Office of Enterprise Assessments
Assessment of Low-Level Radioactive Waste Disposal Practices at the Hanford Site

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Office of Nuclear Safety and Environmental Assessments
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Acronyms

CA	Composite Analysis
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHPRC	CH2M Hill Plateau Remediation Company
COC	Contaminant(s) of Concern
CRAD	Criteria and Review Approach Document
CY	Calendar Year
DAC	Derived Air Concentration
DAS	Disposal Authorization Statement
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
DoN	Department of the Navy
EA	Office of Enterprise Assessments
EM	DOE Office of Environmental Management
EPA	Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
EWAS	ERDF Waste Acceptance Specialist
FR	Facility Representative
FY	Fiscal Year
HCA	High Contamination Area
LFRG	Low-Level Waste Federal Review Group
LLBG	Low-Level Burial Ground(s)
LLW	Low-Level Waste
MOU	Memorandum of Understanding
NARA	National Archives and Records Administration
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
ORP	Office of River Protection
OWTF	Onsite Waste Transfer Form
PA	Performance Assessment
PES	Performance Evaluation System
QA	Quality Assurance
RBA	Radiological Buffer Area
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RWMB	Radioactive Waste Management Basis
RWP	Radiation Work Permit
SCA	Surface Contamination Area
SME	Subject Matter Expert
SWAC	Supplemental Waste Acceptance Criteria
SWITS	Solid Waste Information and Tracking System
SWOC	Solid Waste Operations Complex
TRU	Transuranic
TSDR	CHPRC Treatment, Storage, and Disposal Representative
WAC	Waste Acceptance Criteria
WMIS	Waste Management Information System
WMR	CHPRC Waste Management Representative
WRPS	Washington River Protection Solutions, LLC
WSRP	Waste Shipping and Receiving Plan

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of low-level radioactive waste disposal practices at facilities operated by CH2M Hill Plateau Remediation Company (CHRPC) on the Hanford Site. This assessment is part of a DOE complex-wide evaluation of radioactive waste management practices. EA focused on the operation of the Environmental Restoration Disposal Facility (ERDF) and the 200 Area Low Level Burial Grounds , including implementation of waste characterization processes, determination of and conformance to waste acceptance criteria (WAC) and inventory limits, waste disposal work planning and control for current worker protection, performance assessments, composite analysis, environmental monitoring to verify facility performance and model assumptions, and closure plans intended to ensure long-term performance of the disposal cells.

EA identified several positive attributes associated with the implementation of low level radioactive waste management at the Hanford Site. At ERDF, wastes that meet certain physical or safety hazard thresholds such as elevated dose rates, are subject to supplemental waste acceptance criteria. These criteria require specific Waste Shipping and Receiving Plans to be approved and appropriate controls to be implemented to ensure safe waste handling. High dose rate components or items with potential for higher levels of void space are grouted to assure adequate shielding and long term stabilization. Additionally, Hanford uses a sitewide integrated environmental monitoring program to track and trend ground water contaminants and the effectiveness of remedial actions. Data from this integrated monitoring is used to properly inform and validate the performance assessment and composite analysis model parameters. Based on this data and changes in the site characterizations based on remediation activities, CHPRC has proactively initiated planning to update the site composite analysis.

EA identified some weaknesses in the implementation of work area boundary controls and detection capabilities for potential off-normal conditions to protect workers. EA also, identified some opportunities for improvements in the quality assurance measurement practices used to verify continued adequacy of the original waste stream characterizations.

EA concluded that CHPRC has implemented an effective low level radioactive waste management program at the observed facilities. The Hanford low-level radioactive waste disposal operations are conducted in a manner that conforms to established requirements and provides a reasonable expectation of protection for the workers, members of the public, and the environment, both in the short term and in the long term.

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1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of low-level radioactive waste disposal practices at the Hanford Site as part of a DOE-wide set of targeted assessments of radioactive waste management practices, including disposal operations and waste generator and processor operations. These targeted assessments are intended to evaluate performance at individual facilities, as well as the practical implementation of the current DOE Order 435.1, *Radioactive Waste Management*, and DOE Manual 435.1-1, *Radioactive Waste Management Manual*, for consideration during planned updates to these directives. EA conducted initial onsite scoping and observations from August 28 to 31, 2017, and follow-up onsite observations and data collection from September 25 to 28, 2017.

2.0 SCOPE

As specified in the *Plan for the Office of Enterprise Assessments Assessment of Radioactive Waste Disposal Practices at the Hanford Site, August – September 2017*, this assessment primarily evaluated the disposal operations at the Environmental Restoration Disposal Facility (ERDF) and the active 200 Area Low Level Burial Grounds (LLBG), which are managed through contracts under DOE Richland Operations Office (DOE-RL). Additional disposal facilities exist on the Hanford Site that are not included in the scope of this assessment. These include trench 94 in the 200 east LLBG area, which is operated by the Department of the Navy (DoN) for defueled reactor compartments, the civilian commercial LLRW disposal facility managed by US Ecology under NRC regulations, and the Integrated Disposal Facility (IDF) being developed under the Office of River Protection (ORP) for eventual disposal of glass encapsulated wastes.

EA focused on waste characterization and processes for ensuring compliance with waste acceptance criteria (WAC); waste tracking and inventory control; monitoring to verify conformance to the limits; and environmental testing, monitoring, and modeling that supports the performance assessment (PA) and the composite analysis (CA) to ensure that the dose performance objectives identified in DOE Manual 435.1-1 are satisfied.

3.0 BACKGROUND

Management of the Hanford Site is divided between DOE-RL and ORP. DOE-RL, through the contractor CH2M Hill Plateau Remediation Company (CHPRC), is primarily responsible for the environmental cleanup of the Central Plateau of the Hanford Site, including groundwater remediation and management of low-level radioactive waste and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulated waste disposal operations. ORP, through the contractor Washington River Protection Solutions, LLC (WRPS), is primarily responsible for management of the Tank Farms and development of the facilities intended to provide final treatment and disposition of those wastes.

DOE Order 435.1 provides the high-level regulatory requirements and responsibilities for radioactive waste management throughout DOE. DOE Manual 435.1-1 provides specific requirements intended to protect against exposures to radioactive and hazardous wastes, including the short-term hazards for

current workers, members of the public, and the environment, and long-term hazards to future potential receptors. The DOE Office of Environmental Management (EM) is evaluating the current order and manual, which were issued in 1999 and have had only minor changes since then. A revised technical standard was issued in 2017, and revisions of the order are planned for 2018. Notable events at the Waste Isolation Pilot Plant indicated the need to evaluate the implementation of WAC requirements, disposal facility operations, and impacts on short- and long-term performance of waste disposal facilities across DOE.

4.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*. EA implements the independent oversight program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. Organizations and programs within DOE use varying terms to document specific assessment results. In this report, EA uses the terms "deficiencies, findings, and opportunities for improvement (OFIs)" as defined in DOE Order 227.1A. In accordance with DOE Order 227.1A, DOE line management and/or contractor organizations must develop and implement corrective action plans for deficiencies identified as findings. Other important deficiencies not meeting the criteria for a finding are also highlighted in the report and summarized in Appendix C. These deficiencies should be addressed consistent with site-specific issues management procedures.

This assessment considered requirements in the applicable sections of DOE Order 435.1 and the associated DOE Manual 435.1-1. The objectives, criteria, and lines of inquiry for this assessment were drawn from the following sections of EA Criteria and Review Approach Document (CRAD) 31-11, *Low-Level Radioactive Waste Management*:

- 4.1 Radioactive Waste Management Planning and Generic Safety Requirements
- 4.2 Radioactive Waste Identification, Characterization, and Monitoring
- 4.7 Waste Disposal
    - 4.7.1 Disposal Facility Siting and Approval
    - 4.7.2 Disposal Facility Design and Operations
    - 4.7.3 Facility Closure and Post-Closure Surveillance and Maintenance

EA examined key documents and materials, including WAC, waste profiles, data handling and management systems, PAs, the CA, work packages, radiation work permits (RWPs), environmental sampling procedures and data, policies, and numerous other documents. EA also interviewed key personnel responsible for developing and executing the waste management programs; observed environmental sampling activities; observed waste receipt and disposal activities; and walked down groundwater monitoring wells and process facilities. The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. A detailed list of the documents reviewed, personnel interviewed, and observations made during this assessment, relevant to the findings and conclusions of this report, is provided in Appendix B.

EA has not conducted a recent assessment of low-level radioactive waste disposal activities at the Hanford Site. Therefore, there were no items for follow-up during this assessment.

5.0 RESULTS

5.1 Radioactive Waste Management Planning

Criteria:
Radioactive Waste Management Basis (RWMB): Facilities, operations, and activities that generate, handle, process, store, package, transport, or dispose of low-level waste (LLW) shall have an RWMB consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV; CRAD 31-11, Section 4.1, Criterion 1)

Training and Qualification of Personnel: Training is provided to all personnel associated with the management of radioactive wastes, including planning, identification, characterization, monitoring, generation, storage, staging, processing, treating, packaging, transportation, and disposal, to ensure that they are competent commensurate with their responsibilities for compliance with the requirements of applicable regulations and DOE programs. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV; CRAD 31-11, Section 4.1, Criterion 5)

Quality Assurance (QA) Program: All radioactive waste facilities, operations, and activities have a QA program in accordance with applicable regulations and DOE programs. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV; CRAD 31-11, Section 4.1, Criterion 6)

Integrated Safety Management: Appropriate safety management programs and practices, including Radiation Control, Industrial Hygiene, Fire Protection and Emergency Management, Criticality Safety (as applicable), Maintenance, Industrial Safety, Training, and Qualifications, are established and implemented in effective procedures for the assessed radioactive waste management facilities. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV; CRAD 31-11, Section 4.1, Criterion 8)

Records Management: A program is in place to ensure that appropriate records are maintained to demonstrate that radioactive wastes are managed in an environmentally sound manner, and that recordkeeping-related activities are performed in accordance with all applicable DOE, Federal, state, and local requirements. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV; CRAD 31-11, Section 4.1, Criterion 11)

The fundamental agreements for managing environmental remediation and radioactive waste at the Hanford Site are coordinated with the state, Federal Environmental Protection Agency (EPA), and DOE through the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement), records of decision (RODs), and disposal authorization statements (DASs). These agreements are implemented through a variety of site policies and procedures for physical and administrative controls to ensure the protection of workers, the public, and the environment by ensuring safe management of radioactive wastes. Together, these policies and procedures address the fundamental components of an RWMB and apply to ERDF and the LLBG.

