REMAINING CHALLENGES AFTER 2000 TRUPACT-II SHIPMENTS OF CH-TRU WASTE

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ABSTRACT

Since March 1999, the Waste Isolation Pilot Plant (WIPP), located in southeastern New Mexico, has been operated by the U.S. Department of Energy (DOE) for the permanent disposal of defense-related transuranic (TRU) waste. Approximately 2,300 shipments of contact-handled (CH) TRU waste for WIPP disposal have been completed in the TRUPACT-II packaging. The WIPP transportation program has attained steady-state with respect to the regular receipt of shipments, with over 15 shipments arriving at WIPP each week from DOE sites around the nation. This consistent shipment operation is due, in part, to amendments to the governing documents for the TRUPACT-II payload that track shipment needs identified by DOE sites. Following approval by the U.S. Nuclear Regulatory Commission (NRC), these amendments have been implemented by DOE sites to increase the efficiency of the off-site shipment of waste. To achieve the current shipment schedule, approximately 19 amendments to the TRUPACT-II Safety Analysis Report (SAR) and the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC), the document defining TRUPACT-II authorized contents, were completed. With the NRC approval of these amendments, the majority of general issues restricting shipments have been addressed.

It is becoming increasingly evident that the remaining challenges to the shipment of the DOE CH-TRU waste inventory are related to very specific issues that are, in most cases, unique to specific waste populations or sites. Consequently, the remaining transportation initiatives for the TRUPACT-II payload and other packaging development must adopt a focused approach to addressing these distinct issues with case-by-case analyses. For example, the recent Revision 19c amendment to the TRUPACT-II SAR addressed the shipment of a specific population of waste from the Hanford site that included heat-sealed plastic bags as part of the packaging configuration. The NRC approval of the application for Revision 19c provides a path forward for the shipment of these wastes without the need for repackaging. This paper will discuss recent and ongoing transportation initiatives that use this narrowed focus to resolve residual constraints to the efficient shipment of CH-TRU waste to WIPP.

INTRODUCTION AND BACKGROUND

The WIPP, located in southeastern New Mexico, is the first operational geologic repository for the permanent disposal of TRU wastes generated from weapons production and other defense related activities in the United States. Since its opening in March 1999, the WIPP has received over 2,300 shipments from several DOE sites across the nation. The transportation system for WIPP consists of a fleet of Type B packagings, certified by the NRC under the regulations of Title 10, Code of Federal Regulations (CFR), Part 71 (10 CFR 71) [1]. These packagings include the TRUPACT-II and the HalfPACT for the shipment of CH-TRU wastes and the 72-B Cask and the 10-160B cask for the shipment of remote-handled (RH) TRU wastes. The TRUPACT-III packaging, for the shipment of oversized boxes, is currently under development, and an application is expected to be submitted to the NRC for certification in the near future. The WIPP transportation fleet is depicted in Fig. 1.

Fig. 1 WIPP transportation fleet

Since the certification of the TRUPACT-II packaging in 1989, the WIPP transportation program has been focused on increasing the shippable fraction of TRU waste, by means of amendments to the TRUPACT-II SAR [2] and the development of new packagings and payload containers. The primary drivers for the various packaging SAR amendments and the new packagings have been the following payload (waste) properties:

- Weight – Development of the HalfPACT packaging addressed the shipment of heavier payloads.
- Size – Development of the TRUPACT-III packaging will address the shipment of oversized boxes.
- Fissile Mass – Development of the pipe components and SAR amendments authorizing the use of the pipe components addressed the needed increases in payload fissile mass limits.
- Wattage – SAR amendments addressed payload limitations based on wattage by increasing the wattage limits and providing alternate methods for the evaluation of compliance with flammable gas generation limits.
- Dose rate – Development of the 72-B Cask and authorization of the 10-160B Cask for the shipment of TRU waste addressed the shipment of RH-TRU wastes.

A summary of recently completed packaging and payload initiatives and the key issues addressed by these initiatives is provided in Table I.

Table I Summary of key initiatives for TRU waste transportation

Initiative	Status	Application	Benefit
HalfPACT SAR	Approved	New CH-TRU waste packaging approved for general use in 1998	Shipment of payload containers with increased average weights of ~1,000 pounds. Increased efficiency for shipment of heavier payloads.
72-B Cask SAR	Approved	New RH-TRU waste packaging approved for general use in 2000	Baseline for shipment of RH-TRU waste (payload consists of 3 drums in 1 canister)
10-160B Cask SAR	Approved	Existing commercial cask approved for shipment of CH- and RH-TRU waste in 2001	Alternative to 72-B Cask shipment of drums without need to canisterize (payload consists of 10 drums)
TRUPACT-III SAR	Under preparation for submittal to NRC	New CH-TRU waste packaging proposed for the shipment of oversized boxes	Shipment of large boxes without need for repackaging into smaller containers
TRUPACT-II SAR, Revision 19a	Approved	Payload expansion initiative approved in 2002 to address shipment of 2,000 high-wattage payload containers from Los Alamos National Laboratory	Shipment of high-wattage waste without need for repackaging. Accelerated clean-up of site.
TRUPACT-II SAR, Revision 19c	Approved	Payload expansion initiative approved in 2003 to address shipment of several thousand drums from Hanford	Shipment of waste without need for opening/slashing heat-sealed bag layers and repackaging.
TRUPACT-II SAR, Revision 20 HalfPACT SAR, Revision 3	Under NRC review	Payload expansion initiatives proposed for general use. Initiatives include use of statistical sampling for Waste Type IV, higher total gas generation rate limits for Waste Type IV, shorter shipping periods, and shielded pipe component payload containers.	Proposes shipment of waste under less restrictive conditions without need for extensive testing. Proposes use of new containers to address unique waste forms (e.g., sealed sources).

