

CASE STUDY OF STRATEGY FOR WIPP CERTIFICATION OF REMOTE-HANDLED TRANSURANIC WASTES: BATTELLE COLUMBUS LABORATORIES

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ABSTRACT

Several small quantity sites (SQS) across the U.S. Department of Energy (DOE) complex are currently storing from one to a few hundred drums of transuranic (TRU) waste. The majority of SQS have waste management goals with respect to the status of site cleanup that require the completion of decontamination and decommissioning (D&D) activities under aggressive schedules. The key driver for these SQS goals is the existence of Consent Orders and State Agreements with governing agencies. At each SQS, the development of a strategy for ensuring a timely disposal option for this waste is critical. Currently, the Waste Isolation Pilot Plant (WIPP) is the identified option for TRU waste disposal from these sites. While the small volumes of waste generated by SQS will not be responsible for filling the pipeline to the WIPP, compliance with these agreements is a high priority for the DOE. Prior to receiving authority to transport TRU waste to the WIPP for permanent disposal, each site must demonstrate compliance with transportation and disposal requirements under the WIPP TRU Waste Certification Program (Program). The DOE-Carlsbad Area Office (CAO), which administers the Program, determines site readiness to perform TRU waste certification, characterization, and transportation activities by reviewing and approving required site documents and performing certification audits of site implementation of Program requirements. To be granted certification authority, a site must demonstrate how each of the applicable Program requirements will be met. For SQS generating remote-handled (RH)-TRU waste, the certification program development is complicated by the fact that Program requirements and mobile system capabilities for RH-TRU waste have not been finalized. For these sites, the development of a waste certification program cannot be postponed pending finalization of the WIPP waste acceptance criteria for RH-TRU waste. The SQS are, therefore, responsible for developing strategies that will comply with current contracts and ensure ultimate compliance with final WIPP RH-TRU waste acceptance criteria. The challenge for SQS with RH-TRU wastes is to gather waste certification data in sufficient detail at the time of waste packaging such that post-packaging characterization of the waste will be minimized or eliminated. For those sites that are required to start packaging operations for RH-TRU wastes at the present time, the risk and need for post-packaging characterization can be minimized by following specific guidance from the DOE-CAO, by thoroughly documenting the waste generation and packaging operations under a well-defined quality assurance program, and by involving the DOE-CAO in the certification process at the site. As a case study, the Battelle Columbus Laboratories must complete D&D activities for nuclear research buildings and grounds by the end of 2005, with all TRU waste to be removed by 2002 pursuant to the DOE-Ohio Strategic Plan.

BACKGROUND AND PROBLEM STATEMENT

Transuranic (TRU) waste is material that is contaminated with predominantly alpha emitting radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries per gram (1). TRU wastes are classified as either contact-handled (CH) or remote-handled (RH) depending on the dose rate at the surface of the container. CH-TRU waste containers have an external dose rate less than or equal to 200 millirem per hour (mrem/hr) at the surface of the container while RH-TRU waste containers have external dose rates greater than 200 mrem/hr at the surface of the container. The Waste Isolation Pilot Plant (WIPP) located in southeastern New Mexico is an underground repository for the disposal of TRU wastes generated and/or stored at various U.S. Department of Energy (DOE) and other sites across the United States. Figure 1 is a schematic of the various locations at which TRU wastes are generated and stored. As shown in Figure 1, several small quantity sites (SQS) across the DOE complex are currently storing from one to a few hundred drums of TRU waste. The majority of SQS have waste management goals with respect to the status of site cleanup that require the completion of decontamination and decommissioning (D&D) activities under aggressive schedules. The key driver for these SQS goals is the existence of Consent Orders and State Agreements with governing agencies. These orders and agreements are established to ensure the health and safety of the public and the environment by completing the D&D activities and waste removal from these sites in a timely manner.

