# Construction Quality and Startup Assessment at the Hanford Site Waste Treatment and Immobilization Plant

**March 2019**

Office of Enterprise Assessments
U.S. Department of Energy

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## Acronyms

| | |
|---|---|
| AMR | Ammonia Reagent System |
| ASME | American Society of Mechanical Engineers |
| BNI | Bechtel National, Inc. |
| BOF | Balance of Facilities |
| BSA | Breathing Service Air |
| CFR | Code of Federal Regulations |
| CM | Commercial Grade |
| CRAD | Criteria and Review Approach Document |
| DFLAW | Direct Feed Low-Activity Waste |
| DOE | U.S. Department of Energy |
| DSA | Documented Safety Analysis |
| EA | Office of Enterprise Assessments |
| EMF | Effluent Management Facility |
| FME | Foreign Material Exclusion |
| HLW | High-Level Waste Facility |
| JTG | Joint Test Group |
| LAB | Analytical Laboratory |
| LAW | Low-Activity Waste Facility |
| LCP | LAW Concentrate Receipt System |
| NLD | Nonradioactive Liquid Waste Disposal System |
| NQA | Nuclear Quality Assurance |
| ORP | Office of River Protection |
| PCW | Plant Cooling Water |
| P&ID | Piping and Instrumentation Diagram |
| PTF | Pretreatment Facility |
| Q | Quality Related |
| QAM | BNI Quality Assurance Manual |
| SSC | Structure, System, and Component |
| SSW | Supervisory Safety Watch |
| STE | Startup Test Engineer |
| STI | Startup Test Index |
| SUDS | Startup Desktop Supplements |
| V&ID | Ventilation and Instrument Diagram |
| WCD | ORP WTP Construction Oversight and Assurance Division |
| WTCC | Waste Treatment Completion Company |
| WTP | Waste Treatment and Immobilization Plant |

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**at the Hanford Site Waste Treatment and Immobilization Plant**

## EXECUTIVE SUMMARY

The U.S. Department of Energy's Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of construction quality and the startup program at the Hanford Site Waste Treatment and Immobilization Plant (WTP) from October 29 to November 8, 2018. EA performed this assessment in the broader context of an ongoing program of periodic assessments of construction quality at the WTP construction site.

For construction quality, EA observed and reviewed pressure testing of piping and reviewed the WTP Construction Oversight and Assurance Division welding inspection program. EA found these areas to be satisfactory.

For the startup program, EA reviewed turnover of completed systems from the Construction organization to the Startup organization; handover from the Startup to Plant Management (Operations) organizations; development of startup testing procedures; performance of startup testing; and cleaning and flushing of piping systems.

EA concluded from observations, interviews and document reviews that the guides and procedures that control the turnover and handover activities are adequate and effectively implemented. The tools used for communicating testing requirements for the development of startup test plans and testing procedures for the systems within the test matrices are effective, and the reviewed startup testing procedures are adequate and effectively implemented for the Ammonia Reagent System and the Non-Radiological Liquid Waste Disposal System. However, as a deficiency, the method for determining and measuring cleanness associated with cleaning and flushing piping and instrument systems is not adequately defined.

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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 construction quality and startup activities at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The onsite portion of this assessment was conducted from October 29 to November 8, 2018. This EA assessment was performed within the broader context of an ongoing program of assessments at DOE major construction projects. Because of the safety significance of WTP facilities, EA plans to continue these ongoing periodic assessments at the WTP construction site to ensure that construction contractors meet the requirements of 10 CFR 830, Subpart A, *Quality Assurance Requirements*.

## 2.0 SCOPE

EA conducted this assessment of WTP construction quality and startup processes in accordance with the *Plan for the Office of Enterprise Assessments Assessment of the Hanford Site Waste Treatment and Immobilization Plant Construction Quality and Startup, October – November 2018*. This assessment evaluated construction quality and startup by observing the ongoing construction and startup activities described in the Bechtel National, Inc. (BNI) Design, Construction, and Commissioning contract.

## 3.0 BACKGROUND

The DOE Office of River Protection (ORP) manages the 56 million gallons of liquid or semi-solid radioactive and chemical waste, stored in 177 underground tanks at the Hanford Site. ORP also manages WTP, an industrial complex for separating and vitrifying the radioactive and chemical waste in these underground tanks. WTP systems are in various phases of design, construction, and startup. ORP staff, primarily in the WTP Construction Oversight and Assurance Division (WCD), provide Federal oversight of construction activities at WTP.

BNI manages design, construction, and commissioning activities at WTP under contract to ORP. The quality assurance program requirements for design, construction, and operations of WTP referenced in 24590-LAW-DSA-NS-18-0001, *Documented Safety Analysis for the Low-Activity Waste Facility* (DSA), and cited in the BNI contract, are American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, and DOE Order 414.1C, *Quality Assurance.* BNI document 24590-WTP-QAM-QA-06-001, *Quality Assurance Manual* (QAM), provides a detailed description of the application of the 18 NQA-1-2000 requirements at WTP. The BNI QAM establishes a management system of planned and systematic actions necessary to ensure that structures, systems, and components (SSCs) perform satisfactorily in service.

BNI is under contract to complete the design of the WTP complex and is responsible for delivering equipment and materials necessary for completion of WTP. In March 2017, BNI and AECOM, the contractor responsible for maintenance and commissioning systems, formed a new joint venture named Waste Treatment Completion Company (WTCC). The new organization is a subcontractor to BNI and is contracted to complete construction, conduct startup, and commission WTP. BNI Construction personnel, including craft personnel, field engineers, quality control inspectors, administrative personnel, and managers, became employees of WTCC on March 31, 2017. Administrative changes have been

implemented to transition BNI Construction procedures and AECOM startup and commissioning procedures into WTCC procedures for control of construction, startup, and commissioning work activities. WTCC is required to follow the QAM.

The WTP complex consists of the Pretreatment Facility (PTF) for separating the waste into low-activity and high-activity waste; the High-Level Waste Facility (HLW), where the high-activity waste will be immobilized in glass; the Low-Activity Waste Facility (LAW), where the low-activity waste will be immobilized in glass; the Analytical Laboratory (LAB) for sample testing; and, the balance of facilities (BOF), which will house support functions. Construction work is essentially complete for LAB, LAW, and most BOF buildings.

Construction work activities are deferred in PTF pending satisfactory resolution of technical questions regarding separation and processing of the waste and the design life of PTF equipment. Construction was slowed in HLW pending resolution of technical issues involving the waste treatment process. In late 2016, DOE decided to stop construction of HLW to support starting the processing of direct feed low activity waste (DFLAW) from the tank farms by 2022. DFLAW requires completion of LAW and construction of the Effluent Management Facility (EMF).