REMAINING CHALLENGES FOR TRU WASTE TRANSPORTATION

The TRU waste transportation program has achieved steady-state over the past two years with over 15 TRUPACT-II shipments per week to WIPP from several DOE sites. In addition, TRU waste shipments have been accomplished between sites for the purposes of interim storage and completion of disposal characterization activities. Three RH-TRU waste shipments were completed in the 10-160B Cask from Battelle Columbus Laboratories and the Energy Technology Engineering Center (ETEC) to Hanford for interim storage pending WIPP authorization to receive RH-TRU waste for disposal. One TRUPACT-II shipment of CH-TRU Waste Type IV (solidified organics) was completed from Rocky Flats Environmental Technology Site (RFETS) to Argonne National Laboratory-West (ANL-W) for solids sampling (coring) required for WIPP disposal. The TRU waste transportation program has

demonstrated success in the maintenance of routine CH-TRU waste shipments to WIPP, capability to relocate RH-TRU waste between sites, and in facilitating the first shipments of Waste Type IV, which are associated with an increased level of analysis and/or testing for ensuring safe shipment.

The shipment of TRU waste of forms and properties common to several sites has been accomplished efficiently to date. In addition, it is becoming increasingly evident that the remaining challenges to the shipment of the DOE CH-TRU waste inventory are related to very specific issues that are, in most cases, unique to specific waste populations or sites. Consequently, the remaining transportation initiatives for the TRUPACT-II payload and other packaging development must adopt a focused approach to addressing these distinct issues with case-by-case analyses. Specific recent examples of this case-by-case regulatory analysis are as follows:

Revision 19a of the TRUPACT-II SAR

Revision 19a was developed in response to a specific need at the Los Alamos National Laboratory (LANL) to address safety issues associated with storing high-wattage waste in dispersible form in above-ground facilities in light of security related threats as well as natural disasters like fire. An application to the NRC was developed to allow shipment of these high wattage wastes under a specific set of conditions, as follows:

- Evacuation of the loaded TRUPACT-II and backfilling with an inert gas to reduce the initial concentration of hydrogen, and

- Completion of the shipment in a period of less than 5 days to prevent accumulation of hydrogen.

The shipment of this waste under this specific set of controlled conditions allowed increases in decay heat limits by a large factor compared to normal shipments. The use of this methodology for approximately 2,000 drums of high-wattage waste at LANL was approved by the NRC, and shipments from LANL have been made under Revision 19a. The successful development and implementation of Revision 19a eliminated the need to repackage the waste to meet current limits under the general case.

Revision 19c of the TRUPACT-II SAR

This amendment was developed to address the shipment of several thousand drums of waste from the Hanford site that were packaged with a heat-sealed bag layer in addition to other twist-and-tape bag layers. The presence of a heat-sealed bag layer was prohibited by the TRUPACT-II SAR under Revision 19. An analysis of the waste inventory showed that a significant portion of the waste was loaded at very low levels (i.e., the radioactive material present in each drum was low), and the hydrogen release rate from the heat-sealed bag layer could be conservatively estimated to establish decay heat limits. An application to address this specific population of waste with appropriate limits was developed and submitted to the NRC as Revision 19c [3]. Revision 19c, allowing the use of a heat-sealed bag layer, was approved by the NRC in July 2003 and facilitates the shipment of several thousand drums of waste from Hanford without the need to slash bags and repackage the waste.

Path Forward for Near-Term Amendments

Revisions 19a and 19c are examples of regulatory amendments that fall within the safety envelope required by the regulations and allow relief in terms of the conditions under which a specific population of waste can be shipped. Within the regulatory safety envelope, the packaging safety analysis defines boundary conditions, some of which are expected to remain constant in the near future, as follows:

- The TRUPACT-II has a design wattage limit of 40 watts, based on the thermal analysis presented in the SAR. Payload expansion is expected to occur within this 40-watt limit.

- The payload weight limits [e.g., 453.6 kilograms (1,000 pounds) per drum] are expected to remain constant based on the structural analysis presented in the SAR. Payload expansion is expected to occur within the weight limits and is addressed by the HalfPACT packaging.

