Managing Transuranic Wastes at Sandia National Laboratories/New Mexico — A Small Quantity Site

M.T. Spoerner
Sandia National Laboratories/New Mexico
P.O. Box 5800, Albuquerque, NM 87185
USA

B.J. Humphrey
Weston Solutions, Inc.
6565 Americas Parkway NE, Suite 200, Albuquerque, NM 87110
USA

ABSTRACT

Since 1949, Sandia National Laboratories/New Mexico (SNL/NM) has conducted research and development activities in support of the U.S. Department of Energy's (DOE's) National Nuclear Security Administration (NNSA) and other federal agencies in partnership with universities and industry (1). Several of these projects have generated transuranic (TRU) or suspect TRU wastes. Since the early 1990s the TRU waste has been accepted for storage by the Radioactive Waste/Nuclear Material Disposition Department. The majority of the waste is eligible for disposal at the Waste Isolation Pilot Plant (WIPP), but will require additional management activities to be initiated and completed at SNL/NM before the waste is transported to Los Alamos National Laboratory (LANL) for characterization, certification, and final transport to WIPP. SNL/NM is working with the DOE Carlsbad Field Office (CBFO) to finalize work off plans for this legacy waste.

A joint project between SNL/NM and LANL at SNL/NM will also create newly-generated TRU waste over the next few years. The SNL/NM waste management personnel have been working with the legacy waste project staff to assemble the information required to prepare a TRAMPAC document for shipment of this waste to LANL. By meeting requirements and documenting processes, inputs, and packaging early, SNL/NM hopes to assemble all the necessary information for AK and transportation before the waste is ever generated. This paper will discuss the present and future inventory of TRU waste stored at SNL/NM and the path forward for transport to LANL.

INTRODUCTION

SNL/NM generates and stores TRU or suspect TRU waste. The TRU waste has been generated by several projects throughout SNL/NM and stored at the Radioactive and Mixed Waste Management Facility (RMWMF) or at locations managed by the RMWMF. In addition to the TRU waste generated by SNL/NM, one other former Department of Energy (DOE) small quantity site (SQS), Lovelace Respiratory Research Institute (LRRI), has transferred twenty-nine TRU waste drums to SNL/NM for storage. The majority of this waste is eligible for disposal at the Waste Isolation Pilot Plant (WIPP), but will require additional management activities to be initiated and completed before the waste can be characterized and transported.

For TRU waste to be accepted by and shipped to WIPP for final disposal, a rigorous characterization, certification and transportation program must be implemented by a generator site and the entire program approved by the Carlsbad Field Office (CBFO), the New Mexico Environment Department (NMED), and the Environmental Protection Agency (EPA). The SNL/NM inventory is small in comparison to other

larger TRU waste generator sites [e.g., Los Alamos National Laboratory (LANL), Idaho National Engineering and Environmental Laboratory (INEEL)]; therefore, it is designated as a small quantity site (SQS). Because the implementation of a characterization and certification program requires enormous resources and takes 18 months to 2 years to become certified, the DOE identified that SNL/NM TRU waste would be shipped to LANL for characterization and certification as documented in the *National TRU Waste Management Plan* (2).

LEGACY WASTE INVENTORY

LRRI TRU Waste

The LRRI waste consists of 26 55-gallon drums and three 85-gallon overpacks. This waste is currently packaged compliantly and is ready to ship to LANL when the TRAMPAC is approved and authorization basis documentation is prepared and approved for loading into a TRUPACT-II (3). A paper discussing the closure of LRRI was presented at WM05 (4).

SNL/NM TRU Waste

The current SNL/NM legacy TRU waste inventory consists of seventy-five (75) containers, with a total volume of approximately twenty-two (22) cubic meters (m^3) of debris waste (5). The waste was packaged and placed in storage at the RMWMF from the early 1990s to the present. The containers include 2-, 5-, 10-, 14-, 15-, 20-, 30-, 55-, and 85-gallon drums, 711 and 744 boxes, and a variety of casks. Of the 75 containers, 11 are mixed TRU waste, including mixed TRU sealed sources; 12 are non-mixed sealed sources, 23 are potentially remote-handled (RH) TRU, and the remaining 29 containers are non-mixed TRU.

The physical form of the waste is heterogeneous debris such as filters, plastics, mixed oxides, freezets, metal, paper, solder, silver wires, cobalt pellets, cardboard, towels, swipes, glass, herculite, emptied gas bottles, glovebox waste, personal protective equipment (PPE), respirator cartridges, sources, and decontamination debris.

