THE NEVADA TEST SITE LEGACY TRU WASTE – THE WIPP CENTRAL CHARACTERIZATION PROJECT

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ABSTRACT

This paper discusses the Central Characterization Project (CCP) designed by the Waste Isolation Pilot Plant (WIPP) to aid sites, especially those sites with small quantities of transuranic (TRU) waste streams, in disposing of legacy waste at their facility. Because of the high cost of contracting vendors with the characterization capabilities necessary to meet the WIPP Waste Acceptance Criteria, utilizing the CCP is meant to simplify the process for small quantity sites. The paper will describe the process of mobilization of the vendors through CCP, the current production milestones that have been met, and the on-site lessons learned.

INTRODUCTION

The Nevada Test Site (NTS) has been important to the U.S. Department of Energy (DOE) complex during the days of weapons testing while becoming a regional site for disposal of low-level radioactive waste and storage of legacy transuranic (TRU) waste for other weapons research sites. From the 1970s to the late 1980s, the NTS accepted TRU waste for storage. In the 1990s, NTS decided to dispose of TRU waste at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The NTS is considered a small quantity site since the inventory of legacy drums is approximately 1800 drums. Due to the age of the drummed waste, limited acceptable knowledge (AK) information, and WIPP Disposal requirements, characterization is necessary to determine the contents.

In 1996, the NTS began construction of the Waste Examination Facility (WEF) to allow the site to generate waste characterization data to demonstrate compliance with the WIPP waste acceptance criteria documents. To meet the WIPP acceptance criteria, the site must perform NTS waste characterization activities consisting of Non-Destructive Assay

(NDA), Non-Destructive Examination (NDE), and Headspace Gas Sampling (HSG) on all drums and Visual Examination (VE) as a quality control check of radiography on a sufficient number of drums to determine a site-specific miscertification rate, as required in the WIPP Waste Analysis Plan (WAP) of the Hazardous Waste Permit.

Although many of these characterization processes had been run on the waste during previous characterization campaigns, the data was not collected under a WIPP certified program. To avoid repeating the characterization without a certified program, the U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office (NNSA/NV) decided to utilize the WIPP Central Characterization Project (CCP). The CCP is a program that the Carlsbad Field Office (CBFO) initiated to provide characterization services to the small quantity sites in the complex that were interested in sending their waste to the WIPP but were unable to afford the costs and difficulties of hiring vendors that perform the characterization activities and getting the vendors certified. In addition, the CCP provides assistance to WIPP-certified large quantity sites to assist these sites in meeting production goals and waste shipping milestones.

The CBFO deployed the CCP vendors to the NTS beginning in June 2001. There are currently three DOE sites employing the CCP to characterize their waste for disposal at the WIPP: NTS, Savannah River Site (SRS) and Argonne National Laboratory in Chicago (Argonne-East). SRS was the first site to establish the CCP to aid in increasing the characterization throughput since the site had a TRU waste characterization and certification program (5). The benefit of the CCP for Argonne-East and the NTS was the ability to standardize mobile characterization equipment. Although this is the primary concept of the CCP, due to differences in the waste composition and descriptions at the different sites, different types of characterization equipment are made available for deployment by the CCP. At the NTS, a real-time radiography unit, a mobile HSG drum venting system and a segmented-gamma scanner are utilized. The NTS M&O contractor, Bechtel Nevada (BN), provides the VE services in an established system that conducts VE and repackaging in a permanent structure at the WEF.

The CBFO conducted the Certification Audit of the NTS CCP during the Fall of 2002. Site certification is pending approval of the Certification Audit report by the state of New Mexico. The vendors have been processing drums through the CCP since they deployed in Summer 2001, but shipping to the WIPP cannot become a reality until the site becomes certified.

This paper describes the history of the TRU waste stored at the NTS: the lifecycle project plans for the disposition of the waste at the WIPP, the past characterization activities performed on the waste, and the decision to utilize the CCP. Finally, the paper will lead to a discussion on the lessons learned and improvements that could be made on the project for those sites with TRU waste across the DOE complex that are contemplating the use of the Central Characterization Project.

