Retrieval of Buried Transuranic Waste at Oak Ridge National Laboratory[1]

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ABSTRACT

Remote-handled (RH) alpha-contaminated transuranic (TRU) waste was placed into 22 unlined trenches in Solid Waste Storage Area (SWSA) 5 North at Oak Ridge National Laboratory (ORNL) between 1971 and 1981. The majority of the RH TRU waste is packaged in 204 concrete casks having one of several configurations. In addition, a number of the 22 trenches contain waste packaged in wooden boxes, metal boxes, and metal drums. At least two trenches are documented to contain loose materials placed into the trench with no indication of original packaging, and one trench is documented to contain mixed Resource Conservation and Recovery Act (RCRA) waste and is identified as a RCRA storage unit. Pyrophoric material is also present in at least one trench.

This paper describes the progress to date in retrieval of the TRU waste from the trenches at ORNL SWSA 5 North. A number of lessons learned have been incorporated by the project team as work progressed. Extensive flexibility built into the project during the planning and start-up phases have been crucial to adapting to the as-found conditions that have been encountered. Modifications to project documentation and equipment have also been implemented to refine the retrieval process. The paper documents the details of what has worked well during operations, including operational events and unexpected conditions.

INTRODUCTION

Bechtel Jacobs Company LLC is currently remediating SWSA 5 North under the Oak Ridge Reservation accelerated closure contract to the U.S. Department of Energy (DOE). The scope of the project is to retrieve the inventory of waste packages in the 22 trenches, overpack the wastes, and place the overpacked waste into interim storage pending final characterization, packaging, and disposal. The initially expected inventory of the 22 SWSA 5 North trenches included up to: 204 concrete casks; 18 boxes of various sizes, shapes, and materials of construction; 12 drums of varying construction; and approximately 14 m^3 (500 ft^3) of loose waste placed into the trenches.

The accelerated closure of Melton Valley, including this project, must be complete by September 2006. This project is viewed as one of the highest risk and longest duration projects in the accelerated Melton Valley closure. The SWSA 5 North TRU Trenches waste retrieval project is being performed under a variety of regulatory drivers. The TRU waste is being retrieved under a consent agreement between the DOE and the State of Tennessee. The trench containing RCRA waste is subject to closure under a state-approved RCRA Closure Plan. The entire SWSA 5 North facility is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site, with soil remediation in the 22 trench area and capping of a separate 4-trench area being completed under the CERCLA Melton Valley Record of Decision (ROD).

As of December 2005, retrieval is complete in 14 of the 22 SWSA 5 North trenches, with a total of 191 concrete casks overpacked and staged in interim storage. As each TRU waste package is retrieved, it is overpacked and staged for treatment in the Transuranic Waste Processing Facility (TWPF) that is operated by Foster Wheeler at the ORNL site under contract to DOE. The steel overpacks for the concrete casks were designed by Foster Wheeler to interface with their operating cell at the TWPF. As drums, boxes, and loose waste are retrieved, they will be overpacked into other steel overpacks of appropriate size and shape provided by the remediation contractor. Once in the TWPF, each waste package will be opened, the waste further characterized, and then segregated and repackaged as appropriate for final disposal.

UNEXPECTED CONDITIONS

As fieldwork on the retrieval of TRU waste packages from SWSA 5 North has progressed, a number of unexpected conditions have been encountered. Operating experience has also resulted in lessons learned on how to more effectively accomplish the project. The extensive preparations and robust, flexible approach implemented by the project team has allowed the project to adapt to and incorporate the majority of these conditions into the planned waste retrieval with minimal impact.

