The Advanced Mixed Waste Treatment Project: Optimizing use of This National Asset to Treat Challenging Radioactive Waste From Other Department of Energy Sites – 16064

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ABSTRACT

The U.S. Department of Energy's (DOE) Advanced Mixed Waste Treatment Project (AMWTP) is a world-class radioactive waste treatment facility with a highly experienced and innovative workforce located at the Idaho National Laboratory (INL). The AMWTP's state-of-the-art capabilities include a 62-ton supercompactor, remote cutting and sorting, macroencapsulation systems, assay units, drum repackaging, waste characterization, and payload assembly and loading. Since operations began in 2003, the facility has been the largest shipper for contact-handled (CH) transuranic (TRU) waste to the Waste Isolation Pilot Plant (WIPP). It has successfully processed over 56,000 cubic meters (m^3) of CH TRU waste and mixed low-level waste (MLLW) from the Idaho Site and approximately 700 m^3 of CH TRU waste from 15 other DOE sites. While the AMWTP is nearing successful completion of its Idaho mission, other DOE environmental cleanup sites will require safe and proven capabilities to treat, package, characterize, and certify legacy radioactive waste inventories well into the next decade. In addition, DOE's national security, nuclear energy, and science programs need sustainable treatment capabilities to support ongoing and new missions. The AMWTP could continue to serve a vital role beyond its current Idaho mission to help address these larger DOE needs. To this end and in recognition that AMWTP's current priority is to complete the processing and removal of Idaho waste, DOE's Office of Environmental Management has initiated strategic planning to assess the feasibility of continued AMWTP operations to treat challenging radioactive waste from other generator sites consistent with existing regulatory agreements. This paper describes AMWTP's unique capabilities and identifies potential benefits, opportunities, and possible solutions to packaging and transportation challenges to fully use AMWTP as a national asset. A panel discussion of subject matter experts with audience participation would help to inform DOE's strategic planning on how best to use this national asset into the future.

INTRODUCTION

The AMWTP, located at the INL Radioactive Waste Management Complex (see Fig. 1), is focused on completing the processing and certification of approximately 65,000 m^3 of stored Idaho CH legacy TRU waste and MLLW by December 31, 2018, to meet regulatory commitments. Because this mission is nearing completion, DOE needs to determine whether to continue to operate AMWTP to treat challenging radioactive waste from other DOE sites beyond the completion of its Idaho mission.

To inform this important decision, DOE's Office of Environmental Management is identifying and assessing potential benefits, opportunities, and challenges for optimal use of AMWTP as a national asset.

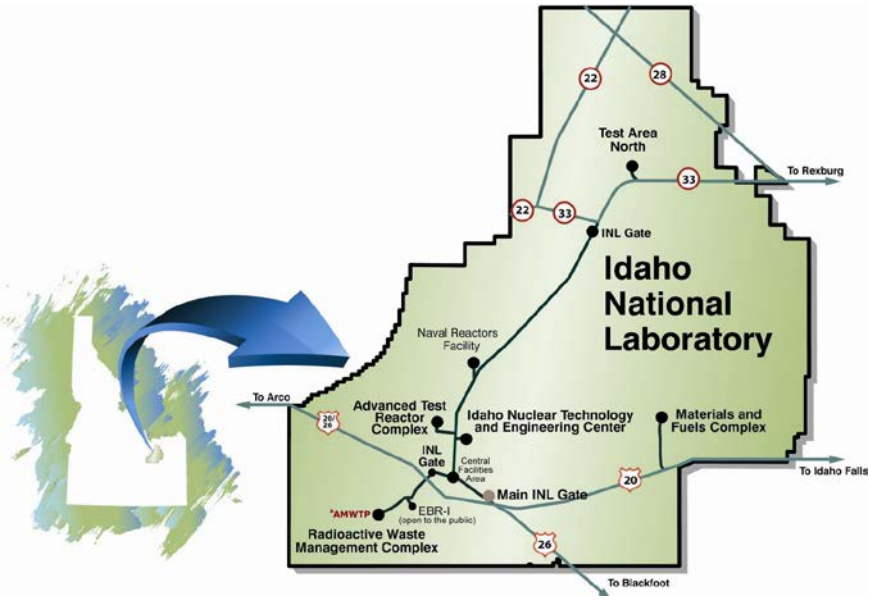

Fig. 1. AMWTP location at the INL

DISCUSSION

AMWTP's Unique Capabilities

The AMWTP is a one-of-the-kind facility capable of processing much of the CH TRU waste in the DOE complex (see Fig. 2) [1, 2]. The AMWTP's unique capabilities include:

- Only facility in the DOE complex that has accepted, validated, and treated CH TRU waste from other DOE sites, having processed approximately 700 m^3 of waste from 15 other DOE sites for permanent disposal at WIPP.
- Largest historical shipper of CH TRU waste to WIPP resulting in mature and proven waste characterization, packaging, and certification capabilities.
- Only supercompactor in the DOE complex, which decreases the volume requiring disposal by a factor of four to one, significantly reducing transportation and disposal costs and preserving valuable space at WIPP for other priority disposal needs.
- Permitted to receive and process wastes that present significant challenges for most DOE TRU waste generator sites, such as waste with high fissile gram equivalent content.
- Able to repackage oversized boxes and other atypical packages that present operational challenges for other DOE sites.

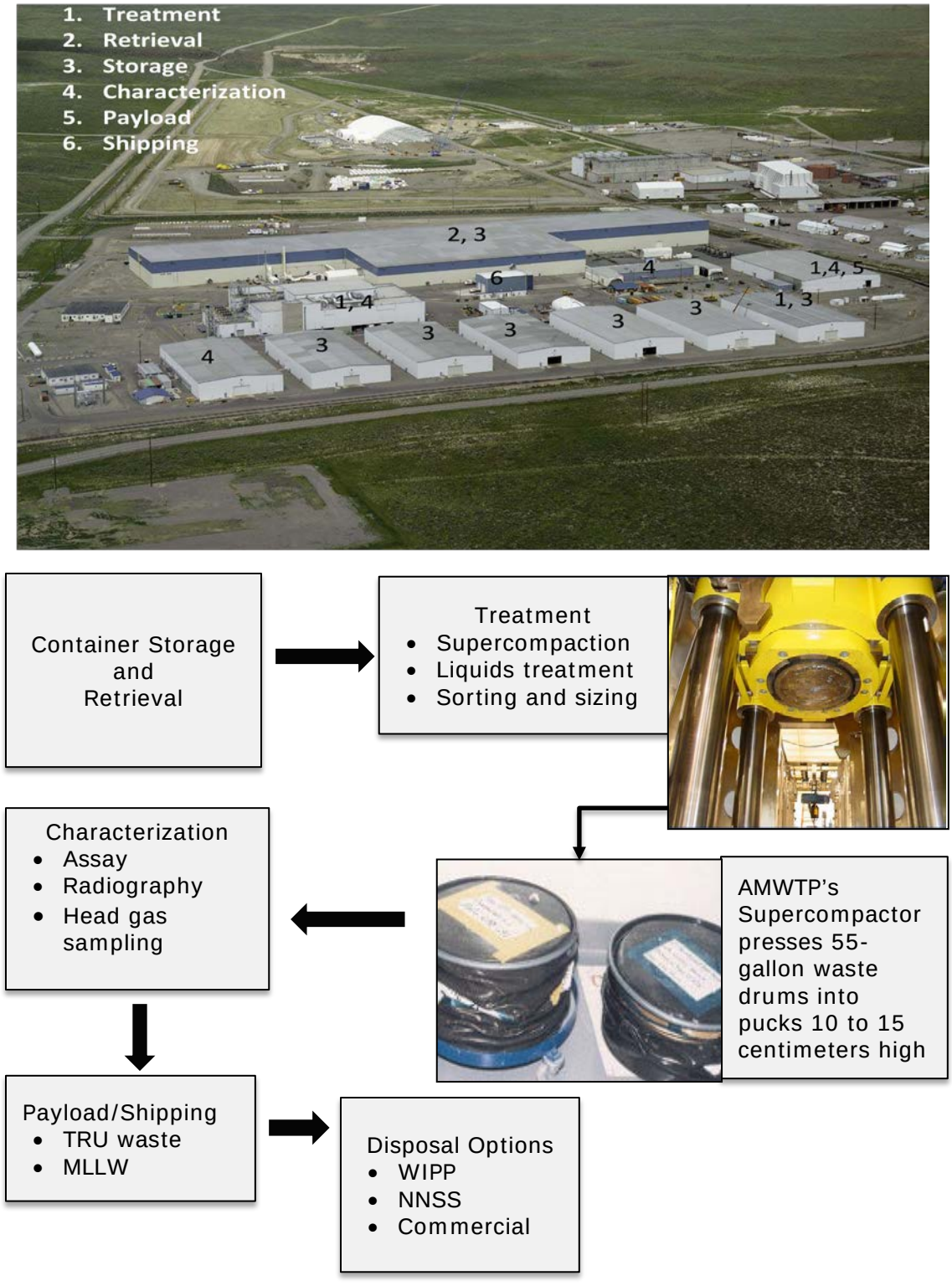

Fig. 2. AMWTP Facility Layout and Process Diagram

- High throughput capability (3,000 m^3 of waste per year) using automated processes and remotely-operated equipment that minimize manual handling of radioactive waste thereby reducing the potential for radiological exposure; specialized equipment includes box lines, Brokk manipulators, and a large band saw for sorting, segregating, and resizing waste for compaction.
- Highly skilled and innovative work force that strives for continuous improvement in worker safety and operational efficiency, as exemplified by onsite development of macroencapsulation technologies that enable direct shipment of MLLW to offsite disposal facilities without further treatment, saving tax payers millions of dollars [3].
- Only permanent facility that can certify TRU waste for disposal at WIPP.

The DOE completed the construction of AMWTP in 2002 at a total cost of approximately $565 million. The facility is located within the 22 hectares that make up the Transuranic Storage Area within the Radioactive Waste Management Complex and all operations take place within this area. It is comprised of approximately 70 buildings (totaling 57,414 square meters) and structures housing waste storage areas, characterization and certification equipment, CH TRU waste and MLLW treatment systems, shipping and receiving, infrastructure, and administrative services. It is a hazard category 2 nuclear facility. Approximately 600 employees support AMWTP operations, which include waste handlers, operators, engineers, technicians, guards, supervisors, administrators, and a variety of other specialists.

AMWTP'S Successful History in Processing Offsite Waste