HISTORY OF THE NEVADA TEST SITE LEGACY TRANSURANIC WASTE

Currently, the NTS is storing a number of different TRU waste streams in different forms of packaging. The bulk of the TRU waste currently stored at the NTS (approximately 1650 containers) was received from Lawrence Livermore National Laboratory (LLNL). This waste, packaged in 55-gallon drums, 85-gallon overpacks and metal boxes of differing dimensions, consists of LLNL glovebox bag-out debris waste, uncategorized metal debris, and a small number of sludge drums. Other TRU waste streams include miscellaneous debris wastes obtained from the Rocky Flats Plant, Lawrence Berkeley Laboratory, and EG&G in addition to soil and gravel debris wastes generated from environmental restoration activities. The entire TRU waste inventory at the NTS consists of approximately 2000 containers. Most of the TRU waste inventory is packaged in 55-gallon metal drums.

Subsequent to arrival at the NTS, the LLNL-generated TRU waste drum inventory was placed inside vented 85-gallon overpack containers to protect against weathering. These overpack containers were removed during earlier campaigns beginning in 1997 as individual containers were characterized during earlier campaigns. Approximately 700 55-gallon drums are currently stored inside vented 85-gallon overpack containers. Most of the TRU waste inventory is packaged in 55-gallon metal drums. The drum population that is stored in 85-gallon overpacks causes a number of concerns in the characterization process. During storage in an overpack, condensation builds up within the overpack and causes the interior drum holding the waste to rust. In order to perform characterization on the drum, it must be removed from the overpack. The rust build up due to condensation compromises container integrity as specified in the WIPP WAC, therefore necessitating the added expense of repackaging in lieu of radiography. In order to perform characterization on the drum, it must be removed from the overpack.

Some of the legacy TRU waste is packaged in 58 metal boxes of various sizes and shapes. These boxes are larger than standard waste boxes and, therefore cannot be characterized by the CCP vendors nor can the boxes in their current configuration be transported in WIPP-required TRUPACT II shipping casks. Consequently, this waste has a different disposition path and will not be processed by the CCP.

Over the last few decades, while the NTS legacy TRU waste has been stored, the DOE has undertaken numerous campaigns with vendors to perform characterization of the NTS legacy TRU waste. Trying to meet the portion of the WIPP hazardous waste permit known as the Waste Analysis Plan (WAP), the NNSA/NV has attempted to make drums available for shipment but has been unable to obtain a site certification. The most recent audit was performed on the Central Characterization Project, not on the NTS characterization programs as designed in the past. The M&O contractor at the NTS has developed and maintained a Visual Examination (VE) program that has processed approximately 600 drums since October 1997. This program was retained at the NTS for use by the CCP during this campaign. Although the VE process at the NTS is a very efficient one, the drums previously run through the process were not through a CBFO certified program, therefore the data was not acceptable for characterization of the waste.

However, this data was very useful for the development of the Acceptable Knowledge (AK) documentation required for shipping.

By employing the CCP, the NNSA/NV would contract vendors that already are compliant with the WIPP requirements and would need little preparation for certification. Although the vendors would still have to go through the certification process, the contractor for the program was the M&O for the WIPP with the intimate knowledge of meeting the specific program requirements (4). This experience base was the primary contributing factor for the CCP selection at to the NTS.

The NNSA/NV and CBFO agreed that the BN-developed VE process would be incorporated into the CCP characterization activities at the NTS. Besides performing the VE, BN would support the vendors by maintaining the inventory database and supplying personnel to provide the drums on a daily basis. The authorization basis for the facility was expected to be in place for this activity so the vendors could operate at a maximum production rate while adhering to all applicable regulations and requirements. BN personnel would be responsible for ensuring the CCP personnel are compliant with on-site Nuclear Facility regulations and site-specific training requirements. In addition, BN would provide oversight of the CCP as the host-site representative.

With the mobilization of the CCP, it appeared to the NNSA/NV that it has finally found a way to dispose of its waste in a cost effective, and time appropriate manner. Milestones and agreements made with the State of Nevada Division of Environmental Protection would now be met, shipping dates were being scheduled with the WIPP, and shipping routes were being outlined.

