Assessment of Radioactive Waste Management at the Oak Ridge Reservation Environmental Management Projects

Interim Report

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Office of Enterprise Assessments
U.S. Department of Energy

Assessment of Radioactive Waste Management at the Oak Ridge Reservation Environmental Management Projects March 2-5, 2020 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 waste management performance at the Oak Ridge Reservation (Oak Ridge). At Oak Ridge, the DOE Environmental Management (EM) radioactive waste management program is implemented by URS CH2M Hill Oak Ridge, LLC (UCOR), North Wind Solutions, LLC (North Wind), and Isotek Systems, LLC (Isotek). Waste management activities include characterizing, packaging, and shipping radioactive waste.

For transuranic (TRU) waste management, generators across the enterprise implement a centralized process for waste characterization and certification, primarily through the Central Characterization Program (CCP), which is coordinated by the Waste Isolation Pilot Plant (WIPP) management and operating contractor, Nuclear Waste Partnership, LLC (NWP), under the oversight of the Carlsbad Field Office. The enhancement of this centralized structure for TRU waste management and the oversight thereof, which was initiated after the 2014 accident events at the WIPP facility, have resulted in program implementation that is generally consistent and uniform.

The assessment team, identified in Appendix A, examined a sample of EM-led cleanup operations involving radioactive waste generated at the East Tennessee Technology Park (ETTP), Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex, the Transuranic Waste Processing Center (TWPC), and ORNL Building 2026, which represent the DOE EM radioactive waste streams managed at Oak Ridge. The diverse control strategy (defense-in-depth) used for EM Oak Ridge radioactive waste management processes, from the generator to final packaging, is illustrated in Appendix B.

This report provides the interim results of the assessment of radioactive waste management at Oak Ridge, addressing 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. In accordance with DOE Orders 227.1A and 226.1B, *Implementation of Department of Energy Oversight Policy*, it is expected that the site will analyze the causes of findings and deficiencies identified in this summary, develop corrective action plans for findings, and implement compensatory corrective actions for program and performance deficiencies.

Summary

Overall, UCOR, North Wind, and Isotek implement waste management programs that provide reasonable assurance of proper characterization, packaging, and shipping of radioactive waste for storage and disposal. In addition, NWP, through CCP, adequately characterizes TRU waste in support of the North Wind mission. The Oak Ridge Office of Environmental Management (OREM) maintains adequate operational awareness of the radioactive waste management activities. This assessment found no findings, two interim recommendations, and six opportunities for improvement for consideration by DOE Federal and contractor management. This assessment also identified a deficiency associated with package closure inspection performed by Isotek and a deficiency involving documentation of issues identified by OREM Facility Representatives. Although these deficiencies ultimately did not result in mishandling of radioactive waste, management attention is warranted to reduce the risks of inadequate waste package closure and waste management issues going unaddressed. In response to the memorandum issued on July 23, 2019, by the DOE Office of Environmental Management (EM) Principal Deputy Assistant Secretary, OREM performed a comprehensive, independent review of the Isotek and North Wind waste management programs. In addition, OREM and UCOR performed a joint programmatic assessment of the UCOR waste management program. OREM identified findings and opportunities for improvement and appropriately required that corrective action plans be developed by Isotek, North Wind, and UCOR to address the identified issues. These assessments were adequate in reviewing Oak Ridge's management of low-level waste (LLW) and mixed LLW (MLLW).

The Oak Ridge peer review was completed subsequent to the completion of the assessment; results were not available at the time of the completion of our site visit. The results of the peer reviews will be addressed in the final compilation report.

Positive Attributes

Waste Characterization

- UCOR uses established process knowledge (PK) for the gaseous diffusion plant facilities at ETTP as the basis for developing characterization plans and sample analysis plans to support the development of waste profiles for waste prepared for onsite and offsite treatment, storage, and disposal.