The AMWTP has successfully treated and/or certified CH TRU waste from 15 other DOE sites. These campaigns met the requirements of the Idaho Settlement Agreement, which requires offsite waste processed at AMWTP to be treated within 6 months of receipt and shipped out of Idaho within 6 months of treatment [4]. Treatment of offsite waste at AMWTP is also consistent with a 2008 DOE Record of Decision to send offsite TRU waste to AMWTP for treatment and characterization [5]. To date, the Hanford Site and the Los Alamos National Laboratory (LANL) have shipped the most CH TRU waste to AMWTP for treatment.

For example, LANL shipped ten corrugated metal boxes to AMWTP in individual 10-160-B casks during November 2013-April 2014 (see Fig. 3). The wastes were sent to AMWTP because they had a high fissile gram equivalent content and LANL lacked adequate capability to process these boxes to meet aggressive regulatory compliance schedules. The AMWTP sorted, segregated, and compacted the boxes into 35 379-liter drums. The successful effort could serve as a blueprint for future shipments to AMWTP because it involved safe alternative transportation approaches in close coordination with stakeholders.

The Hanford Site sent 77 shipments, totaling 923 322-liter drums of CH TRU debris to AMWTP in Transuranic Package Transporter Model 2 (TRUPACT-II) transportation containers during 2010-2011 to accelerate its TRU program and achieve progress against compliance milestones. After compaction and certification, the waste left AMWTP in 25 shipments. Processing the waste at AMWTP resulted in a 68 percent reduction in the number of shipments requiring disposal and enabled disposal space at WIPP to be used more efficiently [6].

The AMWTP has also successfully served small quantity TRU waste generators, such as the Argonne National Laboratory, by certifying its CH TRU waste for disposal at WIPP. This service helped avoid the costs of standing up a central characterization project at those sites.

Fig. 3. A Shipment of CH TRU Waste from LANL Arrives at AMWTP for Processing

National Use of AMWTP: Benefits, Opportunities, Packaging Challenges and Potential Solutions

Benefits

Continued use of AMWTP to serve national radioactive waste treatment needs beyond the facility's current Idaho mission would provide the following benefits:

- Supports accelerated cleanup of DOE sites.
- Avoids/reduces costs of establishing new capabilities when AMWTP could effectively fulfill site needs.
- Reduces disposal volumes at WIPP and other offsite disposal facilities.
- Leverages the demonstrated capabilities of AMWTP's expert workforce to provide safe, effective, and reliable treatment and certification to meet stringent waste acceptance criteria for disposal at offsite facilities.