Trench Configuration

During the scoping of the project, available information indicated that casks had been buried in each trench in a single row. However, as excavation proceeded on the first trench, identified as Trench 1, it was discovered that at least some of the casks in Trench 1 had been stacked directly on top of one another at burial. Waste disposal trenches in the ORNL SWSA 5 South area were known to typically have been loaded in a stacked configuration, with the trench backfilled with grout after placing the packages of waste. It is now believed that, when retrievable storage was first

implemented for TRU waste packages in SWSA 5 North, the practice of double-stacking the containers was carried forth from SWSA 5 South operations into Trench 1. The containers in Trench 1 had not been grouted in place, and subsequent SWSA 5 North trenches have all been single-stacked, indicating further evolution of the waste storage practices in SWSA 5 North over time. Disposal records, especially during the earlier years of waste storage in SWSA 5 North, are often incomplete. Interviews with personnel did not reveal complete information about these early activities, which is likely at least partially due to the amount of time that has elapsed and the previously mentioned evolution of storage practices. While historical records and personnel interviews are valuable, project planning needs to allow for incomplete or inconsistent information.

Container Location and Identification

TRU waste packages at ORNL have historically been identified and tracked using Accountability Transfer Numbers (ATNs), and TRU waste casks in retrievable bunker storage are stenciled with the unique ATN number assigned to each package. While it was somewhat uncertain when the practice of labeling each cask with the ATN number became common, it was anticipated that the majority of the TRU casks in the 22 trenches would be identifiable by ATN markings. This has proven not to be the case, as none of the casks retrieved to date are labeled with visible ATN markings. As a result, the extensive effort to compile and understand historical data has proven to be invaluable in identifying the casks as they are retrieved.

During cask burial operations in SWSA 5 North, two trenches were often open at one time. The project has encountered instances where a cask listed in historical records as being placed in one trench is actually located in an adjacent trench. In each case, the casks are located in a trench that was open at the same time as the trench identified in the historical records. To date, one cask has been retrieved that was not expected based on information found in the available historical records. However, based on the trench where it was located, the cask could be matched to one that had been generated at the time the trench was in use but that was not recorded as being placed in the SWSA 5 North trenches. The significant effort invested in locating, compiling, and reviewing available historical records, interviewing retired operations personnel, and documenting process knowledge of the waste generation and trench storage operations has been key in identifying and documenting the anomalous casks when discovered in a trench.

As originally planned, a data package containing documentation is being prepared for each of the waste packages retrieved and overpacked. These data packages will be used to track the location of the inventory as it is removed from the trenches and staged in the facilities until it can be processed at the TWPF for disposal. The originally planned data package for each container has been expanded to also document and track any relevant new or revised information about the waste package. The data package is also now being used to track the retrieved package against the ATN number that was originally assigned to the waste package and tracked in the ORNL waste inventory tracking system. Due to the higher than expected uncertainties in identifying each individual cask as it is retrieved, the matching of retrieved packages to ATN numbers is often being finalized upon completion of each trench rather than upon retrieval of each individual waste cask as originally planned.

Radiation Protection

The initial planning for radiation protection was based on conservative assumptions, with provisions made for downgrading personnel protection as appropriate after actual field data were collected and evaluated. The radiation dose rates for the majority of the casks retrieved to date have been significantly less than projected by radiological dose rate modeling based on decaying the reported inventories and dose rates at burial. External contamination levels on the retrieved casks have typically also been low. These results, combined with the implementation of multiple types of monitoring, have allowed much of the work to be performed in lower levels of personal protective equipment (PPE), with upgrades instituted only when monitoring indicates the conditions warrant it. This has resulted in work efficiencies and reduced health and safety concerns for the workers. Especially during the summer months, the relatively hot and humid conditions at ORNL significantly limit work time in full PPE. Continuous monitoring of the conditions inside the excavation enclosure during cask retrieval provides the data needed for the field radiological engineer and Radiation Control (RadCon) supervisor to downgrade PPE once baseline data are established, and subsequently to upgrade PPE only when conditions warrant. The continuous monitoring equipment has also been useful in providing a record of the conditions inside the enclosure that can be reviewed following any operational events that are believed to have the potential to result in elevated radiation or contamination levels.