Many of these controls and monitoring practices are implemented in coordination with CERCLA requirements or similar ROD and Tri-Party Agreement requirements. At the time of this assessment, neither ERDF nor the LLBG had formal, signed RWMBs. DOE/RL-2000-25, *Richland Operations Office Implementation Plan for DOE Order 435.1*, includes an interpretation that because the DOE Manual 435.1-1 requirements for an RWMB are considered "administrative" rather than "substantive," a separate RWMB is not required for facilities, such as ERDF, that are also managed under CERCLA processes. The document further states that "In some cases, the interpretation is essentially an exemption from a requirement with the bases stated and justified." Consequently, a separate DOE Manual 435.1-1

compliant RWMB was not developed for ERDF. Similar interpretations of the interface between CERCLA and DOE requirements have been identified at other DOE-managed sites and facilities. EM Headquarters line management is currently assessing the implementation of the RWMB requirements throughout the complex to help clarify the expectations and interface between the Federal EPA CERCLA processes and DOE regulatory processes.

CHPRC has sitewide programs and procedures governing training and qualification of personnel, QA, integrated safety management, records management, and emergency management. Implementation of these functions within the radioactive waste management activities EA observed was generally effective and sufficient to meet DOE Manual 435.1-1 requirements. Specific observations related to each of these areas are presented in the remaining sections of this report.

Radioactive Waste Management Planning Conclusion

Within the scope of this assessment, the fundamental programmatic and procedural structures for safe radioactive waste management and planning are in place and properly implemented at the Hanford Site. DOE RL and the site contractors have established their understanding of the relationship between the RWMB and the EPA CERCLA process, which defers development of a formally reviewed and signed M435.1-1 RWMB based on the regulatory authorities and responsibilities of the EPA CERCLA process that address the fundamental safety controls for waste management. More importantly however, EM headquarters policymakers are currently reviewing the interface between EPA and DOE regulatory processes, specifically related to RWMB requirements, to ensure consistency of expectations and applications in future directives.

5.2 Radioactive Waste Identification and Characterization

Criterion:
Waste Stream Identification and Characterization: The facility has established processes that ensure hazardous and radioactive waste streams are properly identified and characterized. Waste stream characterization and analysis processes and capabilities are designed and implemented to verify conformance with the WAC. Processes incorporate appropriate levels of documentation and clearly defined data quality objectives and limiting conditions. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV; CRAD 31-11, Section 4.2, Criterion 1)

DOE-RL through CHPRC currently operates two active LLW disposal facilities that receive and dispose of low-level radioactive and mixed wastes, principally from Hanford Site generators and site remedial cleanup activities. These include ERDF and the Solid Waste Operations Complex (SWOC) LLBG Trenches 31 and 34. ERDF is located in the center of the Hanford Site and is a large landfill regulated by both DOE and the Federal EPA under CERCLA. ERDF accepts low-level radioactive, hazardous, and mixed wastes that are generated during decontamination, decommissioning, and remediation activities at the Hanford Site; it does not accept any non-Hanford waste. LLBG Trenches 31 and 34 are lined trenches, located in Hanford's 200 West Area, that are used to store and dispose of low-level radioactive waste or mixed waste from Hanford work.

Waste stream identification and characterization is the responsibility of each waste generator. Areas requiring remediation are identified using historical records, process knowledge, and direct sampling or surveys. Identification and characterization of typical source term constituents is conducted by sampling of the waste media and analysis at offsite contracted laboratory facilities. For individual shipments of surface contaminated items, the characterization results are scaled based on some form of direct survey or dose-to-curie modeling based on the waste profiles and original waste stream characterizations analysis. For bulk materials such as contaminated soils or debris, the shipment specific characterization is based on

the weight of the shipment and the original statistical sampling and laboratory analysis for characterization of the waste stream profile.

The following discussion presents EA's observations related to radioactive waste identification and characterization for waste disposal activities at ERDF and for recent shipments to LLBG Trenches 31 and 34. Both ERDF and the LLBG have defined processes for waste identification and characterization consistent with their respective facility's WAC documents, which are further described in Section 5.3.5.

Environmental Restoration Disposal Facility

The waste acceptance process for ERDF, governed by PRC-PRO-WM-53829, *ERDF Waste Acceptance Process*, includes steps for waste profile preparation and modification, waste profile approval, and issuance of onsite waste tracking forms that must accompany each shipment. PRC-PRO-WM-53829 also presents waste characterization requirements. ERDF waste acceptance specialists (EWASs) work with the waste generators to ensure that the waste characterization data is sufficient and to develop approved waste profiles that meet the ERDF WAC.

EA observed ERDF waste receipts from two onsite generators during the assessment, including approximately 30 roll-off containers of contaminated soil and debris from the 618-10 landfill and one, highly contaminated, long pump item from the tank farms. The 618-10 landfill waste profile was appropriately supported by process knowledge, engineering calculations, and sufficient sampling data for both chemical and radiological constituents. The tank farms waste profile was also supported by process knowledge and a vast amount of tank waste sampling data. Because the surface of the long-length item was highly radiologically contaminated with tank waste, the generator prepared a radiological characterization report to quantify the radiological source term using an appropriate and technically supported dose-to-curie methodology. Overall, the waste characterization and waste profile forms for wastes disposed at ERDF during the assessment were sufficiently thorough and detailed to demonstrate compliance with facility WAC.

Active LLBG Trenches

The waste acceptance process for SWOC is governed by PRC-PRO-WM-40523, *Solid Waste Operations Complex Waste Acceptance Program*. The Hanford Solid Waste Acceptance website provides detailed information for all generators intending to ship wastes to SWOC for disposal, including the steps necessary to become a generator and to prepare specific waste stream information for review and approval to ship. In accordance with PRC-PRO-WM 40523, CHPRC waste management representatives (WMRs) are assigned to waste generators to help them prepare waste profiles that are consistent with the facility WAC. Once a draft waste profile has been prepared to the satisfaction of the WMR, it is routed to an independent CHPRC Treatment, Storage, and Disposal Representative (TSDR) for final review. The TSDR may reject the profile if WAC compliance is not clear, approve the profile as is, or request additional information or modification to ensure WAC compliance. Once a waste profile is deemed acceptable, the TSDR approves the profile, allowing the generator to begin working with the WMR to schedule any needed waste shipments.

The active LLBG trenches receive wastes for disposal infrequently, one or two shipments per calendar year (CY). During the assessment, EA observed one shipment to Trench 34. EA also reviewed information from the most recent waste shipments to trenches 31 and 34 including the waste profiles, waste characterization data, and waste shipment and container information for each trench. For Trenches 31 and 34, the most recent shipments were from Perma-Fix Northwest. A Perma-Fix offsite facility accepts Hanford-generated wastes for treatment or repackaging, performs the necessary treatment, and returns the treated waste to SWOC LLBG Trench 31 or 34 for disposal. In this capacity, Perma-Fix

becomes the waste generator and is responsible for completing the waste profiles and characterization for wastes they will be treating and shipping for disposal. For Trench 31, the most recent shipment consisted of five metal boxes assigned to Waste Profile PFNW-100-120-0005, *Thermal and Non Thermal Low Level Waste Processing for Disposal*. For Trench 34, the most recent shipment was a single metal box assigned to Waste Profile PFNW-100-120-0004, *Macro encapsulated Hazardous Debris and Radioactive Lead Solids Waste from Off Site Generators Approved for Disposal at Hanford.* For both shipments, after reviewing the waste profiles, waste characterization, all container and shipment documentation, and waste acceptance workflow documentation, EA found the waste characterization and disposal to these trenches to be WAC compliant and consistent with DOE Order 435.1 requirements.

Radioactive Waste Identification and Characterization Conclusion

The radioactive waste acceptance programs for both ERDF and the LLBG are governed by appropriate procedures designed to ensure compliance with each facility WAC. The process includes providing assistance to waste generators in preparing acceptable waste profile forms for each waste stream to be disposed. EA reviewed a sampling of the waste profiles and waste characterization data for wastes disposed at both ERDF and the LLBGs during the assessment and found the radioactive waste identification and characterization processes to be effectively implemented in accordance with CHPRC requirements and DOE Manual 435.1-1.

5.3 Waste Disposal Operations

5.3.1 Disposal Authorization Statement

Criterion:
Disposal Authorization Statement: A DAS shall be obtained prior to construction of a new LLW disposal facility. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.1, Criterion 4)

ERDF began operations in 1996, and the 200 East and West Area LLBG initial operations date back to the 1960s. These facilities predate the DOE Manual 435.1-1 requirements for a DAS. The initial DOE Manual 435.1-1 compliant DAS included all the active disposal facilities at Hanford and was issued in October 1999. A separate ERDF DAS was issued shortly after approval of an updated ERDF-specific PA in 2001. The current DAS for ERDF was issued in November 2013 after review and approval of another update of the EDRF PA in August 2013. The 200 West and East Area LLBGs continue to operate under the original 1999 DAS. As noted in Section 5.3.2, the current PAs for the 200 West and 200 East Area LLBGs were issued in 1995 and 1996, respectively; therefore, no reissuance of the DAS has been required. EA determined that both the ERDF and LLBGs are operating under the conditions of the approved and applicable DAS.