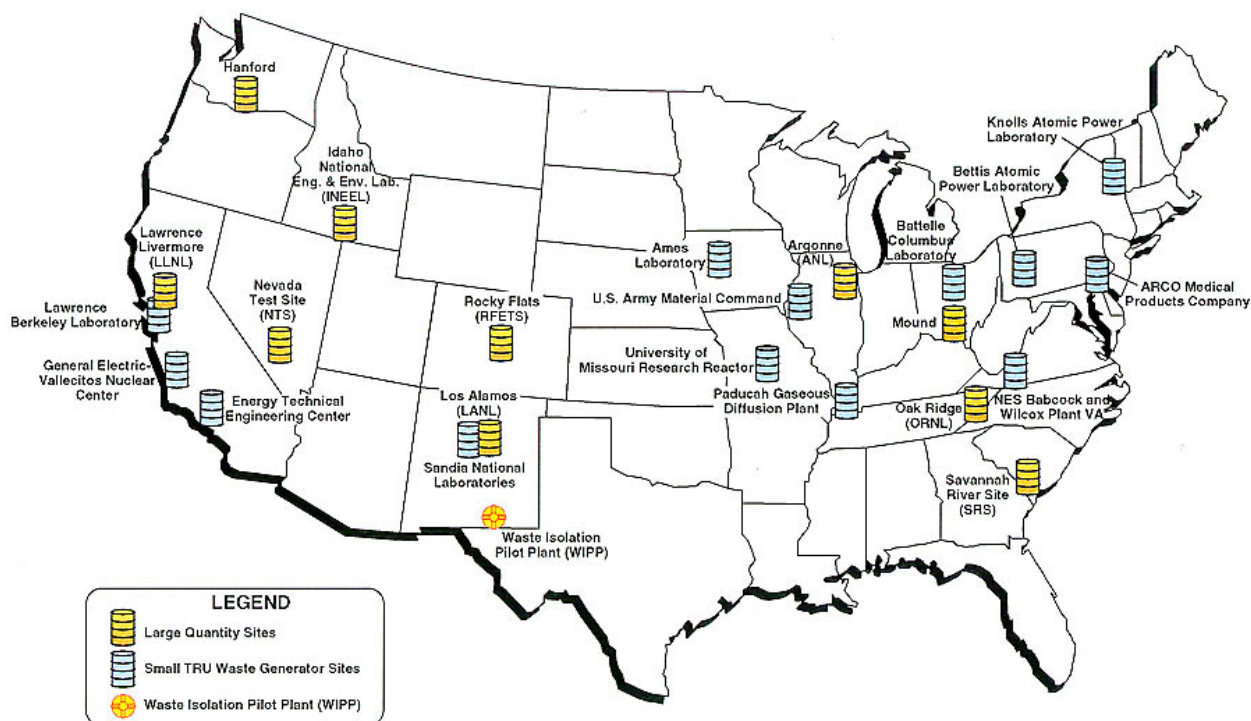


Figure 1
TRU Waste Generation/Storage Sites

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At each SQS, the development of a strategy for ensuring a timely disposal option for this waste is critical. Currently, the WIPP is the identified option for TRU waste disposal from these sites. While the small volumes of waste generated by SQS will not be responsible for filling the pipeline to the WIPP, compliance with these agreements is a high priority for the DOE. Prior to receiving authority to transport TRU waste to the WIPP for permanent disposal, each site must demonstrate compliance with transportation and disposal requirements under the WIPP TRU Waste Certification Program (Program). The DOE-Carlsbad Area Office (CAO), which administers the Program, determines site readiness to perform TRU waste certification, characterization, and transportation activities by reviewing and approving required site documents and performing certification audits of site implementation of Program requirements. To be granted certification authority, a site must demonstrate how each of the applicable Program requirements will be met.

The current Program defines final requirements necessary for the certification of CH-TRU wastes. The DOE-CAO has certified site-specific programs for CH-TRU waste at the Los Alamos National Laboratory, the Rocky Flats Environmental Technology Site, and the Idaho National Engineering and Environmental Laboratory. These sites have independently developed certification capabilities to meet the requirements of the Program. In addition, mobile systems vendors are anticipated to be available to provide CH-TRU waste characterization, transportation, or certification services for the Program, with these mobile services being used primarily at the SQS and to augment their capabilities, which are limited in comparison to the larger sites. The audit process for CH-TRU waste certification by the mobile vendors has been initiated by the DOE-CAO.