Radioactive mixed waste effluents from LAW and LAB will be transferred via buried coaxial piping to EMF for processing by concentration in the EMF evaporator. After concentration, the remaining radionuclides and salts are recycled back to LAW glass production operation, or in off-normal operating scenarios, will be returned to the tank farm via a buried pipe. There is an additional option available to transfer the waste back to the tank farm via a tanker truck. Vapor from the evaporator will be condensed and sampled to assure compliance with the effluent acceptance criteria before being transferred to the existing Hanford site liquid effluent retention facility for processing in the existing effluent treatment facility.

## 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" 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 the 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.

As identified in the assessment plan, this assessment considered the requirements of 10 CFR 830, Subpart A, and DOE Order 414.1C, which specify that the contractor must use appropriate national consensus standards to implement DOE quality assurance requirements.

EA used the following criteria and review approach documents (CRADs):

- CRAD-45-52, *Nuclear Facility Construction – Piping and Pipe Supports*
- CRAD-31-05, *System Operating Test Procedures*.

This assessment included review of documents (e.g., work instructions, procedures, test data sheets, specifications, test matrices, punch lists, test result packages, and drawings) and interviews with key

personnel responsible for performing construction, inspection, and startup activities. EA observed pressure testing and welding inspections, reviewed the process for turnover of SSCs from the WTCC Construction organization to the WTCC Startup organization to the WTCC Plant Management organization (operations), and observed startup testing work activities, including cleaning and flushing of piping. EA also observed system walkdowns, pre-job briefings, and status and completion meetings, and reviewed quality records.

The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. The documents reviewed, personnel interviewed, and observations made during this assessment, relevant to the findings and conclusions of this report, are listed in Appendix B.

## 5.0 RESULTS

### 5.1 Construction Activities

#### 5.1.1 ORP WCD Welding Inspection Program

EA assessed the WCD welding inspection program, which is implemented to verify that commercial grade (CM) piping welds comply with the requirements of the design drawings and specifications and ASME B31.1, *Power Piping*, requirements.

***Criterion:***

*Special processes that control or verify quality, such as those used in welding, shall be performed by qualified personnel using qualified procedures in accordance with specified requirements. (NQA-1, Requirement 9; Policy Q-9.1 of the WTP QAM; and DOE Order 414.1C)*

WCD site inspectors perform independent inspections of one or more attributes on approximately 5% of welds. Most of these welds are categorized as quality related (Q), but some CM welds are included in their independent inspection sample. Welds selected for inspection include structural steel, piping, pipe supports, vessels (tanks), and weld repairs. Welds with unique configurations or geometry that differ in some respect from routine welds are also inspected.

EA observed a WCD site inspector performing an independent final visual inspection of two piping welds and a pipe weld fitup inspection on piping for transferring effluent from the LAW to the EMF associated with the DFLAW process. The WCD site inspector had pre-selected these welds as DOE-designated witness points. Acceptance criteria for visual examination of piping welds are specified in procedure 24590-WTP-MN-CON-01-001-10-09, *Bechtel Nondestructive Examination Standard, Visual Examination VT-ASME.* EA's review of this procedure determined that it is adequate.

The WCD site inspector examined the specific welds listed in Appendix B of this report, and EA examined the welds as well. All welds examined met the visual acceptance criteria. EA and the WCD site inspector reviewed the field welding checklists, weld wire draw slips, and drawings associated with the welds inspected; verified that the correct filler materials and weld processes were used to complete the welds; and, that the size and type of welds matched the construction drawings.

The samples that EA reviewed indicated that the WCD welding inspection program implementation is satisfactory.

### 5.1.2 Pressure Testing Program

EA assessed the pressure testing of CM piping, which is performed to verify that the installed piping systems are leak tight.

***Criterion:***

*Construction and pre-operational tests, such as pressure testing operations for piping and tubing systems, shall be conducted in accordance with methods approved by the design organization. Test procedures shall include test requirements, acceptance criteria, test prerequisites, inspection hold points, and instructions for recording data. Testing shall be observed by qualified inspection personnel. Test results shall be recorded and evaluated by qualified personnel. (NQA-1, Requirement 11; Policy Q-11.1 of the QAM; and DOE Order 414.1C)*

WTCC Construction Procedure 24590-WTP-GPP-CON-3504, *Pressure Testing of Piping, Tubing and Components*, specifies the generic work process and quality requirements for pressure testing, including the test requirements, prerequisites, test sequence, hold points, inspection requirements, instructions for recording and evaluating data, and acceptance criteria. The pressure testing procedure references the appropriate code requirements (ASME Code B31.3, Paragraph 345.5, *Pneumatic Testing*). The procedure was approved by BNI Design Engineering. EA's review of this procedure determined that it is adequate.

EA observed WTCC site personnel performing four pneumatic pressure tests on modified instrument lines associated with pumps for the plant cooling water (PCW) system and on three sections of the outer pipe of the double wall coaxial transfer piping from LAW to EMF. Test pressures were 110% of the piping system design pressure as specified in BNI Design Guide 24590-WTP-3DG-M40T-00001, *Design Parameters & Test Pressures for Equipment and Piping*.

The coaxial transfer piping consists of an inner 3-inch diameter pipe that will contain the effluent and an outer 6-inch diameter pipe that will contain any leakage from the inner pipe. Hydrostatic tests were performed on the inner pipe prior to the EA assessment at a pressure of 900 psi. After the hydrostatic tests on the inner pipe were completed and declared successful, fittings were field welded to complete the outer pipe. Pneumatic pressure tests were performed on the outer pipe after WTCC welding engineers had inspected and accepted the field welds. The required test pressure for the outer pipe was 55 psi. The pipe sections tested were as follows: one for the LAW concentrate receipt system (LCP), one for the LAW secondary offgas/vessel vent system, and one for the radioactive liquid waste disposal system. No leaks were observed.

EA attended the pre-test briefings, reviewed drawings and test data sheets, examined the testing apparatus, verified that the calibration stickers on the test pressure gauges were current, and that whip restraints were installed on pressure hoses. Before the pressure tests, EA examined the piping sections in the pressure test boundaries, including the valve lineup and pressure test tags attached to the valves.

EA witnessed the test pressurization sequence during each pressure test and verified that the systems being tested were pressurized to the designated test pressures. EA verified that the required test pressures were maintained for the required hold time of 10 minutes before the WTCC field engineers initiated the system walkdown to inspect the piping for leakage. EA also verified that the test pressures were maintained during the walkdowns.

EA observed the walkdowns and inspections performed by the WTCC field engineers. Since no leaks were identified during these walkdowns, the WTCC test engineers declared that the tests were successful. EA's review of the test records verified that the test data was accurately recorded; and, for the completed

test record for the PCW instrumentation pressure test, that the results were approved by qualified personnel. EA determined that the WTCC pressure testing program is satisfactory based on the observed pneumatic pressure tests.