5.3.2 Performance Assessment

Criteria:
Performance Assessment: A site-specific radiological PA and CA shall be prepared and maintained. The PA shall include calculations for a 1,000-year period after closure of potential doses to representative future members of the public and potential releases from the facility to provide a reasonable expectation that the performance objectives identified in Manual 435.1-1 IV P (1) are not exceeded as a result of operation and closure of the facility. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.1, Criterion 2)

Performance Assessment: The PA shall be maintained to evaluate changes that could affect the performance, design, and operating bases for the facility. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.2, Criteria 8)

Environmental Restoration Disposal Facility

The most recent update of the ERDF PA was issued on August 27, 2013. There have been no design changes or divergences from expected or planned conditions with regard to site characteristics or ERDF facility attributes that could affect the conclusions of the PA. The annual performance review for 2016 indicated that the forecasted inventory will be greater than that originally predicted for some radionuclides; however, subsequent analysis indicates that there will be no appreciable increase in the peak dose values, which are within the performance objectives.

The PA states that mobile constituents in ERDF leachate will not reach groundwater for over 2,000 years, so indications of leachate affecting the groundwater are not expected. Groundwater and leachate samples have been collected since the beginning of disposal operations in 1996. The site publishes a monitoring report on leachate, lysimeter, and groundwater sampling annually. The 2015 report states that "Based on the CY 2015 data evaluation, there has been no correlation between leachate COC [contaminants of concern] levels and groundwater COC levels that would indicate the leachate is impacting the groundwater under ERDF." EA observed sampling processes at ERDF; inspected more recent leachate, lysimeter, and groundwater data; and concurred with that conclusion. Monitoring results support the conclusions in the annual updates that doses are, and will remain, within the performance objectives. The PA criteria for ERDF are satisfied.

200 East and West Area Low-Level Burial Grounds

The PA for the 200 West Area LLBG was approved in 1995, and the PA for the 200 East Area LLBG was approved in 1996. Both indicate that potential doses will be below performance objectives. Since 1999, the annual PA status reports have provided projected dose estimates that are based on updated radionuclide inventories disposed in the active LLBGs and calculated using the original dose methodology. Estimates of the final inventory on associated dose estimates from future waste disposal actions are unchanged from previous years' evaluations, which indicate that potential doses will remain below performance objectives.

However, the computational methods and some assumed parameters and conditions for the PAs for both 200 West Area and 200 East Area LLBGs have become outdated. The software used for both LLBG PAs can be executed only on obsolete computer operating systems. Section 5.3.3 lists several reasons for the rebuilding and reanalysis of the CA, which is currently under way. The PAs for the LLBG provide crucial source input to the CA. With the rebuilding of the CA, it is important to rebuild the LLBG PAs to maintain the required and expected QA standards of the analyses. (**OFI-CHPRC-1**)

LLBG Trenches 31 and 34 will be used until they are filled or a decision is made to close them. Trenches 31 and 34 are monitored semiannually by a comprehensive network of Resource Conservation and Recovery Act (RCRA) monitoring wells. Samples are analyzed for iodine-129, technetium-99, and uranium in addition to the RCRA suite of constituents, as are several RCRA wells down gradient and up gradient from the LLBG Area. Continuing groundwater monitoring of the LLBG indicates no groundwater contamination due to LLBG waste.

The PA criteria for the 200 East and West Area LLBGs are currently satisfied. However, the 200 West Area PA will require rebuilding and reanalysis to support the reanalysis for the CA expected to be completed over the next three years.

Performance Assessment Conclusion

At ERDF, the basic modeling assumptions and data are reasonable and supported, and the PA criteria are satisfied. Annual summaries for all the disposal trenches appropriately document increases in the total disposed inventory and environmental monitoring results that support the PAs of the facilities. The conclusions of the PAs for the 200 West Area and 200 East Area LLBGs are reasonable, but the computational systems and modeling parameters are out of date. The outdated PA computational models for both LLBGs lack the software QA and parameter validation needed for consistency with the planned CA modeling updates and improved CA accuracy. Although out of date, the LLBG PAs provide reasonable determinations that the DOE Manual 435.1-1 performance objectives will continue to be satisfied.

5.3.3 Composite Analysis

Criterion:
Performance Assessment: A site-specific radiological PA and CA shall be prepared and maintained. The PA shall include calculations for a 1,000-year period after closure of potential doses to representative future members of the public and potential releases from the facility to provide a reasonable expectation that the performance objectives identified in DOE Manual 435.1-1 IV P (1) are not exceeded as a result of operation and closure of the facility. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.1, Criterion 2)

The Hanford Site CA was originally reported in the *Composite Analysis for Low-Level Disposal in the 200 Area Plateau of the Hanford Site* in 1998. An addendum was written in 2001. The CA has been maintained without major revisions or additions for the past 16 years while several decisions were made regarding remediation and disposal in the Central Plateau.

A detailed account of that history was succinctly reported in the FY 2016 CA Annual Status Report, which evaluated information based on the updated remediation and disposal decisions and conditions or new information that could change the source terms considered in the CA, including: (1) PA development and maintenance activities for 200 West Area LLBG, 200 East Area LLBG, ERDF, Integrated Disposal Facility, and Waste Management Area C; and (2) monitoring, research, and development results, including groundwater flow and contamination monitoring, and remediation and technology programs.

EA concurs that current information and data validate the adequacy of the present version of the Hanford Site CA evaluation, which indicates that the performance objectives are satisfied. However, based on the 2016 annual review, the site determined that the CA modeling requires rebuilding and updated analysis to better reflect anticipated conditions and improve its accuracy as a land use planning tool. The accumulation of basis changes and model parameter validation data reported in the annual summary reports over the past 15 years constitute sufficient new information to merit evaluation in an updated analysis, using environmental modeling software that meets current DOE QA requirements. EA and the site are in agreement with the need for a rebuilt, QA-approved, up-to-date CA. DOE-RL and its contractors are developing plans and gathering all appropriate input data for a complete update of the CA, which is expected to be completed over the next three years. In discussions with the lead modeling subject matter experts (SMEs), EA reviewed the plans and progress for the CA rebuilding effort, including the approach to scoping the new analysis, technical approach, input parameter validation, and analysis and reporting phases.

The site has identified the following new information and requirements as justification for updating the CA analysis:

- When the original 1998 CA was developed, some remedial-actions decisions were deferred to determine whether alternate remedies were necessary or available based on additional characterization and development of new remediation technologies. Consensus on many of those decisions has now been reached through negotiations.
- The Final Tank Closure and Waste Management environmental impact statement provided an updated inventory basis, new modeling capabilities, and new decisions reached in the associated ROD that need to be incorporated into the CA.
- Pump & Treat systems, which were not evaluated in the original CA, have had significant impact on groundwater flow, contaminant transport, and contaminant removal from groundwater.
- Development of improved cleanup strategies and improvements from cleanup may lead to establishing points of compliance other than the core zone boundary used in the original CA.
- Receding groundwater levels in the unconfined aquifer have led to an improved understanding of future conditions for the flow system.
- The revised ERDF PA (2013) evaluated the updated inventory, as well as the expansion of the facility to about twice the size that was evaluated in the original CA.
- The geologic structural basis for groundwater models has continued to improve with additional data collection and interpretation.
- The risk assessment scenarios currently in use for the Hanford Site CERCLA and RCRA analyses differ from those evaluated in the original 1998 CA.
- The original CA was prepared before DOE required its contractor to apply NQA-1 standards for use of simulation software for environmental modeling. A new analysis, performed with current software tools qualified under DOE Order 414.1D, *Quality Assurance*, standards and applied under current, compliant QA plans and procedures, is necessary.

Composite Analysis Conclusion

The basic modeling assumptions and data in the current CA are reasonable and conservatively support conclusions that the performance objectives can be satisfied at the currently established receptor locations; however, the analysis has become outdated. Annual summaries appropriately document increases in the total disposed inventory and environmental monitoring results that integrate the performance of the various facilities. The criteria for the Hanford Site CA are satisfied.

Nevertheless, a rebuilt CA is under way to support more accurate evaluation at additional potential receptor locations in order to improve future land use planning. After reviewing the plans for the CA rebuild and discussing progress with the lead modeling SMEs, EA concurs with the site that the rebuild is necessary and has determined that the plans and processes are appropriate.

5.3.4 Hazards Analysis and Control

Criterion:
Hazards Analysis and Control: Hazards associated with the handling, sampling, or assay analysis and disposal of waste have been identified, analyzed, and documented. An appropriate set of controls have been identified in the facility safety basis and implementing procedures. Hazard analysis and controls consider normal operations and potential off-normal conditions, such as a container breach, facility fire, or natural phenomenon events. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV)

EA observed multiple ongoing waste disposal operations at ERDF and one disposal at LLBG Trench 34. EA observed surveillance activities at both trenches 31 and 34. The technical procedures for waste disposal operations adequately governed associated disposal activities, including the scope of work and steps to be performed. Pre-job briefings at both ERDF and the LLBG were effective in conveying the

specific work scopes, associated hazards, and controls. The plan-of-the-day briefings for waste placement operations at ERDF included thorough discussions of responsibilities, precautions and limitations, prerequisites, work instructions, and health and safety requirements contained in procedure WSDO-5-50, *Landfill Cell Operations Procedure*. These briefings also demonstrated good use of enhanced briefing techniques, such as using a projected view of the operating procedure and a question and answer session, to enhance worker engagement.