In contrast to the CH-TRU waste certification program, characterization- and transportation-related Program requirements for RH-TRU waste have not been finalized at this time. The development of a successful WIPP certification program is especially challenging to SQS expected to generate RH-TRU waste. Instead of developing extensive characterization and transportation capabilities for limited TRU waste inventories, the majority of these SQS will develop certification programs to be supplemented by subcontracted mobile TRU waste services. For SQS generating RH-TRU waste, the certification program development is complicated by the fact that Program requirements and mobile system capabilities for RH-TRU waste have not been finalized. Some SQS have initiated the generation and/or storage of RH-TRU waste destined for WIPP disposal in order to meet the terms and schedules of Consent Orders and State Agreements. For these sites, the development of a waste certification program cannot be postponed pending finalization of the WIPP waste acceptance criteria for RH-TRU waste. The SQS are, therefore, responsible for developing strategies that will comply with current contracts and ensure ultimate compliance with final WIPP RH-TRU waste acceptance criteria. The challenge for SQS with RH-TRU wastes is to gather waste certification data in sufficient detail at the time of waste packaging such that post-packaging characterization of the waste will be minimized or eliminated.

As a case study, the Battelle Columbus Laboratories (BCL) must complete D&D activities for nuclear research buildings and grounds by the end of 2005 pursuant to the DOE-Ohio Strategic Plan. For the building interior decontamination and external area remediation to proceed, the removal of the source term (i.e., containerization of RH-TRU waste) must be completed by the

end of 2002. In order to comply with the firm schedule and to ensure a disposal option for the D&D waste, the BCL is proceeding with the development of a waste certification program that anticipates RH-TRU waste characterization and transportation requirements and related mobile system capabilities. In order for the BCL TRU waste certification program to progress as necessary, assumptions based on draft DOE-CAO guidance and available draft documents must be made.

STATUS OF WIPP REGULATORY REQUIREMENTS FOR RH-TRU WASTES

Table I presents a summary of the key regulations governing the disposal of TRU waste at the WIPP, with an indication of the status for CH-TRU and RH-TRU wastes. As required by the WIPP Land Withdrawal Act (2), TRU waste may be transported to the WIPP only in packages approved by the U.S. Nuclear Regulatory Commission (NRC). An application for the certification of the 72-B Cask, a packaging designed for the transport of RH-TRU waste, is currently under review by the NRC. Following its approval, the Program requirements for RH-TRU waste transportation may be extracted from the 72-B Cask Safety Analysis Report, which is the basis for the NRC review (3).

**Table I
Regulations Governing TRU Waste Disposal at WIPP**

Issue	Regulatory Agency	CH-TRU Waste (Reference)	RH-TRU Waste (Reference)
Transportation	NRC	Certificate of Compliance issued in 1989 (4)	Safety Analysis Report under review (3)
RCRA Permit for Mixed Wastes	NMED	Permit issued in 1999 (5)	Permit application to be developed
Disposal of TRU Waste in Repository	EPA-ORIA	Certification decision issued in 1998 (6)	Certification decision issued in 1998 (6)
Operations and Safety	DOE-CAO	Incorporated into WIPP WAC (7)	WIPP WAC for RH-TRU waste to be finalized

EPA-ORIA = U.S. Environmental Protection Agency-Office of Radiation and Indoor Air

The current WIPP Resource Conservation and Recovery Act (RCRA) Permit pertains only to CH-TRU waste (5). Prior to the RH-TRU waste disposal at the WIPP, characterization requirements of 20 NMAC 4.1.500 (incorporating 40 CFR 264.13) must be specified for RH-TRU waste in a modification to the WIPP RCRA Permit. The New Mexico Environment Department (NMED)-approved permit modification will supply the Program with the requirements for RH-TRU waste characterization.

Due to the status of regulatory requirements for the characterization and transportation of RH-TRU waste, the current Program does not define final RH-TRU waste certification requirements, and mobile systems vendors have not yet developed WIPP RH-TRU waste characterization capabilities. The DOE-CAO has issued preliminary draft guidance for the characterization and transportation of RH-TRU waste (8). Revision 5 of the Waste Acceptance Criteria for the WIPP (WIPP WAC) defined preliminary criteria for RH-TRU waste (9).

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According to the current National TRU Waste Management Plan, RH-TRU waste shipments to the WIPP for disposal are anticipated to begin in 2003 (10). This action assumes that the required regulatory approvals will be granted by the NMED and the NRC and that Program requirements will be finalized and published. For those sites that are required to start packaging operations for RH-TRU wastes at the present time, the risk and need for post-packaging characterization can be minimized by following specific guidance from the DOE-CAO, by thoroughly documenting the waste generation and packaging operations under a well-defined quality assurance (QA) program, and by involving the DOE-CAO in the certification process at the site.

