

Independent Assessment of Conduct of Operations at the Hanford Site Tank Farms

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Acronyms

ALARA	As Low As Reasonably Achievable
AR	Action Request
CFR	Code of Federal Regulations
CRAD	Criteria and Review Approach Document
DOE	U.S. Department of Energy
DRUM	Department Roll-up Meeting
EA	Office of Enterprise Assessments
ETF	Effluent Treatment Facility
H2C	Hanford Tank Waste Operations & Closure, LLC
HFO	Hanford Field Office
iCAS	Integrated Contractor Assurance System
ITDC	Integrated Tank Disposition Contract
LERF	Liquid Effluent Retention Facility
LOTO	Lockout/Tagout
NCO	Nuclear Chemical Operator
NFPA	National Fire Protection Association
OFI	Opportunity for Improvement
ORPS	Occurrence Reporting and Processing System
SOM	Shift Operations Manager
SSCs	Structures, Systems, and Components
STE	Shift Technical Engineer
TSCR	Tank-side Cesium Removal
TSR	Technical Safety Requirement
WTP	Waste Treatment and Immobilization Plant

INDEPENDENT ASSESSMENT OF CONDUCT OF OPERATIONS AT THE HANFORD SITE TANK FARMS

Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of conduct of operations at the Hanford Site Tank Farms and other liquid waste facilities, which are managed and operated by Hanford Tank Waste Operations & Closure, LLC (H2C) for the DOE Hanford Field Office. The assessment evaluated the effectiveness of H2C in developing, managing, and maintaining an effective conduct of operations program. The assessment was conducted in June and July 2025.

EA identified the following strengths, including two best practices:

- Functional Tank Farm valve pit mock-ups enhance training effectiveness and provide opportunities for operators to train on multiple conduct of operations elements. (Best Practice)
- Use of three-dimensional reality capture at H2C-operated facilities enhances the effectiveness of conduct of operations by aiding personnel in locating equipment and components, minimizing personnel exposure to hazards, and improving work planning efficiency and effectiveness. (Best Practice)
- Dry runs of waste transfers to the Waste Treatment and Immobilization Plant (WTP) performed in coordination with the WTP operating contractor support successful initiation of the direct-feed low-activity waste process.
- H2C has increased staffing of conduct of operations coaches to improve company-wide conduct of operations practices by performing field observations and providing feedback.
- In response to several recently identified adverse conditions related to conduct of operations program implementation, H2C has initiated significant actions to identify programmatic common causes and to re-emphasize the importance of the program to personnel.

EA also identified several areas of concern, as summarized below:

- Procedure use and adherence by H2C personnel was inconsistent and, in several instances, did not meet requirements or management expectations.
- Several instances were identified where procedures or work instructions were deficient, inconsistent, or contained human error traps.
- H2C operator knowledge of conduct of operations concepts was inconsistent across facilities.
- Checklists were not consistently used during pre-job briefs and shift turnovers, leading to inconsistent communication of required content.
- An unauthorized operator aid was observed in use in the retrieval control room.
- Multiple H2C facilities had a superseded revision of the lockout/tagout (LOTO) procedure in LOTO logs; multiple operations did not perform all required quarterly LOTO and caution tag audits.
- H2C did not ensure that hazard signage was consistent at all personnel entrances to Tank Farms.

In summary, H2C has developed an adequate conduct of operations program, and continues to work to improve identified implementation challenges. However, issues were identified with the consistency of program implementation at the different Tank Farms facilities and operations, including inconsistent procedure use and adherence, and inconsistent pre-job briefs and shift turnovers. Until the concerns identified in this report are addressed or effective mitigations are put in place, the risk associated with Tank Farms operations will be elevated.

INDEPENDENT ASSESSMENT OF CONDUCT OF OPERATIONS AT THE HANFORD SITE TANK FARMS

1.0 INTRODUCTION

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 the effectiveness of Hanford Tank Waste Operations & Closure, LLC (H2C) conduct of operations program implementation at the Hanford Site Tank Farms. H2C operates the Tank Farms for the DOE Hanford Field Office (HFO). This assessment was conducted in June and July 2025.

H2C was awarded the new Integrated Tank Disposition Contract (ITDC) in February 2024 and fully assumed management and operation of ITDC facilities in February 2025. Current ITDC operations include the Tank Farms, the Tank-side Cesium Removal (TSCR) facility, the 242-A Evaporator facility, and other liquid waste operations. Future ITDC functions will include management and operation of the direct-feed low-activity waste process at the Waste Treatment and Immobilization Plant (WTP).

In accordance with the *Plan for the Independent Assessment of Conduct of Operations at Hanford Site Tank Farms, July 2025*, this assessment evaluated the effectiveness of H2C in developing, managing, and maintaining an effective conduct of operations program at the Tank Farms, including the TSCR facility. Program implementation at the 242-A Evaporator facility was not included due to recent readiness review activities.

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which EA implements through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms “best practices, deficiencies, findings, and opportunities for improvement (OFIs)” as defined in the order.

As identified in the assessment plan, this assessment considered requirements related to conduct of operations program performance. EA used objectives and criteria from EA CRAD 31-39, Revision 0, *Review of Conduct of Operations*, to guide this assessment.

EA examined key documents, such as system descriptions, work packages, procedures, manuals, analyses, policies, and training and qualification records. EA also interviewed key personnel responsible for developing and executing the associated programs; observed operations and maintenance activities; and walked down significant portions of selected Tank Farms and other liquid waste facilities, focusing on conduct of operations performance. The members of the assessment team, the Quality Review Board, and the management responsible for this assessment are listed in appendix A.

There were no previous EA findings to follow up on during this assessment.

3.0 RESULTS

3.1 Organization and Administration

This portion of the assessment evaluated H2C’s established conduct of operations organization and administration.

H2C has established and implemented an adequate conduct of operations program in accordance with DOE Order 422.1, *Conduct of Operations*. The documented program consists of an adequate policy (TFC-POL-01, *Conduct of Operations Policy*) that defines expectations for conduct of operations adherence, and a thorough conduct of operations implementation matrix (TFC-PLN-05, *Conduct of Operations Implementation Plan*) that specifies a suite of detailed implementing procedures for all 18 DOE Order 422.1 elements. The program adequately defines roles, responsibilities, authorities, and accountabilities for Operations organization personnel.

