

TRU WASTE REMOVAL FROM ETEC, A SMALL-QUANTITY GENERATOR SITE

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ABSTRACT

The Energy Technology Engineering Center (ETEC) is a former Department of Energy (DOE) nuclear research and development facility which is now undergoing site closure. The decontamination and decommissioning activities resulted in the accumulation of a container-storage volume of about 11 m³ of transuranic (TRU) waste. This waste was on the critical path to site closure, and a concerted effort to remove the TRU waste from the site was initiated in 1997. The strategy undertaken to identify a waste disposal solution consisted of two parallel activities. One was to work with the DOE TRU community to identify and pursue all possible paths forward. The second activity was on-site planning and waste preparation to meet any waste disposition opportunity. That presented several challenges, as the waste included both CH (contact-handled) and RH (remote-handled) waste, non-mixed and mixed waste, and a sludge/liquid component that contained polychlorinated biphenyls (PCBs). Waste disposition options were limited by the constraint that ETEC is too small a site to implement a Waste Isolation Pilot Plant (WIPP) waste certification program.

Several different options were pursued, each with major challenges, and ETEC worked with the DOE, WIPP, and other groups and agencies to define requirements and gain approvals for implementing various steps of each possible option. Detailed waste characterization, documentation, and packaging activities were performed during the same time period, to have the waste packaged and characterized in the best possible form to capitalize on any available path forward.

An opportunity became available for intersite shipment of the ETEC TRU waste to Hanford in late 2002. That opportunity provided a focus and a critical time constraint on the completion of several outside regulatory decision and approval processes. Those processes provided major challenges and were completed successfully, some within days of the final one-week shipping window. They in turn dictated on-site waste preparations that took place up to the arrival date of the shipping casks. The entire ETEC TRU inventory was successfully shipped off-site to Hanford on December 18, 2002. That success is attributed to detailed preliminary preparation and extensive support from a large number of outside organizations.

INTRODUCTION

The Energy Technology Engineering Center is located in the Simi Hills of southern California, approximately 47 km northwest of downtown Los Angeles. It is a former DOE nuclear and liquid-metal research and development facility whose nuclear activities were concluded in the late 1980s. The ETEC operations contract was terminated at the end of 1998, and since that time the decontamination and decommissioning (D&D) of all facilities associated with DOE-sponsored activities has been performed under a DOE site closure contract. When that work is complete, the site property will be released to its owner, The Boeing Company.

The D&D of key facilities was initiated in the 1980s. The D&D activities resulted in the accumulation of about 11 m³ of transuranic (TRU) waste between 1984 and 1995 that could not be shipped off site at that time because of an evolving political climate. The TRU waste was stored at the facility's Radioactive Materials Handling Facility (RMHF) in underground concrete vaults. Those vaults were used originally for the storage of spent nuclear fuel during nuclear fuel decladding operations at the site's Hot Laboratory.

The RMHF is the last remaining operational ETEC facility, and its removal is the critical path for site closure. D&D work on that facility could not be initiated while the TRU remained in storage on site. TRU removal was thus identified as a critical path activity to meet the closure schedule, with removal by the end of 2002 required to meet an ETEC site closure date of 2006.

The removal of the TRU waste from the ETEC site presented several major challenges, associated both with the characteristics of the waste and the identification of a path forward. ETEC is a small-quantity generator site that required off-site TRU waste shipment at a time when DOE TRU program priorities were focused on filling the TRU waste disposal pipeline to WIPP from the large generator sites. Options were not available for TRU waste with characteristics exhibited by most of the ETEC inventory, including, for example, RH homogeneous waste and a PCB contaminant. Several approaches were taken to find a waste disposition solution for the ETEC waste, many of them unsuccessful under the time constraint for waste removal. The general approaches, and the obstacles that were overcome to ship the ETEC waste off site, are described below.