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Background

In April 1943, the Battelle Memorial Institute (BMI), a private research and development corporation, entered into a contract with the Manhattan Engineering District to perform atomic energy research and development activities. Since that time, BMI has continuously performed research and development work at its facilities for the DOE and its predecessor agencies. Three of the affected facilities are located at BMI's Battelle Columbus Laboratories West Jefferson site in West Jefferson, Ohio. Remedial D&D activities began in 1989 under the Battelle Columbus Laboratories Decommissioning Project (BCLDP). The objective of the BCLDP is to decontaminate and decommission the BMI's Columbus King Avenue and West Jefferson buildings and associated grounds. As a result of BCLDP D&D activities, approximately 25 cubic meters of TRU wastes are planned for ultimate disposal at the WIPP, with a major fraction of the total TRU waste being RH-TRU waste. Pursuant to the DOE-Ohio Strategic Plan, the decontamination of the West Jefferson buildings and associated grounds is to be completed by the end of 2005, with all TRU waste to be removed by 2002.

Certification Strategy

In order to comply with the DOE-Ohio Strategic Plan and to ensure a disposal option for the waste, the BCLDP has initiated development of a TRU Waste Certification Program (WCP). The BCLDP TRU WCP has been established on the basis that the TRU waste is predominantly RH-TRU waste, although for completeness the BCLDP TRU WCP also addresses the certification of CH-TRU wastes. Since October 1997, the BCLDP TRU WCP has participated in regular interface with representatives of the DOE-CAO and the DOE-CAO Technical Assistance Contractor to establish the logic and strategy for the certification of TRU waste. In August 1998, the DOE-CAO concurred with the BCLDP TRU WCP strategy (11).

Compliance with the WIPP certification requirements for CH-TRU waste has been documented for the BCLDP TRU WCP in the required site-specific documents. These documents also detail RH-TRU waste compliance with conservatively assumed requirements based on the current CH-TRU waste requirements, draft DOE-CAO guidance, or available draft regulatory documents. Because transportation requirements are very close to being final and are dictated by the packaging (i.e., the Transuranic Package Transporter-II [TRUPACT-II] for CH-TRU waste and the 72-B Cask for RH-TRU waste), almost all of the BCLDP TRU WCP assumptions are associated with RH-TRU waste characterization requirements. The DOE-CAO approved key BCLDP TRU WCP documents in 1999 (12, 13, 14). The balance of the site-specific documents

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requiring DOE-CAO approval (i.e., transportation documentation) will be submitted for the DOE-CAO review upon NRC-certification of the 72-B Cask.

All BCLDP TRU waste is newly generated waste that will be packaged to meet applicable transportation and disposal characterization requirements. As such, acceptable knowledge (AK) and waste generation procedures comprise the primary compliance methods for meeting the WIPP certification requirements. The key elements of the BCLDP TRU WCP methodology are described below.

Acceptable Knowledge Program

An extensive AK document has been published by the BCLDP to comprehensively describe all historical knowledge and available records and database information on past characterization efforts for the TRU waste to be generated by the BCLDP. This AK document provides the basis for identifying the BCLDP TRU waste inventory as eligible for WIPP disposal (e.g., waste streams meeting the definition of defense TRU waste). The use of AK in the BCLDP TRU WCP to characterize TRU waste involves the systematic compilation and confirmation of AK information as well as the ongoing assessment of this process. The implementation of the BCLDP TRU WCP AK program was successfully audited by the DOE-CAO in May 1999.

Waste Generation

The TRU waste from the BCLDP is newly generated waste that is packaged in waste containers to meet all applicable shipping and disposal requirements. The procedures governing BCLDP waste generation ensure this compliance, including removing and segregating all prohibited items, verifying and validating the AK information, and quantifying any required parameters. AK is verified by the visual examination of the waste during packaging and will be confirmed through headspace gas and waste sampling and analyses performed by subcontracted mobile TRU waste services. The BCLDP TRU WCP documentation methodology includes the video and audio documentation of all TRU waste sorting and packaging activities. When TRU waste packaging is not being performed, motion sensitive recording equipment is left running with a videocassette in place to document any movement in the packaging area. This process results in continuous monitoring and visual records of all waste generation activities, which may be used to verify that all packaging was recorded and that no packaging was performed without the proper documentation. In accordance with the DOE-CAO approved site-specific program documents and the associated implementing procedures, the BCLDP has initiated waste segregation and packaging activities and has packaged approximately five drums of RH-TRU waste.