PROJECT APPROACH TO RETRIEVAL

A movable weather enclosure that covers several trenches at once was designed and erected at the site for waste package excavation and overpacking. This retrieval enclosure includes a ventilation system, which ensures worker safety through removal of diesel exhaust from the retrieval equipment and maintains air flow into the enclosure. The retrieval enclosure also includes a water misting system, which can be utilized as necessary in the event of airborne contamination or dusty conditions. The retrieval enclosure includes both an outer and an inner fabric skin, which can be partially or completely replaced if contaminated. The approach to retrieval also includes the availability of a secondary enclosure, similar to an asbestos abatement enclosure, which can be implemented inside the primary retrieval enclosure in the event of high levels of contamination. Remote-operated equipment can also be utilized if high radiation dose or other hazardous situations are encountered during the retrieval operations.

The double-stacked condition encountered in Trench 1 precluded the planned method of TRU waste cask retrieval, which was to use a track loader to lift each concrete cask from the trench by inserting the track loader forks underneath the bottom of the cask after the surrounding soil had been excavated. With the base of the top cask sitting directly on top of another cask, however, there were concerns with potential instability of the top cask. More importantly, there was no way to insert the track loader forks underneath the cask without risking damage to the lid or body of the lower cask.

In response to this condition, the project team developed and implemented an alternative retrieval approach that has been used successfully for most of the 191 casks retrieved to date. An all-terrain crane was incorporated into the retrieval enclosure in addition to the track loader for use during retrieval. Once a cask is excavated, a manlift and/or long-reach tools are used by the field crew to position a sling around the cask in a choker arrangement. The all-terrain crane is then used to lift

the cask from the trench with the sling. The cask can then be positioned for additional measurement and overpacking as originally planned. The track loader can be used to reposition the retrieved cask as needed inside the retrieval enclosure. The alternative crane retrieval method provided efficiencies and benefits during retrieval of the double-stacked casks in Trench 1 such that the project team has elected to continue with this method for retrieval of casks in the subsequent trenches. Fig. 1 shows the alternate retrieval method employed, using the all-terrain crane to lift a cask from the trench onto the track loader, which will be used to position the cask for overpacking.