H2C has appropriately established shift staffing for all operator, engineering, and support positions. All positions were fully staffed during observations, including relief positions. During the observed operation of the TSCR and retrieval systems, all personnel appropriately followed the procedural instructions specified in their operating and rounds procedures. Interviews with seven nuclear chemical operators (NCOs), three shift operations engineers, and two shift operations managers (SOMs) confirmed that they clearly understood their roles and responsibilities, reporting requirements (e.g., proper notification of system status changes), and were appropriately knowledgeable of the systems. Reviewed training and qualification records for each interviewee confirmed full qualification status. At the time of the assessment, one NCO was in the process of qualifying and was appropriately working under the supervision of a qualified NCO.

H2C has also increased staffing to six conduct of operations coaches, three human performance improvement evaluators, and one supervisor to further improve conduct of operations oversight. Coaches are required to conduct multiple observations monthly, focusing on areas such as placekeeping practices for level 1 (the highest operational level) procedures and three-way communication.

H2C conducts adequate monitoring and self-assessments of operations. Independent assessments of conduct of operations are appropriately required by TFC-ESHQ-AP-C-02, *Independent Assessments/Audits*. The reviewed independent assessment FY-2022-ESHQ-I-0006, *Implementation of Conduct of Operation Safety Management Program*, demonstrated that specified assessments are being conducted as required. Management observations of operations are adequately governed by TFC-ESHQ-AP-C-03, *Management Observation Program (MOP)*. During an observed monthly department roll-up meeting (DRUM), managers reviewed performance metrics, MOP reports, and emerging topics, demonstrating effective engagement with field personnel and attention to operational performance. DRUM attendees identified possible trends and potential focus areas for future months.

Organization and Administration Conclusions

H2C has established and implemented an adequate conduct of operations program. Interviewed personnel demonstrated a thorough understanding of their roles and responsibilities. Shift staffing levels were adequate, including relief personnel. The conduct of operations DRUMs demonstrated the pursuit of continuous improvement.

3.2 Shift Routines and Operating Practices

This portion of the assessment evaluated H2C's established shift routines and operating practices.

H2C has established and implemented effective shift routines as specified in TFC-OPS-OPER-C-60, *Surveillance Rounds*, including requirements for inspections, equipment checks, and the use of round sheets (data sheets that identify important equipment and acceptable equipment instrumentation readings). These requirements were properly incorporated into the operating procedures (TO-270-700, *Operation of the TSCR System*; TO-270-039, *Retrieval Operations Rounds*; TF-OR-TSCR-01, *TSCR NCO Control Enclosure Rounds*; and TF-OR-TSCR-02, *TSCR NCO Roving Rounds*). These operations procedures

provide adequate instructions and data recording forms for all facility equipment rounds and surveillances to ensure system functionality, enable performance trends analysis, and appropriately specify response to out-of-tolerance equipment indicators. All observed rounds were appropriately conducted as required. During retrieval rounds, the NCO appropriately announced testing operations prior to performance, and all present NCOs acknowledged the announcement.

H2C has also established and implemented effective operations practices to ensure that shift operators are alert, informed of conditions, and operate equipment properly. TFC-OPS-OPER-C-08, *Shift Routines and Operating Practices*, effectively provides instructions for all operators, including the Operations Manager, regarding current and changed facility status, authority to operate equipment, and personnel in training under the observation of a qualified operator. TFC-OPS-OPER-C-08 also specifies requirements for formal, disciplined operations. Interviews with NCOs and SOMs confirmed their understanding of the requirements for shift routines and cognizance of current facility conditions.

While most operating practices were adequate, a few exceptions were observed. TSCR NCOs were not aware of what work was being performed by personnel observed working near the TSCR facility. Additionally, electrical panels were observed with missing National Electrical Code inspection information and peeling 480-volt warning stickers, and remnants of caution tape were left attached to poles. These issues were not identified during roving rounds.

Shift Routines and Operating Practices Conclusions

H2C has established and implemented effective shift routines and operating practices in operating procedures. Rounds and surveillances were appropriately required by procedure and were effectively performed during the assessment with a few exceptions.

3.3 Control Area Activities

This portion of the assessment evaluated H2C's control area procedures and operations practices.

H2C has established and implemented adequate control area operations practices as required by DOE Order 422.1, attachment 2, requirement 2.c. Procedure TFC-OPS-OPER-C-59, *Control Area and At-the-Controls Area Activities*, appropriately addresses control area access, specifying which positions have unencumbered access, and establishes standards and expectations for operations while in the control area. The procedure further establishes appropriate protocols for entry into the at-the-controls area, limiting access as well as ensuring that performed activities remain focused on facility operations.

Observed control room operators demonstrated adequate surveillance of control panels, trending of key facility performance parameters (e.g., tank levels during retrieval operations), and ability to respond in a timely manner to identify and correct abnormalities and out-of-specification conditions. During control area observations at the Liquid Effluent Retention Facility (LERF)/Effluent Treatment Facility (ETF), the on-duty NCO properly used procedure ETF-ARP-GOD-001, *UV/OX System Alarm Response*, and correctly noted information on the status board and in the log.

Facility observations at the LERF/ETF, the retrieval control room, the TSCR control room, and the central control room confirmed effective control area access with clearly defined boundaries controlled by ropes or partial doors with appropriate postings. Individuals properly requested access from control area personnel and stated their purpose prior to entry. During facility observations in the retrieval control room, LERF/ETF control room, and central control room, facility operators demonstrated understanding of current facility conditions and displayed professional, formal, and disciplined behavior during observed work performance.

Reviewed watchbills for the retrieval control room and central control room adequately assigned operating staff meeting minimum staffing requirements consistent with technical safety requirements (TSRs) and with required qualifications. Reviewed watchbills/shift rosters were prepared manually; while no errors were identified, the manual preparation of watchbills/shift rosters could cause errors with ensuring minimum staffing or qualification. (See **OFI-H2C-1.**) Additionally, during observation of a simulated transfer from the AP farm to WTP, full at-the-controls requirements were not applied during the execution of the simulation even though instructions were to maximize actual job performance, where possible. (See **OFI-H2C-2.**)

Control Area Activities Conclusions

H2C has established and implemented adequate control area operations practices. Control area operations, including entry controls, were performed properly and in a disciplined and professional manner by operations personnel.

3.4 Communications

This portion of the assessment evaluated H2C's operations communications practices.