Hazards associated with waste disposal operations include both non-radiological and radiological hazards. The most prevalent hazards associated with waste disposal activities are non-radiological hazards related to industrial safety, including use of heavy equipment, such as trucks with roll-off type dump containers, dust suppression tanker trucks, transport vehicular traffic, and rugged terrain. Many of the controls for these hazards are contained in job hazard analyses attached to the respective operating procedures. The work planning and control processes implemented at ERDF were consistent with RCC-PRO-WKM-53353 (PAS2-2.1) *Integrated Work Control.* The work planning and control processes implemented at LLBG follow PRC-PRO-WKM-12115*, Work Management.* EA observed appropriately controlled industrial safety hazards during operations, consistent with the institutional procedures. For example, all workers had appropriate personal protective equipment, such as hardhats, safety glasses, safety shoes, and reflective vests. Heavy equipment and waste operators demonstrated good practices, including verification of support equipment status (e.g., heavy equipment, as well as hoisting and rigging associated with the tank pump placement) and establishment of boundaries to protect against potential noise, vehicular, and beryllium hazards. Radiation control technicians conducted the requisite surveys and monitored RWP conformance. With some exceptions, conduct of operations and communication were effective. Radiological and beryllium controls included establishment of boundaries and appropriate postings; however, as noted below, some practices with respect to boundaries and contamination controls increased the potential hazards to the workers.

The most prevalent radiological hazard associated with most of the ERDF bulk waste disposal operations is the potential for distribution of and contact with radiologically contaminated soils/debris. For LLBG, the most significant radiological hazard is the potential for high external radiation fields. EA observed that radiological controls specified in RWPs governing observed work were appropriately designed to measure and address either radiological contamination or external dose rate hazards. At ERDF, EA observed generally appropriate application of radiological postings in the area being used for disposal, which is posted as a High Contamination Area (HCA). Contamination control, ongoing survey performance, and interaction with radiation control technicians during soil offloading and cover placement activities were generally effective. The RWPs established to control radiological hazards for operations at active LLBGs (Trenches 31 and 34), in conjunction with procedural controls, provide appropriate information on expected radiological conditions for specific work and adequately specify requisite radiological controls. With exceptions noted below, workers appropriately followed established controls while performing the tasks that EA observed.

EA identified a vulnerability at ERDF for the potential transfer of contamination when workers must routinely breach the HCA boundary to release the truck container tailgate in order to dump the waste. Interviews with workers and radiological controls staff members indicated that the practice of breaching the plane of the HCA without additional personal protective equipment and/or requisite survey is authorized by IAW-RC-200-4.2, *Routine Personnel Partial Entries.* The scope of this procedure allows for this practice provided that the part of the body crossing the boundary does not come within 6 inches of a potentially contaminated surface or underneath a contaminated surface. Additionally, interviews with ERDF Radiation Control supervision indicated that a Technical Basis had been documented by the prior Site contactor who established this work practice. However, because CHPRC was unable to find this document during the assessment, EA was unable to determine if appropriate ALARA techniques or use of specialized tooling (e.g., impact wrench extensions or water spray wands) had been considered at the time

of instituting these work practices. Furthermore, air monitoring data from the air sampling stations positioned at the ramp confirms the periodic presence of low-level airborne radiological contamination on the order of 2-6% of derived air concentration (DAC) limits, which could result in spreading measurable low levels of contamination outside the posted HCA boundary. Workers' hands and feet undergo limited exit surveys at the surface contamination area (SCA) and radiological buffer area (RBA) boundaries, but EA observed that survey times range from 20 seconds to 35 seconds per individual frisked and cleared (including worker(s) exiting heavy equipment operating within the HCA). This scan rate is too fast to reliably ensure detection of potential contamination, and there were no pauses as required by the survey procedures. These conditions are a common concern when relying on frisking for alpha emitting and/or transuranic (TRU) isotopes within the DOE complex. ERDF does not currently use automated counting systems, such as hand and foot monitors and/or personnel contamination monitors, when personnel exit the area/facility, thus increasing the potential for transport of undetected contamination outside the work area. (**OFI-CHPRC-2**)

The HNF-55719, *Hanford Internal Dosimetry Program*, criteria for assessing internal dose includes "Single or cumulative exposures to airborne radioactivity that result in greater than 10 DAC hours exposure in a calendar year, after correction for respiratory protection." In addition, the document states that "Personnel are required by 10 CFR 835 to participate in an internal dosimetry program, including routine bioassay, if they are likely to receive intakes in a year resulting in a committed effective dose of 100-mrem," and the program recommends periodic bioassay monitoring even at low-level exposures below Airborne Radiation Area posting requirements if the exposure would exceed 40 DAC-hours. With the recorded airborne levels of 2-6 % of DAC depending on the mix of isotopes, the 10 DAC-hour criterion would be exceeded if a worker is in the area between 167 and 500 hours per year. However, individual DAC-hour tracking is not performed at ERDF. Continuous occupational exposure at 2-6% of DAC represents an internal dose potential of 100 to 300 millirem annually (40 to 120 DAC-hours), but since confirmatory bioassays are taken only annually with sensitivity that is not likely to be able to detect that level of intake, the result would inappropriately indicate no internal dose to the workers. (**OFI-CHPRC-3**)

Also, workers are allowed to drink water within the SCA to remain hydrated, but they are not required to remove their gloves, wash their hands, and/or undergo a radiological survey to confirm that the drink containers and mouth surfaces are free of contamination. The work pace and staffing at the truck ramp (Controlled Area) limits workers' ability to rotate out of the ramp area to use the nearby designated shade area (outside of the Controlled Area) to hydrate. The SCA is posted: "Controlled work area, Authorized workers only, No eating, drinking, tobacco use, or application of cosmetics." (**Deficiency**)

Hazards Analysis and Control Conclusion

Overall, site-level work planning and control processes provide for appropriate identification of hazards and controls for waste disposal operations at ERDF and LLBG Trenches 31 and 34. A few vulnerabilities associated with contamination control, internal dose tracking, and radiological survey practices were identified.

5.3.5 Waste Acceptance Criteria, Inventory Control, and Receipt Acceptance

Criteria:
Waste Acceptance Criteria and Inventory Control: Each facility receiving waste for accumulation, storage, or staging; processing, treatment, or repackaging; shipping; or final disposal shall have a defined WAC. WAC for receipt of material to the facility are established based on the facility capabilities in conformance to the facility safety basis, hazards analysis, and limitations in the DAS. Processes are established and implemented to ensure inventory controls, WAC conformance, and documentation of

waste container constituents. Facility inventory records are maintained to accurately reflect receipt and disposal. Records archive processes are established to ensure retrievability and traceability to specific waste generators, shipments, and packages. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV; CRAD 31-11, Section 4.2, Criterion 2)

Monitoring to Certify Waste Acceptance Criteria Conformance: Each facility that receives and handles LLW shall have effective analysis, monitoring, and/or inventory records processes to certify that the wastes conform to the WAC, the facility safety basis, and the inventory limits. Measurement, analysis, and process records techniques shall be sufficient to verify all aspects of WAC compliance (radiological, chemical, and physical attributes). (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV; CRAD 31-11, Section 4.2, Criterion 3)

Receipt Acceptance: A process is established to verify conformance to the WAC. The process may include a review of certification documentation, shipping manifests, periodic sampling, and/or monitoring of received packages or shipments. Transfer for receipt shall not be authorized unless the supplying facility can certify conformance to the WAC. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV)

The ERDF WAC is presented in ERDF-00011, *Environmental Restoration Disposal Facility Waste Acceptance Criteria.* The WAC for the SWOC LLBG disposal facilities are contained in HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*. EA's review of both WAC documents indicated conformance to CHPRC and DOE Manual 435.1-1 requirements. The ERDF WAC and the active LLBG disposal facility WAC documents consider the relevant waste acceptance parameters, including physical, chemical, and/or radiological characteristics; transportation and handling requirements; container packaging requirements; safety basis considerations; worker safety; and long-term waste stability and long-lived isotopic concentrations that impact future receptor doses as analyzed in the PA. The WAC documents also define prohibitions for reactive, energetic, or pyrophoric materials, and toxic gases, as well as limitations on void space and free liquids as appropriate for shallow land burial sites.

ERDF also has a supplemental WAC document, ERDF-00003, *Supplemental Waste Acceptance Criteria for the Environmental Restoration Disposal Facility*. The supplemental WAC (SWAC) are additional criteria based on specific radiological and physical limits that require special planning and handling to ensure safety during disposal operations. Wastes meeting the radiological and/or physical restrictions defined in the SWAC require development of a specific Waste Shipping and Receiving Plan (WSRP), governed by ERDF-PRO-EN-54025 (WO-100-1.1), *Waste Shipping and Receiving Plans.* The WSRP is a requirements document that provides physical, radiological, and industrial hygiene information about the waste; specific requirements for packaging, shipping, and disposal of the waste; hazards associated with the waste; and a list of ERDF procedures or work packages to be used in handling the waste at ERDF. For example, due to the magnitude of its contamination, the highly contaminated long-length item discussed in Section 5.2 met the SWAC criteria for development of a WSRP. EA found that the WSRP prepared by the generator (tank farms) for disposal of this item at ERDF was comprehensive and valuable in identifying all relevant hazards and special handling controls necessary for safe disposal. EA considers the SWAC requirement for WSRPs for wastes with unique physical or safety hazards to be a positive initiative.

EA's observations concerning receipt acceptance and inventory management and control processes for ERDF and the LLBG are described in the remainder of this section.