Other benefits will be identified and considered in DOE's ongoing opportunities assessment.

Opportunities

Transuranic waste requires rigorous characterization and certification to meet the waste acceptance criteria (WAC) for disposal at WIPP, which includes acceptable knowledge documentation, real-time radiography, non-destructive assay, headspace gas sampling, qualified personnel, and other specialized procedures and equipment [7]. The DOE complex requires TRU waste processing capability for several decades to support the disposition of TRU waste from environmental cleanup, national security, nuclear energy, and science missions.

Figure 4 shows the stored and projected CH TRU waste generated from defense activities included in the WIPP inventory. Approximately 94 percent of the CH-TRU waste (excluding Idaho Site TRU waste) is stored or will be generated at the Hanford-Richland (RL) Site, LANL, Oak Ridge National Laboratory, and Savannah River Site. Significant volumes of stored legacy CH TRU waste at Hanford-RL and LANL require repackaging to meet the WIPP WAC, such as the removal of WIPP prohibited items (e.g., aerosol cans) or to place waste into WIPP compliant containers (e.g., standard waste boxes). These activities require an experienced work force, specialized equipment, and demonstrated processes to ensure worker protection, public safety, and regulatory compliance. Stored legacy TRU waste in large boxes presents an extraordinary challenge because the contents often require resizing to fit within WIPP-compliant containers.

The DOE's current TRU waste processing needs vary by generator site based on the maturity of the generator's TRU program, volume of legacy and newly generated TRU waste, and whether the current packaging is WIPP compliant. The AMWTP could continue to help CH TRU waste generator sites efficiently process CH TRU waste, avoid duplicative processes, and reduce disposal volumes. Opportunities fall into two primary areas:

- Perform final characterization and certification of waste that does not require repackaging (e.g., does not contain prohibited items) and, if appropriate, compact the waste to reduce the number of shipments and volume requiring disposal to preserve valuable WIPP space.
- Repackage, compact, and perform other treatment, characterization, and certification to meet offsite disposal facility requirements.

The first opportunity can be more readily served because the waste does not require packaging solutions to be transported to AMWTP under existing protocols. The second opportunity, which would have the greatest benefit for the TRU waste programs, is more challenging because packaging solutions would be needed to ship non-WIPP compliant waste to AMWTP for processing to meet the WIPP WAC, as discussed below.

