Assessment of Radioactive Waste Management at the Oak Ridge National Laboratory

Interim Report

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Office of Enterprise Assessments
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Assessment of Radioactive Waste Management at the Oak Ridge National Laboratory December 2-12, 2019 Interim Report

Overview

This assessment is in response to the Deputy Secretary of Energy's July 9, 2019, memorandum directing the Office of Enterprise Assessments (EA) to undertake a U.S. Department of Energy (DOE)-wide assessment of the procedures and practices for packaging and shipping radioactive waste. The assessment activities focused on the waste management performance of the Oak Ridge National Laboratory (ORNL) management and operating contractor UT-Battelle, LLC (UT-B) and oversight provided by the ORNL Site Office (OSO). UT-B waste management activities include characterizing, packaging, and shipping low-level waste (LLW) and mixed low-level waste (MLLW) and characterizing and packaging transuranic (TRU) waste for disposal.

UT-B currently stores its solid TRU waste onsite in facilities managed by another contractor, UCOR, until UT-B establishes the facilities, equipment, processes, and resources to store TRU waste for disposal at the Waste Isolation Pilot Plant (WIPP). UT-B sends its liquid waste (some of which contains TRU material) to UCOR for processing, characterization, and certification with other liquid waste managed by UCOR. An EA assessment of waste management of LLW, MLLW, and TRU waste in Oak Ridge, Tennessee by UCOR (including the storage of UT-B solid TRU waste and the processing of UT-B-generated radioactive liquid waste) and other contractors for the DOE Office of Environmental Management (EM) was performed in March 2020 and is documented in a separate interim report.

The assessment team, identified in Appendix A, examined a sample of waste generator operations representing about 80% of the total waste being shipped for disposal. The UT-B strategy (defense-in-depth) for its waste management processes, from the generator to final packaging, is illustrated in Appendix B. During December 10-12, 2019, a team from the Nevada National Security Site (NNSS) concurrently assessed UT-B LLW and MLLW management as part of the NNSS radioactive waste acceptance program.

This report provides the interim results of the assessment of radioactive waste management at ORNL, identifying non-compliances and apparent causes contributing to weaknesses. At the conclusion of the enterprise-wide assessment, a final compilation report will include the results of this summary. The perspective gained by conducting this assessment could change as additional information becomes available from subsequent site assessments. The final compilation report will identify best practices, lessons learned, and cross-cutting recommendations.

DOE Order 227.1A, *Independent Oversight Program*, describes and governs the DOE independent oversight program, which EA implements through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. DOE Order 227.1A defines the terms best practices, findings, deficiencies, opportunities for improvement, and recommendations and how these are required to be addressed. It is expected that UT-B will develop and implement a corrective action plan for the finding identified and manage (address) the deficiencies identified in accordance with the ORNL Quality Assurance Program established to meet the requirements of DOE Order 414.1D, *Quality Assurance*.

Summary

Overall, UT-B's waste management program ensures proper characterization, packaging, and shipping of radioactive waste for disposal, and management of newly-generated high-activity radioactive waste from spent fuel examinations, radioisotope production, and irradiated material examinations. The OSO also maintains adequate operational awareness of radioactive waste management activities. However, this assessment identified a finding regarding vulnerabilities in the management of small quantities of MLLW and LLW generated in two radiological laboratories. These vulnerabilities were not addressed in corrective actions taken following UT-B's shipment of MLLW to the commercial LLW Bear Creek Processing Facility in August 2016 and weaken UT-B's defense-in-depth strategy in these laboratories, allowing the potential for another non-compliant shipment to a disposal site.

Specifically, this assessment identified a finding due to weaknesses and deficiencies in UT-B's planning, documentation, execution, and evaluation of radioactive waste management in the Radiological Materials Analytical Laboratory (RMAL) and the Low Activation Materials Development and Analysis (LAMDA) laboratory at ORNL. The following four deficiencies and two weaknesses, respectively, are related to this finding:

- numerous unlabeled waste bags
- numerous waste accumulation containers inadequately logged, labeled, segregated, and inspected
- inadequate UT-B assessment of waste stream control by UT-B organizations that generate waste
- inadequate control of the time waste can be accumulated by UT-B organizations generating waste
- insufficient waste disposition instructions for workers and researchers
- not providing waste management training to radiological control technicians and maintenance personnel that generate and bag waste

The NNSS team determined that UT-B's waste certification program has remained effective and identified no findings or deficiencies. The NNSS team identified three observations (weaknesses) that did not impact waste compliance. However, the small sample of work activities observed by the NNSS team was limited to verifying waste packaging in the High Flux Isotope Reactor and UT-B's management of certified waste containers. The NNSS team did not observe waste generating activities and control in the radiological laboratories that are the basis for the finding and deficiencies identified by the EA team.