Environmental Restoration Disposal Facility

As noted in section 5.2, the typical wastes received at ERDF are either contaminated components sent by the ORP contractor, WRPS, from the tank farms or other D&D activities, or bulk soils removed from various remediation sites managed by DOE-RL contractor CHPRC, which also manages the ERDF. EA reviewed individual component package characterizations such as the long pump item from the tank farms and found the processes to be technically sound. Similarly EA reviewed documentation of the initial characterization and waste profile processes used for accepting bulk waste from the remediation sites. EA observed shipments of bulk waste from one remediation site and noted that, with the exception of general truck contamination and dose rate surveys to verify acceptable transportation requirements, individual shipment waste characterization was based on the original waste profile characterizations and shipment weight information. Routine shipment sampling is not performed to verify that the waste composition within the soil column has not varied from the original characterizations. Although periodic sampling at the remediation site is performed to determine if sufficient soil has been removed to satisfy the remediation criteria, and a final site sampling is performed prior to termination of remediation activities, this data is not used to modify the characterization inventory certification of the individual shipments or provide a QA verification of the adequacy of the original characterization.

The waste acceptance process for individual shipments of waste to ERDF is governed by PRC-PRO-WM-53829 and implemented using an electronic Waste Management Information System (WMIS), which provides for automation of waste management processes and data collection, along with the generation and routing of waste-related forms into an integrated and retrievable format. WMIS allows users to initiate, track, and close waste packages through the various stages of waste management, including generation, identification, characterization, packaging, container management, procurement, storage, treatment, transportation, and disposal. In reviewing the use of and data outputs from WMIS in relation to observed waste shipments from two separate waste profiles disposed at ERDF during the review, EA found WMIS to be effective in managing the information associated with the waste profiles, automated WAC shipment limit checks, packaging, transport, receipt, waste acceptance, and location and inventory tracking for disposed waste material within ERDF.

The waste acceptance process begins with an approved waste profile, as discussed in Section 5.2. Once a waste profile has been approved and before shipping waste to ERDF, the Waste Generator Representative must request an Onsite Waste Transfer Form (OWTF) from the EWAS for each waste shipment to be sent. The EWAS reviews each request and resolves any identified discrepancies before requesting an OWTF through WMIS. Unlike the Solid Waste Information and Tracking System (SWITS) system used at the SWOC facilities, which requires manual verification against the waste profile limits, the WMIS system used at ERDF conducts automated WAC limit checking of each waste shipment against the approved waste profile and will not allow creation of an OWTF if any waste parameters exceed the established limits. The OWTF is the sole approval document authorizing waste shipment and waste acceptance into ERDF, and must accompany each shipment.

When a waste shipment arrives at ERDF, the driver scans the OWTF barcode into the WMIS at the ERDF scale. The scale reader board informs the driver to exit the scale, and the driver then proceeds to the assigned waste placement location within ERDF for offloading. During waste placement, the waste is physically observed to identify suspect waste or visible anomalies. This process, as well as actions to be taken if suspect waste is identified during the disposal process, are described in WSDO-5-50. EA reviewed the workflow process for receipt acceptance and observed receipt and placement of waste shipments from two different waste profiles, and found them to be consistent with applicable requirements.

To verify WAC compliance, ERDF principally relies on the remediation facility documentation of the waste characterization in the WMIS system and visual inspection of bulk wastes during offloading, which can only detect physical anomalies and the presence of prohibited items. ERDF does not use any verification non-destructive assay or waste sampling to validate that the radiological or chemical characteristics are consistent with the approved waste profile. Since the remediation site does not routinely perform confirmatory QA analysis to verify the individual bulk shipments are consistent with the original characterization as remediation activities move through the soil column, and since the ERDF does not perform periodic confirmatory QA measurements, there is potential for the waste constituents to deviate from the approved profiles and WAC. (**OFI-CHPRC-4**)

Active Low-Level Waste Burial Grounds Trenches 31 and 34

The waste acceptance process for individual shipments of waste to the LLBG disposal trenches is governed by appropriate procedures and is implemented through use of an electronic system, SWITS, a client-server Windows-based program that Hanford generators and SWOC personnel use to track waste through the characterization, storage, processing, treatment, shipment, and disposal processes. The system provides complete records management and real-time tracking for all wastes destined for SWOC facilities. SWITS tracks most aspects of waste management and disposal, including waste profiles and characterization, packaging, shipment and movements, location history, and final disposition locations. SWITS does not provide automated WAC limit checking; a manual system is used for each waste shipment, as discussed below. EA reviewed the use of and data outputs from the SWITS system for the most recent shipment of waste disposed at Trenches 31 and 34, as well as some randomly selected exposed waste containers accessible for viewing in each trench. The system was effective in managing and retrieving all required waste management information, including approved waste profiles and characterization data, container data, shipment and receipt history, specific global positioning system (GPS) placement locations in each disposal cell, and material-at-risk and cell waste inventories.

As required by PRC-PRO-WM-40523, wastes to be shipped to the LLBGs must have an approved SWOC waste profile. WMRs perform pre-shipment reviews of all packaged waste documentation, as well as WAC compliance checks. The pre-shipment reviews include review of physical, chemical, radiological, and packaging information against WAC criteria. WMRs ensure completion of specialty reviews by SMEs, as required by the procedure, and document any specific questions or concerns. The WMR then routes the shipment information through SWITS to the TSDR, who independently reviews the WMR's work and is responsible for final validation that the waste shipment is compliant with all WAC requirements and is acceptable for receipt. Once the TSDR electronically approves all containers for shipment, the shipment can be scheduled. EA reviewed shipment documentation for each of the most recent shipments to Trenches 31 and 34, including waste profiles, waste characterization, container data sheets, waste acceptance workflow approval documentation, and shipping papers. EA also observed waste receipt at Trench 34, including truck receipt, radiological survey, container inspection, shipping paper review, and waste placement. The reviews and observations indicated that the waste acceptance processes and inventory tracking were performed in accordance with DOE Manual 435.1-1 requirements.

A positive aspect of the SWOC waste acceptance program is a field waste verification program, which EA has not seen at other reviewed disposal facilities. PRC-PRO-WM-40524, *Waste Verification Program for Solid Waste Operations Complex Acceptance*, defines the performance evaluation system (PES) and waste verification processes for wastes shipped to the SWOC facilities. The PES and waste verification program (QA program) consists of field visual inspection of a percentage of each generator's waste to ensure that it is properly characterized and meets all WAC requirements. The PES establishes the rate at which verification is to be performed, as a percentage, during approval of generators' waste profiles. This percentage can increase or decrease, based on the generator's performance in meeting the verification protocols during visual inspection of the chosen waste containers. EA found that the

documentation associated with recent waste verification efforts provided acceptable verification of physical attributes of the waste contents for WAC compliance. However, like ERDF, SWOC does not use any verification non-destructive assay or waste sampling to validate that the radiological or chemical characteristics are consistent with the approved waste profile as part of a field verification program. (**OFI-CHPRC-4**)

Records Management and Retrieval

CHPRC has implemented a policy for waste records management and retrieval that is consistent with the National Archives and Records Administration (NARA) approved DOE Records Schedule Guidelines for records retention, which calls for destruction of many operational records after 75 years. However, the active monitoring and maintenance period is expected to last 100 years. It is DOE-RL policy to maintain and enforce institutional controls and land use restrictions as long as necessary to ensure that the PA and CA dose objectives can be satisfied. The SME elicitation estimates the median effective period for institutional controls to be 250 years. Records destruction at 75 years, which is consistent with the NARA and DOE records schedule, is not consistent with recommendations in DOE Guide 435.1-1, which states on page IV-91: "DOE low-level waste disposal facilities should plan on maintaining pertinent records at least through the operations, closure, and post-closure monitoring periods, and consider making them part of any local land use records. The pertinent records would be those that identify physical, chemical, and radiological characteristics of the waste and the certification of that information." Records destruction before the end of the active monitoring and maintenance period would adversely affect maintenance or remediation decisions in the later portion of that period.

Waste Acceptance Criteria, Inventory Control, and Receipt Acceptance Conclusion

EA found that both the SWOC and ERDF WAC documents conform to CHPRC and DOE Manual 435.1-1 requirements. Both SWOC and ERDF have formal and appropriate waste acceptance processes that are defined by procedures and consist of several steps, including waste profile development, pre-shipment review and manual or automated WAC and waste profile limit checks, and visual inspection of some waste materials as they are packaged or unloaded. ERDF also has a SWAC document, ERDF-00003, containing additional criteria based on specific radiological and physical limits that require special planning and handling to ensure safety during disposal operations.

WAC verification methods differ between ERDF and LLBG. Due to the nature of ERDF, which disposes of significant quantities of bulk soil and debris that are offloaded by dump truck, visual inspection is used routinely. SWOC disposal cells receive containerized wastes and have appropriately instituted a field waste verification program, which consists of visual inspection of a percentage of each generator's waste packages as a means of verifying WAC compliance. While visual inspection is appropriate, neither facility has protocols in place, as suggested by the implementation guide for DOE Manual 435.1-1, to verify non-physical parameters, such as radiological or chemical composition of the waste, to ensure consistency with WAC and waste profile limits.

With regard to waste records management and retrieval, CHPRC has implemented a policy consistent with the NARA-approved DOE Records Schedule Guidelines for records retention, which calls for destruction of many operational records after 75 years. However, this time limit is less than the active monitoring and maintenance period (100 years), and much less than the longer institutional controls period (250 years), during which such records will be necessary to support actions that ensure that the PA and CA dose objectives can be satisfied.