## 5.2 Startup Activities

### 5.2.1 WTP Turnover Process

EA assessed the WTP turnover process, the formal transfer of systems and components from WTCC Construction to WTCC Startup, and the handover of systems and components from WTCC Startup to Plant Management after startup testing.

***Criteria:***

*Work activities, such as the process for turnover of SSCs from construction to startup and operations and acceptance and readiness of the SSCs for plant commissioning, shall be conducted in accordance with methods approved by the design and plant management organizations, and performed in accordance with approved procedures and instructions. The procedures and instructions shall include or reference appropriate acceptance criteria for determining that construction of the SSCs are completed and satisfactory for plant commissioning. (NQA-1, Requirement 5; Policy Q-5.1 of the QAM; and DOE Order 414.1C)*

**Turnover Process Description**

EA reviewed various aspects of each phase of the turnover process, including reviewing a sample of procedures and observing planning meetings and field walkdowns. In addition, EA conducted interviews with key individuals associated with each phase of the turnover program to assess process implementation, conformance to procedures, organizational alignment, and challenges.

The process for the turnover of systems is adequately described in WTCC procedure 24590-WTP-GPP-RATO-TO-0101, *WTP Turnover Process*, and WTCC procedure 24590-WTP-PD-RATO-TO-0001, *Turnover Program Description*. These processes formally manage the transfer of systems from Construction to Startup to Plant Management for commissioning and operation. In Construction, the process includes walkdowns at eight and three weeks before turnover of a system to Startup. A punch list is part of the formal turnover. Once in Startup, the systems are tested to ensure that they meet established design criteria, as defined in WTCC procedure 24590-WTP-PD-RASU-SU-0002, *Startup Program Description.* Startup testing focuses principally on components and stand-alone system functionality. Plant Management is responsible for accepting systems at handover after completion of the required startup test, performance of a walkdown, and review of the test result packages from each startup test. Plant Management develops a Management Operability Review utilizing form 24590-RATO-F00001, *WTP/WTCC System/Area Turnover Management Operability Review*, which is a checklist for verifying that all required tests have been addressed prior to handover, for review and acceptance by Plant Management. Plant Management is then responsible for performing commissioning tests, which include integrated system tests for both cold and hot commissioning.

**Turnover from Construction to Startup**

EA reviewed the process for turnover of systems from Construction to Startup for system testing after completion of construction. EA reviewed the following WTCC documents, which specify the methodology for ensuring construction completion and turning over systems from Construction to Startup:

- WTCC Construction Procedure 24590-WTP-GPP-CON-1602, *System and Area Completion and Turnover*
- WTCC Construction Guide 24590-WTP-GPG-CON-1602, *Turnover Walkdown*
- WTCC Construction Procedure 24590-WTP-GPP-CON-1603, *Control of Punchlist Items*
- WTCC Procedure 24590-WTP-GPP-RATO-TO-0101, *WTP Turnover Process*
- WTCC Procedure 24590-WTP-PD-RATO-TO-0001, *Turnover Program Description*
- WTCC Guide 24590-WTP-GPG-RASU-SU-0001, *System Scoping*.

EA concluded that these documents are adequate to control activities performed by Construction and Startup for turnover of systems from Construction to Startup.

Startup initiates the turnover process by preparing scoping documents in accordance with WTCC Guide 24590-WTP-GPG-RASU-SU-0001. These documents show the boundaries of the system to be turned over from Construction to Startup, which are used to support startup testing.

The scoping documents are provided to Construction, which uses the scoping documents to plan turnover packages in accordance with WTCC Construction Procedure 24590-WTP-GPP-CON-1602. This procedure requires Construction to review construction records to ensure that construction is completed for the system being turned over, compile a package containing a list of the applicable construction and inspection records, and prepare a punch list showing the work that needs to be completed before commissioning. Appendix 6 of Procedure 24590-WTP-GPP-CON-1602 lists the construction records that are required for turnover.

Procedure 24590-WTP-GPP-CON-1602 requires performance of walkdowns eight weeks and three weeks before the planned turnover date and updating of punch lists as required to document the work remaining before plant commissioning. WTCC Construction Guide 24590-WTP-GPG-CON-1602 provides guidance on performing these walkdowns. WTCC Construction Procedure 24590-WTP-GPP-CON-1603 addresses the control of punch list items, which are prioritized by the receiving organization as A, B, C, E or 0. Type A items must be completed by Construction prior to turnover, Type B items by Construction after turnover, unrestrained (construction has option to complete either before or after turnover) Type C items by Construction or other WTP organizations, restrained items by a receiving organization, while Type E items are completed after turnover by the receiving organization. Type 0 items are classified as out of scope. The procedure addresses requirements for validation of punch list items, punch list item completion, and progress meetings.

EA reviewed Construction turnover document AMR-B-01, WTP-CTO-CON-18-0017, dated August 6, 2018, for turnover of the ammonia reagent system (AMR) to Startup. This document lists the Construction records specified in Appendix 6 of Procedure 24590-WTP-GPP-CON-1602. EA also observed one eight-week walkdown and two three-week walkdowns and reviewed the associated punch lists. The eight-week walkdown was performed on the PCW system associated with cooling the Melter power supply units. The three-week walkdowns were performed on the LAW C2V ventilation system and the breathing air supply system on Elevation 3 in the LAW. The sample of turnover walkdowns observed by EA were performed by the personnel designated in the turnover procedures and in

accordance with the applicable procedures. EA concluded that the construction turnover process is adequate.

**Handover from Startup to Plant Management (Operations)**

As noted above, handover occurs when a system has completed startup testing and is transferred to the Plant Management for continued operations and final integrated testing. EA, accompanied by WTCC shift managers, walked down two systems that had completed the process of handover to Plant Management: the fire water system and the demineralized water system. The walkdowns included an assessment of labeling, material condition, configuration control, and general area housekeeping. EA verified that system components were appropriately labeled in accordance with WTCC procedure 24590-WTP-GRP-RACO-CO-0018, *Component Labeling.* EA also verified that the material condition of equipment, configuration control, and general area housekeeping were in accordance with the requirements of the QAM. EA observed Plant Management technicians conduct system lineups and independent verifications of the fire water system following maintenance. Technician performance was in accordance with DOE Order 422.1, *Conduct of Operations.*

EA's review of the WTCC guides and procedures that control the turnover and handover processes determined that they are adequate. EA concluded that the system turnover program is being implemented in accordance with applicable WTCC procedures, the QAM, and DOE orders.

### 5.2.2 Startup Testing

EA assessed development of startup testing requirements, performance of startup tests, and documentation of results.

