and over-packed in 55-gallon drums. This necessitated loading activities to be conducted in the confinement tent when the 30-gallon is removed from the over-packed 55-gallon drum. In addition, to minimize the spread of contamination and for ease of loading, the 30-gallon drum was placed in a mesh drum-handling bag (supplied by the MLU team) for insertion into the SCA. Figures 3 and 4 illustrate these operations.

Fig. 3. Removal from Over-pack **Fig. 4. Drum-lifting Bag**

The AHC operators performed these operations using manipulators through a shield wall and the transfer from over-pack into the drum-handling bag is carried out with an overhead crane and a drum lifter. The next step was to transfer the 30-gallon waste drum in the drum-lifting bag into the SCA with the overhead crane and manipulators. Figure 5 illustrates this transfer.

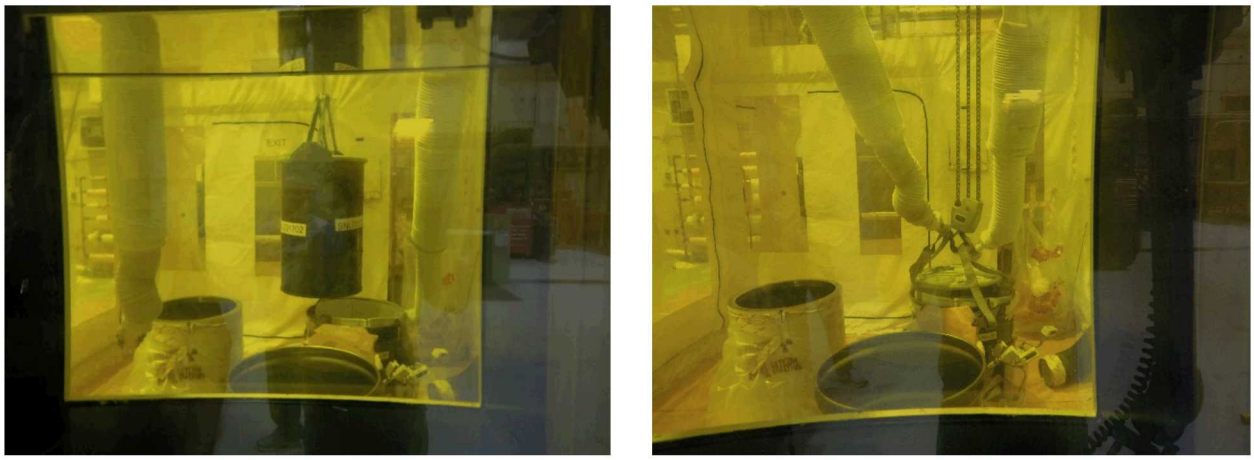

Fig. 5. Bag Transfer into SCA

U.S. DEPARTMENT OF ENERGY NNSA

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

Sandia National Laboratories

Once the drum-handling bag containing the 30-gallon waste drum is placed in the SCA, the SCA lid is lowered using the lifting fixture onto the SCA and positioned using alignment points. AHC operators insert and tighten three (3) of bolts using manipulators and removed the lifting fixture. Radiological control technicians (RCTs) enter the tent to check for contamination and determine preliminary dose rates. Once cleared for entry, the MLU team enters the tent, inserts the remaining bolts, and tightens to the WIPP required torque. Figure 6 shows the SCA, lid, and lifting fixture.