5.3.6 Disposal Cell Design and Operations

Criteria:
Support Facility and Disposal Cell Design and Operations: The following facility requirements and general design criteria, at a minimum, apply:

- *LLW systems and components shall be designed to maintain waste confinement.*
- *Ventilation: Staging, assay, and disposal facilities are designed and maintained with appropriate ventilation controls that consider normal conditions, such as off-gassing, and potentially off-normal situations, such as an energetic event or area fire. Ventilation controls shall prevent deflagration or detonation; protect the health and safety of facility workers from acute and chronic exposures; and ensure that airborne effluents are maintained within applicable requirements and guidelines.*
- *Disposal facilities are designed and maintained with appropriate monitoring and controls for personnel exposures to direct radiation, contamination, chemical, and physical hazards, considering both normal and potential off-normal situations.*
- *Disposal facilities are designed and maintained to control contamination or prevent or minimize release of the material during normal operations and during off-normal conditions or emergency events.*
- *Facilities shall include sufficient capacity for controlling site runoff and dewatering of disposal cell operations (i.e., removal, containment, monitoring, and if necessary treatment, and/or effluent release of leachate and contact water).*
- *Disposal facilities and systems are designed, maintained, and managed to conform to applicable National Fire Protection Association code requirements. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.2, Criterion 4)*

ERDF and the LLBGs have engineering features to minimize release of materials, control site run off, dewater disposal cell operations, and ensure long-term stability. As open air facilities, ERDF and the LLBGs are not equipped with active ventilation systems or installed real-time radiological monitoring systems.

One of the key engineered components of ERDF is the liner built into each cell, which consists of multiple layers of plastic and other impermeable materials and a drainage system to collect and removed rain or liquids as they move through the waste materials. ERDF does not accept liquid waste for disposal, but water enters the facility when it rains and snows. The collected water, or leachate, is routed to an onsite treatment facility to remove contaminants.

At ERDF, waste stabilization activities include compaction of soil and debris and integration of debris into a compacted soil matrix by compacting layers of clean soil over the wastes to minimize the potential for dispersion during operations. Containers are required to be at least 95% full. At the disposal facility, grout is added to waste items or containers to avoid potential void spaces; EA observed this activity for tank pump components, and it sufficiently met procedural requirements. Furthermore, ERDF maintains ongoing operations to monitor and ensure that compaction of soils meets minimum compaction requirements.

LLBG Trenches 31 and 34 are designed with RCRA-compliant double liners and accept both LLW and mixed LLW. These trenches are rectangular landfills 30 to 40 feet deep and contain 3,612 and 5,296 individual packages respectively, but they currently receive only one or two additional packages per year. Both trenches are less than 25% full. While the initial layer of waste has been covered or grouted, much of the second layer of waste containers is currently uncovered. Because the trenches are used so infrequently, some containers have been exposed to the elements for an extended period and exhibit significant corrosion and weathering. DOE Manual 435.1-1, Chapter IV, N(3) requires low-level

radioactive waste to be stored in a location and manner that protects the integrity of the waste for the expected time of storage and minimizes worker exposure. DOE Guide 435.1-1, Chapter IV, N(2) and (3) provide additional information on acceptable methods for meeting these requirements. Although these containers are considered to be disposed rather than stored, there remain potential vulnerabilities from container degradation and natural events, including wind-blown dispersion, heavy precipitation, or wildfire.

Both ERDF and the LLBGs use postings to identify active disposal areas as Controlled Areas and/or RBAs, as appropriate. Depending on the waste handling operations, these areas may be temporarily up-posted to radiological areas (i.e., Radiation Areas, High Radiation Areas, and/or Contamination Areas/ HCAs). During ERDF waste placement and treatment operations, up-posting to Contamination Area/ HCA is often necessary, as was the case for waste placement operations that EA observed during this assessment. However, in accordance with CHPRC processes, controls for whole-body monitoring of personnel entering the posted HCA were not required for the soil dumping and earth moving activities that EA observed, because physical contact with the contaminated waste was not necessary; dozer and compactor operators stay within their vehicles, which are maintained as an RBA. Once active placement of contaminated soil and debris is completed and materials are compacted, waste is covered over with "clean" soils as required by ERDF operations procedures.

EA observed radiation control technicians conducting job coverage and routine area radiological and contamination surveys in accordance with RWPs and operational procedures to verify and document the radiological conditions. Contamination surveys included roll-off container tailgates and surveys of workers' hands and shoes after completion of waste placement. With some exceptions noted in Section 5.3.4, both ERDF and LLBG exercised active radiological control during all operations and appropriately performed active air monitoring during waste handling operations at ERDF.

Disposal Cell Design and Operations Conclusion

Overall, support facility and disposal cell design and operations are generally acceptable in terms of monitoring and controls for release of materials from the cells and personnel exposures to direct radiation, contamination, and chemical and physical hazards. However, there were some notable exceptions. The delay in applying fill cover and/or grouting of exposed waste containers at the LLBGs has resulted in prolonged exposure of the containers to the elements, with premature physical degradation and potential for leaks.

5.3.7 Environmental Monitoring

Criteria:
Monitoring Plan: A preliminary monitoring plan for an LLW disposal facility shall be prepared and submitted to Headquarters for review with the PA and CA. Plans shall be implemented to ensure sufficient monitoring of groundwater, surface water, gaseous or particulate effluent releases, and ambient radiation conditions to evaluate conformance to the PA and CA objectives. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.1, Criterion 3)

Monitoring: Capabilities and procedures shall be implemented to ensure sufficient monitoring of ground, surface, leachate, or contact water; gaseous or particulate effluent releases; and ambient radiation conditions to evaluate conformance to the PA. The monitoring plan shall be updated within one year following issuance of the DAS to incorporate and implement conditions specified in the DAS and address changes identified during operations. Plans will be reviewed and updated whenever changes in conditions or operations are identified. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.2, Criterion 7)

DOE Manual 435.1-1, Chapter IV requires the following attributes for the monitoring plan:

- The site-specific PA and CA shall be used to determine the media, locations, radionuclides, and other substances to be monitored.
- The environmental monitoring program shall be designed to include measuring and evaluating releases, migration of radionuclides, disposal unit subsidence, and changes in disposal facility and disposal site parameters that may affect long-term performance.
- The environmental monitoring programs shall be capable of detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the performance objectives.

Groundwater at ERDF and LLBG flows eastward toward the Columbia River, the primary exposure route for contaminants to reach human and ecological receptors. The EA assessment focused on monitoring of the subsurface pathways and potential impacts that may occur from ERDF and the 200 Area LLBGs. The linkage between the PA monitoring activities and the operational monitoring programs is described in detail in the *Performance Assessment Monitoring Plan for the Hanford Site Low Level Burial Grounds* and is updated regularly.

Environmental Restoration Disposal Facility

The RODs require that groundwater monitoring at ERDF be performed in accordance with RCRA regulations (40 CFR 264, Subpart F). ERDF is a double-lined facility with a leachate collection system. Landfill expansions constructed after 2004 include basin lysimeters below the liner system sumps. Currently, both leachate and lysimeter basin liquids are in a monitoring program to provide, in part, an indication of whether the liners are performing within the design standards and to assess potential delisting of the leachate as a hazardous waste.

Hanford groundwater monitoring and associated environmental surveillance programs are implemented to conform to DOE Order 435.1 and DOE Order 458.1 *Radiation Protection of the Public and the Environment*, along with the CERCLA, RCRA, and Washington State regulations. The Tri-Party Agreement states that RCRA and CERCLA will be integrated, and DOE Orders 458.1 and DOE Manual 435.1-1 also require facility-specific monitoring objectives. While the monitoring program requirements for each of these orders, agreements, and regulatory constraints have different monitoring objectives and analyte-sampling requirements, the site has integrated them into a single monitoring program that, for practical reasons, use the same wells as sampling points.

Three kinds of sampling are performed at ERDF: (1) leachate from within the lined landfill cells, (2) lysimeters in the vadose zone soil in close proximity under the liners, and (3) deep groundwater wells. Groundwater samples are collected semiannually from four monitoring wells in the vicinity of ERDF. The network consists of one up gradient well and three down gradient. The groundwater levels in the ERDF well network have gradually fallen since monitoring began in 1995 due to the sitewide termination of ground discharge operations.

Leachate is pumped out of ERDF and treated. The composition of the contaminants in the ERDF leachate reflects the waste being disposed. Typically, ERDF leachate contains detectable concentrations of nitrate, sulfate, chromium, uranium, tritium, technetium-99, and gross alpha/beta. Carbon-14 concentrations in the leachate peaked in recent years consistent with the rate of graphite disposal. Since March 2015 the concentration of Carbon 14 in the leachate has continue to decline.

EA reviewed leachate and lysimeter monitoring data. Due to the widespread deep groundwater contamination, the collection and analysis of the shallower lysimeter data from immediately below the bottom cell liner is critical to evaluating the integrity of the ERDF liner. The absence of technetium-99 within the lysimeter liquid is a good indication that the leachate collection system located above the

lysimeters is not leaking liquid into the lysimeters. In addition, the sulfate concentrations in the lysimeter liquid remains high in comparison to the leachate, indicating that the lysimeter liquid has not been diluted by leachate leaking through the liner system. This data, along with other supporting evidence, indicates that the vadose zone below ERDF has not been contaminated by ERDF wastes. The vadose zone data has been trended and is acceptably consistent.

In addition to the comparison of the leachate and the lysimeter data, EA reviewed the deep groundwater monitoring data. Nitrate, carbon tetrachloride, gross beta, gross alpha, technetium-99, iodine-129, and uranium are currently present in samples collected from the natural geological deposits hundreds of feet below the cells in the ERDF monitoring wells due to the migration of contaminants underneath ERDF from non-ERDF sources in the 200 West Area up gradient from ERDF. Based on the calendar year (CY) 2015 data evaluation, there has been no correlation between leachate COC levels and groundwater COC levels that would indicate the leachate is impacting the groundwater under ERDF.