***Criteria:***

*Construction and pre-operational tests shall be conducted in accordance with methods approved by the design organization. Test procedures shall include test requirements, acceptance criteria, test prerequisites, inspection hold points, and instructions for recording data. Test results shall be recorded and evaluated by qualified personnel. (NQA-1, Criterion 11; Section 11 of the SWPF QAP; and DOE Order 414.1C).*

*Startup test procedures accomplish the testing objectives and are consistent with the contractor's technical and administrative criteria, PDSA* [preliminary DSA] *and DSA commitments, design documents, regulatory requirements, and Technical Safety Requirements. (*DOE O 420.1C, *Facility Safety*; Title10 CFR Part 830, *Nuclear Safety Management*, Subpart B, *Safety Basis Requirements*.)

**Development of Startup Testing Requirements**

WTCC procedure 24590-WTP-GPP-RASU-SU-0011, *Startup Test Planning and Test Index Development*, assigns the lead responsibility for developing a startup test index (STI) for their assigned scoped systems to startup test engineers (STEs). The system boundaries for startup testing are defined using a "scoping" process to facilitate efficient testing. The boundaries of the scoped systems may not align with the system boundaries defined by BNI Design Engineering and may include portions of multiple engineering-defined systems. The STI lists the startup tests planned for the scoped system, including generic tests, flush tests, functional tests, and acceptance tests. The STE and a supporting team identify the test requirements specified in the design and engineering documents, applicable codes and standards, and vendor/manufacturer's documents, along with appropriate generic tests to ensure that individual system components are functioning correctly. EA's review of the STIs for the AMR and the

nonradioactive liquid waste disposal system (NLD) – AMR-B-01, NLD-B-01, NLD-B-05, and NLD-B-07 – determined that they have been developed consistent with procedure 24590-WTP-GPP-RASU-SU-0011.

WTCC also developed a tool called the test matrix to assist the STEs in identifying startup and commissioning testing requirements in source documents. The test matrix is an engineering document collaboratively developed by a multi-disciplined group that include representatives from the Startup and Plant Management. The test matrix consolidates the test requirements (including the conditions necessary to perform the test) and provides a link to the source documents. After reviewing the test matrices for the AMR and NLD and interviewing the BNI design organization resident engineers, assigned to the WTP construction site, and STEs, EA concluded that the test matrix is an effective tool for Design Engineering to communicate the testing requirements to the STEs as they develop STIs and testing procedures for their assigned systems.

EA observed two meetings of the Startup Joint Test Group (JTG), a group governed by procedure 24590-WTP-GPP-RASU-SU-0010, *Startup Test Group*. The JTG is responsible for overseeing the implementation of the startup test program, including review and approval of various documents associated with the planning, development, revision, and implementation of test documents. Based on observations, the JTG adequately addresses issues associated with startup test approvals, test matrix changes, and scope of testing, and the meetings are in accordance with the JTG procedure.

WTCC Startup conducts several types of tests, including generic tests, flush tests, functional tests, and acceptance tests. EA reviewed test procedures for a flush of the AMR-B-01 scoped system (24590-BOF-AMR-FTP-0001, *Anhydrous Tank Facility (AMR-B-01) Velocity Flush and Cleanness Verification*) and functional test of the NLD-B-01 scoped system (24590-BOF-NLD-FT-0001, *Non-Radioactive Liquid Waste Disposal System Functional Test (NLD-B-01)*). Both procedures are consistent with 24590-WTP-GPP-RASU-SU-0005, *Test Procedure Development*, and are written at a level of detail to support adequate control of the tests. These procedures identify the criteria (e.g., cleanness requirements, functional criteria, acceptance criteria) necessary to demonstrate that the system meets the design requirements. EA validated that the startup testing requirements identified in the test matrix for the NLD are adequately captured in the corresponding functional test procedure for the NLD-B-01 scoped system.

**Observations of Startup Testing**

Startup has implemented field oversight processes to ensure that more senior management staff oversees the conduct of activities in the field at WTP. The Supervisory Safety Watch (SSW) observation process is governed by WTCC procedure 24590-WTP-GPG- MGT-0008, *Supervisory Safety Watch (SSW)*. The SSW program is used at the discretion of the WTCC Site Manager to provide oversight in the field to ensure that management performance expectations are met. It is not intended to replace assessments or routine management observation of work, but to provide increased management oversight during critical activities or to offset a negative performance trend. EA observed the interaction between an SSW and a testing supervisor. The SSW observed and critiqued the pre-job brief and field walkdown to verify system configuration prior to initial startup of the LAW Annex humidifier units. EA verified that the SSW's activities were in accordance with the SSW procedure, and the feedback provided to the testing supervisor was focused on performance improvement and acknowledged positively by the testing supervisor.

EA reviewed WTCC procedure 24590-WTPP-ES-SU-18-001, *Startup Conduct of Operations/Conduct of Testing Crosswalk*, which compares the startup conduct of testing documents against DOE Order 422.1. Startup has prepared a number of standards that are implemented and codified in testing standards, referred to as Startup Desktop Supplements (SUDS), including:

- SUDS-006-1, *Conduct of Testing – Logkeeping*
- SUDS-006-2, *Conduct of Testing – Communications*
- SUDS-006-3, *Conduct of Testing – HPI Best Practices*.

In addition, Startup created Desktop Supplement SUDS-012, *Startup Observation Program*, which establishes a routine observation of test engineers by Startup management for the purpose of continued development of test engineering staff. EA reviewed the current observation schedule and three examples of Startup observation reports. The reports provided constructive feedback to the test engineers in accordance with the intent of the program. As observed by EA, the program developed by Startup to align the conduct of testing with conduct of operations standards and expectations has improved the performance of the organization.

EA assessed the implementation of the WTCC startup testing processes for two systems: the AMR and the NLD. The AMR had been turned over from Construction to Startup, and startup testing of the system and its components was in progress. Startup testing had been accomplished for the NLD, and the system had been handed over to Plant Management. EA reviewed 24590-BOF-3ZD-AMR-00001, *Ammonia Reagent System (AMR) System Design Description*, and 24590-BOF-3YD-NLD-00001, *System Description for the Waste Treatment Plant Non-Radioactive Liquid Waste Disposal (NLD) System*, which were identified as key engineering source documents for testing requirements for the AMR and NLD. EA confirmed that the startup testing processes resulted in the startup testing requirements from the NLD system description being included in testing procedures. (The AMR functional test procedure was still in the development/approval process and therefore was not reviewed by EA.) EA reviewed the AMR and NLD STIs (AMR-B-01, NLD-B-01, NLD-B-05, and NLD-B-07) and concluded that they had been developed consistent with procedure 24590-WTP-GPP-RASU-SU-0011.