TRU WASTE DISPOSITION CHALLENGES

The original TRU waste inventory was generated in the 1984-85 time frame during spent nuclear fuel decladding and as part of the D&D of a former nuclear materials development facility. Most of the generated TRU waste was shipped to the Hanford site at that time, with the shipment of a few containers delayed by repackaging requirements. Those containers were scheduled for shipment in 1987, but the DOE-Richland Operations Office (DOE-RL) suspended TRU waste acceptance at Hanford in 1987 pending resolution of agreements with the State of Washington, and the remaining inventory could not be shipped. The waste was repackaged to Idaho National Engineering and Environmental Laboratory (INEEL) waste acceptance criteria in 1988, but could not be shipped because of a 1989 State of Idaho moratorium. That waste thus remained in storage at the ETEC site. It was packaged in twelve 0.21-m³ (55-gallon) drums, where some inner packaging used heat-sealed bags for contamination control. One drum contained internal

lead shielding, and several others were categorized as mixed waste (having combined radiological and hazardous waste properties).

An additional waste stream was added to the TRU inventory during the decontamination and complete demolition of the site's Hot Laboratory. Most of that material was recovered from the Hot Laboratory's drain lines during their removal in 1993-95, packaged in 3.8-liter (1-gallon) paint cans, and stored in concrete-shielded drums. Additional drain line material was stored in dry and aqueous sludge form in an 11.4-m³ (3000-gallon) drain line hold-up tank and two weir boxes, the latter used as baffle systems at the drain tank entrance port. The drain line residue waste was categorized as homogeneous RH TRU waste. Initial drain tank sampling indicated the presence of a PCB contaminant at a concentration greater than 50 ppm (parts per million).

The small ETEC TRU inventory thus had several characteristics that made finding a waste disposition path forward difficult. Those characteristics included a mixture of CH and RH waste, a quantity of mixed CH waste, some CH and RH waste packaged in heat-sealed bags (prohibited from present TRU waste shipping packages), internal shielding (shielding credit not allowed for shipment as CH waste), RH waste in aqueous sludge/liquid form, and the identification of a PCB contaminant in the sludge.

ETEC also faced several external programmatic and regulatory challenges. DOE emphasis at that time was on CH TRU waste from the large-quantity generator sites that had high-priority regulatory drivers. The DOE Waste Management Programmatic Environmental Impact Statement (PEIS) Record of Decision (ROD) permitted shipment of the ETEC TRU waste only to WIPP, while the WIPP permit prohibited the acceptance of RH TRU waste or waste with PCB concentrations greater than 50 ppm. Liquids could not be shipped in the approved TRU waste shipping packages based on transportation requirements. At the same time, the Environmental Protection Agency's (EPA's) Toxic Substance Control Act (TSCA) regulations prohibited the solidification of PCB liquids to avoid incineration. Only some of the ETEC waste could be shipped in the DOE's CH TRU waste shipping package (TRUPACT-II), and the DOE's planned RH TRU shipping package (RH-72B) had not yet been fabricated. There was thus no path forward for TRU waste disposition from ETEC.

APPROACHES TO FIND A PATH FORWARD

A concerted effort to remove the TRU waste from the site was initiated in 1997. The strategy undertaken to identify a TRU waste disposition path and remove the waste consisted of two parallel activities. The first was a directed effort to work with the DOE TRU community to identify and pursue all possible options. The second activity was on-site planning and waste preparation to meet any opportunity that might become available. That work was performed under the constraint that ETEC could not implement a WIPP waste certification program. ETEC resources were very limited and the very small waste quantity made the development of a large program impractical. Further, no WIPP waste acceptance criteria existed for RH TRU waste because of its prohibition by the WIPP Hazardous Waste Facility Permit and the need for EPA certification of WIPP for acceptance of RH TRU waste for disposal.

Interfaces with the DOE TRU community included participation in DOE meetings, workshops, focus groups, and WIPP planning activities, direct interfaces with DOE and other TRU waste generators, requests and support for new technology development, the investigation of intersite transfer as an alternative to direct WIPP disposal, and the outside review of ETEC-specific plans and documentation for waste treatment and off-site transportation. An important benefit of this participation was an understanding of, and input to, DOE strategies for meeting the WIPP disposal challenges presented by TRU waste with several complicating characteristics.

A general road map identifying the different waste disposition paths pursued for the ETEC TRU waste is shown in Fig. 1. Both direct shipment to WIPP and intersite transfer to an interim storage/certification site were addressed. CH and RH TRU waste were considered to have potentially different paths, because the DOE was developing a different approach to WIPP certification for RH waste to minimize the personnel risks associated with its characterization. The thin-lined boxes in the Fig. 1 flow diagram represent the primary challenges identified for the different waste disposition paths.