CENTRAL CHARACTERIZATION PROJECT

When the NTS contracted with the CBFO to have the CCP mobilize on-site to characterize its TRU waste, the understanding was that CCP would come equipped with vendors, operators and managers. The CBFO M&O, Washington TRU Solutions (WTS) (formerly Westinghouse), sponsored the program and the CCP was formed. In order to provide the vendors for characterization, WTS contracted with various companies that were able to meet the WIPP WAP waste characterization requirements for sampling methods. The inception of the CCP through the CBFO is described in more detail in a paper entitled "Characterization Strategy for Contact-Handled TRU Waste Generated by Small Quantity Sites" by Bennington, Porter and Kelley et al.(4).

As required by the WIPP waste acceptance requirement documents, data from the following characterization methods must be provided to confirm the Acceptable Knowledge: Non-Destructive Assay, Non-Destructive Examination, Headspace Gas Sampling and Visual Examination.

Non-Destructive Assay (NDA)

The Segmented Gamma Scanner (SGS) is a gamma spectroscopy-based NDA system that is used to quantify the activity, i.e., quantity, of individual radioisotopes and/or to determine the isotopic ratios for actinides such as plutonium and uranium. Acceptable Knowledge (AK) supports the presence of only actinides in the waste, the isotopic measurement may be the only analysis that is required if the isotopic ratios are integrated with a neutron assay system. The collimated coaxial detector views the drum directly across from the transmission source for determining matrix density. The coaxial detector and transmission sources are scanned vertically along the height of the drum in 4" segments. Measurements of individual radioisotope activities are made with and without the transmission source being exposed to the drum. A collimated low-energy germanium (LeGe) detector views the entire drum and can determine the ratios of plutonium isotopes, ^{235}U/Pu, ^{241}Am/Pu, ^{237}Np/Pu, ^{239}Np/Pu and ^{243}Am/Pu in the waste container. For radioisotopes, which are not measured by the low-energy version of the Multi Group Analysis (MGA) code, the SGS will measure these radioisotopes directly.

Data is collected as 4096-channel spectra for each detector. There are also additional spectra collected for the coaxial detector, based on the angular position of the turntable. An index pulse issued once each rotation, based on the turntable "index" position, is used to start data collection in "group 1," then "group 2," etc. for 8 groups per rotation. This data is used to indicate non-uniform distribution of matrix material and radioactive material.

According to the WIPP Waste Acceptance Criteria, Non-Destructive Assay, or radioassay, is required in order to "track the WIPP radionuclide inventory, by isotopic activity and mass, for…radionuclides listed…, to demonstrate that each payload container disposed of at the WIPP contains TRU waste…, verify that applicable transportation and facility limits on individual payload containers and assemblies for Fissile Gram Equivalent, Plutonium Equivalent-Curie, and decay heat are not exceeded…" (1)

Personnel perform NDA in accordance with an approved operating procedure. All equipment is operated by trained and qualified personnel in accordance with the CCP Training and Qualification Plan.

Visual Examination (VE)

The VE process is performed in the Visual Examination and Repackaging Building (VERB) located at the NTS Waste Examination Facility. The VERB consists of a glovebox located within a secondary containment structure housed within a metal building. High-Efficiency Particulate Air (HEPA) filters are installed in the ventilation systems in both the glovebox and the secondary containment structure to ensure isolation of radiological hazards. A control room-operated remote camera and communication system is used to record and document VE results. The process consists of the following steps:

- Bag-in selected drum for which to perform VE.
- Remove drum lid.
- Remove drum contents describing the waste configuration and recording contents as the waste is removed from the drum.
- Sort contents by debris waste type (referred to as waste material parameters).
- Repack waste contents into an inspected, prepared payload container (55-gallon drum approved for shipping to WIPP inside a WIPP shipping cask).
- Record waste description and waste item weights on videotape and in a database as the waste is packed into the designated payload container.
- Bag-out payload container on completion of repacking.
- Generate required data reports documenting the VE process.

VE is required "to verify the TRU mixed waste streams by Waste Matrix Code for purposes of physical waste form identification, determination of sampling and analytical requirements, and to identify prohibited items." Also, VE is required "to provide a process check on a sample basis by verifying the information determined by radiography, and to confirm the waste stream delineation by acceptable knowledge" (2).

