Assessment of Radioactive Waste Management at the Hanford Site and the Pacific Northwest National Laboratory

Interim Report

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Office of Enterprise Assessments
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Assessment of Radioactive Waste Management at the Hanford Site and the Pacific Northwest National Laboratory January 6-13, 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 Hanford Site (Hanford) and the Pacific Northwest National Laboratory (PNNL). At Hanford, the radioactive waste management program is implemented by CH2M Hill Plateau Remediation Company LLC (CHPRC) and Washington River Protection Solutions LLC (WRPS). At PNNL, the radioactive waste management program is implemented by Battelle Memorial Institute (Battelle). For both sites, commercial waste treatment company, Perma-Fix Northwest, Inc. (PFNW), provides services to support program implementation.

Waste management activities at these sites 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, which is coordinated by the Waste Isolation Pilot Plant (WIPP) contractor, Nuclear Waste Partnership, under the oversight of the Carlsbad Field Office. However, the TRU waste certifying program is not currently operating at Hanford, as TRU waste is not presently being certified and shipped to WIPP for disposal.

The assessment team, identified in Appendix A, examined a sample of radioactive waste operations at the CHPRC Solid Waste Operations Complex (SWOC), including the Central Waste Complex (CWC) and the Mixed Waste Trenches; the CHPRC Environmental Remediation Disposal Facility (ERDF); the WRPS Tank Farms facility, WRPS 222-S Analytical Laboratory Complex (222-S), and WRPS Effluent Treatment Facility; and the PNNL Radiochemical Processing Laboratory (RPL) and PFNW waste treatment facility, which represent the radioactive waste streams managed at Hanford. The diverse control strategy (defense-in-depth) used for Hanford's 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 Hanford and PNNL, 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, the radioactive waste management programs implemented at Hanford and PNNL ensures proper characterization, packaging, and shipping of radioactive waste for storage and disposal, and the Richland Operations Office (RL), the Office of River Protection (ORP), and the Pacific Northwest Site Office (PNSO) maintain adequate operational awareness of the radioactive waste management activities. This assessment found one finding associated with PNNL's waste generation processes, no interim recommendations, and five opportunities for improvement for consideration by DOE Federal and contractor management. This assessment also identified three deficiencies associated with CHPRC's verification of waste generator processes; ORP's oversight of packaging and transportation; and RL's functional area reviews. Although these deficiencies ultimately did not result in mishandling of radioactive waste, management attention is warranted to reduce the risks. In addition, this assessment found that the self-assessment performed by CHPRC, as required by the DOE Office of Environmental Management (EM) in a memorandum issued on July 23, 2019, by the EM Principal Deputy Assistant Secretary, was adequate in reviewing Hanford's management of low-level waste (LLW) and mixed-LLW (MLLW).

The expected peer reviews are under way, but the peer review at this site had not been completed at the time of this assessment. A peer review was not scheduled for Hanford; however, the peer review for PNNL was scheduled to be completed by February 15th. The results of the peer reviews will be addressed in the final compilation report.

Positive Attributes

Waste Characterization

- CHPRC verification representatives (VRs), deployed in accordance with a performance evaluation system (PES) criteria (PRC-PRO-WN-54298, *Performance Evaluation System for Solid Waste Operations Complex Waste Acceptance*), effectively verify and document waste container contents and were observed to demonstrate a high level of proficiency in performing their duties. CHPRC waste management representatives (WMRs) effectively team with waste generators to ensure proper characterization of waste at the point of generation. CHPRC treatment, storage, and disposal representatives (TSDRs) work effectively with WMRs to ensure waste is compliant with Hanford Site waste acceptance criteria (WAC). All observed VRs, WMRs, and TSDRs were adequately trained and qualified.

- Since mid-2018, CHPRC has used the PES to establish a 100% verification rate for all TRU waste sent to SWOC. The PES requires each waste container in a TRU waste stream to be subjected to complete verification to ensure compliance with acceptance criteria, allowing CHPRC to gather adequate data for developing acceptable knowledge information to support final disposal at WIPP.

- CHPRC has adopted the requirements outlined in SWSD-PRO-WM-54091, *TRU Program Review*, for TRU waste acceptance into CWC. These requirements mirror the WIPP WAC in many ways, including requirements for chemical compatibility evaluations and evaluations that test for oxidizers. By implementing these requirements for acceptance into CWC, CHPRC facilitates the waste characterization process for TRU waste that will eventually be shipped to WIPP. The added rigor necessary to meet these criteria will likely result in more efficient processing when the Central Characterization Program (the WIPP certified program) commences TRU waste characterization operations.