At the time, shipment of the CH TRU waste directly to WIPP was contingent upon the approval of a Centralized Characterization Facility (CCF) at WIPP for waste certification. That also required a WIPP permit modification for the certification of homogeneous waste without sampling and chemical characterization. The ETEC CH TRU waste included homogeneous waste, for which a certification capability within the CCF had not been identified. An outside vendor was required to validate the TRU determination of the waste before shipment to WIPP by performing an independent non-destructive assay (NDA) of each container. That required advanced techniques because of the low TRU concentrations in the drums and significant waste self-shielding.

Shipment of RH TRU waste to WIPP required EPA authorization for repository acceptance of RH waste. Shipment of the RH waste directly to WIPP also required two WIPP permit modifications: one for the acceptance of RH waste, and a second modification for the acceptance of waste with PCB concentrations greater than 50 ppm. The final RH waste permit would also define the criteria for waste acceptance; site requirements for waste packaging, characterization, and certification would not be known until that time.

The alternative of intersite transfer to another site for interim storage and final waste certification presented a separate set of challenges. They included negotiated agreements between the DOE, the receiving site, and the receiving site state, plus an amendment to the PEIS Record of Decision to allow the ETEC waste to be transported to a location other than WIPP.

Other significant challenges that affected all options were approvals for the solidification of the PCB-containing sludge to permit transportation, and the identification, availability, and approval of TRU waste shipping packages for transportation. ETEC was not located on a TRU shipping corridor, and site-specific transportation routes required approvals, permits, and emergency response planning. All options required the development and approval of detailed acceptable knowledge (AK) packages, but the details of those packages depended upon the waste disposition path.

ETEC worked within the TRU community to push for a near-term solution along each of these paths. The following are examples of those interfaces.