EA assessed several aspects of the Startup organization's approach to configuration control and work authorization for systems. For the AMR flushing operations observed by EA, the flush test procedure 24590-BOF-AMR-FTP-0001 was the primary tool used to establish the initial configuration of the system. Extensive prerequisites in the procedure, as well as comprehensive initial valve lineups, were effective in aligning the system into the required initial configuration. The flush test procedure then adequately maintained configuration by detailed steps controlling component manipulations. The STE developed flush sketches in accordance with WTCC procedure 24590-WTP-GPG-RASU-SU-0016, *Flush Sketch Development*, to define the flow paths necessary to flush the entire AMR-B-01 system. The flush sketches aided procedure development and supported visualizing the flow path during the actual flushing operations. Several modifications to the AMR were necessary to support the flushing operation. WTCC has several adequate mechanisms to make, control, and restore these modifications, including the use of construction work packages (usually tracked on the punch list), startup test instructions, temporary changes (as described in procedure 24590-WTP-GPP-RASU-SU-0006, *Conduct of Testing*, Section 6.25), temporary modifications (per procedure 24590-WTP-GPP-RAEN-EN-0013, *Temporary Modification Control*), and the flushing procedure 24590-BOF-AMR-FTP-0001 itself. One of the modifications to the AMR to support the flush was the connection of a temporary instrument air system (i.e., nitrogen cylinders and temporary tubing) to allow the air-actuated valves within the AMR to be opened and closed. This modification to the actuators was not explicitly controlled by the 24590-BOF-AMR-FTP-0001 procedure, but it was identified in the temporary change log in accordance with procedure 24590-WTP-GPP-RASU-SU-0006. The temporary change process ensures that the original system configuration is restored and includes a "concurrent verification" by a second test engineer. The startup punch list was used effectively to capture the modifications that were to be restored after completion of testing by Construction.

EA also observed startup tests performed in accordance with WTCC procedures 24590-WTP-SU-GT-0002, *Generic Test Procedure, Scheme Checks*, on LAW Annex Power Panels, and 24590-LAW-DOW-

SUTI-0001, *LAW Annex C1V Humidifiers Initial Startup.* The observations included the pre-job briefings, lockout/tagout verification, craft training verification, in-plant walkdown of work areas, review of Measurement and Test Equipment (M&TE), and implementation of procedure prerequisites. Testing was conducted in accordance with WTCC procedure 24590-WTP-RASU-SU-0006. STEs adequately followed procedures and implemented human performance tools, such as three-point communications and procedure place-keeping.

**Documentation of Startup Testing Results**

EA reviewed the following test results packages:

- 24590-BOF-NLD-TRP-0023, *Test Results Package for the Steam Plant Building Non-Radioactive Liquid Waste Disposal System Functional Test (NLD-B-05), and Driven Mechanical (GT-19) of NLD-PMP-00025A/B*
- 24590-BOF-NLD-TRP-0004, *Test Results Package, NLD-B-07, 24590-WTP-SU-GT-0045 and -0046*
- 24590-BOF-NLD-TRP-0006, *Test Results Package for the Non-Radioactive Liquid Waste Disposal System Functional Test (NLD-B-01), NLD Potable Water Initial Fill and Vent Procedure, and NLD System Startup & Shutdown Procedure.*

EA concluded that the three test result packages adequately record the data, document the results generated during startup testing, and conform to the requirements of WTCC procedure 24590-WTP-GPP-RASU-SU-0008, *Test Results Review and Approval*.

## 5.3 Cleaning and Flushing of Piping and Instrument Systems

EA assessed the engineering specification and test procedures for cleaning and flushing piping and instrument systems.

***Criteria:***

*Pre-operational tests, such as cleaning and flushing of piping and instrument tubing systems, shall be conducted in accordance with methods approved by the design organization and performed in accordance with approved procedures, design drawings, manufacturer's instructions, and other design basis documents. The procedures, instructions, and drawings shall include or reference appropriate quantitative or qualitative acceptance criteria for determining that the prescribed cleanness has been satisfactorily attained. (NQA-1, Requirement 5; Policy Q-5.1 of the QAM; and DOE Order 414.1C)*

*Cleaning and flushing procedures shall include acceptance criteria, prerequisites, inspection hold points, and instructions for recording data. Cleanness and flushing operations shall be performed by qualified personnel. (NQA-1, Requirement 11; Policy Q-11.1 of the QAM; and DOE Order 414.1C)*

Cleaning and flushing of piping and instrument systems is performed by Startup STEs. BNI Specification No. 24590-WTP-3PS-G000-T0005, *Engineering Specification for Cleanness Requirements for WTP Fluid Systems*, establishes the minimum requirements for cleaning and management of cleanness control for WTP fluid systems during manufacturing, construction, repair, and modification. The scope paragraph of this specification states that it does not include the detailed methods or procedures to be followed in performing the cleaning or specify the required actions for maintaining the various cleanness levels. Instead, Attachment A of this specification lists the minimum cleanness classes for the WTP fluid systems and the type of flushing media (fluids/air).

BNI Specification No. 24590-WTP-3PS-G000-T0016, *Engineering Specification for Flushing and Cleaning Requirements for the Startup of Quality and Commercial Fluid Systems in all Facilities*, specifies the work process and quality requirements for cleaning and flushing of piping and instrument tubing, including the prerequisites, sequence, acceptable type of fluid/air to be used for cleaning and flushing operations, system cleanness requirements, hold points, inspection requirements, instructions for recording and evaluating data, acceptance criteria for cleanness, and system restoration requirements. The specified media (fluids/air) for cleaning and flushing are based on the system function and the type of materials used in construction. Appendix A of 24590-WTP-3PS-G000-T0016 specifies minimum cleanness classes for the WTP fluid systems and the flushing media.

In reviewing the designated cleanness classes listed in Attachment A of 24590-WTP-3PS-G000-T0005 and in Appendix A of 24590-WTP-3PS-G000-T0016, EA noted that the different levels of cleanness and type of flushing media were specified for some systems. For example, for the nitric acid and sodium hydroxide systems, Attachment A of 24590-WTP-3PS-G000-T0005 specifies an internal cleanness Class D, utilizing demineralized water as the flushing media. Appendix A of 24590-WTP-3PS-G000-T0016 specifies an internal cleanness Class E (described below), using potable water as the flushing medium for the nitric acid and sodium hydroxide systems.

Both specifications reference ASME NQA-1, Subpart 2.1, *Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components for Nuclear Power Plants*, as the applicable code to establish cleanness of WTP project fluid systems. The code lists four cleanness classes, A through D; Class A is the highest level, while Class D is the lowest. The flushing acceptance criteria for Classes A through D are based upon observed particle size at the flushing medium discharge point. The standard practice to verify that the required cleanness is obtained is to filter the flushing medium through mesh screens to trap and collect any particles at the flush medium discharge point so the size and number of particles can be observed in the flush discharge. The screens are examined after each flush cycle, and flushing is repeated until the desired cleanness is achieved.

The WTP specifications establish a fifth cleanness class, Class E, for cleaning fluid systems. The acceptance criterion for Class E is to flush the system until the discharge from the outlet is clear and unobstructed to the normal eye. The cleanness requirement for most of the WTP CM and Q piping systems is designated in Appendix A of 24590-WTP-3PS-G000-T0016 as Class E.