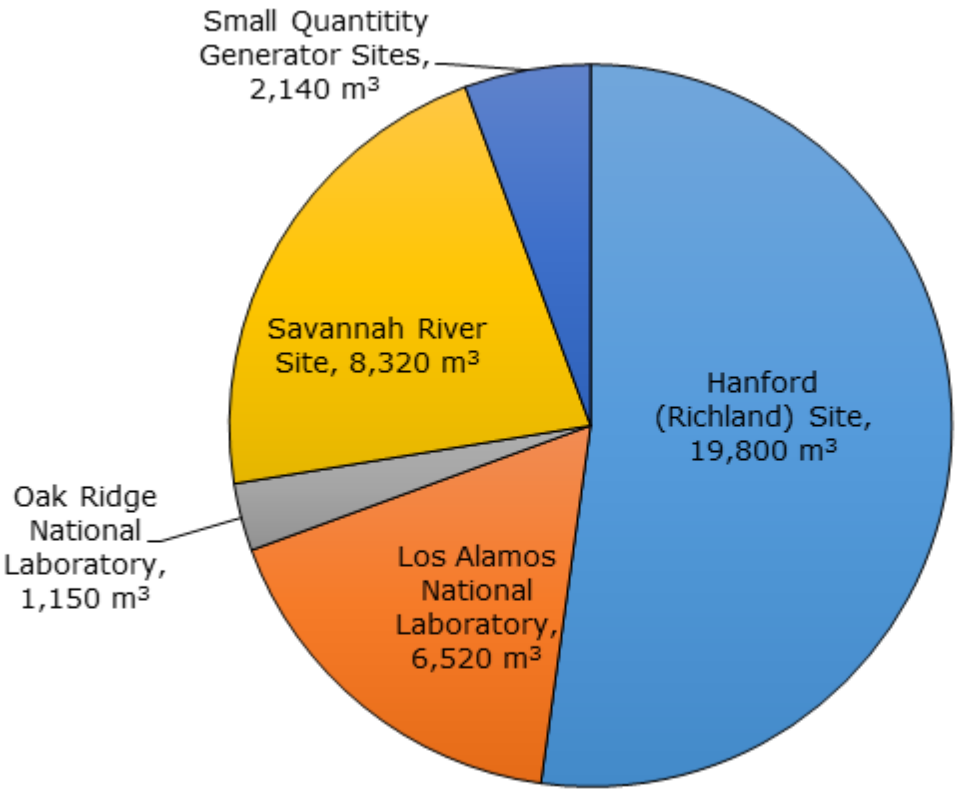

Fig. 4. Total DOE Stored and Projected Defense CH TRU Waste (excluding INL) [8]

Packaging Challenges and Potential Solutions

A significant challenge to sending offsite CH TRU waste to AMWTP for processing is that much of the stored legacy waste containers do not meet the WIPP WAC in their present configuration. For example, much of the waste requires repackaging to remove prohibited items, to reduce the fissile gram equivalent content, or to place it in appropriately sized containers that can be transported to and disposed of at WIPP. Consequently, although the waste meets AMWTP's WAC, it cannot be shipped to AMWTP under current packaging and transportation requirements (see Fig. 5).

The DOE's Memorandum of Agreement with the Western Governors' Association requires TRU waste shipments through Western States be accomplished in accordance with the Western Governors' Association WIPP Transportation Safety Program Implementation Guide, the Cooperative Agreement between the Western Governors' Association and DOE-Carlsbad Field Office, and the DOE TRU Waste Transportation Plan [9, 10]. Based on these governance documents, shipments from generator sites to AMWTP must be transported as if they are going to WIPP for disposal (i.e., in NRC-certified packaging, such as TRUPACT-IIs). Key points associated with this requirement are:

- NRC-certified packaging must be used for TRU waste shipments. The DOE National TRU Program uses four NRC-approved Type B shipping packagings: TRUPACT-II, TRUPACT-III, HalfPACT, and RH-TRU 72-B. However, “other NRC-approved packagings may be used” according to the TRU Waste Transportation Plan. Other non-TRUPACT Type B packaging, such as the 10-160B, have been successfully used.
- Certificates of Compliance for Type B packagings restrict contents with prohibited items as well as inappropriate shapes and configurations. Significant volumes of TRU waste at generator sites cannot meet the requirements for the TRUPACT-II, or any existing NRC packaging, based on current certificates of compliance. For example, the TRUPACT-II certificate contains certain restrictions including:
    - Materials must be restricted to prohibit explosives, corrosives, nonradioactive pyrophorics and compressed gases.
    - Within a payload container, radioactive pyrophorics must not exceed one percent by weight, and residual liquids must not exceed one percent by volume.
    - Flammable organics and methane are limited along with hydrogen to ensure the absence of flammable gas mixtures in TRU waste payloads as described in the Contact-Handled Transuranic Waste Authorized Methods for Payload Control, Chapter 5.0, Gas Generation Limits [11].
    - All payloads shall meet the activity limits specified in the Contact-Handled Transuranic Waste Authorized Methods for Payload Control, Section 3.3, Activity Limits [11]. The payload is limited to 105 A2 quantities.
- The 10-160B certificate of compliance contains similar requirements. However, a revision was accomplished several years ago which broadens the certificate to include corrugated metal boxes and certain quantities of prohibited items within those boxes.