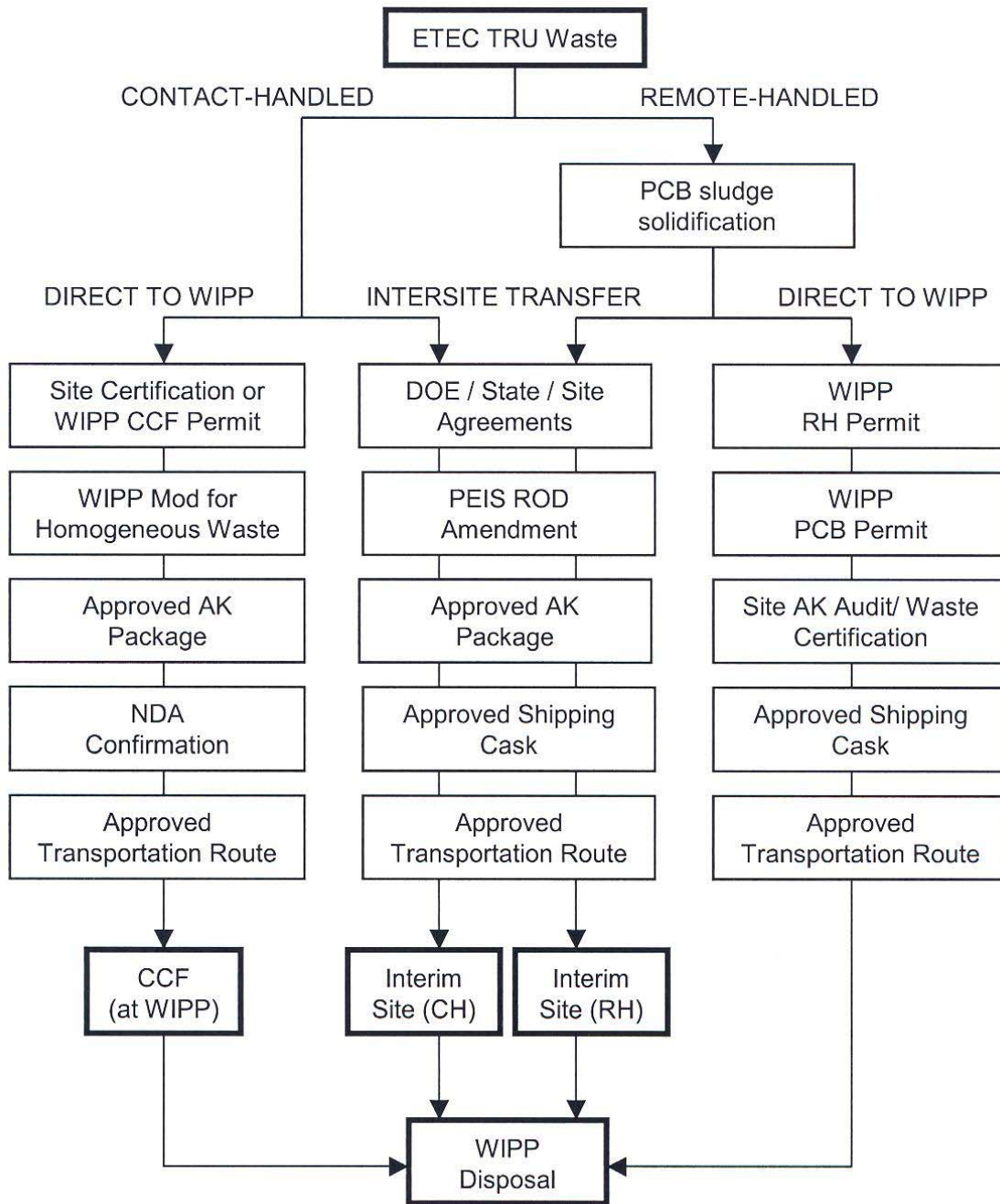


Fig. 1 ETEC TRU Waste Disposition Path Options and their Challenges

Environmental Management Integration (EMI) Program: ETEC participated actively in the 1998-99 EMI program to identify high-priority small-quantity TRU generator sites and evaluate TRU waste disposition alternatives [1]. This program identified ETEC as one of four high-

priority small-quantity sites requiring near-term TRU waste disposition, evaluated the alternatives and associated costs for several CH and RH waste options, and concluded that TRU waste shipment to Hanford was the most cost-effective approach. However, subsequent DOE direction led to more detailed planning for ETEC CH waste transfer to INEEL and RH waste transfer to the Oak Ridge National Laboratory. While DOE decisions rearranged small-site priorities, the EMI program provided the visibility required for ETEC to move its program forward.

WIPP RH Waste Permit Modification Development: ETEC participated in DOE workshops on strategies to develop a path forward for RH TRU waste, and in the review process for several drafts of the WIPP RH waste permit modification request during its preparation by the DOE-Carlsbad Field Office (DOE-CBFO). The proposed RH TRU waste certification plan was based on the use of waste stream acceptable knowledge where available, instead of new certified measurements, to minimize personnel exposures. ETEC had developed detailed acceptable knowledge documentation of its RH waste streams, and provided that documentation as a small-quantity site example for inclusion in the RH waste permit submittal process. One option was to certify the ETEC waste streams as part of the permit modification approval process.

National TRU Management Plan: ETEC campaigned actively to ensure that its required RH TRU waste shipments were incorporated in the National TRU Management Plan baseline shipping schedule [2].

TRUPACT-II Envelope Expansion: ETEC proposed the development of a shielded shipping package in 1998 for TRU waste transport as part of the National TRU Program Technology Development Needs Program. The objective was to allow shipment of small quantities of RH waste in the Transuranic Package Transporter Model II (TRUPACT-II) shipping package as CH waste, in the event that an RH waste shipping container would not become available in the required time period. Westinghouse TRU Solutions (now Washington TRU Solutions) developed a shielded pipe component to meet that need, and obtained Nuclear Regulatory Commission (NRC) approval for its use in TRUPACT-II. ETEC performed shielding measurements and calculations in support of that effort. The shielded pipe component was not used for the ETEC RH waste, because it was later determined that shipping the material to WIPP in that package would require its characterization as CH waste. That would require detailed characterization as a high-specific-activity homogeneous waste, for which a characterization capability was not available. However, the development program provided a new packaging option for the TRU complex.

Shipping Cask Content Code Approvals: Beginning in 1998, ETEC pursued approvals for shipment of its CH waste in the TRUPACT-II shipping package and its RH waste in the RH-72B shipping cask in preparation for possible use of those containers. Westinghouse TRU Solutions and the IT Corporation (now the Shaw Group) prepared the ETEC waste content codes and obtained the NRC approvals as part of the series of Safety Analysis Report revisions that were developed to expand the authorized use of those two shipping packages.