Section 1, *Scope*, of 24590-WTP-3PS-G000-T0016 states that Construction is typically responsible for turning over piping systems in a clean condition. Appendix B of this specification, *Class E Justification*, implies that the justification is based in part on the assumption that Construction cleaned the systems after installation, eliminating the possibility that contaminants introduced during fabrication, storage, installation, or repairs could contribute to or cause a malfunction in an operating system.

EA reviewed the following documents that define the requirements for construction fabrication and installation of the WTP piping systems:

- BNI Specification 24590-WTP-3PS-PS02-T0003, *Engineering Specification for Field Fabrication and Installation of Piping*
- WTCC Construction Procedure 24590-WTP-GPP-CON-3502, *Underground Piping Installation*
- WTCC Construction Procedure 24590-WTP-GPP-CON-3503, *Aboveground Piping Installation*
- WTCC Construction Procedure 24590-WTP-GPP-CON-3510, *Foreign Material Exclusion (FME).*

The engineering specification contains some general statements regarding cleaning of installed piping but does not provide any specific details on cleaning methods or acceptance criteria. The construction procedures provide inspection criteria for examining welded and flanged joints for cleanness but do not contain any specific instructions on the methods for cleaning installed piping or any specific inspection requirements to verify that the piping systems are clean and free from foreign materials.

Visual inspection of internal piping surfaces after installation is often not possible because of the configuration of the piping system. In complex piping systems, it may be difficult to determine how effective cleaning and flushing operations have been unless some method, such as a mesh screen at the discharge point, is used to verify that a system is clean. The FME procedure provides instructions to prevent introduction of foreign materials into clean, enclosed systems after installation, but it does not address methods for verifying cleanness.

EA observed flushing of three sections of AMR piping at the Anhydrous Tank Facility. Procedure 24590-BOR-AMR-FTP-0001, *Anhydrous Tank Facility (AMR-B-01) Velocity Flush and Cleanness Verification*, outlines the steps required to establish an internal cleanness level of Class E. The flushing was accomplished using plant service air. The duration of each flush observed by EA was approximately 10 to 20 seconds and was not repeated for a second flush cycle. The flush procedure did not specify the minimum duration of the flush and did not address the minimum lighting level for observing the discharge flume.

EA also reviewed WTCC Startup Procedure 24590-WTP-GPP-RASU-SU-0003, *Certification of Startup Personnel*, which specifies the minimum training and experience for certification as an STE. This procedure references BNI Procedure 24590-WTP-GPP-RAWS-OM-0023, *Employee Job Task Analysis Assignment and Fitness for Duty Examination Coordination*, for the physical requirements necessary to perform STE duties. The procedure contains no requirements for the visual acuity of the test engineers or for an annual vision check, as are typically required for inspection personnel.

The reason for defining Class E cleanness is to ensure that piping systems turned over from Construction are in a clean condition. However, there are no requirements or procedures for Construction to clean and flush fluid systems before turnover. The Class E cleanness criteria are not in accordance with ASME NQA-1 Subpart 2.1, and the criteria for measuring cleanness are not adequately defined and depend on the lighting conditions at the flush effluent discharge point and the visual acuity of the observer. However, the cleaning and flushing procedures do not specify minimum requirements for lighting and test engineer visual acuity. **(Deficiency)**

## 6.0 FINDINGS

EA did not identify any 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 did not identify any opportunities for improvement during this assessment.

## 8.0 ITEMS FOR FOLLOW-UP

EA will continue to follow configuration management within the WTP construction quality and startup processes.

## Appendix A
## Supplemental Information

**Dates of Assessment**

Onsite Assessment: October 29 – November 8, 2018

**Office of Enterprise Assessments (EA) Management**

Nathan H. Martin, Director, Office of Enterprise Assessments
John S. Boulden III, Acting Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, 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**

John S. Boulden III
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**EA Site Lead for Hanford Office of River Protection**

Samina A. Shaikh

**EA Assessors**

Samina A. Shaikh – Lead
Ronald G. Bostic
Frank A. Inzirillo
Joseph J. Lenahan

## Appendix B
## Key Documents Reviewed, Interviews, and Observations

**Documents Reviewed**

- Condition Report: 24590-WTP-GCA-MGT-18-01070, *WTP Line Surveillance Report 24590-BOF-SV-OP-18-001, NO evidence that a systematic review of design criteria and engineering documents had been performed*
- 24590-WTP-MN-CON-01-001-10-09, *Nondestructive Examination Standard Visual Examination, VT-ASME*, August 8, 2013
- 24590-BOF-PPTR-CON-18-0107, *Pressure Test Data Sheet*, October 29, 2018
  - 24590-BOF-PPTR-CON-18-0201, *Pressure Test Data Sheet*, October 30, 2018
- WTCC Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 19, *Pressure Testing of Piping, Tubing and Components*, April 3, 2018
- Design Guide No. 24590-WTP-3DG-M40T-00001, Rev. 0, *Design Parameters & Test Pressures for Equipment and Piping*, June 26, 2017
- BNI Specification 24590-WTP-3PS-PS02-T0003, Rev. 10, *Engineering Specification for Field Fabrication and Installation of Piping,* November 20, 2013
- WTCC Construction Procedure 24590-WTP-GPP-CON-3502, Rev. 6, *Underground Piping Installation*, September 27, 2017
- WTCC Construction Procedure 24590-WTP-GPP-CON-3503, Rev. 8, *Aboveground Piping Installation*, May 24, 2017
- WTCC Construction Procedure 24590-WTP-GPP-CON-3510, Rev. 1A, *Foreign Material Exclusion (FME)*, March 27, 2008
- Specification No. 24590-WTP-3PS-G000-T0005, Rev. 4, *Engineering Specification for Cleanness Requirements for WTP Fluid Systems*, February 22, 2016
- Specification No. 24590-WTP-3PS-G000-T0016, Rev. 3, *Engineering Specification for Flushing and Cleaning Requirements for the Startup of Quality and Commercial Fluid Systems in all Facilities*, October 13, 2016
- WTCC Construction Guide 24590-WTP-GPG-CON-1602, Rev. 5, *Turnover Walkdowns*, September 10, 2018
- WTCC Construction Procedure 24590-WTP-GPP-CON-1602, Rev. 8, *System and Area Completion and Turnover*, February 15, 2018
- WTCC Construction Procedure 24590-WTP-GPP-CON-1603, Rev. 6, *Control of Punchlist Items* August 9, 2018
- WTCC Startup Procedure 24590-WTP-GPP-RASU-SU-0003, Rev. 2, *Certification of Startup Personnel*, December 21, 2017
- BNI Procedure 24590-WTP-GPP-RAWS-OM-0023, Rev. 1, *Employee Job Task Analysis Assignment and Fitness for Duty Examination Coordination,* March 27, 2017
- WTCC Startup Procedure 24590-WTP-GPP-RASU-SU-0006, Rev. 2, *Conduct of Testing*, December 21, 2017
- WTCC Startup Guide 24590-WTP-GPP-RASU-SU-0001, Rev. 0, *System Scoping*, November 2, 2017
- WTCC Startup Procedure 24590-WTP-GPP-RASU-SU-0001, Rev. 2, *Test Results Review and Approval*, June 12, 2017
- WTCC Guide 24590-WTP-GPP-RATO-TO-0101, Rev. 2, *WTP Turnover Process*, October 10, 2018
- WTCC Program Description 24590-WTP-PD-RATO-TO-0001, Rev. 0, *Turnover Program Description*, August 30, 2018
- WTCC Construction Procedure 24590-WTP-GPP-CON-7101, Rev. 13, *Construction Quality Control Program*, March 9, 2017