This EA assessment also identified that the transition of responsibility for newly generated TRU waste at ORNL from EM to the Office of Science and the loss of EM-managed TRU waste handling capabilities have created infrastructure gaps in the path to disposal for TRU waste that are not acknowledged in the radioactive waste management basis (RWMB). Accordingly, two OSO deficiencies were identified as OSO has not approved the continued generation of TRU by UT-B without a path to disposal or approved changes to the RWMB reflecting the transition of TRU waste management to UT-B. The NNSS team did not assess OSO performance.

This report provides two interim recommendations to OSO and UT-B to improve the control and oversight of waste streams in these radiological laboratories and across ORNL.

After the incident at the Y-12 National Security Complex, UT-B and OSO paused waste shipments until training directed by the Deputy Secretary was completed. Per the direction of the Office of Science to its sites, OSO and UT-B established a common understanding of the lessons learned from the Y-12 incident to support continuous improvement, rather than performing a self-assessment of their radioactive waste management program. Although the peer reviews of radioactive waste management across DOE have concluded, the peer review at this site had not been completed at the time of this assessment. The results of the peer reviews will be addressed in the final compilation report.

Positive Attributes

Radioactive Waste Management Program Description

- The Standards Based Management System (SBMS) provides an intuitive interface for the variety of short-term researchers and laboratory staff to access the elements of the radioactive waste management program applicable to their work.

Waste Characterization

- The processes for characterizing radioactive wastes are well defined in implementing procedures and effectively implemented.

Waste Stream Control

- UT-B proactively worked with personnel from WIPP to obtain acceptable process knowledge and perform visual examinations of UT-B-generated TRU waste to facilitate its certification via the Central Characterization Program, on a campaign basis starting in fiscal year 2024. These actions should preclude the need for the equipment and performance of real-time radiography to certify this TRU waste for disposal at WIPP.

- UT-B uses an internally developed and qualified software application (BroadPointe) that tracks the waste loaded in each shipping container through characterization and certification. This software also generates the shipping manifests to effectively maintain continuity and accuracy of data.

- Waste Services Representatives (WSRs), assigned to all organizations that generate radioactive waste, engage with individual waste generators during waste characterization and packaging. During interviews, managers emphasized the importance of WSR involvement in their activities.

- Some WSRs have instituted waste bag identification labels to help validate conformance of the bag with the intended waste profile. Other WSRs for adjacent radiological laboratories have allowed waste bags to be unlabeled. (See **Deficiency D-UT-B-1**.)

- Some WSRs work with their assigned organizations to promptly move waste into a waste container, log the contents in BroadPointe for certification, and control access to the waste container to prevent introduction of unauthorized items. Other WSRs for adjacent radiological laboratories have allowed waste to accumulate, complicating the management of waste accumulation or staging areas. (See **Deficiency D-UT-B-4**.)

Packaging and Shipping

- An in-depth review of eight shipping records, which compared the documented package and contents with the requirements and waste profiles, confirmed compliance with U.S. Department of Transportation regulations and the disposal facility waste acceptance criteria.

Quality Assurance

- UT-B exhibited a self-critical approach to waste characterization, packaging, and shipping performance with 20 internal and 3 external assessments conducted over the past fiscal year.

Federal Oversight

- OSO proactively ensured that funding and a disposal site would be available for waste generated from examinations of high-burnup fuel in the Irradiated Fuel Examination Facility before authorizing these examinations.

- OSO maintains a strong working relationship with UT-B and effectively leverages information from the UT-B contractor assurance system to tailor OSO oversight.

- OSO's Assessment Planning Tool provides a good method for planning assessments covering a three year period based on past assessments stored in this planning tool.

- OSO effectively partners with UT-B to perform joint assessments, some led by OSO and some led by UT-B with OSO team members, significantly increasing the number of assessments.

Findings

Findings are deficiencies that warrant a high level of attention on the part of management. The finding identified during this assessment is listed below. DOE Order 227.1A requires the development and implementation of corrective action plans for findings per site-specific issues management systems.