Battelle Columbus Laboratories initiated an extensive effort in 2000 to demonstrate and gain approval for the use of the Duratek, Inc. CNS 10-160B shipping cask as an alternative shipping

container for both CH and RH TRU waste. ETEC supported that effort as a potential user, and began discussions with Duratek in 1999 on obtaining 10-160B content code approvals for the ETEC TRU waste. The Shaw Group prepared those codes for ETEC based on the NRC-approved content codes for the TRUPACT-II and RH-72B shipping containers. The 10-160B content codes were submitted to the NRC by Duratek, the cask fabricator and Certificate of Compliance holder, in June 2002 and approved for use in October 2002.

The 10-160B cask appeared to be ideally suited for transport of both the ETEC CH and RH TRU waste, and the only option available near-term. A single cask can transport ten drums, arranged in two stacked layers that are loaded and unloaded remotely using five-drum steel pallets. The pallets can be loaded separately in advance of shipment, and the drums can remain on the pallets for simplified remote handling during storage. ETEC initiated an order for the fabrication of several pallets in September 2002 so that required shipping hardware would be available if a near-term shipping opportunity became available.

PCB Path Forward: ETEC participated in the Environmental Protection Agency (EPA) PCB 2000 data calls in support of the WIPP permit modification to increase allowable TRU PCB concentrations, and interfaced with the DOE's TRU and Mixed Waste Focus Area to explore options for solidification of the PCB-contaminated sludge. Those activities and subsequent interactions with DOE-Headquarters beginning in February 2002 resulted in a DOE request to the EPA for waste-specific approval to solidify the ETEC sludge for future transportation and safe storage.

Hanford Interfaces: Several discussions and meetings were held over the 1999-2002 time period between DOE-Oakland Operations Office (DOE-OAK), DOE-RL, ETEC, Battelle Columbus Laboratories, and Hanford site personnel on requirements and options for TRU waste shipments from ETEC and Battelle Columbus to the Hanford site. Those interfaces established working relationships between the sites, defined Hanford waste acceptance criteria, and identified possible Hanford storage locations in the event that agreements could be reached between the DOE and the State of Washington for TRU shipments to Hanford. ETEC was an approved generator/shipper for low-level waste disposal at Hanford, and received approval in 2002 as a generator/shipper of TRU waste for interim storage. DOE-OAK and ETEC supported Battelle Columbus in the acquisition of concrete vaults as potential storage containers for RH TRU waste at Hanford.

PEIS Record of Decision Amendment: An amendment to the PEIS Record of Decision that would allow TRU waste shipments from ETEC and other high-priority small quantity generator sites to locations other than WIPP was initiated during the 1999 EMI program activities, but was tabled because of intersite transfer uncertainties. DOE-OAK initiated a new effort in April 2002, in coordination with DOE-Headquarters, to prepare a Record of Decision amendment for the transfer of both the ETEC and Battelle Columbus Laboratories TRU waste to Hanford. The initiation of that effort was based on the ongoing Hanford interfaces.

WASTE CHARACTERIZATION AND PRELIMINARY PACKAGING

The significant challenges and uncertainties associated with each of the identified waste disposition options, and the lengthy process to address those challenges, meant that ETEC would be unable to meet its closure schedule unless a window of opportunity was created. To prepare for the possibility of a quickly developing opportunity, ETEC planned and performed on-site waste characterization and packaging to the extent possible to be prepared for any waste disposition path. That work was performed under the constraint that an outside WIPP-certified organization would have to perform final WIPP waste certification. On-site waste preparation included extensive physical, chemical, and radiological waste characterization, detailed acceptable knowledge documentation, and a strategy for repackaging that would permit minimal final packaging to meet the requirements of the to-be-determined waste transportation shipping package and receiving site.

Extensive historical records were acquired which provided detailed information on the waste. Those records included, but were not limited to, inventory logs of waste collection and packaging, waste management records, radiological survey data, radiological and chemical sampling data, computed tomography analyses of the CH waste drums, documents describing facility operations, D&D procedures, waste handling and packaging procedures, and certifications for the 1988 repackaging to INEEL waste acceptance criteria. Limited video records of those repackaging activities were also available.