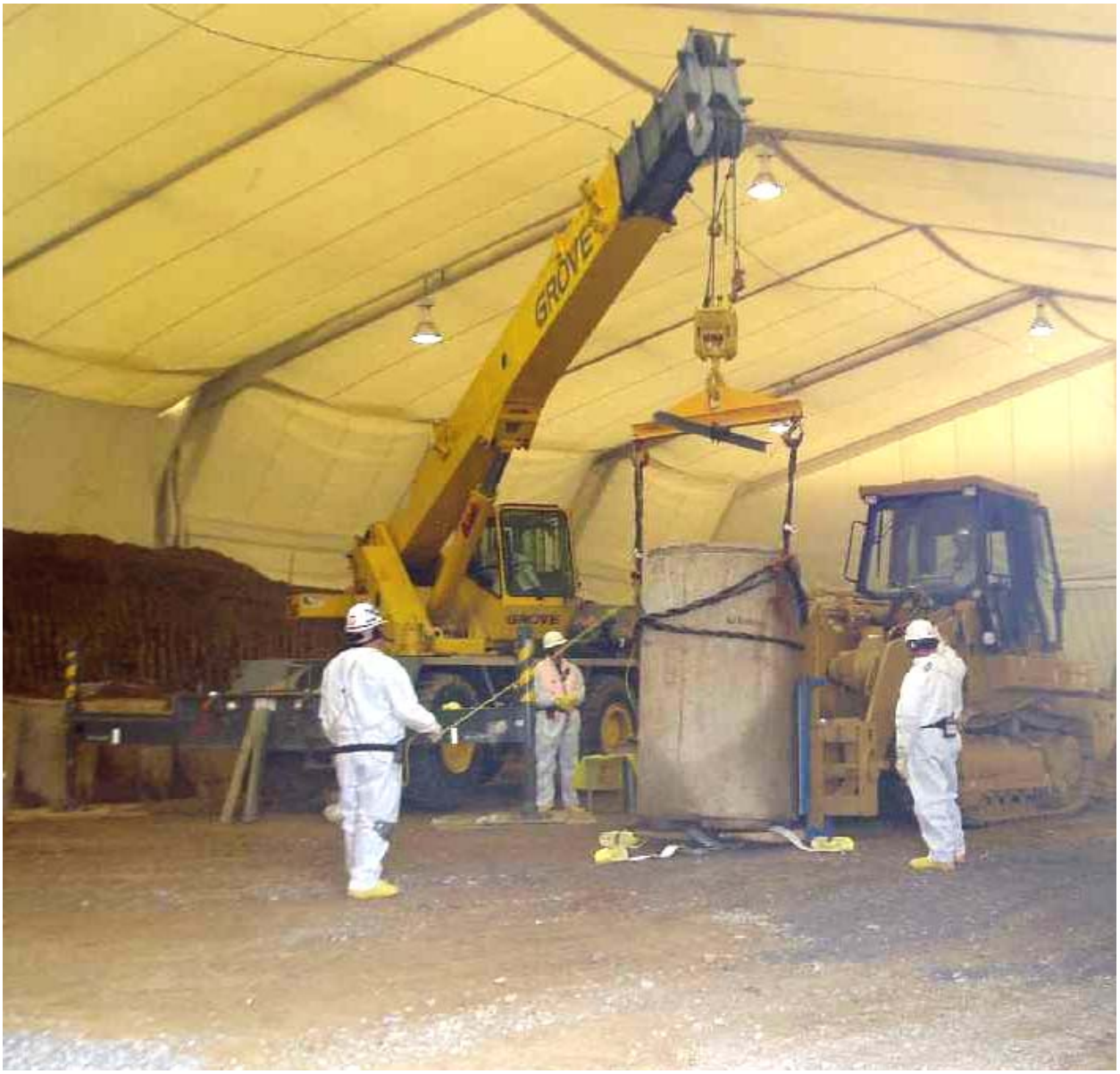

Fig. 1. Alternate TRU waste cask retrieval using all-terrain crane and track loader

WORK CONTROL AND SAFETY BASIS

As noted above, the TRU waste casks retrieved to date are not labeled with unique ATN numbers as had been expected. Without this primary means of identification, additional effort is required to match each overpacked package to an historical ATN number. Cask type, location, any available markings or identification, and relative position in the trench are all used to match a known ATN number to each cask. This approach relies on being able to identify all casks in a trench, and often multiple trenches, before a final match to the correct ATN number can be made. The planned project approach called for the waste packages to be retrieved one at a time. As each item is retrieved, its identity would be verified, and it would be overpacked and moved to one of the nearby staging facilities.

Modifications have been made to the project safety authorization basis to allow flexibility in retrieving and identifying unknown or anomalous (i.e., unexpected) packages. The SWSA 5 North retrieval project is being performed as a Nuclear Category 3 activity, as no single waste package approaches the Nuclear Category 2 threshold. While the total of all the packages in the trenches exceeds the Nuclear Category 2 threshold, if the six packages with the highest individual radiological inventory are excluded, then all the remaining waste packages combined do not approach the Nuclear Category 2 threshold. Since none of the six highest inventory packages individually approach the Nuclear Category 2 threshold, each of these six packages can be retrieved, overpacked, and identified as a Category 3 activity. Available information indicates these packages should be readily identifiable when excavated. However, one of the existing project staging facilities, identified as Building 7823E, has been designated as a temporary staging location to be used as needed for suspect high inventory and other anomalous packages. The project plan has been modified to allow retrieval and staging of waste, including the six highest inventory packages, as long as the combined radiological inventory of exposed waste containers in the retrieval enclosure and retrieved waste in staging facility 7823E is maintained to less than 90% of the Hazard Category 2 Sum of Fractions. Once they are identified, each of the six highest inventory packages will be moved off the project footprint into existing Nuclear Category 2 interim storage facilities until processed for disposal along with the remaining packages. The only credited design feature in the project is the steel overpack, and most controls are either administrative controls or interface controls from nearby facilities.