Unlike other TRU waste sites that must characterize and evaluate TRU waste generated in the past for compliance with current requirements, the BCLDP TRU waste will be generated and packaged to meet the existing WIPP certification requirements. This approach, as directed by the BCLDP TRU WCP, will minimize the need for post-packaging characterization of the generated waste. The BCLDP maintains detailed records of the waste generation processes including audio and video records of specific events generating the wastes. The waste characterization data from these records will not only be cost effective and in compliance with as low as reasonably achievable (ALARA) principles, but will also yield better characterization than any post-sampling of the waste containers.

Waste Characterization

The BCLDP TRU WCP plans to subcontract mobile vendors approved by the DOE-CAO to perform all CH-TRU waste characterization. Requirements pertinent to QA objectives (QAOs); method requirements; quality control; equipment testing, inspection, maintenance, and calibration; and data management will be performed in accordance with the a mobile vendor interface plan, the subcontractor's TRU Waste Characterization Quality Assurance Project Plan, and associated implementing procedures.

With the exception of waste properties typically determined by radioassay, the characterization requirements for RH-TRU waste are assumed to be similar to those outlined by the Program for CH-TRU waste. Excluding radioassay, the BCLDP TRU WCP plans to subcontract mobile systems vendors to perform other characterization activities following the development of required RH-TRU waste capabilities and approval by the DOE-CAO. The BCLDP approach for RH-TRU waste characterization is consistent with the current DOE draft guidance (8). The draft guidance states the guiding principles for designing radioassay methods for RH-TRU waste as follows:

- Must provide the data needed to ensure the QAOs are met
- Must be practical for the generator site to apply
- Must be consistent with worker safety (ALARA principles).

The proposed QAOs interpret limit compliance as "measured value plus the uncertainty." This provides sites with "the flexibility to weigh the cost versus the benefit of developing higher precision and accuracy analytical methods and optimize for their particular situation.... Small quantity sites may find it more efficient to use less expensive, less precise measurement methods...." This proposal is key to the BCLDP method, for which the accuracy is periodically verified. The BCLDP TRU WCP methodology for the determination of radioassay properties for RH-TRU waste, which meets the above principles and has been specifically designed for implementation by the BCLDP (a SQS), is summarized as follows.

The isotopic content for an identified waste stream is determined by a combination of (1) representative waste stream sample analyses and (2) conservative application of ORIGEN code values for isotopes expected to be present in spent nuclear fuel, but not represented by the sample analyses. The determinations are verified on an approved, periodic basis by sample submission to the BCLDP Radioanalytical Laboratory (RAL) for gamma and/or alpha spectroscopy. In certain circumstances, field gamma isotopic screening may be implemented to differentiate between photon-emitting isotopes, which facilitates Cs-137 correlation to TRU waste components.

The RAL operates under a QA plan that is consistent with the requirements of DOE Order 5700.6C and the American National Standards Institute/American Society of Mechanical Engineers Nuclear Quality Assurance-1 (15, 16). In addition, an internal RAL quality control program ensures that the analytical results are reliable and that data integrity is maintained throughout the measurement system. If gamma and/or alpha spectroscopy results for periodic samples indicate the presence of source terms other than those initially determined for an identified waste stream, the model is amended to incorporate the appropriate source terms.

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It is expected that there will be three specific source terms for the West Jefferson North (JN) facility, which is the primary focus of the BCLDP D&D activities:

- JN Standard Isotopic Mix (applicable to general contamination at Building JN-1)
- JN Hot Cell Specific Isotopic Mix
- JN-1 Pool Cleanup Isotopic Mix.

During waste packaging, BCLDP personnel will inventory the waste items loaded into each payload container and document the source location (hot cell, pool, etc.) for each waste item. This inventory is used to select the proper isotopic mix for the waste items. Only waste items from the same source location will be packaged together to ensure the correct assignment of isotopic mix to each loaded payload container. If an isotopic mix for a specific source location is not established, the methodology will be amended to incorporate the appropriate source terms, spreadsheets, and any other tools needed to facilitate assessment of the quantities and nature of the isotopes involved.

After the isotopic mix is established, the expected external dose rates for 1 millicurie of the mix are estimated for different packaging configurations using an appropriate conservative matrix. From the measured weights and dose rates of the payload containers, the quantity of radionuclides in each container can be determined. A computer program is used by the BCLDP to determine compliance with the limits on the following transportation and disposal parameters for RH-TRU waste based on the inputs of payload container dose rate, weight, and source:

- TRU alpha activity concentration
- Fissile grams equivalent
- Pu-239 equivalent activity
- Decay heat.