A Transuranic Waste Management Plan and a TRU Waste Acceptable Knowledge Documentation Procedure were prepared, with the acceptable knowledge procedure modeled after those used at other TRU generator sites. The acceptable knowledge procedure then provided the basis for the preparation of four draft acceptable knowledge summary reports that documented the ETEC waste stream characteristics, provided the justification for a defense waste classification, and linked the waste stream knowledge to a large file of source documents. Most waste stream characteristics were corroborated by multiple data sources.

Review of the TRU source documentation identified areas where additional data were required to complete characterizations or resolve inconsistencies, and where storage packaging configurations did not meet requirements for waste transport in the potentially available TRU shipping containers. Hot Laboratory and glove box capabilities no longer existed on site, and a temporary sampling and repackaging facility was constructed to augment the waste characterization and perform repackaging activities. The facility consisted of a HEPA-filtered, fire-retardant plastic enclosure that was located at the bottom of a HEPA-ventilated storage vault within a radiologically controlled facility (Fig. 2). This configuration provided a double-containment working environment.

The specific-activity of all materials, including the RH waste, was sufficiently low that personnel could work with the material directly. All TRU characterization and repackaging activities were performed within this facility by personnel using double layers of personal protective clothing, full respirators with air lines, shielded work areas, and procedures that minimized exposures and were based on pre-operations mockup testing and process hazards analyses. Other protective measures included continuous air monitoring, frequent surveys, extensive personal dosimetry,

and a clear tent top for observation. Multiple plastic layers were used within the enclosure to allow change-out for contamination control, and five video cameras were installed to document operations.



Fig. 2 Temporary containment structure fabricated for TRU waste repackaging activities

All of the ETEC TRU waste required some repackaging. The minimum requirement was to move the waste into new certified drums with current filter vent certifications. The CH waste that had been packaged in heat-sealed bags was placed into new HEPA-ventilated plastic bags and sealed with a retractable knife inside. Each original heat-sealed bag was slit open using the pliability of the HEPA bag to handle the knife from the outside. The HEPA bags were then placed into the new certified drums. This process included a visual examination for prohibited items, and smear samples were collected from selected bags for additional waste stream radiological characterization. New characterization data were incorporated in the waste stream acceptable knowledge documentation.

The 3.8-liter paint cans that were used to package part of the RH residue removed from the Hot Laboratory drain lines exhibited some degradation when selected containers were accessed for characterization. It was not known how long they must remain in storage, or how they would eventually be shipped, and thus a vented stainless steel container was designed to overpack each paint can. The overpack containers were designed to fit within the shielded storage drums or the TRUPACT-II shielded pipe component, or several could be loaded into an unshielded RH drum (Fig. 3). The containers had tabs for lid attachment and container lifting using extended-reach

tools to reduce personnel exposure during handling. All of the 3.8-liter paint cans were overpacked in this manner. Several additional overpack containers were also fabricated for repackaging the PCB-containing sludge material when EPA and DOE approvals were granted.



Fig. 3 Overpack Containers Used for the Remote-Handled Waste, and Loading Geometry in a Remote-Handled Drum.

The initial drain tank sampling that had indicated the presence of a PCB contaminant also exhibited large variation, and a comprehensive sampling and analysis program was carried out to provide detailed chemical characterization of the entire Hot Laboratory drain line residue waste stream. Samples were collected from the 3.8-liter paint cans during their repackaging, and additional samples were collected from the 11.4-m³ drain tank and a weir box. The radiological activity of these samples was too high for handling by standard commercial laboratories, and chemical analyses were performed by the Lawrence Livermore National Laboratory. The results confirmed the PCB contaminant and showed that the waste stream was otherwise non-hazardous.

OVERCOMING THE OUTSIDE CHALLENGES

Interfaces with the DOE and the Hanford site during 2002 identified a possible window of opportunity for shipping both the ETEC and the Battelle Columbus Laboratories TRU waste to Hanford in late 2002. The opening of that window was contingent upon in-progress negotiations between the DOE and the State of Washington. Shipping window closure was late December 2002, based on a winter restriction on highway usage for these TRU shipments. The opportunity provided both a focus and a critical time constraint for the completion of the regulatory decision and approval processes for intersite transfer, transportation, PCB waste solidification, and Hanford waste acceptance that had been initiated previously to address all possible paths forward.