All of the current SNL/NM legacy TRU waste must be repackaged before shipment to LANL. The RMWMF is the location where the repackaging is proposed to take place. The RMWMF is a radiological facility, whereas a Hazard Category 3 nuclear facility is required for some of the waste repackaging and all TRUPACT-II loading. Seventeen of the 75 payload containers exceed the sub Hazard Category 3 limit.

Non-Mixed TRU

There are 29 containers of non-mixed TRU waste. This waste is eligible for transport to LANL for final characterization, certification, and disposal at WIPP. All of these containers need repackaging and four exceed the subcategory 3 limit and cannot be repackaged at the RMWMF.

Table I. General Properties of the Non-Mixed TRU Waste

Property	Range
Packaging dates	1996 through 2003
Container types	5-gallon to 744 boxes
Physical form	Solids only
Matrices	Glovebox waste, metals, freezets, bottles, plastic, paper, mixed oxide, aluminum and steel parts, platinum wires, cobalt pellets, tape, swipes, towels, pipettes, sheeting, PPE.
Radionuclides	Am-241, Cs-137, Pu-238, Pu-239, Pu-241, Th-234, U-234, U-235, U-236, U-238, Cm-242, Cm-243, Eu-154, Eu-155, Sr-90, Np-237
Hazardous waste numbers	None

Mixed TRU

Eleven containers are mixed TRU waste and at the present time, LANL cannot accept this waste. Although they can accept non-mixed TRU from SNL/NM, their NMED permit does not allow the transfer of mixed TRU to Area G. A permit modification is currently in process to allow LANL to accept this waste in the future.

The Resource Conservation Recovery Act (RCRA) hazardous waste numbers include silver (D011), lead (D008), and one container assigned flammable (D001) and reactive (D003) codes for an americium/lithium hydride source. None of the mixed containers exceed the subcategory 3 limit, but do need repackaging. Table II lists the general descriptions of the mixed CH TRU waste.

Table II. General Properties of the Mixed TRU Waste

Property	Range
Packaging dates	1997 through 2003
Physical form	Solids only
Matrices	Sources, filters, paper, plastic, bottles, wires, solder, foils
Radionuclides	Am-241, Co-60, Cs-134, Cs-137, Eu-154, Eu-155, Pu-238, Pu-239, Pu-240, Sr-90, Th-234, U-233, U-234, U-235, U-238, Y-90, Zr-95
Hazardous waste numbers	D001, D003, D008, D011

Sources

Twelve containers contain non-mixed sources. SNL/NM has consulted with the LANL Off-Site Recovery (OSR) program and determined the sources are above the threshold and meet the OSR criteria. Most of these sources are registered with known tracking numbers. When these containers are examined, some of the sources may not qualify as TRU and can be segregated. All of these waste containers must be repackaged and three of these containers exceed the subcategory 3 limit and cannot be repackaged at the RMWMF. Table III lists the general properties of the TRU sources.

Table III. General Properties of the TRU Sources

Property	Range
Packaging dates	1999 through 2004
Physical form	Solids
Matrices	Sources
Radionuclides	AmBe neutron source, PuF, Am-241 alpha source, Cd-109, gamma standards, Co-60, mixed gamma source
Hazardous waste numbers	None

Potential Remote Handled

Twenty three containers are classified as potentially RH. The waste is packaged in a variety of casks (e.g., queencasks, pacocasks, or kingcasks) or in drums lined with concrete or lead. All of these containers require repackaging and fourteen of them exceed the subcategory 3 limit at the RMWMF. Table IV lists the properties of the RH waste.

Table IV. General Properties of the RH Waste

Property	Range
Packaging dates	1998 through 2004
Physical form	Solids
Matrices	Waste from hot cell facility, ion chromatography waste,
Radionuclides	Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Th-234, U-234, U-235, U-236, U-238, Cm-242, Cm-243, Eu-154, Eu-155, Sr-90, Np-237, Pm-147
Hazardous waste numbers	None

Other work that needs to be completed includes preparation of defense determinations and acceptable knowledge (AK) documentation, preparation and approval of a TRU Waste Authorized Methods for Payload Control (TRAMPAC), and establishment of an approved shipping route.
The major hurdle to completing this work in a timely manner is the Radioactive and Mixed Waste Management Facility (RMWMF), the location where the waste repackaging and TRUPACT-II loading is proposed to take place. The RMWMF is a radiological facility, whereas a Hazard Category 3 nuclear facility will be required for some of the waste repackaging and the majority of the shipment loading. These activities will require that the RMWMF be upgraded to a temporary Category 3 nuclear facility using a general BIO.