H2C has established and implemented generally adequate operations communications practices in accordance with DOE Order 422.1, attachment 2, requirement 2.d. Procedure TFC-OPS-OPER-C-31, *Communications Guidelines*, provides appropriate guidance for accurate, unambiguous communications among operations personnel during emergency and normal operations, including appropriate protocols for face-to-face, phone, radio, and public address (PA) communications.

Control area operators used appropriate radio and phone communications during several observed activities. Operators made proper use of repeat-back communications, although the use of the phonetic alphabet varied. The PA system was appropriately used solely for normal operational situations. Although observed operations personnel executed repeat-back communications appropriately, operations personnel participating in the Cycle 8 operator continuing training frequently did not make use of appropriate repeat-back communications or the phonetic alphabet. (See **OFI-H2C-3.**)

Communications Conclusions

H2C has established and implemented generally adequate operations communications practices, which were adequately performed during all observed operations.

3.5 On-shift Training

This portion of the assessment evaluated H2C's procedures and practices for operator on-shift training.

H2C has established and implemented adequate operations procedures that control on-shift training as required by DOE Order 422.1, attachment 2, requirement 2.e. Procedures TFC-BSM-TQ-STD-17, *Operator Qualification Program Description*, and TFC-IMP-C-04, *Conduct of On-The-Job Training/Evaluation (OJT/OJE)*, include appropriate guidance for the conduct and execution of operator training, provide adequate operations practices that control the on-shift training of facility operators, and prevent inadvertent or incorrect trainee manipulation of equipment. The procedures appropriately cover authorization and documentation of training activities and implementation of facility conditions and controls for conducting training during operational activities, including suspension of training during unanticipated or abnormal events.

Interviewed control area operators appropriately demonstrated their knowledge of the requirements associated with continuing and on-shift training. The observed Cycle 8 operator continuing training demonstrated adequate instruction. Each cycle is currently only offered quarterly for four hours; however, H2C is in the process of increasing training time. Notably, this cycle included a simulated valve lineup using an H2C-created AP Valve Farm Mock-up. The mock-up included real valves and piping such that the correct execution of the line-up could be physically verified using compressed air. Use of the mock-up is considered a **Best Practice** because it enhances training effectiveness and provides an opportunity to exercise several conduct of operations elements, including operational confirmation of the valve lineup via the fully functioning valve/piping arrangement.

Observed on-shift training was generally adequate. The observed on-shift training of a walkthrough of procedure TO-270-533, *Transfer from 241-AP-104 to 241-AP-107*, appropriately involved a trainer who was qualified as an on-the-job trainer for this activity. One element trained and exercised was the use of the phonetic alphabet and repeat-back communications protocols. Observations of multiple operators who performed the mock valve line-up showed some examples of effective communication, but also many instances where expected operating communication protocols were not executed. Further, during interviews with operators regarding required elements of the conduct of operations program, some responses revealed potential knowledge gaps. (See **OFI-H2C-3**.)

On-shift Training Conclusions

H2C's on-shift training procedures and practices adequately control on-shift training of facility operators and prevent inadvertent or incorrect trainee manipulation of equipment. H2C's use of the AP Valve Farm Mock-up is considered a best practice.

3.6 Investigation of Abnormal Events, Conditions, and Trends

This portion of the assessment evaluated H2C's process for investigating abnormal events, conditions, and trends.

H2C has developed adequate procedures (TFC-OPS-OPER-C-14, *Event Investigation Process*, and TFC-OPS-OPER-CD-72, *Guidance for Conducting Event Investigations*) for managing event scenes and performing event investigations. The procedures include provisions and criteria for identifying specific events that require investigation; specify training and qualification requirements for event investigators; require causal analysis, extent-of-condition reviews, and corrective actions to preclude recurrence; and include guidance for conducting critiques. The reviewed event investigations, causal analyses, trend data, and operability evaluations demonstrate that H2C is adequately implementing TFC-OPS-OPER-C-14 and DOE Order 422.1, attachment 2, requirement 2.f.

Fact-finding meetings and critiques are appropriately required by TFC-OPS-OPER-C-14 and TFC-MD-198, *Fact-Finding Meeting*, to determine whether an event investigation is needed. An observed fact-finding meeting associated with an entry into an electrical enclosure with unexpected stored energy associated with high voltage capacitors at the ETF was effectively conducted in accordance with TFC-MD-198 requirements. The meeting was well attended by appropriate personnel involved in the event, including shift operators, first line supervisors, a shift technical engineer (STE), and the H2C Maintenance Manager. The meeting was adequately conducted by a trained and qualified event investigator who effectively set the expectations and purpose of the meeting. The meeting was open, focused on fact finding, did not attempt to assign blame to individuals, and focused primarily on identifying the issues attributed to unexpected stored energy associated with high voltage capacitors within the electrical enclosure. The "event quad chart" tool was used during the fact-finding meeting to effectively identify critical information, including event timeline, issues, potential causes, and corrective

actions/compensatory measures. Two other observed fact-finding meetings demonstrated the appropriate use of the event quad chart and followed TFC-MD-198 requirements.

H2C has developed an adequate procedure, TFC-ESHQ-QC-C-06, *Trend Analysis Process*, for analyzing, evaluating, and monitoring performance data. Effective use of TFC-ESHQ-QC-C-06 was demonstrated in response to a declining trend in hazardous energy control performance and an increase in TSR violations. This adverse performance was recognized by the H2C Operations Director and documented in condition report ITDC-CR-2025-2336. Reviewed records demonstrated that a timely meeting was conducted prior to issuance of the condition report with personnel from multiple disciplines (e.g., training, program subject matter experts, operations, maintenance) and HFO Facility Representatives to discuss the adverse performance and needed corrective actions.

Investigation of Abnormal Events, Conditions, and Trends Conclusions

H2C has established and implemented adequate operations practices for investigating and reporting abnormal events, conditions, and trends.

3.7 Notifications

This portion of the assessment evaluated H2C's operations procedures and practices to ensure appropriate notifications and timely response to events.