The PEIS Record of Decision amendment for intersite transfer from ETEC and Battelle Columbus to Hanford was signed on August 27, 2002, based on favorable negotiations between DOE-RL and the State of Washington, and was published in the Federal Register on September 6, 2002. That allowed the DOE to issue a 60-day shipping notice, opening the shipping window in early November 2002.

Battelle Columbus was working in parallel on the acquisition of three CNS 10-160B casks for a fall 2002 shipping campaign to Hanford. The three casks included a DOE cask purchased jointly by the DOE-Ohio Field Office and DOE-CBFO, a commercial cask leased from Duratek, Inc., and a Navy cask obtained under an interagency agreement. The NRC completed its review of the 10-160B Certificate of Compliance amendment during this time period that included the ETEC TRU waste content codes, and granted approval on October 15. That approval provided a transportation path forward for the ETEC shipments, to be coordinated with Battelle Columbus, and formally defined the packaging criteria for waste shipment.

The EPA prepared a PCB draft enforcement discretion letter in September 2002 for the solidification of the ETEC TRU aqueous sludge for transportation or storage, including a list of technical requirements, and issued the final enforcement discretion letter on October 24, 2002. ETEC provided a comprehensive response to those requirements, and obtained DOE approval on November 6, 2002. The EPA and DOE approvals provided a path forward for solidifying the aqueous sludge and qualifying it for shipment.

The negotiations between DOE-RL and the State of Washington provided the go-ahead for the submittal of Waste Profile Sheets to Hanford for the ETEC TRU waste streams. Those profiles were submitted on October 9, 2002, and were subject to two sets of reviews. One was to establish that the waste met Hanford Waste Acceptance Criteria, and the second was to confirm that the acceptable knowledge documentation, submitted to Hanford in draft form as part of the profiles, met Hanford requirements for their waste certification to WIPP acceptance criteria. This information was also used to identify potential interim storage locations for the waste at Hanford, which in turn determined the final packaging configuration for the ETEC waste. Waste management requirements differed for the different waste streams because of the varied waste stream characteristics.

Planning was also initiated with the DOE-CBFO and the State of California to establish a highway route for shipments to Hanford. Shipment from ETEC required shipment-specific planning, including tractor/cask driver crews, routing, emergency response planning, identification of truck inspection and inclement-weather safe parking locations, scheduling to avoid large metropolitan areas during rush hours, and special permits for cask transport as overweight shipments. These considerations were worked by a multi-organizational team, including DOE-CBFO, DOE-OAK, ETEC, and the California Energy Commission's California Nuclear Waste Transport Working Group.

IMPLEMENTING THE PATH FORWARD

The outside decisions and approvals on intersite transfer to Hanford, solidification of the PCB-containing aqueous sludge, and the use of the 10-160B shipping cask provided direction for the

final packaging of the ETEC waste. The aqueous sludge was solidified and completely repackaged into overpacked 3.8-liter cans three days after approvals were granted. One RH drum of debris waste, classified as mixed hazardous because of its lead content, was repackaged into two CH drums to meet Hanford requirements for hazardous waste storage. The Hot Laboratory drain line residue waste stream could be shipped remote-handled in the shielded 10-160B cask and stored at Hanford as RH PCB-containing waste, and thus the overpacked 3.8-liter paint cans were moved from approximately fifty shielded storage drums to seven certified RH shipping drums (Fig. 3). That reduced the total TRU waste volume to 4.2 m³ and the total number of ETEC TRU waste drums to twenty, and reduced the number of 10-160B shipping casks required to ship the entire ETEC TRU inventory off site to two.

Planning for waste shipments to Hanford also included updates to the acceptable knowledge data packages, the preparation of Hanford Container Data Sheets for the twenty drums, the completion of cask handling and loading procedures for the 10-160B cask, the specification of quality assurance inspection requirements for the planned shipments, and extensive interfaces with the State of California on transportation details. The container data sheets were submitted to Hanford on November 21, 2002 for approval. The quality assurance requirements were developed to assure compliance with the cask handling and loading procedures, the 10-160B Certificate of Compliance, and the Hanford Waste Acceptance Criteria. They included detailed check lists that were used to review compliance with all requirements for each waste stream.