OPERATIONAL EVENTS

Through December 2005, containers other than concrete casks have only been encountered in one trench, identified as Trench 13. This trench was expected to contain a total of nine drums: one 208-L (55-gal) carbon steel drum, and one 114-L (30-gal) and seven 208-L (55-gal) stainless steel drums. As anticipated, it appears that the carbon steel drum has deteriorated to the point where it is no longer intact. During Trench 13 retrieval operations, metal that appears to be the remnants of a deteriorated drum was excavated along with approximately eight drums that appear to be intact. The area near the apparent deteriorated drum contained a white substance and several glass jars containing a black substance. A sample of the white substance was analyzed and found to be vermiculite, apparently used as a packing material around the smaller glass jars when placed in the deteriorated drum. While retrieving the loose waste, a reaction occurred in the trench and excavator bucket. A flame, approximately 1.5 m to 2.5 m (5 to 8 ft) high, formed and lasted approximately 5

seconds. Workers evacuated from the retrieval enclosure to the boundary control station immediately. Before evacuating, the equipment operator emptied the excavator bucket back into the trench and swung the bucket away from the trench so as to minimize the potential for the reaction to involve the equipment's hydraulic hoses. Upon subsequent evaluation, it has been determined that no emergency situation existed. No personnel contamination or release or spread of contamination has been detected either at the time of the event or during subsequent surveys. The barriers and controls in place at the time of the event on this project worked well during this event.

Subsequent investigation indicates that at least one of the glass jars in the trench was broken and has spilled its contents. The contents (i.e., black substance) are now believed to be uranium in the form of uranium carbide particles. The material would have originated from nuclear fuel development activities during the 1960s in ORNL Building 4508. Following extensive discussions with DOE and the State of Tennessee, a decision was reached to stabilize Trench 13 by placing concrete shoring blocks as a retaining barrier around the exposed sides of the excavation and covering the area of concern with layers of coke, sand, and soil to prevent the potential for additional pyrophoric reactions. The four overpacked drums and the box of loose material that have been recovered from the trench were placed back in the Trench 13 area and stabilized as well. Fig. 2 shows the Trench 13 area inside the retrieval enclosure being stabilized with the concrete block shoring wall and backfill.

Fig. 2. Stabilization of Trench 13 area

Retrieval of TRU waste casks from the remaining trenches in SWSA 5 North will continue while the final disposition of the Trench 13 waste is evaluated and resolved. TRU waste retrieval operations in the adjacent trenches resumed in November 2005, and modifications to the project approach are currently being evaluated by DOE and will be presented to the regulatory agencies for concurrence prior to proceeding with work in Trench 13.

CONCLUSION

The retrieval enclosure and the conservative selection of equipment have provided a solid basis for the SWSA 5 North TRU waste retrieval operations to proceed safely. A number of work control and method of accomplishment modifications have been incorporated into the project as work progressed and lessons learned became available. Unexpected conditions were found in the trenches, which required extensive acquisition and application of historical information and process knowledge to identify the individual waste packages. These modifications have allowed the work to proceed with retrieval, overpacking, and staging of 191 concrete casks through the end of December 2005. Further refinements to the project are anticipated throughout the retrieval and overpacking of the remaining packages and the closure of the 22 Trench area. The retrieval of the TRU waste from the 22 Trench area in SWSA 5 North is a key piece of the accelerated Melton Valley Closure Project and is projected to be completed in the spring of 2006.