Finding F-UT-B-1: Contrary to DOE Order 435.1, *Radioactive Waste Management*, UT-B has not adequately "systematically planned, documented, executed, and evaluated" radioactive waste management activities in the RMAL and LAMDA laboratory at ORNL. This assessment identified several deficiencies and weaknesses in the management of small quantities of MLLW and LLW generated in these radiological laboratories that were not addressed in corrective actions taken following UT-B's shipment of MLLW to the commercial LLW Bear Creek Processing Facility in August 2016. The following four deficiencies and two weaknesses, respectively, are related to this finding:

- numerous unlabeled waste bags (See **Deficiency D-UT-B-1**.)
- numerous waste accumulation containers inadequately logged, labeled, segregated, and inspected (See **Deficiency D-UT-B-2**.)
- inadequate UT-B assessment of waste stream control by the UT-B organizations that generate waste (See **Deficiency D-UT-B-3**.)
- inadequate control of the time that waste can be accumulated by UT-B organizations generating waste (See **Deficiency D-UT-B-4**.)
- insufficient waste disposition instructions for workers and researchers (See Other Areas of Weakness.)
- not providing waste management training to radiological control technicians and maintenance personnel that generate and bag waste (See Other Areas of Weakness.)

Together, these deficiencies and weaknesses significantly weaken UT-B's defense-in-depth strategy for its radioactive waste management in these laboratories. Resolution of this finding should ensure that: (1) systemic issues (weaknesses) are adequately resolved, and (2) best practices being documented in the final compilation report (from EA assessments at other sites with radiological laboratories and performing research) are adequately evaluated for implementation at ORNL.

Deficiencies

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below. It is expected that UT-B and OSO will manage (address) their deficiencies in accordance with the ORNL Quality Assurance Program established to meet the requirements of DOE Order 414.1D and DOE Order 227.1A, respectively.

- **Deficiency D-UT-B-1:** Contrary to the SBMS Environmental Management Subject Area Exhibit, "Segregating and Packaging Waste and Excess Materials General Segregating Instructions,"

numerous bags of accumulated LLW in the RMAL and the LAMDA laboratory were not marked with the generator name and date. Bags lacking this labeling are more likely to be mischaracterized during subsequent waste certification. In December 2018, the UT-B Transportation and Waste Management Division (TWMD) identified weaknesses in the control of waste, based on its assessment of trends in waste characterization issues, including UT-B's shipment of MLLW to the commercial LLW Bear Creek Processing Facility in August 2016. However, the recommended corrective actions from this TWMD assessment have not been implemented a year later.

- **Deficiency D-UT-B-2:** Waste observed in all five of the reviewed satellite accumulation areas (SAAs) in the RMAL and LAMDA laboratory had non-compliances with associated SBMS environmental management requirements. There were numerous examples of improperly logged, labeled, segregated, and/or inspected waste accumulation containers in SAAs. One SAA also exceeded the 55-gallon capacity limit for SAAs.

- **Deficiency D-UT-B-3:** Contrary to the ORNL Quality Assurance Program, Criteria 9 and 10, neither TWMD nor the Office of Integrated Performance Management adequately assessed waste stream control by the UT-B organizations that generate waste to ensure "adequacy of resources and workers assigned to perform work, process and system performance, technical and programmatic verifications to support ORNL divergent mission-related activities, and compliance with requirements." Waste generator control of waste packaging is the first line of defense and is essential to ensuring that prohibited articles are not placed into waste streams.

- **Deficiency D-UT-B-4:** Contrary to DOE Manual 435.1-1, *Radioactive Waste Management Manual*, Chapter IV, Section N.(7), UT-B does not require that LLW staged by the generator longer than 90 days (or 120 days, in accordance with the OSO-approved RWMB) be considered "in storage" and subject to implementation of additional controls for storage per DOE Manual 435.1-1, Chapter IV, Section N.(1)-(7). The UT-B requirements in the RWMB only limit the storage of waste after the Package Certification Inspection Checklist (PCIC) is completed, allowing a waste package to be staged by the generator indefinitely before the PCIC is complete. Per DOE Guide 435.1-1, *Implementation Guide for use with DOE M 435.1-1*, the requirement in DOE Manual 435.1-1 to invoke the requirements for storage when staging for longer than 90 days is to address "the need for safe interim storage at generator…facilities prior to… shipment. The requirement addresses the weaknesses and conditions of having waste stored at staging locations for longer periods of time than planned. Also, this requirement partially addresses the Complex-Wide Vulnerability for storing waste in inadequate storage conditions." Thus, allowing generators to accumulate waste for an unlimited time before completion of the PCIC does not meet the intent of DOE Manual 435.1-1.