One consideration that arose during the planning for 10-160B drum pallet loading was the demonstration that each cask payload met the cask limitation to exempt quantities of fissile materials. The TRU fissile isotopes content was far below the limit, but the total ²³⁵U content of the Hot Laboratory drain line residue, which was to be shipped in a single cask, exceeded the 15 g per payload criterion. The fissile exempt limitation was met by designing the packaging geometry to meet the alternative criterion of no more than 5 g of fissile material in any 10-liter volume [3]. That required rearrangement of some of the overpacked 3.8-liter cans within and between drums, minor repackaging of a few cans, and the specification of the drum loading arrangement on the drum pallets. The repackaging was completed on December 7, 2002. The twenty drums were then loaded onto four 10-160B drum pallets on December 8 in preparation for shipping approvals and final shipping arrangements, and placed in a facility storage vault.

A decision was made by DOE-Headquarters on December 12 to send the Duratek and Navy 10-160B casks from Battelle Columbus to ETEC for shipment of the entire ETEC TRU inventory to Hanford as a single shipping event. A seven-day shipping notice was given to California and Oregon on that date in anticipation of an agreement between DOE-RL and the State of Washington for waste receipt. Loading hardware for the 10-160B cask was shipped from Hanford to ETEC on December 13, and the two casks and a Duratek loading crew arrived at ETEC on December 16. DOE-RL and the State of Washington reached a shipping agreement on December 16, and a one-day-early waiver to the shipping date was agreed upon by California and Oregon to beat a predicted early-winter snowstorm. Hanford approvals to ship were received on December 17, and the two casks were loaded on that day. Duratek performed and documented the cask closure and pre-shipment inspections as the NQA-1-qualified registered user of the cask.

The two loaded CNS 10-160B casks and transport vehicles were inspected on the morning of December 18 and the TRU was shipped off-site that afternoon (Fig. 4). Emergency response capabilities were provided by a van of DOE-CBFO personnel that followed the shipment. The shipment was tracked by both DOE and the State of California using the DOE Transportation Tracking and Communication System (TRANSCOM) and passed through northern California a few hours before the predicted snowstorm closed the highway. The overweight status of the shipments did cause delays in Oregon to resolve permit issues and to stop highway traffic at a bridge to cross one tractor/cask rig at a time. The TRU shipment successfully arrived at the Hanford site in the early morning of December 20, 2002.



Fig. 4 Loaded CNS 10-160B Casks and Emergency Response Van Staged for Shipment

LESSONS LEARNED

This program met several major challenges, and successfully eliminated the TRU waste inventory from the ETEC site because of an extensive effort by both on-site and off-site personnel. A long series of activities was required to identify and implement a path forward. When an opportunity became available, the execution window was exceedingly narrow. The shipping window was about a week, defined by DOE decisions, negotiations, and approvals, winter shipping restrictions, the Christmas holiday season, and the end of the lease periods for the Duratek and Navy casks. Detailed preliminary preparation was critical to be able to take advantage of that opportunity.

The DOE national TRU strategy has evolved since this work was performed, with a greater focus on TRU removal from the small-quantity generator sites. That is expected to improve the process for other small sites. However, several general observations based on the ETEC experience are relevant to the TRU waste disposition programs at other sites:

- (1) Be an active member of the TRU community, to maintain a current awareness of requirements, politics, technology developments, and national strategies, and to ensure being an integral part of those strategies.
- (2) Pursue all possible options, because the evolving political and regulatory climate will impact strongly which option is ultimately approved. The work on alternative paths is valuable, as it helps establish communication ties with the rest of the TRU community, identify and set requirements, and maintain the high site visibility necessary to effect a waste disposition solution.
- (3) Know all of the requirements (regulatory requirements, shipping requirements, and waste acceptance criteria) in detail and plan ahead to meet them. No step in the process is simple, and each requires attention to all details.
- (4) Begin documentation and waste preparation early in the process. That will provide the opportunity to identify and resolve issues that require additional characterization or repackaging with minimal schedule impact.

The ETEC success can also be attributed to not giving up on the process, in spite of the overwhelming odds that challenged near-term success.

REFERENCES

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