- WTCC Procedure 24590-WTP-GPP-MGT-044, Rev. 11, *Nonconformance Reporting and Control*, August 9, 2018
- Document number 24590-WTP-QAM-QA-06-001, Rev. 18, *Quality Assurance Manual*, January 30, 2018
- WTCC Flush Test Procedure 24590-BOF-AMR-FTP-0001, Rev. 0, *Anhydrous Tank Facility (AMR-B-01) Velocity Flush and Cleanness Verification*
- BNI Drawing No. 24590-LAW-M6T-BSA-00002001, Rev. 0, *Scoped P&ID LAW Breathing Service Air System – Air Piping and Condensate Drainage, BSA-CMP-00001*
- BNI Drawing No. 24590-LAW-M6T-BSA-00002002, Rev. 0, *Scoped P&ID LAW Breathing Service Air System – Compressor Lube Oil and Cooling Water, BSA-CMP-00001*
- BNI Drawing No. 24590-LAW-M6T-BSA-00002003, Rev. 0, *Scoped P&ID LAW Breathing Service Air System – Purification Package, BSA-CMP-00001*
- BNI Drawing No. 24590-LAW-M6T-BSA-00002004, Rev. 0, *Scoped P&ID LAW Breathing Service Air System – BS- VSL – 00001 and Backup Cylinders Rack, BSA-CMP-00001*
- BNI Drawing No. 24590-LAW-M6T-BSA-00003001, Rev. 0, *Scoped P&ID LAW Breathing Service Air System Distribution Header El. 3 Ft*
- BNI Drawing No. 24590-LAW-M6T-PCW-00002003, Rev. 1, *Scoped P&ID LAW Plant Cooling Water System – Melters Power Supply Cooling MVE-PSUP-20001 and 20002*
- BNI Drawing No. 24590-LAW-M6T-PCW-00002002, Rev. 1, *Scoped P&ID LAW Plant Cooling Water System – Melters Power Supply Cooling PCW-PMP-00013A/B*
- BNI Drawing No. 24590-LAW-M6T-PCW-00002001, Rev. 2, *Scoped P&ID LAW Plant Cooling Water System – Melters Power Supply Cooling PCW-HX-00007A/B*
- BNI Drawing No. 24590-LAW-M8T-C2V-00001002, Rev. 1, *Scoped LAW Vitrification Building Plant Room V&ID C2 Supply System EL 48-0*
- BNI Drawing No. 24590-LAW-M8T-C2V-00002001, Rev. 1, *Scoped LAW Vitrification Building Volumetric V&ID C2 Air Distribution EL 48-0 & EL 68-0*
- BNI Drawing No. 24590-LAW-M8T-C2V-00002002, Rev. 1, *Scoped LAW Vitrification Building Volumetric V&ID C2 Air Distribution EL 48-0 & EL 68-0*
- BNI Drawing No. 24590-LAW-M8T-C2V-00003001, Rev. 1, *Scoped LAW Vitrification Building Volumetric V&ID C2 Air Distribution EL 28-0*
- BNI Drawing No. 24590-LAW-M8T-C2V-00004002, Rev. 1, *Scoped LAW Vitrification Building Volumetric V&ID C2 Air Distribution EL 3-0*
- BNI Drawing No. 24590-LAW-M8T-C2V-00004002, Rev. 2, *Scoped LAW Vitrification Building Volumetric V&ID C2 Air Distribution EL 3-0*
- BNI Drawing No. 24590-LAW-M8T-C2V-00006001, Rev. 0, *Scoped LAW Vitrification Building Plant Room V&ID C2 Exhaust EL 3-0*
- BNI Drawing No. 24590-LAW-M8T-C2V-00006002, Rev. 0, *Scoped LAW Vitrification Building Plant Room V&ID C2 Exhaust EL 3-0*
- BNI Drawing No. 24590-LAW-M8T-C2V-00006003, Rev. 0, *Scoped LAW Vitrification Building Plant Room V&ID C2 Exhaust EL 3-0*
- BNI Drawing No. 24590-LAW-M6T-CHW-00015001, Rev. 3, *Scoped P&ID LAW Chilled Water System Distribution EL 28-0*
- BNI Drawing No. 24590-LAW-M6T-CHW-00022001, Rev. 1, *Scoped P&ID LAW Chilled Water System Distribution EL 48-0*
- Three Week Turnover Punch List C2V-L-01, dated October 29, 2018
- Three Week Turnover Punch List BSA-L-01, dated October 31, 2018
- Eight Week Turnover Punch List PCW-L-02, dated October 3, 2018
- 24590-WTP-PD-RACT-CT-0001, Rev. 3, *Commissioning Testing Program Description*, July 10, 2018