- **Deficiency D-OSO-1:** Contrary to DOE Manual 435.1-1, Chapter I, Section 2.F.(19), OSO has not approved "conditions under which radioactive waste with no identified path to disposal may be generated." ORNL is currently generating TRU waste to be disposed of at WIPP; however, the facilities (i.e., the "identified path") for packaging larger waste items (e.g., high efficiency particulate air filters), loading remote-handled TRU waste shipping casks, and certifying TRU waste are not designed or authorized for construction.

- **Deficiency D-OSO-2:** Contrary to DOE Manual 435.1-1, Chapter I, Section 2.F.(2)(a), the ORNL RWMB does not adequately identify, analyze, and establish the necessary administrative controls for processing TRU waste. Specifically, since 2017, significant changes in the organization responsible for characterizing and certifying TRU remote-handled and contact-handled waste have been implemented per ORNL-TWMD-PL-581-R1, *Oak Ridge National Laboratory Transuranic Waste Management Transition Plan*, dated September 2018. However, the last major revision of the

RWMB was approved by OSO in February 2011, so it does not reflect these changes. DOE Manual 435.1-1, Chapter I, Section 2.F.(2) requires field element approval of the basis for radioactive waste operations before they begin.

Other Areas of Weakness

Other areas of weakness represent potential vulnerabilities that warrant site management's consideration but do not rise to the level of a finding or deficiency as defined in DOE Order 227.1A. The site should review these vulnerabilities and take appropriate actions. These weaknesses will be further reviewed against subsequent enterprise-wide site assessments to determine whether the vulnerability is cross-cutting and warrants an enterprise-wide response.

Waste Stream Control

- Long-term, excessive accumulation of waste materials complicates waste disposition and may impact mission accomplishment. For example:
  - Waste that has accumulated in the Irradiated Fuel Examination Laboratory for over 20 years is precluding maintenance on mission critical equipment (e.g., overhead cranes and manipulators within the hot cells). One of the two overhead cranes is out of commission and cannot be accessed for repairs due to high dose rates from the accumulated waste and high levels of surface contamination. UT-B is implementing a project in fiscal year 2020 to reduce surface contamination levels and to develop the capabilities to reduce the size of the waste items to support disposal. Disposal of these and other legacy waste items in non-reactor nuclear facilities is funded through fiscal year 2024.
  - Legacy hot cell material stored in the Irradiated Material Examination and Testing facility over the past 20 years has recently been declared waste. Due to the loss of process knowledge and lack of accurate information from over 20 years, each can of this legacy material must be opened before disposal to determine whether hazardous material is present.

- Although research safety summaries may include some information on radioactive waste and controls, UT-B lacks a rigorous process for documenting – prior to generation – the waste, its associated physical and administrative controls, and disposition instructions for managing waste generated by researchers and visiting users.

- Radiological control technicians and maintenance personnel are not required to take UT-B's waste generator awareness training, but these individuals can introduce sealed bags of radioactive and/or mixed waste into ORNL waste streams. In the absence of this training, the waste bags from these personnel are more likely to include prohibited items that may be undetected during the external examinations of the waste for certification.

Interim Recommendations

Interim recommendations are intended to capture the evolving need for possible DOE management attention based on identified conditions from a single or multiple-site assessment. Interim recommendations should be considered suggestions for improving program or management effectiveness.

- It is recommended that OSO and UT-B use the results of this assessment to further refine their oversight and assessments of radioactive waste management by providing additional focus on waste stream control by organizations that generate waste.

- It is recommended that OSO and UT-B promote sharing of best practices between WSRs to ensure the adequacy of waste stream segregation and control to prevent introduction of prohibited items or incompatible materials.

Opportunities for Improvement

No opportunities for improvement resulted from this assessment.