Procedure TFC-OPS-OPER-C-24, *Occurrence Reporting*, documents adequate instructions for providing required and informational notifications to H2C management, support groups, and HFO, as required by DOE Order 422.1, attachment 2, requirement 2.g. Thirty-one reviewed events reported in the DOE Occurrence Reporting and Processing System (ORPS) between December 2020 and June 2025 were timely and appropriately categorized. Additionally, the associated final reports for these events contained adequate causal analysis and corrective actions to address the identified issues. Two recordable events occurred during the onsite portion of the assessment, one involving hazardous energy control and the other involving a facility worker injury. Both events were promptly documented and reported in accordance with TFC-OPS-OPER-C-24. The interviewed Issues Management Manager and ORPS Coordinator thoroughly understood the occurrence reporting and notification process.

TFC-Charter-76, *Action Request Screening Meeting*, establishes an effective action request (AR) screening process. This process effectively adds a level of oversight for evaluating issues submitted to the H2C issues management system (integrated Contractor Assurance System [iCAS]). Using the AR screening process, H2C management appropriately confirms the assignment of the responsible manager or organization best suited to manage the issue, the significance level of the issue, appropriate process flags, and trend codes.

Notifications Conclusions

H2C has developed an adequate procedure for managing event scenes, performing event investigations, and providing required and informational notifications. Reviewed ORPS reports and notifications for two observed recordable events demonstrate that H2C is implementing TFC-OPS-OPER-C-24. Additionally, the AR screening process effectively adds a level of oversight for evaluating issues submitted to iCAS.

3.8 Control of Equipment and System Status

This portion of the assessment evaluated H2C's practices for the control of equipment and system status.

Procedure TO-025-002, *Operate Tank Farms Monitor and Control Systems*, adequately addresses DOE Order 422.1, attachment 2, requirement 2.h, by establishing and implementing operations practices for equipment lineups and subsequent changes to ensure that facilities operate with known and proper configurations, as designed. This procedure appropriately invokes the work control requirements of TFC-OPS-MAINT-C-01, *Tank Operations Contractor Work Control*, to plan and authorize any repair or maintenance work, including work on safety significant structures, systems, and components (SSCs). Procedure TO-025-002 also invokes TFC-OPS-OPER-C-11, *Equipment Temporary Modification and Operational Bypass*, establishing administrative systems and requirements to ensure that design changes to SSCs are documented, installed, monitored, and removed under a temporary modification process. Operations and maintenance personnel appropriately coordinate with engineering personnel to maintain configuration control of system alignment. The SOM was observed appropriately reviewing applicable facility documentation at the beginning of each day and effectively informing operators and workers of the facility status. At the start of each daily work shift, the SOM held a formal facility management meeting, effectively communicating to staff the current day's facility and equipment status, changes from the previous day, currently planned work activities, and shift assignments.

Interviews with STEs and observations of control room activities, including shift turnovers and log entries, confirmed continuous awareness of facility equipment status. Interviews also confirmed that NCOs and operations management personnel clearly understood their responsibilities for maintaining proper configuration and authorizing status changes for major equipment. Implementation of the temporary modification program was observed to be appropriately controlled as documented in the temporary modification log and limited to one modification, *Water Isolation from Stream Stripper System*, at the ETF. Extensions were adequately documented and approved as required by TFC-OPS-OPER-C-11.

While generally adequate control of equipment and system status was observed during walkdowns, the following weaknesses were identified:

- Contrary to National Fire Protection Association (NFPA) 80, section 5.5.5, *Standards for Fire Doors and Other Opening Protectives*, H2C did not document a fire system impairment permit for three observed interior fire doors propped open in Building 241-AZ-702. (See **Deficiency D-H2C-1.**) A propped-open fire door impairs the firewall and increases the risk of fire propagating to an adjacent fire area.
- Contrary to DOE Order 422.1, attachment 2, requirements 2.a.(4) and 2.h, observed hazard signs at several personnel entrances to the 241-AW Tank Farm did not consistently communicate the same hazard information. (See **Deficiency D-H2C-2.**) Inconsistent hazard signage can result in workers being unaware of or confused about facility hazards, or not donning appropriate personal protective equipment (see Figure 1).

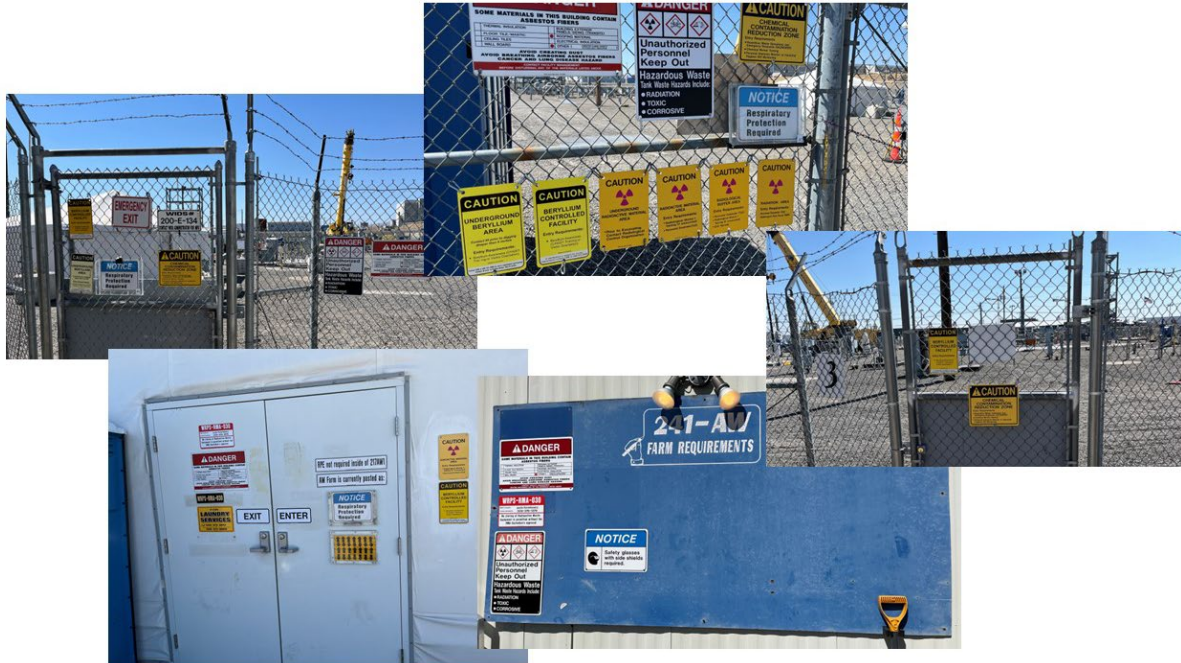


Figure 1 – Inconsistent Hazard Signage for the 241-AW Tank Farm

Control of Equipment and System Status Conclusions

H2C has established adequate practices for initial equipment lineups and subsequent changes to ensure that facilities operate with known and proper configurations. However, weaknesses were identified in the areas of fire system impairment documentation and hazard signage.