- UCOR develops effective sample analysis plans to support waste characterization by determining a comprehensive set of analytes, establishing clearly-defined data quality objectives, and contracting with well-qualified sample analysis laboratories to perform the analytical work. NNSS-DQO-AS-001R2, *Data Quality Objectives (DQOs) for LGWO LLW Secondary Solid Waste Forms Sampling and Analysis for (Filtercake and Zeolite)*, provides adequate rationale for required sampling based on the Nevada National Security Site (NNSS) waste acceptance criteria (WAC) for all reportable radionuclides that contribute more than 1% of the NNSS Action Level.

- UCOR non-destructive assay (NDA) and characterization processes appropriately identify constituents in the waste, including isotopes that are not directly measurable, using scaling factors based on sampling and analysis. UCOR NDA processes also include review and evaluation of analytical data that could indicate anomalous waste constituents that were not previously identified through PK. The UCOR staff performing NDA measurements and analyses are trained, qualified, and knowledgeable of the waste stream PK, instrument quality controls, and waste geometry modeling.

- Each waste container characterized by NWP CCP at TWPC undergoes real-time radiography (RTR) or Visual Examination (VE), providing independent verification that the waste packages do not

contain prohibited items before shipping to the appropriate DOE waste disposal facility – i.e., either WIPP or NNSS. Waste that is not determined to be LLW/MLLW receives additional assessment for certification through such means as RTR, NDA, and flammable gas analysis (FGA), which are effectively performed by well-trained and qualified NWP CCP operators at TWPC.

- North Wind operators who generate secondary LLW at TWPC process facilities receive waste awareness training from the Waste Certification Official and are also trained on the identification and required segregation of prohibited items. This training provides a level of defense at the point of waste generation to prevent the introduction of non-compliant items into the waste stream.

- North Wind uses a "fast scan" (i.e., radiograph of containers prior to processing) as an operational aid prior to processing in order to identify prohibited drum contents and contents that may present unique concerns to operations. If the drum is later determined to contain LLW or MLLW, the radiograph provides an added layer of defense against the shipment of prohibited items.

- A formal interface document defines NWP's support for North Wind's mission to dispose of LLW and MLLW by providing RTR and NDA data for containers that it determines through CCP to be LLW or MLLW waste containers.

- NWP employees perform VE on ORNL's newly-generated TRU waste prior to storage by UCOR so that the TRU waste containers will not need to be opened again before shipment to WIPP in the future.

- The North Wind AK expert gathers information and uses PK (i.e., original waste generation/historical records and drum repackaging information) on excluded waste containers that may be WIPP eligible, in order to relate the waste container to an approved waste stream, thereby facilitating disposal at WIPP and helping minimize "orphan" waste containers.

- TWPC is working with CCP to revise procedure CH-REF-OP-014, *Absorbing Liquids in the Glovebox and Box Breakdown Area*, to expand the list of acceptable sorbents, to include Zeolite for use on legacy waste and eliminate potential issues that may affect the acceptability of treated waste at WIPP. Revising this procedure has given NWP an advance opportunity to assess waste constituent impacts on the WIPP WAC.

Waste Stream Control

- North Wind has a systematic approach to accepting TRU waste for treatment from UCOR and other offsite sources into TWPC. For contact-handled and remote-handled TRU waste, the acceptance criteria are delineated in CH-X-AD-001, *Contact Handled Waste Acceptance Criteria*, and RH-X-AD-001, *Remote Handled Waste Acceptance Criteria*, respectively. Waste received at TWPC is checked for prohibited items, including pyrophoric materials. Free liquids are anticipated and are treated in accordance with CH-REF-OP-014 to support compliance with the WIPP WAC.

- North Wind and its subcontractors implement the Waste Inventory Control System (WICS) database, which provides a robust set of tools to support TRU waste acceptance, receipt, and management at TWPC.