Appendix A
Supplemental Information

Dates of Office of Enterprise Assessments (EA) Onsite Assessment

December 2-12, 2019

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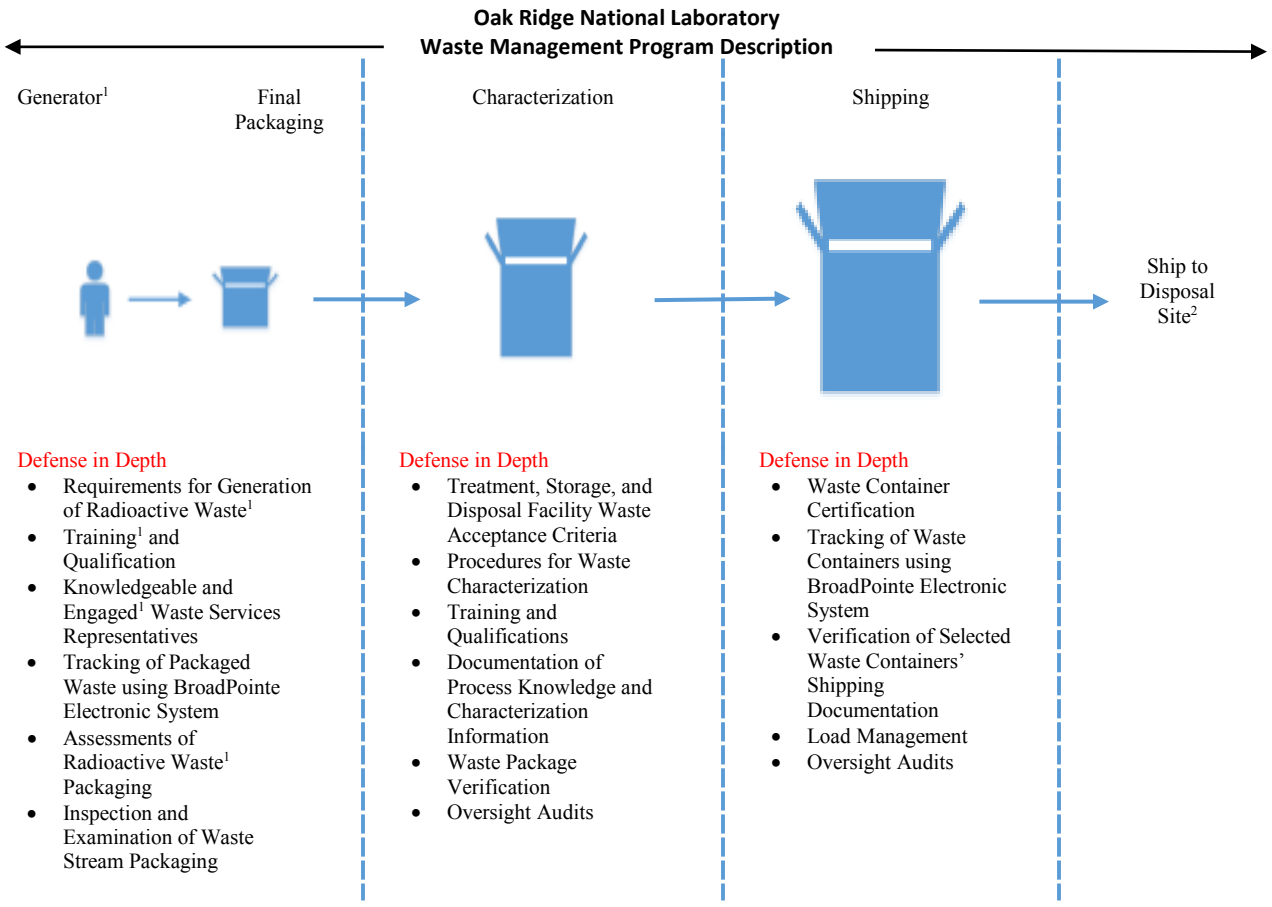
Appendix B
Description of Waste Control Defense-in-Depth as Applied at ORNL

This figure shows the various engineering and administrative controls implemented throughout the radioactive waste management process to ensure that waste shipped to a disposal site meets all waste acceptance criteria and that no prohibited items are accidentally introduced into waste streams. Defense-in-depth is intended to reduce the likelihood of a non-compliant waste package by implementing a diverse defensive control strategy, so that if one layer of defense turns out to be inadequate, another layer of defense will prevent a non-compliance. In this figure, the generator is the point of origin of any waste stream. As waste progresses through the process, it can be accumulated and stored at various locations. Along the way, the waste is characterized and verified to be appropriate for the approved waste stream. Once finally packaged, the waste is certified to have met all requirements and is shipped to its final disposal site.



Footnotes:
[1] – This assessment identified a finding to address systemic weaknesses associated with the four deficiencies and two other areas of weakness identified in the management of radioactive waste in radiological laboratories at ORNL.
[2] – UT-B is currently storing newly generated transuranic waste (TRU) waste in facilities managed by UCOR until UT-B establishes the facilities, equipment, processes, and resources to store TRU waste for disposal at the Waste Isolation Pilot Plant WIPP.