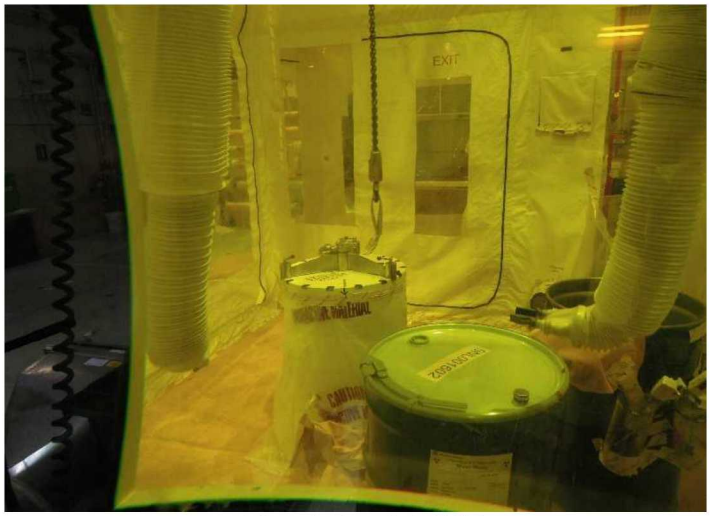

Fig. 6. Loaded SCA

Once the RCTs determine that the SCA is not contaminated, it is removed from the tent and placed on a stand outside the tent. This allows the RCTs to conduct the final, WIPP-required surveys on the four (4) side quadrants, bottom, and top of the SCA. Figure 7 shows the loaded and closed SCA.

Fig. 7. Loaded SCA

U.S. DEPARTMENT OF ENERGY NNSA

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

Sandia National Laboratories

Lessons Learned

Sandia is the second TRU waste generator site to load SCAs, ANL being the first. A major difference between Sandia's and ANL's process is ANL's 30-gallon drums are not contaminated. Sandia had to perform many of the loading activities in a confinement tent, using manipulators. Consequently, loading was a slower process, only one loading evolution per day.

The original list of twelve drums identified by Sandia as candidates for using SCAs included one drum that had two shield pots inside, SNL001513. In order to be able to use SCAs, the site cannot take credit for any internal shielding, therefore, that container had to be removed from the list. Sandia identified a replacement container, SNL001706, with a dose rate of 12 R/hr. While the estimated allowable limit for the SC-30G1 is 10 R/hr, Sandia and WIPP agreed to leave it on the list and determine if it would meet the < 200 mrem/hr limit after loading in an SCA. It did not pass, but remains in the SCA for storage purposes. All remaining 11 containers passed and are listed in Table IV.

TABLE IV. SCA Final Dose Rates

Container ID	SCA Dose Rate on Contact mrem/hr
SNL001401SC	80
SNL001402SC	80
SNL001403SC	150
SNL001509SC	14
SNL001602SC	100
SNL001702SC	18
SNL001703SC	36
SNL001704SC	7
SNL001705SC	16
SNL001706SC	600
SNL001708SC	31
SNL001711SC	150

CONCLUSION

The entire process involved funding from the National Nuclear Security Administration (NNSA) and Sandia, as well as coordination and frequent communication between individuals and departments at Sandia, and many WIPP and NWP personnel. Careful and detailed planning by the AHCF, the MLU teams, and the Sandia's NMM/MC&A contributed to this project being conducted and completed on schedule with no issues.

U.S. DEPARTMENT OF ENERGY NNSA

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

Sandia National Laboratories

The four new SCA designs are in the procurement and fabrication stage, with testing and final approvals anticipated in FY21. Sandia plans to procure 14 of these new designs which will allow shipment of the entire inventory of Sandia's RH TRU waste to WIPP.

Since Sandia and ANL have successfully loaded and have either shipped or are in the process of finalizing shipment of the SCAs, other TRU waste generator sites have a renewed interest in utilizing SCAs for their RH TRU waste.

REFERENCES

1. Sharif, F, Pancake, D., et al, "RH TRU Disposition Alternatives Analysis", presented to the WIPP Corporate Board, 2016.
2. Nelson, R.A., White, D.S., "Shielded Payload Containers Will Enhance the Safety and Efficiency of the DOE's Remote Handled Transuranic Waste Disposal Operations, Waste Management Symposia, February 24-28, 2008, Phoenix, AZ.

U.S. DEPARTMENT OF ENERGY NNSA

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

Sandia National Laboratories