200 West and 200 East Areas Low-Level Burial Grounds

The primary pathways of interest are air and groundwater for both operational and post-closure conditions at the 200 East and 200 West LLBGs. The approach to performance monitoring for the LLBGs makes use of the existing air, subsidence, and RCRA groundwater monitoring programs. For groundwater, the performance-related constituents of interest (uranium, technetium-99, tritium, and iodine-129) are co-sampled with the RCRA groundwater sampling schedule for the LLBG. The programs for air sampling and analyses and subsidence monitoring are currently used for performance assessment at the LLBG. Also, the results of groundwater monitoring from other programs (e.g., CERCLA and State Waste Discharge Permit) are used for LLBG performance monitoring and performance review. This integrated monitoring adequately supports the conclusions of the LLBG PA analysis.

Environmental air quality is measured at a large number of sitewide and offsite locations within and outside the perimeter of the Hanford Site. The network consists of two types of programs: the near-facility environmental monitoring program and the surface environmental surveillance program. Near-facility air sampling monitors are used to determine the effectiveness of the facility-specific controls and effluent treatment systems in reducing effluents and emissions. These air samplers also measure ambient diffused source emissions. A total of 43 near-facility environmental air sampling locations are operating in the 200 West and East Areas, and upwind and downwind monitoring locations exist around the burial grounds. The sitewide air monitoring program also includes air sampling units in nearby communities (Yakima, Toppenish, and Othello) and around the periphery of the Hanford Site.

EA examined groundwater monitoring practices by observing a groundwater sampling planning meeting, sampling preparations, collection of groundwater samples, storage of samples, and all related field activities. All field staff worked safely and in accordance with technical procedures in SGRP-PRO-SMP-50043, *Operational Monitoring Groundwater Sampling*. Sampling staff were well organized; were prepared with appropriate, calibrated, and tested equipment; and handled samples with appropriate preservation processes and chain of custody records. EA observed staff using groundwater monitoring data in the sitewide database, including tabulating, trending, and posting within the database. Groundwater collection, chemistry, and data analysis staff were experienced and knowledgeable.

In addition, EA toured the 200 West and 200 East LLBG and associated monitoring wells. Monitoring wells and the injection/pumping wells associated with the groundwater treatment systems were map-located for evaluation of spacing relative to such parameters as source size, groundwater flow direction, and rate of groundwater flow. The evaluations of the monitoring wells show that the networks are adequate for assessing impacts from the LLBG.

Environmental Monitoring Conclusion

Hanford uses integrated sitewide monitoring and data analysis processes, and the monitoring programs meet DOE Manual 435.1-1 requirements. The current monitoring data indicates that ERDF and the LLBG are performing within expectations of the models and parameter assumptions for the facilities' PAs. Monitoring data is analyzed to support and validate modeling parameters. Current modeling in the PAs indicates that the performance objectives are satisfied.

5.3.8 Closure Plan Development and Maintenance

Criteria:
Closure Plan: The disposal facility design and operation must be consistent with the disposal facility closure plan and lead to disposal facility closure that provides a reasonable expectation that performance objectives will be met. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.2, Criterion 6)

Closure Plan Development and Maintenance: A preliminary closure plan shall be developed and submitted to Headquarters for review with the PA and CA. The closure plan shall be updated following issuance of the DAS to incorporate conditions specified in the DAS. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.3, Criterion 1)

Prompt Closure Processes: Closure of a disposal facility shall occur within a five-year period after it is filled to capacity, or after the facility is otherwise determined to be no longer needed. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.3, Criterion 2)

Institutional Controls and Monitoring: Monitoring plans shall be implemented to support verification of performance objectives during a period of post-closure administrative control. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV; CRAD 31-11, Section 4.7.3, Criterion 4)

Environmental Restoration Disposal Facility

ERDF is intended to continue operations until the remediation efforts are completed per the ERDF ROD. A final closure date has not been determined because several CERCLA remediation decisions are not yet final.

The inventory used in the ERDF PA source term model includes the currently disposed inventory and the forecasted inventory to the closure time (year 2035) from waste sites where cleanup has been planned. The majority of the forecasted inventory is estimated from 100 Area reactor buildings (including pipelines with associated soil, solid waste, and building debris), solid waste sites, and burial grounds that contain uranium metals and research waste. The inventory of carbon-14 associated with graphite blocks is considered separately as an insoluble waste form; it constitutes the largest fraction of the total carbon-14 inventory.

All waste material received at ERDF is compacted or grouted at the time of disposal to minimize void space and potential subsidence in the future. Earthmovers equipped with ground-monitoring equipment place the waste in layers and drive over the waste to compact it and eliminate any air pockets or gaps in the landfill. Waste items with voids (e.g., pipes) are either filled with grout or cut into pieces. CP-60151, *ERDF Performance Assessment Preliminary Closure Plan*, dated March 2015, satisfies the requirements of DOE Manual 435.1-1. The preliminary closure plan assumes that a CERCLA-compliant cap will be installed at the time of closure. Generic cover design details are considered to assist modeling for the PAs but are subject to change as technology develops or understanding of cap performance

evolves. Final closure activities for ERDF are expected to begin in the FY 2035 timeframe. Closure activities are expected to include the development of final PA and CA documents, a final closure plan, closure cover design, cover construction, and initiation of post-closure maintenance and monitoring activities.

200 West and 200 East Areas Low-Level Burial Grounds

Many of the older trenches pre-date DOE Manual 435.1-1 requirements for a closure plan. Active LLBGs in the Central Plateau began accepting waste from processing operations on the Hanford Site in the early 1960s and were anticipated to continue to receive waste until approximately 2045. By January 1, 1999, approximately 358,000 cubic yards of LLW and 12,000 cubic yards of low-level mixed waste had been disposed in the LLBGs in various types of containers, including drums and boxes made of steel, wood, and cardboard. Early efforts to cap the filled trenches placed as little as 2 feet of soil over the waste, but the remediation contractors, through experience, recognized that 8 feet of soil was required to minimize animal and plant intrusion concerns. Some of these operational caps exhibit signs of subsidence. The LLBG subsidence safety issue is highlighted in HNF-2030, Rev. 1, *Subsidence Potential in the Burial Grounds*, published in August 2016 (revision of a study originally performed in 1998). The original study reviewed SWITS to identify areas in the burial grounds that had the potential for a subsidence event of sufficient magnitude to endanger the life of vehicle operators and pedestrians moving over buried waste areas. Based on this study, Hanford restricts vehicular and pedestrian traffic over specific LLBG cells.

The current DOE-RL-2000-70, *Closure Plan for Active Low-Level Burial Grounds*, was approved in 2000 and follows DOE Manual 435.1-1. The plan describes the closure approach, initial closure steps, a conceptual cover design, and cap construction. It applies to the LLBG trenches in the 200 West and 200 East Areas, which cover a combined (but not contiguous) area of 1400 acres. Older waste facilities around the site are assigned to the environmental restoration contractor for surveillance and maintenance pending final remediation and closure. Only the mixed waste Trenches 31 and 34 are currently active in the LLBG areas.

The final closure schedule has not yet been determined for the filled LLBG trenches with operational covers, pending determination of the potential need for further remediation. The current policy based on the ROD is that all stored TRU waste will be retrieved from the LLBGs before they are closed. Older trenches that are currently used for TRU storage may be reused for LLW disposal, or they may be refilled with native soil in advance of closure. After TRU retrieval, the trench contents must be compacted to provide a stable base before construction of the final cover. The need to characterize and retrieve TRU before closure activities begin has delayed the closure time and contributed, in part, to the LLBG subsidence safety issue.

The Central Plateau 200 East and West Area LLBGs are lagging behind in their closure and maintenance activities. Site discussions have suggested that delays result, in part, from prioritization of available funding for characterization studies. Awareness of subsidence as a safety issue in the LLBG has been a positive first step in LLBG maintenance. A DOE-RL site waste management SME indicated that additional characterization is needed to determine if remediation and treatment are needed prior to final closure for some of the filled LLBG trenches. Currently, a plan, DOE/RL-2004-60, Rev. 1, *200-SW-2 Radioactive Landfills Group Operable Unit RCRA Facility Investigation/Corrective Measures Study/Remedial Investigation Feasibility Study Work Plan*, has been prepared to identify information needed to proceed to closure of a portion of the LLBG.

Closure Plan Development and Maintenance Conclusion

The current ERDF and LLBG closure plans, CP-60151 and DOE/RL-2000-70, satisfy the requirements of DOE Manual 435.1-1. However, in some non-contiguous areas of the LLBGs that have not been used for decades the potential for subsidence over degraded high void space waste containers presents safety hazards. Additionally, some of these areas will require further remediation to remove TRU before final closure.

6.0 FINDINGS

EA identified no findings during this assessment. Deficiencies that did not meet the criteria for a finding are listed in Appendix C of this report, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified some OFIs to assist cognizant managers in improving their programs and operations. OFIs may identify potential solutions for findings and deficiencies identified in appraisal reports but may also address other conditions observed during the appraisal process. EA offers these OFIs only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

CH2M Hill Plateau Remediation Company

OFI-CHPRC-1: Consider rebuilding and analyzing the PAs for both the 200 East and 200 West Area LLBGs using up-to-date operating systems, NQA-1 compliant software, and current information regarding the subsurface migration conceptual and computer models, and other relevant parameters and conditions. Incorporate QA standards compatible with the CA currently being rebuilt and analyzed.

OFI-CHPRC-2: Consider implementing enhanced clearance and monitoring techniques, such as the use of hand and foot or whole body monitors, to ensure that personnel and equipment are free of contamination before leaving work sites.