- For TRU waste from offsite generators, such as Nuclear Fuel Services, Inc. (NFS), North Wind and its subcontractors use the Generator Waste Acceptance System (GWAS) to facilitate approval of waste profiles and containers based on characterization data provided through GWAS. Using GWAS,

North Wind effectively validates that the provided data fits an acceptable waste profile before receipt into TWPC.

- Waste disposed of at the Environmental Management Waste Management Facility (EMWMF) is required to meet WAC requirements as implemented through comprehensive procedures. Waste generators conduct their activities in accordance with PROC-WM-2027, *Waste Generator's Guide to Disposing of Waste at the EMWMF*, which adequately addresses the process used by UCOR waste generators and waste management staff to qualify waste planned for disposal at EMWMF. Additional procedural and/or planning measures, which provide an adequate level of assurance of WAC compliance, include UCOR-4024, *Waste Acceptance Criteria Attainment Team Project Execution Plan*, as well as various procedures associated with such areas as waste container management, readiness-to-ship checklists, and data package preparation.

- UCOR Liquid and Gaseous Waste Operations (LGWO) operators visually inspect and sample waste that is generated and prepared for shipment to NNSS. As part of package certification, LGWO operators conduct pre-loading activities, which include identification of any special packaging requirements (e.g., shielding, container type required for specific waste stream) and inspection of container condition. Activities required for packaging and package closure include identification of potential incompatible or prohibited items; verification of need; type and addition of absorbent; minimum container volume – i.e., 90% for mixed and polychlorinated biphenyl (PCB) waste containers; package closure; and verification of container integrity, marking, and labeling.

- North Wind, UCOR, and NWP CCP coordinate in a weekly TRU interface meeting; DOE representatives and a representative from the Tennessee Department of Environment and Conservation (TDEC) also attend. The meeting covers the status of upcoming oversight activities, progress toward characterization of remote-handled and contact-handled waste for shipment to WIPP, status of LLW/MLLW that has "fallen out" of the CCP characterization process, upcoming challenges, and upcoming transfers between UCOR and North Wind. TDEC attendance has positively affected relations between the TWPC facility and the state regulator.

Packaging and Shipping

- UCOR uses radio frequency identification (RFID) for all onsite waste movements along the designated haul road to EMWMF. This process feature provides enhanced tracking capabilities and eliminates the need for multiple shipping documents. The RFID tag identifies the vehicle and waste loads as required to electronically transmit data into the Waste Transportation Management System (WTMS). The RFID information includes shipping document information as well as arrival and departure times, which are recorded electronically when entering and exiting EMWMF via the haul road or the EMWMF scale.

- UCOR transportation personnel block intersections during shielded over pack (SOP) shipments between UT-Battelle, LLC (UT-Battelle) and UCOR storage facilities to reduce the opportunity for transportation incidents while the shipment is in transit.

Quality Assurance

- North Wind effectively assesses waste management activities using management and independent assessments. Management assessments of CCP's characterization activities are performed quarterly, and annual independent assessments of North Wind's MLLW/LLW Certification Program are performed for compliance with the NNSS WAC. North Wind also performed an independent surveillance of the NFS Waste Certification Program to verify its implementation and effectiveness before receiving TRU waste directly from NFS.

- North Wind initiated an independent review of waste management operations (i.e., a Collective Significance Review) following a series of operational events at TWPC. The review incorporated conduct of operations concerns communicated to North Wind by the OREM Facility Representative (FR), was performed by experts external to TWPC, collected a series of observations, determined common causal factors, and identified recommendations for continued improvement.

- UCOR effectively assesses waste management activities using assessments and surveillances across various radioactive waste management areas. A review of 13 out of 178 completed assessments and surveillances determined that a blend of compliance- and performance-based oversight was performed in fiscal years 2017, 2018, and 2019, and the assessments were sufficiently self-critical. For example, the 2018 annual independent assessment of the waste certification program to verify compliance with the NNSS WAC was a performance-based review that included document reviews, interviews, and field activity observations and identified six findings, seven observations, and two opportunities for performance improvement.