3.9 Lockout and Tagouts

This portion of the assessment evaluated H2C's operator practices for the installation and removal of lockout/tagouts (LOTOs) to protect personnel, and the use of caution and miscellaneous tags to support facility operations.

LOTO Procedures

H2C has established and implemented generally adequate practices for installing and removing LOTOs to protect personnel from hazardous energy sources. Procedure DOE-0336, *Hanford Lockout/Tagout Procedure*, adequately addresses the processes, roles, and responsibilities associated with the development, documentation, review, installation, independent verification, and removal of a LOTO consistent with DOE Order 422.1, attachment 2, requirement 2.i; 29 CFR 1910, *Occupational Safety and Health Standards*; 29 CFR 1926, *Safety and Health Regulations for Construction*; and NFPA 70E, *Standard for Electrical Safety in the Workplace*. However, contrary to DOE Order 422.1, attachment 2, requirement 2.p, and DOE-0336, section 2, two facilities were observed using outdated versions of DOE-0336. (See **Deficiency D-H2C-3.**) Not using the current version of the LOTO procedure could result in work not being performed in accordance with requirements and at increased risk to workers.

LOTO Installations

Reviewed LOTO installations demonstrated proper control of tags, locks, lockboxes, chains, and other components in accordance with DOE-0336. The reviewed LOTO permits (LO-25-007, *CTF Replace*

Safety Device; LO-25-005, *POR 471-WT-LDXA-401 Troubleshoot*; AZ-25-020, *AW 103A Valve Inspection*; AZ-25-028, *AWA Laser Scan*; LEF-24-004, *Replace 65C-P-6 Pulsa Feeder and Motor*; LEF-25-009, *Steam Stripper VFD Cabling Replacement*; and LEF-25-061, *CO2 Blower Replacement*) demonstrated proper authorization for LOTO installation, and identification of any special conditions or operations impacts. However, contrary to DOE Order 422.1, attachment 2, requirement 2.i, and DOE-0336, section 5.10, H2C did not complete all required quarterly LOTO surveillances in the second quarter of calendar year 2025. (See **Deficiency D-H2C-4.**) Not performing LOTO surveillances and audits could result in missed opportunities for early identification of LOTO-related issues impacting worker safety.

Caution Tags

H2C has established and implemented generally adequate practices for installing and removing caution tags for equipment protection or operational control. Procedure TFC-OPS-OPER-C-39, *Caution Tags*, adequately addresses the processes, roles, and responsibilities associated with the development, documentation, review, installation, and removal of a caution tag consistent with DOE Order 422.1, attachment 2, requirement 2.i. An observed removal of a caution tag was properly performed in accordance with TFC-OPS-OPER-C-39. However, contrary to DOE Order 422.1, attachment 2, requirement 2.i and TFC-OPS-OPER-C-39, section 4.6, H2C did not complete all required quarterly reviews of caution tags in the second quarter of calendar year 2025. (See **Deficiency D-H2C-5.**) Not performing reviews of caution tags could result in missed opportunities for early identification of caution tag related issues impacting equipment protection or operational control.

Lockout and Tagouts Conclusions

H2C has established and implemented generally adequate LOTO practices that meet the requirements for controlling hazardous energy sources to protect personnel. The reviewed LOTO activities were performed in accordance with established procedures, and facility personnel demonstrated proper attention to detail. Additionally, H2C's caution tag program is generally adequate to inform and alert personnel to pertinent information. However, weaknesses were identified in the areas of procedure version control, quarterly LOTO surveillances, and quarterly caution tag reviews.

3.10 Independent Verification

This portion of the assessment evaluated H2C's operator practices for implementing independent verification.

H2C has established and implemented an adequate independent verification process. Procedure TFC-OPS-OPER-C-34, *Independent Verification*, adequately addresses DOE Order 422.1, attachment 2, requirement 2.j. Observed workers adequately performed an independent verification of the removal of an administrative lock on the sluicing pump at the retrieval control room. The check was properly separated by time and distance and constituted an actual identification of the component and determination of component position in accordance with TFC-OPS-OPER-C-34.

Independent Verification Conclusions

H2C has established and implemented an adequate independent verification process to verify that equipment configuration is in accordance with controlling documents.

3.11 Logkeeping

This portion of the assessment evaluated H2C's logkeeping procedures and practices, which are meant to ensure thorough, accurate, and timely recording of events and equipment information for performance analysis and trend detection.

Procedure TFC-OPS-OPER-C-17, *Operating Logbooks*, adequately addresses DOE Order 422.1, attachment 2, requirement 2.k, and appropriately specifies which key positions are required to maintain narrative logs. The procedure appropriately requires the prompt and accurate recording of information; a specified type, scope, and format for log entries; a defined method for recording late entries and correcting erroneous entries without obscuring the original entry; periodic supervisory reviews for accuracy, adequacy, and trends; and document retention.

Reviewed logs at the retrieval control room, the LERF/ETF control room, and the central control room were adequate. They were legible and contained appropriate entries with proper techniques for recording late entries and correcting entries. Supervisory reviews and annotations were adequately completed. An alarm condition at LERF/ETF was appropriately documented in logs and status boards.

Logkeeping Conclusions

H2C logkeeping procedures and practices are adequate to ensure that thorough, accurate, and timely operations logs are recorded. H2C operations personnel adequately performed logkeeping in accordance with governing procedures.

3.12 Turnover and Assumption of Responsibilities

This portion of the assessment evaluated H2C's operational shift and operator relief turnover processes to verify the thorough, accurate transfer of information and responsibilities at shift or operator relief.