WORK OFF PLANS

The CBFO coordinated with site program execution plans, management plans and regulatory requirements to create site-specific work-off plans for each TRU waste site (6). Items to be addressed in the work-off plans included defense determinations, inventory, acceptable knowledge, issues, drivers, options, actions, and schedule. The goals of the work-off plans were to:

- keep the pipeline full,
- close SQSs,
- support the integrated baseline,
- reduce costs by increasing efficiencies, and

- manage the TRU waste using this corporate approach.

These site-specific work-off plans were to be integrated into a TRU complex wide plan where

- budgets and schedules would be coordinated to maximize resource and transportation utilization;
- waste streams would be identified and prioritized to efficiently feed characterization/certification;
- a backlog of certified waste would be developed to continuously fill the pipeline; and
- issues would be identified early.

CBFO identified information that is needed to develop the work off plans. The first issue is the status of the defense determination. TRU waste cannot be disposed of at WIPP unless it has been generated from defense activities or irretrievably commingled with waste from defense activities. The Land Withdrawal Act provides a list of activities that qualify as defense activities. Other WIPP activities should not proceed unless the waste will qualify as defense. Secondly, an AK summary report is required before WIPP characterization begins.

A description of the waste, containers, volumes (current and projected), and chemical and radiological data is required. This information is used to determine a path forward such as does the waste need to be transported to another site for characterization, are more resources needed, does the waste need to be repackaged, how many waste streams are involved, does the site have screening capabilities, and did the waste come from another site. All of this information is included in the AK summary report. Pre-1970 volumes need to be identified as they are not considered to be retrievably stored.

Regulatory or site drivers need to be identified and options discussed to meet these drivers. Loading of a TRUPACT-II and finalizing the authorization basis are particularly problematic at SQS, which typically do not have that capability. Finally, working with the sites to define the actions and schedules are crucial to ensure success.

SNL/NM Site-Specific Work-Off Plan

In early 2005, WIPP personnel met with SNL/NM waste management staff to discuss the SNL/NM legacy TRU inventory, packaging configurations, CH and RH designations, sources, RCRA issues, and a proposed plan forward. There are no regulatory drivers, however, the State of New Mexico would like the waste disposed of in a timely manner. Discussions included the LRRI waste which is packaged to meet the TRUPACT-II requirements, and the SNL/NM waste that needs repackaging. Based on the SNL/NM inventory discussed above, several issues were identified (6).

1. Funding for the repackaging of the TRU waste has not been included in the SNL/NM baseline. Funding is based on NNSA priorities as established by the Sandia Site Office (SSO).
2. For FY06, SSO priority is the packaging and disposal of Special Nuclear Material (SNM) in order to decrease the funding needed for security of the SNM.
3. The LANL Part B Permit allowing mixed TRU waste from SNL/NM to be transferred needs approval.
4. The authorization basis documentation for the mobile loading unit needs preparation and approval.

PATH FORWARD

Based on the discussions between CBFO and the SNL/NM waste management personnel, several items were identified for the TRU waste to move forward toward shipment to LANL and final characterization, certification, and disposal. Defense determinations are needed for both the SNL/NM and the LRRI waste streams. Three potential waste streams were listed: LRRI (CH-heterogeneous debris), SNL/NM (CH-heterogeneous debris), and SNL/NM (RH-heterogeneous debris). The AK Summary Report for the LRRI is in preliminary draft form, but not completed. A TRAMPAC document for the LRRI is near completion. The AK Summary Report for the SNL/NM CH and RH TRU has not yet been started.

Based on the items discussed above, the following actions were drafted and presented to SNL/NM and CBFO.

Actions

- CBFO, LASO and SSO were to establish priority
- LASO was to direct LANL to finalize Part B Permit by end of FY06.
- Prepare defense determinations
- Prepare preliminary AK and TRAMPAC for SNL/NM and LRRI
- Repackage 90% of the waste
- Ship repackaged waste to LANL for characterization using CCP line
- CBFO, LASO and SSO establish priority for hot cell upgrade
- SNL/NM process remaining RH and high activity CH waste for shipment to LANL
- Ship remaining waste to LANL.

A schedule has been presented to SNL/NM by CBFO, however SNL/NM knows of no further action taken.

At the time this paper was prepared, the priority formerly established by SSO to repackage and dispose of the SNM (non-TRU) waste was still in effect.