- WRPS procedural requirements for radioactive waste generation are well integrated into the conduct of experiments and work practices that generate waste at the 222-S laboratory. Observations of persulfate oxidation and coulometric detection experiments, as well as routine waste generation activities, demonstrated good training and procedural implementation.

- WRPS Hazardous Material Control performs a thorough visual inspection of all radioactive waste generated in the 222-S laboratory at the time of packing in preparation for shipment to treatment and disposal facilities. Waste is accumulated in the 222-S laboratory satellite accumulation areas in clear plastic bags that can be used to verify contents, and each bag is accompanied by a completed waste contents sheet. WRPS Hazardous Material Control technicians visually inspect and confirm the contents of each bag. Following this inspection, the waste is placed into a uniquely identified (bar coded) drum and is documented on a form that is ultimately entered into the Solid Waste Information Tracking System (SWITS).

- WRPS procedure ATS-LO-100-151, *Laboratory Waste Generation*, establishes appropriate guidelines for collecting and managing liquid and solid wastes generated in radiologically controlled areas of the 222-S laboratory. Among other wastes, ATS-LO-100-151 includes instructions for managing LLW, TRU waste, maintenance waste, and wastes from unused or expired chemicals. In addition, ATS-LO-100-151 provides instructions for entering data into SWITS for containers to be disposed of.

Waste Stream Control

- SWITS, used by both CHPRC and WRPS, is a streamlined and versatile software tool that effectively tracks waste from generation through disposal. It effectively associates waste characterization information with the waste package, supports proper classification of waste, and helps maintain the traceability of waste from generation through disposal. In addition, SWITS has provisions to support overpacking or repackaging of waste containers to ensure that information is not lost during these operations.

- The CHPRC 324 Building Disposition Project Waste Management Plan appropriately describes the process for managing highly radioactive soil while protecting the health and safety of the workforce, the public, and the surrounding environment. A high-fidelity mockup facility is effectively used to train operators and refine work processes to minimize radiation exposure in the field.

- WRPS appropriately manages segregation of MLLW, LLW, and hazardous waste generated by the Tank Farm facilities using clear demarcation, marking and identification of waste streams, and special separation at the 616 Building facility.

Packaging and Shipping

- WRPS procedure ATS-LO-100-153, *Laboratory Waste Packaging for Transportation*, establishes adequate guidelines for packing, adding to, confirming, sorting, and repackaging LLW and MLLW containers at the 222-S laboratory. The procedure also provides instruction and guidance to WRPS Hazardous Material Control technicians on how to perform dose-to-curie conversions to determine the activity in a radioactive waste package and how to document information on the waste summary sheet and container data sheet for entry into SWITS.

- CHPRC obtained the services of an expert consulting firm to evaluate the readiness of their Federal Motor Carrier Program to begin radioactive waste shipping activities, which are necessary to transport radioactive materials that are not regulated by the U.S. Department of Transportation. The resulting report detailed a thorough assessment, which ultimately determined that CHPRC's program

was adequately prepared to begin hiring drivers, establishing driver files, performing drug and alcohol testing, obtaining insurances, and functioning effectively to meet all regulatory requirements. Obtaining the services of an outside consultant was prudent to help ensure compliance and begin a new regulatory activity.

- For shipments of radioactive waste to PFNW for size reduction and repackaging that will potentially be categorized as TRU waste, qualified Washington State Police personnel conduct independent pre-shipment inspections of the shipping cask, transport equipment, and shipping documentation, providing defense-in-depth to help ensure safe and compliant transport (i.e., Level 6 Inspection).

Quality Assurance

- Both the CHPRC radioactive waste management basis (RWMB), PRC-MP-WM-52872, *Waste Management Basis*, Appendix B, *Flow Down of Waste Management Requirements to Implementing Documents* (maintained by CHPRC) and the *PNNL Radioactive Waste Management Basis* (maintained by Battelle) provide a detailed flowdown of radioactive waste management requirements from DOE Manual 435.1-1, *Radioactive Waste Management Manual*, to the implementing procedures. In addition, the SWOC RWMB, Appendix C, establishes assessment subject area and periodicity requirements for evaluating the CHPRC radioactive waste management programs.

- WRPS performs monthly management observations of waste management, including packaging and transportation operations. The Waste Services Organization reviews every problem evaluation request that identifies waste management issues and assigns waste management trend codes; issues that have been assigned trend codes are used to evaluate trends and report quarterly.

- The Battelle performance assurance process provides comprehensive performance data to help assure PNSO that radioactive waste management activities are performed within the requirements of the RWMB.

Federal Oversight

- Both RL and ORP have implemented a new integrated contractor assurance system (iCAS) for issues management that has improved the planning and performance of assessments and helped to coordinate RL and ORP oversight efforts.