H2C has established and implemented adequate shift and operator relief turnover processes to provide for continued safe operations. Procedure TFC-OPS-OPER-C-07, *Turnover of Shift Responsibility*, adequately defines all key positions and the process for the formal turnover of operations from one shift to another and from one person to another to ensure thorough understanding of equipment status and in-process or planned activities. Procedure TFC-OPS-OPER-C-07 also includes the defined content of turnover checklists, which ensures comprehensive communication and documentation of current operations. Turnover checklists are prepared and reviewed using the electronic e-turnover tool, with hard-copy backup available. Reviewed turnover checklists appropriately included key information, such as the facility operating mode and status, status of safety equipment, operational limits in effect, limiting conditions for operations in effect (normal or abnormal), and upcoming or in-progress maintenance, testing, or evolutions. All operations personnel interviewed were familiar with the expectations for turning over ongoing activities. Observed shift turnovers demonstrated that sufficient time is allowed for oncoming operations personnel to review logs and other document updates and discuss any information contained in the turnover documentation.

Operations personnel performed generally adequate turnovers during observed shift changes and operator relief. Observed shift briefings in the retrieval control room were thorough and addressed all topics identified in TFC-OPS-OP-C-07. However, turnovers observed at other locations varied in content and level of detail; neither conduct of operations nor safety topics were addressed at two other control areas and instead focused solely on equipment status and daily work assignments. (See **OFI-H2C-4**.)

Turnover and Assumption of Responsibilities Conclusions

H2C has established and implemented adequate shift and operator relief turnover processes. Operations personnel performed generally adequate turnovers during observed shift changes and operator relief.

3.13 Control of Interrelated Processes

This portion of the assessment evaluated H2C's control of interrelated processes through established operating practices that support facility safety or operations.

Procedure TFC-BSM-CP_CPR-C-17, *Interface Management*, adequately addresses DOE Order 422.1, attachment 2, requirement 2.m, by establishing and implementing appropriate interface control documents and other interface agreements for communicating expectations and responsibilities for physical interfaces of interrelated processes between facilities or systems. Implementation of these interfaces is managed through H2C's work authorization procedure, TFC-OPS-MAINT-C-01. An observed table-top (simulated) exercise demonstrated effective integration planning with WTP personnel for future waste transfers. However, during a simulation of continuous-use procedure TO-270-708, *Transfer from 241-AP-106 to WTP*, in preparation for coordinating waste transfers with the operating contractor for the direct-feed low-activity waste process, the following weaknesses were identified:

- Contrary to TFC-OPS-OPER-STD-69, *Technical Procedure Use and Adherence*, section 3.6, which requires each step in a continuous-use procedure to be completed before starting the next step, not all steps of TO-270-708 were simulated in the instructed sequence. (See **Deficiency D-H2C-6** and **OFI-H2C-5**.) Performing procedure steps out of sequence can adversely affect facility operations. Specifically, during the pre-job brief, participants were briefed that sections 5.1 through 5.4 were complete, even though one step (or set of steps) in three of those sections was required to be performed by the dry-run operators. For section 5.2, a note allowed steps to be performed in any logical order; however, for the other two sections, partial performance at the beginning of the simulated transfer resulted in steps being performed out of order in a continuous-use procedure.
- Not all requirements for conduct of personnel in the at-the-controls area were implemented and observed. Specifically, the simulator control room was posted with an "at the controls area" chain put up across the door, but not all personnel were required to observe the associated requirements. (See **OFI-H2C-5**.)
- Time compression was used in two instances, eliminating periods during which operators would have had time to review procedure placekeeping and complete data sheets and logs during actual operating conditions. (See **OFI-H2C-5**.)
- Multiple "IF" (contingency) steps in early sections of TO-270-708 directed actions for upset conditions, including if shutdown conditions are met. These individual steps in a continuous-use procedure are required to be marked as started but, in most cases, are never completed. The procedure also contains several redundant steps, further contributing to potential confusion.¹ (See **OFI-H2C-6**.)
- Steps 5.5.14 through 5.5.17 of TO-270-708 are marked "N/A" if the transfer pump is successfully started. However, if the pump fails to start or run, those steps contain conditional branching requiring internal jumps between portions of steps. (See **OFI-H2C-6**.) During an unexpected plant response to an operator action (unsuccessful pump start), these steps would likely be difficult for the operator to follow successfully, especially because a reader-worker technique was not being used in the control room.

¹ The specific contingency steps noted were 5.5.6, 5.6.1, 5.6.2, 5.6.17, and 5.7.1. Additionally, steps 5.5.6 and 5.6.1 are identical, as are steps 5.6.17 and 5.7.1

- A substantial amount of manual calculation is required on TO-270-708 data sheets, particularly when calculating a waste balance to verify successful transfer with no leaks. (See **OFI-H2C-7.**)

Control of Interrelated Processes Conclusions

H2C has established and implemented generally adequate operating practices for the control of interrelated processes. However, weaknesses were identified associated with continuous-use procedure compliance during an observed simulation activity.

3.14 Required Reading

This portion of the assessment evaluated H2C's required reading program to verify that operators are updated on important information.

Procedure TFC-OPS-OPER-C-33, *Required Reading*, adequately addresses required reading in accordance with DOE Order 422.1, attachment 2, requirement 2.n. The procedure appropriately requires H2C to identify the material to be distributed via required reading, the individuals who are required to read distributed material, and the documentation of proper distribution and timely completion. Assigned required reading completions are appropriately tracked, with notices provided to supervision when due dates are exceeded. Periodic reports are provided to track completion status, and specific reports are easily prepared. Also, several new required reading packages were appropriately identified in reviewed daily shift instructions for operator action.

Required Reading Conclusions

H2C has an adequate required reading program to keep operators updated on important information.

3.15 Timely Instructions/Orders

This portion of the assessment evaluated H2C's practices for timely written direction and guidance from management to operators.

Procedure TFC-OPS-OPER-C-40, *Timely Instructions/Orders*, adequately addresses DOE Order 422.1, attachment 2, requirement 2.o, including appropriate circumstances for the use of timely instructions/orders; designated levels of review and approval prior to issuance; configuration control of timely instructions/orders; distribution of timely instructions/orders to appropriate personnel; and documentation of their receipt and understanding. H2C appropriately issues standing orders for longer-term communications and shift instructions (both daily and intermittent) for short-term communications. Reviewed shift orders and shift instructions demonstrated adherence to TFC-OPS-OPER-C-40. Active standing orders were appropriately noted in the production operations shift manager turnover checklist.

Timely Instructions/Orders Conclusions

H2C provides adequate timely written direction and guidance from management to operators.

3.16 Technical Procedures

This portion of the assessment evaluated H2C's practices for developing and maintaining accurate, understandable written technical procedures.