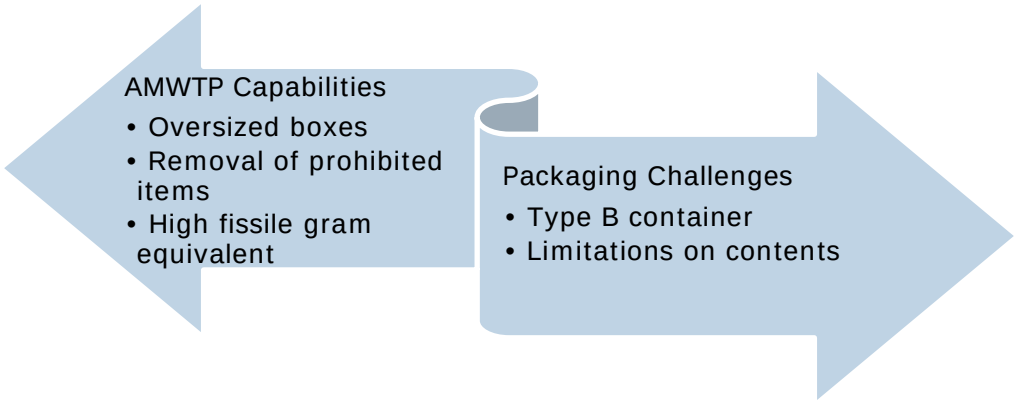

Fig. 5. Optimized Use of AMWTP as a National Asset Requires Packaging Solutions to Ship Waste to AMWTP

The existing transportation guidelines established among DOE, Western Governors' Association, and other stakeholders were developed through extensive dialogue and continued coordination. As a result, DOE's National TRU Program has achieved an exemplary transportation safety record throughout its history. The DOE and the Western Governors' Association have the ability to make case-by-case changes or exceptions to TRU waste shipping protocol. Specifically, the Western Governors' Association Memorandum of Agreement states WIPP protocol applies to TRU waste through Western States "not including shipments within the same DOE site or other TRU waste shipments as agreed to between DOE and the states." This provides for the possibility of exception to WIPP protocols when impacted states agree. To fully use AMWTP as a national asset, potential packaging solutions that could be considered by DOE and its stakeholders for intersite shipments to AMWTP include:

- Seek approval to use non-NRC approved packagings. This would open up the range of packagings that could be used. Potential opportunities include use of existing Department of Transportation Type A packaging and DOE-certified packaging for certain waste types.
- Revise certificates of compliance for TRUPACT-II and/or 10-160B packagings. For example, DOE could request modifications that would allow currently ineligible TRU waste to be packaged in these containers for shipment to AMWTP. The 10-160B certificate of compliance revision for the LANL corrugated metal box shipments to AMWTP is a model for how this might be accomplished.
- Seek an exemption to move certain TRU waste outside of current requirements. Particularly, this might be considered for very large and odd-shaped boxes of legacy TRU waste. For example, an exemption might specify a limited number of shipments to move to AMWTP on secure flatbeds with escort vehicles.

Any proposed changes to support shipments to AMWTP would need to be carefully analyzed, discussed, and approved by the Western Governors' Association and States to ensure safety standards are maintained.

Stakeholder Coordination

Coordination with stakeholders is vital to identifying and implementing potential opportunities to optimize AMWTP as a national asset for helping to solve radioactive waste challenges at other DOE sites. Examples of specific topics that could benefit from stakeholder interactions include:

- Which DOE sites could best be served by sending CH TRU waste to AMWTP for processing?
- What alternative packaging and transportation solutions could be considered to safely optimize intersite shipments to AMWTP?
- Are there other radioactive wastes and materials besides CH TRU waste that could benefit from processing at AMWTP?

- As a broader perspective, what other options for AMWTP reuse could be considered consistent with the DOE Guide 430.1-8, *Asset Revitalization Guide for Asset Management and Reuse* [12]?

CONCLUSION

The AMWTP is one of the nation's premier facilities for the treatment of CH TRU waste and MLLW. While DOE has made considerable progress in the management and removal of TRU waste from generator sites, there are still significant inventories at the Hanford Site, LANL, and other DOE sites that require treatment and certification to meet the WIPP WAC. Extended operations of AMWTP to support the treatment of this challenging waste would help these DOE sites accelerate their cleanup schedules, reduce waste volumes requiring disposal, and achieve potential cost savings. However, full use of AMWTP as a national radioactive waste treatment asset requires transportation packaging solutions to optimize CH TRU waste shipments to AMWTP. Potential solutions for intersite shipments to AMWTP that DOE and its stakeholders could consider include revisions to certificates of compliance to existing Type B packages, use of alternative Department of Transportation approved packagings, and specific exemptions to ship waste using escort vehicles. Any proposed packaging solutions would need to ensure continued protection of workers, the public, and the environment consistent with existing standards and protocols.

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