Non-Destructive Examination (NDE)

The Mobile Real Time Radiography (RTR) Non-Destructive Examination System is a nondestructive qualitative and semi-quantitative technique used to verify the physical form of the waste in each waste container. The physical form must match the waste stream description and the waste matrix code assigned to the waste container by the Acceptable Knowledge (AK) document. The RTR performs nondestructive examination (NDE) using x-ray scanning of the contact-handled (CH) TRU waste containers.

The RTR is used to x-ray TRU waste drums, up to 83 gallons in volume, to determine their content attributes. The RTR operator views the drums looking for WIPP prohibited items - liquids and sealed containers - verifies the waste matrix code, and determines the waste material parameter volumes. The RTR system contains an x-ray tube, which operates in the range of 20kV to 320kV. There are normally only minimum radiological restrictions on occupancy on the outside of the RTR trailer during x-ray operations. However, some Host Sites may require limited radiation posting during operations. Background radiation levels from adjacent storage areas or when used near other NDE/NDA mobile trailers must be less than 2.5mR/hr, so as not to adversely effect the measurements taken in this trailer.

Headspace Gas Sampling System (HSGS)

The Headspace Gas Sampling System (HSGS) is an intrusive process that samples and analyzes the headspace gas in a TRU waste drum. Since the HSGS has the potential to introduce a spark and a spark source into the TRU waste drum, the process is preformed remotely inside a cabinet designed to contain any hydrogen/air deflagration. The HSGS

is an on-line system that automatically collects a representative sample of drum headspace gas through a piping manifold connected to a Gas Chromatograph (GC) with a Flame Ionization Detector (FID), Thermal Conductivity Detector (TCD) and Mass Spectrometer (MS). The HSGS has two GC/MS units; each unit is capable of processing every other drum loaded into the system to optimize the system's throughput.

The HSGS system equipment has the capability to perform the multiple functions of drum venting, headspace gas analysis, purging and installation of HEPA grade filter vents on transuranic waste (TRU) 55-gallon waste drums.

HSGS is required "to identify the Volatile Organic Compounds (VOCs) and quantify the concentrations of the VOC constituents in the total waste inventory to ensure compliance with the environmental performance standards" of hazardous waste standards. (2)

The analytical methods are equivalent in performance to those specified by DOE-CBFO for the TRU waste container headspace gas characterization as follows:

- "Modified Method TO-14 for the Gas Chromatography/Mass Spectrometry Determination of Volatile Organic Compounds in Waste Container Headspace";

- ASTM Method 1946-82, "Standard Method for Analysis of Reformed Gas by Gas Chromatography";

- EPA-SW-846, method 8260B, "Volatile Organic Compounds by GC/MS."

On-line sampling and analysis considerations such as on-line control sampling and on-line Quality Assurance/Quality Control requirements are equivalent to EPA-SW-846 approved draft method 8450 "Determination of Volatile Organic Compounds and Methane in Headspace Gas by Fourier Transform Infrared Spectroscopy". Equivalent performance has been demonstrated through documented system and instrument tests, as well as successful participation in Headspace Gas Performance Demonstration Program (PDP) analysis of blind samples.

The HSGS is used for the analysis of VOCs, in the range from less than QAPjP-specified Method Detection Limits (MDLs) to levels of approximately 500 to 1200 ppmv. The HSGS unit uses a fixed sample loop and a split injector to meet minimum VOC concentrations specified in the QAPjP, while extending the upper limit of linear calibration. The process is based upon the introduction of VOCs onto a capillary column using a fixed volume injection loop. An MS is used to identify all of the VOCs of concern (NOTE: m- and p-xylene are undifferentiable using this method and are reported as m,p-xylene) up to a concentration level of approximately 1200 ppmv (limited by the upper linear limit of the calibration curve) by direct injection and analysis.

The HSGS also provides analysis of hydrogen and methane in the range from less than the MDL to volume percent concentrations.

The HSGS is required to analyze blind audit samples. These audit samples are part of the Performance Demonstration Program. Details of this program are in the *Performance Demonstration Program Plan for Analysis of Simulated Headspace Gases* (Gas PDP Plan), current version.

Personnel perform HSG sampling in accordance with an approved operating procedure. All equipment is operated by trained and qualified personnel in accordance with the CCP Training and Qualification Plan.