- Isotek adequately assesses various areas of waste management using a management assessment process that includes reports and checklists to document the results of each review criterion addressed. During the five years between 2014 and 2019, Isotek performed management assessments of waste management areas including packaging and transportation, waste stream management, and sampling and analysis. The assessments were adequately critical and identified opportunities for improvement, as well as issues that required the generation of condition reports, which were appropriately managed by an Isotek condition reporting process. Each assessment included document reviews, interviews, and field observations.

Federal Oversight

- OREM scheduled and performed 10 waste management surveillances between 2017 and 2020, per the OREM Integrated Assessment Schedule. These included six surveillances of UCOR operations, three of North Wind operations, and one of Isotek operations. OREM performed a radioactive waste management basis assessment for each of these three prime contractors in 2017.

- One OREM waste management subject matter expert (SME) is completing qualification requirements in accordance with DOE Order 426.1B, *Department of Energy Federal Technical Capabilities*, for Federal personnel. The Federal SME is supported by two general service support contractors (GSSCs).

- In response to the memorandum issued on July 23, 2019, by the EM Principal Deputy Assistant Secretary, OREM performed a comprehensive, independent review of the Isotek and North Wind waste management programs. In addition, OREM and UCOR performed a joint programmatic assessment of the UCOR waste management program. OREM identified findings and opportunities for improvement and appropriately required that corrective action plans be developed by Isotek, North Wind, and UCOR to address the identified issues.

- OREM performs detailed triennial assessments of contractor packaging and transportation programs, as required by DOE Order 460.2A, *Departmental Materials Transportation and Packaging Management*. The assessments cover various aspects of activities including, but not limited to, packaging utilization, transportation management, and tie-down securements.

Findings

The assessment identified no findings.

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, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

- **Deficiency D-Isotek-1:** Contrary to 49 CFR 173.475, *Quality control requirements prior to each shipment of Class 7 (radioactive) materials*, Isotek procedure ISO-WMP-203, *Transportation Procedure*, does not include a process to ensure that packages are properly inspected (e.g., via examination or appropriate tests) to re-verify that containers are properly closed, sealed, and secured before shipment (e.g., tightening of closure bolts). Though it was observed that waste containers were receiving proper initial closure (e.g., closure rings applied and torqued appropriately), and no unsecured containers were observed, the additional defense provided by this inspection against unsecured containers was not being provided.

- **Deficiency D-OREM-1:** Contrary to OREM-QA-IP-04, *Issue Reporting and Resolution*, Rev. 2, OREM Facility Representatives do not consistently enter all identified issues into the Issues Management System. When all issues are not consistently entered into the appropriate issues management system, the integrity of data used for tracking and trending may be compromised, and the timely resolution of issues may be inhibited.

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 Characterization

- UCOR disposal and storage facility WAC do not require rigorous chemical compatibility evaluations for MLLW, similar to the evaluations for TRU waste, even though the non-radiological hazards related to chemical compatibility are commensurate. Without a WAC requirement, generators may not develop a robust understanding of the hazards associated with combining certain chemical constituents in MLLW. The constituents of the waste streams currently being processed are not likely to present significant unrecognized hazards; however, planned future deactivation and decommissioning work is likely to produce waste streams with more complex hazards. (See OFI-UCOR-1.)

- UCOR does not regularly perform sampling or direct measurements (e.g., NDA, portal monitors, isotope identifier surveys) of waste shipments to verify initial waste characterization and profile development and to verify that waste streams have not changed during deactivation and decommissioning. (See OFI-UCOR-2.)

- Isotek uses a water source that is not internally controlled or tested to mix grout for liquid waste solidification. Testing of the potable water source happens, but Isotek has not documented the source of the water or basic chemical properties (e.g., pH, alkalinity, etc.) and any potential impacts on the U-233 stabilization process waste profile. (See OFI-Isotek-1.)