- PNSO used technical expertise from the DOE Office of Science Integrated Support Center (Chicago) to augment detailed functional area reviews of the RPL radioactive waste management program. The reviews used detailed criteria and lines of inquiry to assess compliance with DOE Order 435.1, *Radioactive Waste Management*.

Findings

Findings are deficiencies that warrant a high level of attention on the part of management. Findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

- **Finding F-Battelle-1:** Contrary to PNNL procedure EPRP-HWTU-018, *Neutralization and Precipitation Treatment*, Rev. 10, Step 7.4.3.1.3, Battelle staff performing TRU waste treatment at the Radiochemical Processing Laboratory (RPL) did not ensure that the glovebox exhaust rate was greater than or equal to (≥) 35 cubic feet per minute (cfm), to be read as 0.04 inches water column (WC) on the associated Pitot flow gauge. In addition, contrary to DOE Order 422.1, *Conduct of Operations*, Attachment 1, *Program Requirements*, Section 2.p.(3), Battelle did not ensure that a

technically accurate procedure was in place and capable of being performed as written to implement practices that ensured safe and effective operations when performing the TRU waste neutralization and precipitation treatment operation. Finally, contrary to DOE Order 422.1, Attachment 1, Section 2.p.(4), Battelle did not correctly implement the procedure change process to fully address introduction of a hazardous material (dry ice) into the TRU waste neutralization and precipitation treatment operation.

- During an operation to neutralize and solidify acidic liquid TRU waste, workers and their supervision did not verify the glovebox exhaust rate, as required by procedure EPRP-HWTU-018, Step 7.4.3.1.3, to allow implementation of dry ice (i.e., solidified CO_2).
- Analyses completed after the operation concluded that sufficient flow was available; however, a Pitot flow gauge reading of 0.04 inches WC, stated in EPRP-HWTU-018, was no longer accurate because it would not reflect the needed ≥ 35 cfm of glovebox exhaust flow.
- Dry ice was introduced into the glovebox atmosphere as a field-level process improvement to cool the neutralized solution and speed up the required reaction. However, following this process change, the relationship between ventilation flow rate and differential pressure was never validated (i.e., 35 cfm no longer correlated with 0.04 inches WC), which in turn invalidated procedure Step 7.4.3.1.3.

Battelle supervision discontinued use of dry ice when the missed procedure step was identified and spoke with staff conducting glovebox work to emphasize the expectations for following procedures. In addition, further glovebox work with dry ice was paused until procedure EPRP-HWTU-018 was revised to correct Step 7.4.3.1.3.

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-CHPRC-1:** Contrary to ERDF-00011, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Rev. 1, Section 3.2.3, Verification, and PRC-PRO-WM-53829, *ERDF Waste Acceptance Process*, Rev. 0, 07-25-2018, CHPRC does not observe waste generator processes to verify that waste shipments comply with waste certification requirements of DOE Order 435.1. Currently, CHPRC reviews waste profiles and shipping manifests but does not observe the waste loading process to confirm compliant waste management per the approved waste profile. Performing such observations as part of the verification process is an added layer of defense that would help provide reasonable assurance of generator compliance with the ERDF WAC.

- **Deficiency D-ORP-1:** Contrary to DOE Order 460.2A, *Departmental Materials Transportation and Packaging Management*, Section 5.f.(8), ORP does not evaluate contractor compliance with transportation and packaging requirements every three years. Shipment non-compliances, including erroneous shipment documentation and incorrect labeling, marking, and/or placarding, can result in improper communication, which can adversely affect emergency response.

- **Deficiency D-RL-1:** Contrary to DOE Order 226.1B and DOE Manual 435.1-1, RL has not performed a functional area review of the waste management safety management program (SMP) within the past three years as stated in the approved contractor oversight plan.

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

- During radioactive waste packaging operations that have been targeted for waste verification in accordance with the CHPRC PES, VRs collect handwritten characterization data on a Container Activity Record. For some generation activities, the waste generator also records the waste container contents (e.g., PFNW's Waste Container Loading Sheet), simultaneously, in the field. The records produced by both the VR and generator are subsequently reconciled and then loaded into the Integrated Document Management System (IDMS), which contains all official records for a given waste container. By not creating one official record of waste container inventory from the two handwritten records, subsequent transcription errors may be introduced when identical data has to be maintained in twice as many records. This presents an unnecessary challenge to quality assurance. Note that no transcription errors were found during this assessment.

- CHPRC does not address the hazards associated with chemical incompatibility in MLLW with the same rigor as those in TRU waste. CHPRC disposal and storage facility WAC do not require rigorous chemical compatibility evaluations for MLLW, similar to the evaluations for TRU waste, although 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. (See OFI-CHPRC-1.)