H2C has established and implemented generally adequate operations practices for developing and maintaining accurate, understandable written technical procedures. Requirements for procedure format are adequately contained in TFC-OPS-OPER-STD-01, *Technical Procedure Format and Preparation Standard*. Requirements for procedure use and adherence are appropriately specified in TFC-OPS-OPER-STD-69, including direction on procedure use designation (continuous, reference, or multiple), critical steps, and human performance tools, such as placekeeping and reader-worker techniques. Technical procedures are controlled by TFC-OPS-OPER-C-13, *Technical Procedure Control and Use*, which appropriately includes processes for completing and documenting review and approval of initial issue and revisions of hard-copy and electronic procedures.

At the time of this assessment, H2C was in the process of changing procedures from a knowledge-based system to a rules-based system. Personnel from training, procedures, operations, and conduct of operations organizations were reviewing procedures and beginning the change process. An interviewee explained that over 1,300 technical procedures still needed to be reviewed and revised. H2C management asserts that completion of this process will greatly improve procedure accuracy and significantly reduce the number of procedure adherence errors.

Almost all reviewed procedures were technically and administratively accurate, using clear language in accordance with TFC-OPS-OPER-STD-01, and correctly identified referenced documents. Retrieval operations, retrieval rounds, TSCR rounds, and a dry run for a transfer from 241-AP-106 to WTP were observed. All observed operations were conducted using current procedures. Procedure adherence was observed to be generally adequate, including operations that were governed by continuous-use procedures, and placekeeping techniques were, in general, properly used. However, contrary to DOE Order 422.1, attachment 2, requirement 2.p.(3), procedures requiring steps to be performed multiple times did not allow for proper documentation of that performance. (See **Deficiency D-H2C-7.**) Performing steps multiple times without having the provisions for properly recording the performance could lead to steps not being performed as required. Operator rounds procedures were all continuous-use procedures. In several cases, steps had requirements for periodic performance (e.g., repeat every four hours) and the procedure provided no allowance for repeating steps. This issue was also observed during retrieval operations (TO-270-039).

During an observed performance of Work Order 1181823, *Replace AP Primary Exhauster A/B TRAIN Pre-Filters*, compliance with procedures, including radiation protection procedures, was excellent (as observed from the Tank Farms fence line due to access restrictions), with one exception. The work order appropriately contained a requirement in the *Precautions and Limitations* section, which was reviewed during the pre-job brief, and two notes in the detailed work instructions requiring a three-man lift when handling lead blankets weighing approximately 80 pounds. However, contrary to Work Order 1181823, observed handling of lead blankets was performed by only two workers. (See **Deficiency D-H2C-8.**) Not following work instructions as written could result in worker injury or damage to equipment.

Additionally, section 5 of Work Order 1181823 contained two tasks: Task 1 addressed the “A train” filter change and Task 2 addressed the “B train” filter change. Most instructions were identical except for SSC designators specific to the train/task. However, the work instructions contained the following discrepancies (see **OFI-H2C-8**):

- The B train instructions included a direction in step 5.48 for the field work supervisor (FWS) to perform a walkdown of the work site and to verify with the workers that temporary radiological boundaries were adequate and of sufficient size to perform the work, and that ingress/egress requirements were satisfied and functional. Performance of this step was required to be signature-verified by the FWS. However, no similar step was provided in the A train instructions, even though the work and hazards were the same.

- The A train instructions directed the filter housing to be reinstalled prior to doffing cut resistant gloves. However, the B train instructions were reversed, requiring workers to handle the filter housing door after removing their gloves.
- Several other parallel steps contained discrepant wording that did not meet the standards of PPA AP-907-005, *Procedure Writer's Manual* (e.g., steps 5.14.2 and 5.49.2, 5.16 and 5.51, and 5.18.2 and 5.53.2).

Technical Procedures Conclusions

H2C has established and implemented generally adequate practices for developing and maintaining accurate, understandable written technical procedures. However, weaknesses were observed associated with procedure compliance and adequacy.

3.17 Operator Aids

This portion of the assessment evaluated H2C's practices for managing and using operator aids.

H2C has established and implemented an adequate process for providing accurate, current, and approved operator aids. Procedure TFC-OPS-OPER-C-41, *Operator Aids*, adequately addresses DOE Order 422.1, attachment 2, requirement 2.q, with instructions for developing and implementing accurate, current, and approved operator aids. Observed operator aids showed evidence of management approval, with one exception discussed below, and appropriately served as necessary and useful conveniences that did not alter or conflict with approved procedures or controlled documents. Additionally, observed operator aids did not obscure equipment, were administratively controlled, and were periodically reviewed for adequacy, continued utility, and correctness. Interviewed personnel were aware of the requirements for operator aids.

Notably, H2C uses three-dimensional reality capture of Tank Farms equipment and component locations. Technicians use cameras to make interactive three-dimensional models to aid H2C personnel in locating equipment and components. This technology was developed as an operator aid, but other uses have been identified, such as for keeping radiation doses to workers as low as reasonably achievable (ALARA), training, plant tours, pre-job briefs, work planning, familiarization, and team discussions. Information can be displayed on desktop computers, at Tank Farms change trailers, or on tablets carried by NCOs in the field. The information is also linked to a software suite for plant design and engineering that provides technical information about the component. There are several potential additional uses and upgrades for the 3D Reality Capture, such as map integration and integrating visual radiation surveys with the labelled component. Use of this proactive three-dimensional reality capture technology is considered a **Best Practice** because it enhances the effectiveness of conduct of operations and supports ALARA practices. It also can be used to minimize environmental and industrial hazard exposures and human error, and to improve work planning efficiency and effectiveness.

While the operator aid procedure is adequate, a weakness was observed at the retrieval control room. Namely, a photograph of the sluicing pump nozzle overlaid with a tape measure was being used as a visual reference, without having been approved as an operator aid, to determine how deep to insert the nozzle when sluicing below the surface. Consequently, contrary to DOE Order 422.1, attachment 2, requirement 2.q, and TFC-OPS-OPER-C-41, section 4.1, H2C did not approve the use of an observed operator aid. (See **Deficiency D-H2C-9**.) Use of an unapproved operator aid could lead to the application of outdated or incorrect information, resulting in harm to personnel or damage to the equipment, system, area, or facility.