LESSONS LEARNED

For other small quantity sites and sites that wish to employ the CCP program to characterize its TRU waste, the following discussion of lessons learned at the NTS can be useful. Although the CCP has been effective in characterizing a population of the NTS TRU legacy waste, there are some areas with opportunities for improvement.

Mobilization and Setup

The CCP began mobilization at the NTS in June 2001 with the HSG and SGS unit arriving first. The RTR unit was the final unit to arrive at the NTS in October 2001. The process for the mobile vendors to get on-line was time consuming and fairly complicated. Each piece of characterization equipment had a mobilization period that ranged from two weeks to over a month. Each unit required support from the host-site for utilities such as having the site ready with power hookups and phone lines. In addition, an administration trailer was required to function as the home base for the CCP team. Once all the utilities are provided and the equipment is up and running, the equipment must go through a series of tests and quality assurance checks. Also, there were Quality Assurance requirements to be completed on the equipment before running actual TRU waste drums.

Training and Procedures

When the CCP deployed to the NTS, the program was just beginning. The CCP Project Office had begun to staff up to support the three different sites but the field personnel were just coming on board. Each characterization unit had core resources (experts) to support the equipment but qualified operators were needed. The process of locating, hiring, and training personnel resulted in unplanned start-up delays.

In addition to hiring and qualifying personnel, CCP procedures for the characterization equipment needed to be completed prior to startup. Many of the CCP procedures are universally utilized at the different sites. Depending on the type of characterization equipment utilized and the requirements of the host site, site-specific procedures may be required. At the NTS, the type of characterization equipment was different than any other site which required completing new procedures prior to startup. Dry-run activities operating to the new procedures were required as well.

Prior to beginning characterization of contaminated waste drums, a Management Assessment (MA) was conducted to verify implementation of host-site and CCP procedures and processes governing the waste characterization activities. All findings associated with the MA were required to be completed prior to starting characterization. It is important that the team be prepared and all processes fully understood to avoid unnecessary delays associated with the initial startup assessment. Other assessments conducted throughout the first phase of the project additionally prepared the team for the Certification Audit. Once the characterization activities began, the focus of the project was on preparing for the Certification Audit versus full-scale production. This phase of the project was crucial and contributed to the success of the Certification Audit.

Production and Schedule

With nearly 2000 legacy TRU drums at the NTS to be characterized and shipped to WIPP for disposal, only 1060 were involved in this first campaign. Starting June 2001, the CCP has processed approximately 300 to 500 drums by the different characterization processes.

Each of the characterization systems works at a different production rate. The RTR unit takes an average of 30 minutes per drum depending on operator efficiency and drum contents. The SGS system takes about 40 minutes per drum because it processes the drum in multiple segments, or detector positions, with each being evaluated for 10 minutes. Due to the invasiveness of the VE process, only one or two drums can be run through the glovebox per day. Because VE is only used as a QC check for RTR, or when repacking is necessary due to integrity of the container or removal of prohibited items, only a percentage of the drums will have to go through this process.

The HSG system is the most time consuming system of the vendors due to the 3 hour warm-up and quality assurance checks required each operating day and the frequent but regular malfunctioning of the drilling component. The system continued to operate at a slow production rate until software and hardware overhaul corrected the situation. To meet the WIPP WAP, the drums processed through the HSG must be heated, or thermally conditioned, for a minimum of 72 hours at 65 degrees Fahrenheit. This causes difficulties for the NTS in that there are few facilities available for meeting this conditioning. Until a Thermal Conditioning Unit (TCU) could be purchased and placed on-line, many Safety Basis issues would have to be resolved. In the meantime, the Visual Examination and Repackaging Building was used to heat the drums. Although this conflicted with any efforts to VE or repackage drums for the CCP, once the TCU was in place this problem was resolved.