The application of the ORIGEN code in the proposed BCLDP TRU WCP methodology for determining radioassay properties for RH-TRU wastes is conservative. In addition, associated measurement errors and assumptions have been conservatively estimated to determine a total error that is bounding for the methodology.

Use of Mobile Vendors

Mobile systems technology is being promoted as the solution to TRU waste characterization issues at DOE sites without fixed-facilities and necessary funding or the waste volume to justify the development of new facilities. Mobile systems were conceptualized to meet the needs of the national TRU waste system and the site clean-up acceleration goals established by the DOE. This technology is intended to facilitate site compliance with Consent Orders and State Agreements.

The use of mobile vendors is a significant part of the BCLDP TRU WCP. For the BCLDP TRU WCP logic to be consistent, the mobile systems vendors, which currently are designed to characterize CH-TRU waste, must develop capabilities for the characterization of RH-TRU waste. The BCLDP TRU WCP assumes that the mobile vendors will be able to provide all RH-TRU waste characterization services except for nondestructive assay, for which a reliable

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methodology is in place at the BCLDP. These services are anticipated to include headspace gas and RCRA sampling and analysis for newly generated RH-TRU waste containers.

Specifications for the subcontracted TRU waste services and interface requirements for characterization and transportation support of the BCLDP TRU WCP will be established according to a mobile vendor interface plan. This plan will ensure BCLDP certification of the wastes characterized and transported by the mobile vendors in accordance with the BCLDP TRU WCP. Clear division of responsibilities, including signature authorities; specific methods of interaction and points of contact; and courses of action for CH- versus RH-TRU payload containers (e.g., in sampling activities), will be defined as consistent with BCLDP TRU WCP plans and procedures. The BCLDP/mobile vendor interface will be audited by the DOE-CAO as part of the BCLDP TRU WCP.

Potential Future Activities

Although the majority of waste to be generated by the BCLDP is expected to be RH-TRU waste, a small amount of CH-TRU waste also may be generated by the BCLDP. The BCLDP TRU WCP has purchased two pipe overpack payload containers for use in CH-TRU waste studies to evaluate possible shipment options in pipe overpack payload containers (i.e., one 6-inch or 12-inch diameter pipe component overpacked in a 55-gallon drum) in the TRUPACT-II. As the pipe component by design provides some shielding, this packaging configuration may be used to certify CH-TRU waste that would otherwise be considered RH-TRU waste. If the BCLDP TRU WCP determines through the planned studies that the dose rate of each loaded pipe overpack will measure ≤ 200 mrem/hr at the surface, specific waste streams may undergo additional segregation to identify CH-TRU waste forms.

As a parallel path, the BCLDP is investigating the possibility of using the ChemNuclear Services (CNS) 10-160B Cask for RH-TRU waste shipments to the WIPP. The CNS 10-160B Cask is an NRC-approved Type B lead-shielded cask. The RH-TRU waste packaging and payload configurations must be reviewed and approved by the NRC as CNS 10-160B Cask authorized contents. The DOE-CAO must evaluate the WIPP feasibility for handling the CNS 10-160B Cask and the impact to ALARA concerns at the WIPP site as the 55-gallon drums would be removed from the CNS 10-160B Cask and overpacked into an RH-TRU canister prior to WIPP disposal. For this option to be possible, the DOE-CAO must revise the WIPP WAC to include the CNS 10-160B Cask as an approved method of transport for RH-TRU waste to the WIPP.

SUMMARY

The SQS require an immediate path forward for the ultimate disposal of RH-TRU waste. For the generation of RH-TRU waste destined for WIPP disposal, the development of WIPP waste certification programs cannot be delayed. Therefore, the following key items must be considered in WIPP certification strategies of RH-TRU SQS:

- All waste generation activities must be documented under a rigorous site-specific QA program.
- The DOE-CAO must be involved as the waste is generated and packaged under the site-specific waste certification program.

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- Post-packaging characterization must be minimized. Thorough documentation and DOE-CAO participation should reduce additional characterization requirements to be met following waste packaging.
- Mobile vendor RH-TRU waste capabilities must exist before waste shipments from RH-TRU SQS may be initiated.

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