OFI-CHPRC-3: Consider further analyzing low-level airborne radioactivity and contamination conditions at the ERDF dump ramps and their potential for internal dose. This may include more rigorous air sampling, DAC-hour tracking, and/or isotopic source term analysis, consistent with the recommendations of the DOE Internal Dosimetry Standard. Also consider additional technical evaluation of air sampling data to establish the likelihood of workers in low DAC environments to exceed the monitoring threshold of 100 mrem per year. If the evaluation shows a likelihood of exceeding the 100 millirem per year threshold, monitoring in accordance with 10 CFR 835, *Radiation Protection* will be required either in the form of individual DAC-Hour tracking, or participation in a routine bioassay program in accordance with the Hanford Internal Dosimetry Manual

OFI-CHPRC-4: Consider instituting procedural requirements for additional periodic QA measurement and surveillance methods, such as sampling, assays, and/or spectrographic measurements, or truck portal monitoring to verify that the radiological and/or chemical composition of the waste shipments remain consistent with the original waste profile characterization analysis and WAC requirements.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: August 28-31, 2017 and September 25-28, 2017

Office of Enterprise Assessments (EA) Management

William A. Eckroade, Acting Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
William E. Miller, Deputy Director, Office of Environment, Safety and Health Assessments
C.E. (Gene) Carpenter, Jr., Director, Office of Nuclear Safety and Environmental Assessments
Kevin G. Kilp, Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

Quality Review Board

Steven C. Simonson
John S. Boulden III
Thomas R. Staker
William E. Miller
Michael A. Kilpatrick

EA Site Lead (Acting) for the Hanford Site

Samina Shaikh

EA Assessors

Timothy Mengers – Lead
Ron Bostic
Tom Naymik
Joe Lischinsky
Mario Vigliani

Appendix B
Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

- WSDO-5-50, *Landfill Cell Operations Procedure*
- Job Hazard Analyses associated with WSDO-5-50
- WSDO-5-82, *Facility Support Operations Procedure*
- WFMP-2016-WSA-16074, *Waste Management at Waste & Fuels*
- *Controlling Access and Waste Movement*
- SW-100-141, *Management of Waste at LLBG*
- RCC-PRO-WKM-53352 (PAS-2-1.1), *Integrated Work Control*
- Waste Shipment Folder contents for shipments off loaded at ERDF 08-30-2017
- Waste Shipment Folder contents for shipment receipt and placement at LLBG Trench 34, 09-28-2017
- ERDF Cell Operation Data Sheets for shipments offloaded at ERDF 08-30-2017
- Radiological Work Permits (ERDF-17-003, ERDF-17-001)
- ERDF Non-Critical Lift Data Sheets 08-29-2017PRC-MP-MS-003, *Integrated Safety Management System/Environmental Management System Description (ISMSD)*
- PRC-PRO-WKM-12115, *Work Management*
- PRC-PRO-WKM-079, *Job Hazard Analysis*
- CHPRC-00072, *CH2M HILL Plateau Remediation Company Radiation Protection Program*
- CHPRC-00073, *CHPRC Radiological Control Manual*
- PRC-MP-IRM-40119, *Document Control and Records Management Plan*
- PRC-PRO-IRM-10588, *Records Management Processes*
- PRC-MP-QA-599, *Quality Assurance Program*
- PRC-PRO-TQ-40164, *Personnel Training and Qualification*
- PRC-PRO-QA-052, *Issues Management*
- PRC-PRO-EM-7647, *Emergency Preparedness Program Requirements*
- HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*
- PRC-PRO-WM-40519, *Waste Characterization*
- PRC-PRO-WM-40523, *Solid Waste Operations Complex Waste Acceptance Program*
- PRC-PRO-WM-40524, *Waste Verification Program for Solid Waste Operations Complex Acceptance*
- SWSD-PRO-OP-51636, *Management of Waste at LLBG*
- SWSD-PRO-OP-51684, *Controlling Facility Access & Waste Movement*
- EP&SP-2017-SURV-17963, *Performance Evaluation System (PES) Process*
- SWSD-STD-EP-53087, *Low-Level Burial Grounds Trenches 31-34-94 Waste Analysis Plan*
- Waste Profile PFNW-100-120-0004, *Macro encapsulated Hazardous Debris and Radioactive Lead Solids Waste from Off Site Generators Approved for Disposal at Hanford*
- Waste Profile PFNW-100-120-0005, *Thermal and Non Thermal Low Level Waste Processing for Disposal*
- Mixed Waste Trench 31 Waste Shipment CH1704, *Shipment paperwork, container data sheets, radiological detail reports, waste tracking sheets, SWITS R120 reports, waste acceptance and workflow*
- Mixed Waste Trench 34 Waste Shipment PR1701, *Shipment paperwork, container data sheets, radiological detail reports, waste tracking sheets, SWITS R120 reports, waste acceptance and workflow*

- *Memorandum Of Understanding Between The Department Of Navy and the Department Of Energy For Disposal Of Decommissioned, Defueled Naval Reactor Compartments at the Hanford Site*, December 1996
- ERDF-00011, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*
- ERDF-00003, *Supplemental Waste Acceptance Criteria for the Environmental Restoration Disposal Facility*
- CP-60156, *ERDF Waste Disposal Requirements (EWDR)*
- PRC-PRO-WM-53829, *ERDF Waste Acceptance Process*
- ERDF-PRO-EN-54026, *ERDF Engineering Waste Acceptance Review*
- ERDF-PRO-EN-54046 *Un-reviewed Disposal Question*
- WSDO-5-18, *Waste Acceptance Procedure*
- ERDF-PRO-EN-54025 (WO-100-1.1), *Waste Shipping and Receiving Plans Procedure*
- WSDO-5-65, *Landfill Packaged Waste Inventory Tracking Procedure*
- Waste Profile, CH61810BBG001, *618-10 Bulk Burial Ground Waste*
- ERDF Waste Shipment 618E-17-8650 8734 8903 8909 WMIS OWTF
- Waste Profile WP-WRPSGLBL002, Rev9, *WRPS Tank Farms Global*
- WSRP OHC-RP-W0186 000, *Waste Shipping and Receiving Plan Tank Farms 241-AW-106A Pump Disposition*
- DOE/RL-2004-60, Rev. 1,"200-SW-2 Radioactive Landfills Group Operable Unit RCRA Facility Investigation/Corrective Measures Study/Remedial Investigation/Feasibility Study Work Plan," June 2016
- DOE/RL-2016-67, Rev. 0, Hanford Site Groundwater Monitoring Report for 2016, September 2017
- SGW-59564, Rev. 1, Engineering Evaluation Report for Low-Level Burial Grounds Trenches 31 and 34 and Low-Level Burial Grounds Trenches 31 and 34 Waste Storage and Treatment Pads, August 2017
- SGRP-PRO-SMP-50043, GRP-FS-04-G-004, Operational Monitoring Groundwater Sampling, Rev. 6, Change 0. 03/22/2017
- DOE/RL-2015-56, Rev. 0, Hanford Atomic Energy Act, Sitewide Groundwater Monitoring Plan and Supporting Plate Maps
- Mehta, Sunil, 2014, Performance Assessment for the Environmental Restoration Disposal Facility, Hanford Site, Washington, Waste Management, March 2-6. 2014
- Overview of Modeling Quality Assurance for Washington River Protection Solutions (with corresponding CHPRC program), WRPS Course #352064

Interviews

- CHPRC ERDF Operators
- CHPRC ERDF Operations Manager
- CHPRC ERDF Operations Supervisor
- CHPRC ERDF Radiation Control Technician
- CHPRC ERDF Radiation Control Supervisor
- CHPRC Radiation Protection Manager
- CHPRC ERDF Industrial Hygienist
- CHPRC ERDF Waste Specialists
- CHPRC LLBG Trench 34 Operators
- CHPRC LLBG Operations Supervisor
- CHPRC LLBG Trench 34 Radiation Control Technician

- CHPRC Transportation and Waste Integration, Waste Data Management Manager
- CHPRC Transportation and Waste Integration, Waste Data Management Database Administrators for SWITs and WMIS
- CHPRC Transportation and Waste Integration, Waste and Transportation Services Waste Manager
- CHPRC Transportation and Waste Integration, Waste and Transportation Services WMRs and TSDRs
- CHPRC ERDF Project Engineers
- CHPRC ERDF Radiological Controls Manager
- 618-10, ERDF, and 300 Area Radiological Controls Manager
- DOE-RL Radiological Controls SME
- CHPRC Environmental Sampling Manager
- CHPRC Environmental Sampling Scientists
- CHPRC Environmental Sampling Technicians
- CHPRC Modeling Manager
- CHPRC Modeling Scientists and Engineers

Observations

- Low-Level Radioactive Waste Shipment Receipt and Acceptance of Waste Shipments into ERDF
- Low-Level Radioactive Waste Shipment Receipt and Acceptance of Waste Shipments into LLBG Trench 34
- ERDF Disposal Cells Waste Placement, Soil Grading and Compaction Operations
- ERDF Plan-of-the-Day and Shift Turnover Meetings
- LLBG Trench 34 Pre-job briefings for Waste Shipment Receipt and Placement
- ERDF hoisting, rigging, placement and preparation for macro encapsulation of AY 106 Tank Pump
- Walk down LLBG Trench 31
- Walk down LLBG Trench 34
- ERDF 618-10 Can Waste Placements
- ERDF 241-AW-106A Pump Waste Placement
- CHPRC LLBG Extraction Well Treatment Facility Sampling Event
- ERDF Groundwater Monitoring Well Sampling Event
- Integrated Groundwater Database Trending Demonstrations
- ERDF lysimeter and well walkdown
- LLBG Monitoring Well Network Reconnaissance

Appendix C
Deficiencies

Deficiencies that did not meet the criteria for a finding are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

Deficiency: Contrary to the Integrated Safety Management core function to perform work within controls, and contrary to the occupational safety and health procedure PRC-PRO-SH-7085, *Safety Responsibilities*, CHPRC has not ensured that individuals working within posted controlled work areas heed the safety notice and warning postings that state “no drinking” within the ERDF off-loading buffer area.