NEWLY-GENERATED TRU WASTE AT SNL/NM

SNL/NM and LANL are conducting a joint experiment that will generate newly-generated TRU waste at SNL/NM. LANL is supplying the targets and SNL/NM is conducting the material testing experiments using the Z machine at SNL/NM. It is the largest z pinch driver in the world today.
The wastes to be generated are containment vessels, specifically designed to fit into a 55-gallon drum, and after loading the Pu target and detonating the material, are not opened again.

In order to meet the needs of the SNL/NM storage and WIPP requirements, meetings were held between the Z pinch group and waste management staff at SNL/NM and LANL to discuss the project, the potential waste to be generated, and the characteristics of the waste. The Z pinch group assembled a "picture" of the containment vessel make-up to define the constituents (7). Included were the ferrous, non-ferrous, plastic, rubber, glass, and other material types of the vessel, the radiological and chemical constituents of the vessel and target, weights, volumes, and descriptions of the experiment.

There are three components to the vessel: the ultra-fast closure valve (UCV), the upper containment chamber (UCC), and the load assembly. Fig. 1 illustrates the UCV, Fig. 2 is the UCC, and Fig. 3 depicts the load assembly. The design groups involved in supplying components were Ktech and Bechtel/Nevada and they were asked to submit material breakdowns for their respective parts.

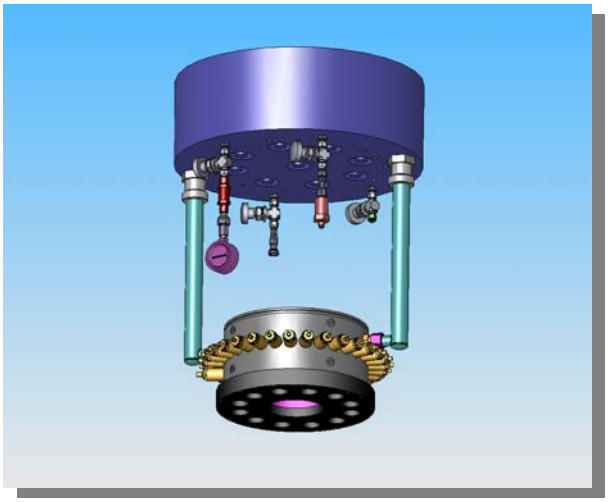

Fig. 1. Ultra fast closure valve

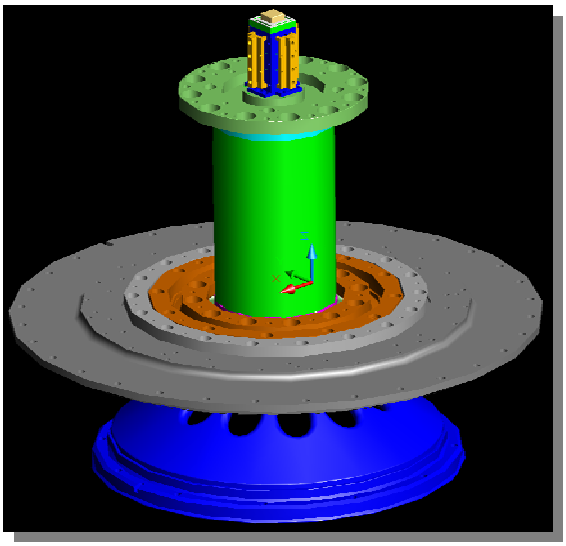

Fig. 2. Upper containment chamber

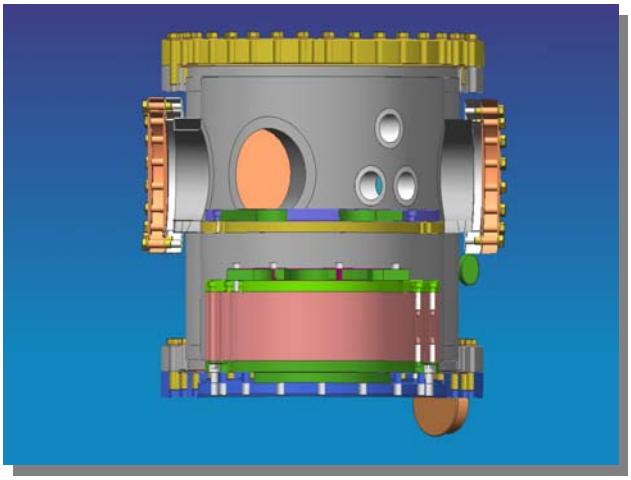

Fig. 3. Load assembly

A used containment vessel from a successful shot (not TRU) was weighed and consisted of the UCV, the UCC, and the load hardware. A complete vent chamber was weighed separately and the total weight of the complete unit was 399.2 kg. By adding the weight of the 55-gallon drum, the total weight was 427 kg, which was 2 kg over the weight limit for SNL/NM storage. To solve that problem, some of the extraneous hardware will be removed after the experiment is complete and before packaging to reduce the weight to within acceptable limits.