Operator Aids Conclusions

H2C has established and implemented an adequate process for providing accurate, current, and approved operator aids. H2C's use of three-dimensional reality capture of Tank Farms equipment and component locations is considered a best practice. However, a weakness was identified associated with the use of an unapproved operator aid.

3.18 Component Labeling

This portion of the assessment evaluated H2C's practices for clear, accurate equipment labeling.

H2C has established and implemented an adequate process for equipment labeling. Procedure TFC-ENG-STD-12, *Tank Farm Equipment Identification Numbering and Labeling Standard*, adequately addresses DOE Order 422.1, attachment 2, requirement 2.r. Procedure TFC-OPS-OPER-C-32, *Tank Farms Temporary Component Identification Tags*, provides further details concerning required information for the various types of temporary labels. Interviewed SOMs and operators were aware of their roles and responsibilities regarding component labeling. Observations of accessible facility SSC areas confirmed that valves, instruments, and piping exhibited labels that were properly applied, were durable, and contained the required information, enabling facility personnel to accurately identify equipment.

Component Labeling Conclusions

H2C has established and implemented an adequate process for equipment labeling. Observed valves, instruments, and piping exhibited appropriate labels.

4.0 BEST PRACTICES

Best practices are safety-related practices, techniques, processes, or program attributes observed during an assessment that may merit consideration by other DOE and contractor organizations for implementation. The following best practices were identified as part of this assessment:

- H2C's use of the AP Valve Farm Mock-up enhances training effectiveness and provides an opportunity for operators to train and exercise multiple conduct of operations elements, including visual confirmation of the valve lineup via the fully functioning valve/piping arrangement.
- H2C's proactive use of three-dimensional reality capture enhances the effectiveness of conduct of operations by aiding H2C personnel in locating equipment and components. Other benefits of this technology include supporting ALARA practices, reducing environmental and industrial hazard exposures and human error, and improving work planning efficiency and effectiveness.

5.0 FINDINGS

No findings were identified during this assessment.

6.0 DEFICIENCIES

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

Hanford Tank Waste Operations & Closure, LLC

Deficiency D-H2C-1: H2C did not document a fire system impairment permit for three observed interior fire doors blocked open in Building 241-AZ-702. (NFPA 80, sec. 5.5.5)

Deficiency D-H2C-2: H2C did not ensure that hazard signage was consistently communicated at all personnel entrances to Tank Farms. (DOE Order 422.1, att. 2, requirements 2.a.(4) and 2.h)

Deficiency D-H2C-3: H2C did not maintain the current version of the LOTO procedure at all facilities. (DOE Order 422.1, att. 2, requirement 2.p, and DOE-0336, sec. 2)

Deficiency D-H2C-4: H2C did not complete all required quarterly LOTO surveillances in the second quarter of calendar year 2025. (DOE Order 422.1, att. 2, requirement 2.i, and DOE-0336, sec. 5.10)

Deficiency D-H2C-5: H2C did not complete all required quarterly caution tag reviews in calendar year 2025. (DOE Order 422.1, att. 2, requirement 2.i, and TFC-OPS-OPER-C-39, sec. 4.6)

Deficiency D-H2C-6: H2C did not ensure that all steps of a continuous-use procedure (TO-270-708) were simulated in the instructed sequence. (TFC-OPS-OPER-STD-69, sec. 3.6)

Deficiency D-H2C-7: Several H2C procedures requiring steps to be performed multiple times do not allow for the proper documentation of that performance. (DOE Order 422.1, att. 2, requirement 2.p.(3))

Deficiency D-H2C-8: H2C workers did not use a minimum three-man lift when handling lead blankets weighing approximately 80 pounds each. (Work Order 1181823)

Deficiency D-H2C-9: H2C retrieval operators were observed using an unapproved operator aid. (DOE Order 422.1, att. 2, requirement 2.q, and TFC-OPS-OPER-C-41, sec. 4.1)

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified the OFIs shown below to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the assessment process. These OFIs are offered 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.

Hanford Tank Waste Operations & Closure, LLC

OFI-H2C-1: Consider developing an electronic watchbill tool that would automatically verify watchstander qualifications and ensure TSR minimum staffing.

OFI-H2C-2: Consider increasing the fidelity of simulations for “dry runs” of direct-feed low-activity waste transfer to mimic plant conditions during actual operations as closely as possible.

OFI-H2C-3: Consider conducting additional training, exercise activities, and reinforcement on elements of conduct of operations, especially in communications (e.g., the use of repeat-back communications and the phonetic alphabet) and on-shift training to enhance operator performance.

OFI-H2C-4: Consider requiring the formal use of checklists during pre-job briefs and shift turnovers to ensure common, minimum content.

OFI-H2C-5: Consider improving the fidelity of simulations such that personnel practicing plant operations experience, as closely as possible, the same conditions expected during actual waste transfers.

OFI-H2C-6: Consider reviewing continuous-use procedure TO-270-708 for human error traps, such as contingency steps/actions applicable to the entire procedure but written into multiple sections separately, or excessive branching logic that may be better communicated with a flowchart. Some information in contingency steps may be more appropriately included as precautions and limitations.

OFI-H2C-7: Consider automating some of the manual calculation required to be done on continuous-use procedure TO-270-708 data sheets, particularly for waste inventory balance.

OFI-H2C-8: Consider reviewing the work instructions in Work Order 1181823, and other similar work orders that provide parallel instructions for the same work on multiple trains of a system, to ensure that instructions match and steps are written appropriately to minimize the possibility of human performance errors.

Appendix A Supplemental Information

Dates of Assessment

June 30 to July 23, 2025

Office of Enterprise Assessments (EA) Management

John E. Dupuy, Director, Office of Enterprise Assessments
William F. West, Deputy Director, Office of Enterprise Assessments
Kevin G. Kilp, Director, Office of Environment, Safety and Health Assessments
David A. Young, Deputy Director, Office of Environment, Safety and Health Assessments
Brent L. Jones, Acting Director, Office of Nuclear Safety and Environmental Assessments
David Olah, Acting Director, Office of Worker Safety and Health Assessments
Jack E. Winston, Director, Office of Emergency Management Assessments
Brent L. Jones, Director, Office of Nuclear Engineering and Safety Basis Assessments

Quality Review Board

William F. West, Advisor
Kevin G. Kilp, Chair
Christopher E. McFearin
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EA Site Lead for the Hanford Site

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