Waste Stream Control

- To support selection of waste containers for processing and treatment, North Wind frequently moves waste containers. Also, for selection of waste containers requested by CCP for characterization operations, additional waste container movements must be made. The risk of incidents involving waste container movements (e.g., dropped drums, damaged containers) increases with the number of waste container movements. (See OFI-North Wind-1.)

- The TWPC Analytical Lead and Waste Acceptance/Transfer Lead use experience and knowledge to implement good practices when executing elements of procedures CM-P-OP-114-85, *Waste and Activity Inventory Control*, and CH-P-WP-001, *Contact Handled Waste Container Selection Process*, respectively; however, not all of these good practices are formally documented in the procedure. (See OFI-North Wind-2.)

- Isotek has not currently developed a formal plan to disposition wastes ancillary to the U-233 disposition project. The potential reactive impacts of residual nitric acid contaminants and associated dried salts need to be analyzed for compatibility with the final waste forms, and the potential for organic materials in filters and wipes should be evaluated and controlled. (Recommendation)

Packaging and Shipping

- GPS technology is not used after waste is offloaded at the EMWMF dump ramps to identify final disposal locations. (Recommendation)

Quality Assurance

- UCOR does not track and trend the discovery of materials that may become prohibited items when identified by the waste packaging specialist, who is the second and final line of defense for waste shipped to NNSS. Failure to track and trend such materials represents a missed opportunity to identify repeat issues and implement corrective actions to strengthen the first line of defense. (See OFI-UCOR-3.)

Federal Oversight

- Timely resolution of concerns regarding poor conditions in several facilities associated with low-level liquid waste processing and disposition at ORNL has not resulted from feedback communicated by OREM Facility Representatives through the OREM management chain.

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 UCOR implement/expand the use of the global positioning system (GPS) for determining the location of waste emplaced at EMWMF in addition to the use of RFID and access point scans that UCOR currently implements at Oak Ridge. Other disposal sites (e.g., the Environmental Restoration Disposal Facility at Hanford) use GPS mounted on excavators or bulldozers to track the elevation and coordinates of waste placement.

- It is recommended that Isotek develop a plan to implement treatment, packaging, and shipment processes for wastes ancillary to the U-233 disposition project (e.g., glovebox filters, pumps, valves, tubing, ventilation hood wipe-down debris).

Opportunities for Improvement

Opportunities for improvement are suggestions that are offered to assist cognizant managers in improving programs and operations.

- **OFI-UCOR-1:** UCOR should consider evaluating the need to establish chemical compatibility evaluation requirements in the WAC for disposal cells that accept MLLW.

- **OFI-UCOR-2:** UCOR should consider implementing a quality assurance verification process for evaluating and accepting waste into EMWMF that follows one or more of the methods recommended in DOE Guide 431.1-1, *Implementation Guide for Use with DOE M 435.1-1, Radioactive Waste Management Manual*, Chapter IV, *Low-Level Waste Requirements*.

- **OFI-UCOR-3:** UCOR should consider supporting quality assurance effectiveness by tracking and trending the source and characteristics of materials discovered by the waste packaging specialist that, if not discovered, would become prohibited items in the planned disposal path.

- **OFI-Isotek-1:** Isotek should consider documenting its source for the potable water used for waste solidification (i.e., grout mixing). This documentation should include due diligence to confirm that the water chemistry will not affect waste form stability.

- **OFI-North Wind-1:** North Wind should consider reviewing its work planning practices to identify any opportunities to reduce the number of times waste containers must be moved to support waste treatment and processing operations. Similarly, North Wind should consider coordinating with NWP to identify any opportunities to reduce waste container movements in support of CCP characterization activities.

- **OFI-North Wind-2:** North Wind should consider evaluating the work processes of functional leads who support waste receipt, characterization, and shipping/transfer processes to identify good practices and ensure that these practices are formally incorporated into applicable procedures when appropriate.

Appendix A
Supplemental Information

Dates of Office of Enterprise Assessments Onsite Assessment

March 2-5, 2020

Assessment Team

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

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.