The material parameters were also calculated and resulted in 98.17% ferrous metals, 1.45% non-ferrous metals, 0.12% plastic, and 0.26% other (including epoxy, rubber, glass, vacuum grease, carbon, and PZT). A component of the non-ferrous category is lead. Lead is considered to be found in solder, brass, and PZT sensors. Calculations resulted in 0.038 pounds of lead in 1.39 pounds of solder, brass and PZT combined. In relation to the total mass of the containment vessel, this represents 4.3E-5% of the total mass. Therefore this is non mixed waste.

An explosive, Primasheet 1000, is used in the experiment. This is a flexible explosive material that meets specification MIL-E-46676 (military specification) and consists of pentaerythritol tetranitrate (PETN) (63%), acetal tributylcitrate (28%), nitrocellulose (8%), and dye (1%). Concerns regarding whether the explosive is completely consumed, the constituents of the explosive gas by-products, and documentation that the UCV functioned properly were discussed with the Z pinch staff.

The Z pinch staff provided documentation stating what the indicators were to demonstrate the UCV has functioned properly. These indicators will be checked after each experiment. The Z ICE UCV contains two sets of 15 detonators. A series of reverse initiation tests were conducted to confirm that if only one of the detonators were initiated, the HE in the other detonators would be consumed. Several configurations were tested and in all cases the HE was consumed. The UCV explosive gas composition and the number of moles of gas from 90 grams of HE was calculated and are as follows: 2.14 moles of water (H_2O), 0.06 moles of hydrogen (H_2), 2.93 moles of carbon (C), and 0.43 moles of nitrogen (N_2). Less than 1% of NO_x are formed. Because H_2 is formed, the tank may be purged with N_2 before placement in a drum.

The targets consist of new and old Pu-239 (weapons grade). Each experiment will contain different amounts of material, however all will be SNM. The targets will be manufactured at LANL and shipped to SNL/NM in a 6M, 2R Type B container. LANL will include a certified isotopic distribution with each target. After the experiment is complete, the entire chamber is placed in a 55-gallon drum, and stored at SNL/NM until shipment to LANL in a TRUPACT-II. Currently, three experiments are scheduled for FY06; then the Z-pinch is scheduled for refurbishing. More experiments are scheduled after the refurbishing is complete with a total number envisioned to be up to 20 experiments.

As discussed above, the Z pinch staff is working regularly with the SNL/NM and LANL/Central Characterization Project (CCP) waste management personnel to ensure that the newly generated TRU waste will meet the requirements for SNL/NM storage and WIPP requirements.

CONCLUSIONS

The differences between the legacy waste and the newly generated waste are striking. The more information that is assembled, reviewed, evaluated against requirements, and updated, the less problematic the resolutions become. It is understood that much of the legacy waste was generated and packaged before SNL/NM waste management was involved with the WIPP TRU program and have not been funded to prioritize the TRU waste. However, this comparison certainly demonstrates that it saves time and resources if communication and cooperation occurs very early in the project.

REFERENCES

1. SNL, (2005), *Mission Areas*, Sandia National Laboratories, New Mexico http://www.sandia.gov/mission/index.html

2. DOE (2002), *National TRU Waste Management Plan*, DOE/NTP-96-1204, Revision 3, U.S. Department of Energy, Carlsbad Field Office, July 2002.

3. SNL/NM (2005), *Waste Specific Data Package CH TRAMPAC for Sandia National Laboratories/New Mexico*, Draft, Revision A, November, 2005, Sandia National Laboratories, Albuquerque, New Mexico.

4. Humphrey, B., Muller, D., Spoerner, M., Baker, D., *"The Road To Closure,"*, presented at Waste Management Conference, February 2005, Tucson, Arizona

5. SNL/NM (2005) *Report on the Status of SNL/NM TRU Waste Stored at the Radioactive and Mixed Waste Management Facilities*, Draft, Revision A, April 2005, Sandia National Laboratories, Albuquerque, New Mexico.

6. Moody, D. and Burns, T., *Work Off Plans*, presented at the National TRU Waste Corporate Board Meeting, May 17-18, 2005.

7. Memo from Jeff Gluth to Mike Spoerner and Chris Deeney, *Containment Vessel Weight Analysis and Acceptable Knowledge Document*, September 13, 2005.