    - As a specific example, WRPS does not address the hazards associated with chemical incompatibility in MLLW with the same rigor as those in TRU waste. At the 222-S laboratory, radiological decontamination and standard laboratory practices allowed by WRPS procedure use absorbent materials, which may contain organic constituents that may be comingled with acid, caustic, or other incompatible corrosive compounds. Organic constituents are known to be potentially reactive with acids and thus present potential chemical compatibility concerns. For TRU waste, extensive chemical compatibility evaluation is driven by the WIPP WAC; however, CHPRC operated LLW disposal facility WAC do not drive the same degree of evaluation, even though the non-radiological hazards related to chemical compatibility are the same.

- Battelle TRU waste generators add shield materials as needed to waste packages in the field to facilitate waste handling, without specified design parameters or an analysis of potential impacts. During a contact-handled/remote-handled TRU waste packing activity, waste generators at RPL fabricated a container with supplemental beta radiation shielding to help minimize extremity dose during handling. The rubber shielding was allowed and accounted for on waste profile documentation. However, the procedure for this activity did not include steps to specify shielding design parameters and verify that no applicable WAC requirements are violated. (See OFI-Battelle-1.)

Waste Stream Control

- EM has not revised the waste management directives to incorporate the reinterpretation of high-level waste issued in the Federal Register in June 2019. Without this update, dispositioning of Tank Farms

waste and implementation of the "waste incidental to reprocessing" (WIR) citation process presents a challenge for waste management operations performed by WRPS.

Quality Assurance

- The WRPS quality assurance program plan does not specify a periodicity for performing the required independent assessments, and no WRPS waste management SMP document flows down this requirement from the quality assurance program plan. TFC-PLN-02, *Quality Assurance Program Description*, Chapter 18, *Audits/Independent Assessments*, specifies the need to perform independent assessments to verify program compliance, performance, and effectiveness; however, WRPS has not formally implemented this requirement in waste management program documentation. Therefore, the quality of the WRPS waste management SMP is subject to potentially inadequate evaluation and verification. However, despite this potential weakness, inadequacies were not observed during this assessment. (See OFI-WRPS-1.)

Federal Oversight

- Currently, RL employs a total of only 9 qualified Facility Representatives (FRs) out of 16 allotted full-time equivalent positions; the 9 FRs are supported by 4 technical services contractors. Understaffing may contribute to the limited frequency of oversight assessments performed of the waste management SMP.

- RL employs only one Federal employee as a qualified commercial driver to transport Federal shipments from Hanford to PFNW. DOE must take radioactive waste shipments out of commerce and transport it as a Federal shipment when the radioactivity exceeds Department of Transportation limits. Scheduling and preparation for these shipments is coordinated between DOE, CHPRC, and the State of Washington, but shipments will be delayed if for any reason the one qualified Federal driver cannot perform his responsibilities, as observed during this assessment. (See OFI-RL-1.)

- Records from August 2019 to the present show that of the 53 functional area reviews performed by ORP and RL, none were planned or conducted for the waste management SMP. In addition, records from April 2019 to the present show that over 85% of all planned and/or completed waste management oversight activities were operational awareness activities; the rest were surveillances. Neither RL nor ORP performed formally planned assessments to evaluate waste management programs. The depth, breadth, and substantive value of a sample of 12 operational awareness activity reports varied widely. (See OFI-ORP-RL-1.)

Interim Recommendations

No interim recommendations resulted from this assessment. 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.

Opportunities for Improvement

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

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

- **OFI-WRPS-1**: WRPS should consider documenting the requirement to perform independent assessments in waste management program documentation, and specifying the periodicity on which to perform such assessments.

- **OFI-RL-1**: RL should consider hiring and/or qualifying additional Federal staff as commercial drivers so that schedules can be maintained appropriately for Federal shipments.

- **OFI-ORP-RL-1**: ORP and RL should consider formalizing a larger percentage of oversight activities to ensure that planned, criteria-driven assessments of waste management programs are regularly performed and better support trending of contractor performance using iCAS.

- **OFI-Battelle-1**: Battelle should consider evaluating processes for making field-level procedure and process modifications to ensure thorough analysis of impacts, and then revising procedures for radioactive waste treatment and packing operations to include steps that specify all details and key design parameters of any field-level changes.

Appendix A
Supplemental Information

Dates of Office of Enterprise Assessments Onsite Assessment

January 6-13, 2020

Assessment Team

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Appendix B
Description of Waste Control Defense-in-Depth as Applied at Hanford and PNNL

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.