The TRU waste at the NTS is stored on a concrete pad covered with a polyvinyl-chloride coated polyester fabric material that meets National Fire Protection Agency (NFPA) requirements. This tent structure has dimensions 27.6m (90.5ft) wide and 72.2m (236.8ft) long with a maximum height of 12.6m (41.3ft). This structure houses all legacy TRU drums as well as the oversized boxes. The TRU Pad Cover Building (TPCB) is approximately 248m (800ft) from the Waste Examination Facility (WEF) where the

vendors are located (3). In order for the drums to be provided to the vendors for characterization, ironworkers must move pallets from the TPCB to the WEF. Logistics for such drum movement must be determined or the production schedule can be drastically affected. Because each characterization area is limited to a small population of drums (~4) by the AB, a just-in-time (JIT) pickup and delivery system is required. The JIT system is very time-consuming and labor intensive.

The site must decide how the shipping protocol will be met. The method for shipping TRU waste to WIPP is to use the TRU Pact II container. Each container holds 14 shrink-wrapped drums, with a maximum of 3 TRU Pact II containers on each flatbed. The CCP provides a Mobile Loading Unit (MLU) to the sites to load the TRU Pact II containers. With the MLU, the site gets a grating surface with stairs and leak checking equipment. Although the site must provide a crane and operators for that activity, the CCP provides the operators for the leak checking equipment. For the NTS, the best location for the MLU has been determined to be on the TRU Pad. Mobilization of the MLU is not expected until second quarter fiscal year 2003.

Opportunities for Improvement

Since SRS was the first site to utilize the CCP, lessons learned from the inception of the program at that site would prove to be valuable to the initiation of the program at the NTS. After successful utilization of the CCP at the NTS, suggestions on how the process can be more effective at other sites that initiate the program for characterization of their TRU waste will be discussed below.

As with most projects, free flowing and open communication are extremely important. As noted in "Managing TRU Waste Certification at Multiple Sites through Centralization" by Sparks-Roybal, Crawford, Cantu et al., the CCP at SRS found that communication between the two organizations needed improvement when first deployed due to the amount of data that is transferred between the two projects (5). Similarly at the NTS, communications between the site and the CCP became an important part of making the program a success. The main players of the project at the NTS include NNSA/NV, CBFO, BN and WTS, not to mention the many other stakeholders both public and private. After deployment of the CCP at the NTS it was noted by the CCP management personnel, BN management personnel and the NTS NNSA/NV and CBFO DOE management personnel that more regular and frequent communications was necessary. Often regularly scheduled weekly meetings were not attended by all four groups and as a result communication breakdowns occurred. A regularly scheduled monthly management meeting is suggested so that any potential project hurdles can be quickly overcome. It was discovered that the on-site operations need more formal daily communications with the host-site supervision. This was achieved through a Plan of the Day meeting attended by all BN and CCP field personnel. It is also suggested that management needed more weekly and monthly discussions on the production level issues as well as project management issues in order to prevent affecting schedules with little notice of the managers.

In the experience of the NTS with the CCP, it is noted that the Safety Basis and Nuclear Facility infrastructure must be in place before mobilization of the CCP. Some of the most devastating production delays were caused by limitations of the drum inventory due to the existing safety basis. CCP operations were suspended in late 2002 as the available drum population under the existing radiological facility safety basis was exhausted. BN is currently preparing for an Operational Readiness Review to become a Category 2/3 Nuclear Facility as early as April 2003. Current plans are for CCP to return shortly after the change in authorization basis.

CONCLUSION

Before the CCP was utilized at the NTS, the legacy TRU waste had a path forward to be disposed at the WIPP but had not been able to achieve this milestone. Although no shipments have been made from the NTS to WIPP at this time, the prospects of gaining certification and beginning shipments are more of a reality than it has been with prior characterization campaigns. With the successful completion of a CBFO Certification Audit in September 2002, the pending approval by the U.S. Environmental Protection Agency and the New Mexico Environmental Department is a major achievement.

The State of Nevada has approved, and the State of California has indicated they are going to comply, with a shipping corridor for the NTS TRU waste to make its final disposition at the WIPP. The shipping schedule calls for the NTS to make its first shipment to WIPP in 2003. By achieving milestones such as this, the NNSA/NV and CCP are working diligently to make the closure of legacy TRU waste at small quantity sites around the complex a reality. The success of this project is due to the contribution of many years of planning by the NNSA/NV and BN personnel in the Nevada Operations Office and the Nevada Test Site. The contribution of the CCP WTS personnel has aided in the completion of a project so many years in the planning.

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