- The TRUPACT-II dose rate limits [e.g., 2 x 10^{-3} sievert (200 millirem) per hour on the surface of the container] are expected to remain constant based on the shielding analysis presented in the SAR. Payload expansion beyond these dose rate limits is achieved by the design of new payload containers like the pipe components and by the RH-TRU waste packagings (i.e., 72-B Cask and 10-160B Cask).

Within these boundary conditions, revisions to address future challenges will be in terms of site needs. Program drivers expected to dictate packaging needs in the future are as follows:

1. ***Relief for Package Criticality Limits*** – The current criticality limits for shipment of drums in a TRUPACT-II are 200 grams (g) fissile gram equivalent (FGE) per drum and 325 g FGE per TRUPACT-II, effectively limiting the average FGE in a payload of 14 drums to 23 g FGE per drum. Some of the newly generated waste forms, which are loaded to the payload container decay heat limits for operational efficiencies, would benefit from an increase to the package FGE limit to allow more efficient shipments. Potential pathways to achieve this increase include design of a more robust drum (which ensures payload container integrity and waste retention in accident conditions) and credit for the composition of the waste (e.g., cemented waste forms can be shown to retain the radionuclide material even under accident conditions based on chemical and thermodynamic considerations that show that the radionuclides cannot be easily leached from the cement).

2. ***Clean-up Milestones at Small Quantity Sites*** – Several of the small quantity sites with TRU wastes may require specific applications to allow waste consolidation at a larger site without the need for extensive characterization and remediation, facilities for which are not available at these sites. Very specific safety analyses can be developed for these sites to facilitate safe transportation under conditions and limits (not necessarily the same as the general case in the TRAMPAC) that are strictly controlled while these limited shipments are made.

3. ***Shipments of Waste Type IV from RFETS and the Idaho National Engineering and Environmental Laboratory (INEEL)*** – The Waste Type IV inventory (solidified organics), primarily present at RFETS and INEEL, currently requires shipment under very restrictive conditions as the G-value has not been quantified to determine hydrogen and total gas generation rates. Recent testing has demonstrated the need for more realistic assumptions with respect to total gas and closer data analysis with respect to hydrogen, including an allowance for statistical sampling. In an effort to use more realistic assumptions, the application for Revision 20 of the TRUPACT-II SAR proposes the performance of the pressure analysis for a maximum of 60 days, which is consistent with the maximum shipment time of 60 days. The first shipment of this waste type was recently made from RFETS and shows that this challenge can be overcome.

4. ***Shipment of High-Loaded Pu-238 Wastes***: In addition to the high-loaded wastes at LANL that are shippable under Revision 19a, Pu-238 wastes at the Savannah River Site and LANL are currently not shippable due to the high decay heat in the containers and the potential for hydrogen gas generation. While measurement and testing are current options for the shipment of these wastes (i.e., if it can be shown that hydrogen gas generation in the containers is minimal, they can

be shipped irrespective of the decay heat in the container), an option similar to that provided under Revision 19a would facilitate the safe shipment of these wastes under less restrictive conditions. A future TRUPACT-II SAR amendment could be prepared to address this initiative.

5. ***RH-TRU Waste Shipments*** – No RH-TRU waste shipments have been made to WIPP due to the fact that the U.S. Environmental Protection Agency certification and a permit modification from the State of New Mexico are yet to be approved. RH-TRU waste shipments have been made in the 10-160B Cask from Battelle and ETEC (two small quantity sites) to Hanford. As WIPP gets ready to receive RH-TRU waste, the challenges will be in matching the requirements with the RH-TRU inventory, incorporating applicable initiatives that have been completed for CH-TRU waste, and ensuring future waste generation and packaging such that minimal post-packaging characterization is needed.

6. ***Large Box Inventory Shipments*** –The TRUPACT-III packaging is currently being designed for the shipment of the large box inventory. The TRUPACT-III packaging provides a safe alternative for the shipment of oversized boxes without the need for repackaging and size reduction necessary for shipment in currently licensed packagings. The certification of the TRUPACT-III will initiate the process for determining the path-forward for the shipment of these boxes and the need for any future modifications to the TRUPACT-III SAR.

CONCLUSIONS

With a fleet of approximately 100 Type B packagings, the WIPP transportation system has functioned smoothly in terms of meeting the shipments needs of the TRU waste program, with more than 2,300 shipments made to date. The remaining challenges in the TRU waste transportation program include specific, small populations of unique wastes at the sites (including the small quantity sites), the solidified organic waste inventory, the RH-TRU waste, and the large box inventory. These challenges are being met and a continued path forward is shown by an active SAR amendment process, as well as by the design and use of new packagings and payload containers.

REFERENCES

1 NRC, "Packaging and Transportation of Radioactive Material," 10 CFR 71, U.S. Nuclear Regulatory Commission (2003).

2 DOE, "Safety Analysis Report for the TRUPACT-II Shipping Package," Rev. 19c, U.S. Department of Energy, Carlsbad Field Office (2003).

3 DOE, "TRUPACT-II Authorized Methods for Payload Control (TRAMPAC)," Rev. 19c, U.S. Department of Energy, Carlsbad Field Office (2003).