- 24590-WTP-PL-RACT-CG-0001, Rev. 0, *Commissioning Plan*, July 5, 2017
- 24590-WTP-PL-RATO-TO-0002, Rev. 0, *Turnover Program Assessment Plan*, August 31, 2018
- 24590-WTP-G63-RACA-CA-0001, Rev. 4, *Nuclear Safety and Quality Culture*, July 3, 2018
- 24590-WTP-3DP-G04T-00914, Rev. 5, *Engineering Review of Test Documentation*, February 24, 2016
- 24590-WTP-PD-RARM-RM-0001, Rev. 8, *Requirements Management Program Description*, September 20, 2018
- 24590-WTP-GPG-RACT-CT-0009*,* Rev. 1, *Commissioning Test Index*, March 27, 2017
- 24590-WTP-GPG-RACT-CT-0004, Rev. 0, *Commissioning Test Plan Development*, February 18, 2018
- 24590-WTP-GPG-RACT-CT-0001, Rev. 3, *Commissioning Test Requirements Management*, January 18, 2018
- 24590-WTP-PD-RASU-SU-0001, Rev. 1, *Startup Integration Description*, March 9, 2017
- Procedure 24590-WTP-3DP-G04B-00004, Rev. 5, *Technical Requirements Management*, February 24, 2016
- Supplemental Guide 24590-WTP-3DI-G04T-00004, Rev. 5, *Technical Requirements Management*, February 24, 2016
- 24590-WTP-3DP-G04B-00047, Rev. 8, *Engineering Deliverables to Construction, Startup, and Plant Operations*, February 18, 2014
- 24590-WTP-GPP-RASU-SU-0012, Rev. 3, *Startup Handover to Plant Management*, December 21, 2017
- 24590-WTP-GPP-RASU-SU-0008, Rev. 2, *Test Results Review and Approval*, June 12, 2017
- 24590-BOF-3ZD-AMR-00001, Rev. 1, *Ammonia Reagent System (AMR) System Design Description*, March 29, 2017
- 24590-WTP-RPT-ENG-17-046, Rev. 1, *Test Matrix for the AMR System*, August 1, 2018
- 24590-WTP-RPT-ENG-16-019, Rev. 3, *Test Matrix for the NLD System*, May 9, 2018
- Startup Test Index for AMR-B-01, run date November 1, 2018
- Startup Test Index for NLD-B-01, run date March 1, 2017
- Startup Handover Punchlist for AMR-B-01, run date October 24, 2018
- Commissioning and Testing (CT) Punchlist, run date November 6, 2018
- 24590-WTP-GPG-RASU-SU-0015, Rev. 0, *Startup Work Authorization*, November 1, 2017
- 24590-WTP-3DJ-F04T-00001, Rev. 3, *Test Matrix Development*, November 30, 2017
- 24590-BOF-NLD-TRP-0006, Rev. 0, *Test Results Package for the Non-Radioactive Liquid Waste Disposal System Functional Test (NLD-B-01), NLD Potable Water Initial Fill and Vent Procedure, and NLD System Startup & Shutdown Procedure*, October 8, 2018
- 24590-BOF-NLD-TRP-0004, Rev. 1, *Test Results Package, NLD-B-07, 24590-WTP-SU-GT-0045 and -0046*, January 31, 2018
- 24590-BOF-NLD-TRP-0023, Rev. 0, *Test Results Package for the Steam Plant Building Non-Radioactive Liquid Waste Disposal System Functional Test (NLD-B-05), and Driven Mechanical (GT-19) of NLD-PP-00025A/B*, June 14, 2018
- 24590-BOF-NLD-FT-0001, Rev. 0, *Non-Radioactive Liquid Waste Disposal System Functional Test (NLD-B-01)*, April 3, 2017
- 24590-LAW-NLD-FT-0001, Rev. 0, *Non-Radioactive Liquid Drain Functional Test (NLD-L-01)*, November 20, 2017
- 24590-WTP-3YD-NLD-00001, Rev. 2, *System Description for the Waste Treatment Plant Non-Radioactive Liquid Waste Disposal (NLD) System*, February 17, 2017
- 24590 WTP-GPP-RASU-SU-0011, Rev. 1, *Startup Test Planning and Test Index Development*, March 10, 2017
- 24590-WTP-RPT-ENG-01-001, Rev. 12, *Technical Baseline Description*, May 18, 2018

- 24590-WTP-PD-RASU-SU-0002, Rev. 0, *Startup Program Description*, October 3, 2018
- 24590-RATO-F00001, WTP/WTCC *System/Area Turnover Management Operability Review*
- 24590-WTP-GPP-RASU-SU-0005, Rev. 3, *Test Procedure Development*, March 27, 2017
- 24590-WTP-GPG-MGT-0008, Rev. 3, *Supervisory Safety Watch (SSW)*, March 27, 2017
- 24590-LAW-DOW-SUTI-0001, Rev. 0, *LAW Annex C1V Humidifiers Initial Startup*, September 25, 2018
- 24590-WTP-SU-GT-0002, Rev. 7, *Generic Test Procedure, Scheme Checks*, May 23, 2017
- 24590-WTPP-ES-SU-18-001, Rev. 0, *Startup Conduct of Operations/Conduct of Testing Crosswalk*, October 1, 2018
- 24590-WTP-GRP-RACO-CO-0018, *Component Labeling*
- SUDS-006-1, Rev. 0, *Conduct of Testing – Logkeeping*, August 30, 2018
- SUDS-006-2, Rev. 0, *Conduct of Testing – Communications*, August 30, 2018
- SUDS-006-3, Rev. 0, *Conduct of Testing – HPI Best Practices*, September 5, 2018
- SUDS-012, Rev. 0, *Startup Observation Program*, October 31, 2018
- 24590-WTP-GPP-RASU-SU-0010, Rev. 6*, Startup Joint Test Group (JTG),* September 26, 2018
- 24590-BOF-SV-OP-18-001, Rev. 0, *WTP Line Surveillance Report*, September 24, 2018

**Interviews**
- WTCC Field Engineer
- WTCC Plant Management System Engineer
- WTCC Mechanical Field Engineers (2)
- WTCC Welding Engineer
- WTCC Quality Civil Control Inspector
- WTP Construction Oversight and Assurance Division Site Inspectors
- WTP Construction Oversight and Assurance Division Facility Representatives
- WTCC Nuclear Facility Manager
- WTCC Startup Manager
- WTCC Facility Startup Manager, LAW
- WTCC Senior Startup Engineers (9)
- WTCC Fire Protection Manager
- BNI Project Technical Representative – Startup and Commissioning
- BNI Principal Nuclear Engineer/Scientist
- WTCC System Engineer
- WTCC Startup Support Manager
- WTCC Shift Operations Manager
- WTCC Commissioning Test Program Manager
- WTCC Resident Engineer (2)
- DFLAW Completion Manager
- DFLAW Completion Team Member
- Transition Program Manager
- Commissioning Test Engineer
- Commissioning Manager

**Observations**
- Observed WCD site inspector perform examination of three EMF piping welds. Weld examinations performed were: (1) Fit-up inspection of Weld GB-02 on BOF-FWCL-CON-18-04014 (Line BOF-DEP-PW-0006-3114); (2) Final inspection of Weld GB-03 on BOF-FWCL-CON-18-0324 (Line

BOF-DEP-ZS-00139-S11C-2); and (3) Final inspection of Weld FW-01 on BOF-FWCL-CON-17-04604 (Line BOF-DEP-ZS-00283-S11C-10).

- Observed performance of a pneumatic pressure test performed on a section of coaxial LCP containment pipe, test number 24590-BOF-PPTR-CON-18-0201
- Observed performance of a pneumatic pressure test performed on a section of coaxial LAW secondary off-gas/vessel vent system containment pipes, test number 24590-BOF-PPTR-CON-18-0201
- Observed performance of a pneumatic pressure test performed on a section of coaxial radioactive liquid waste disposal system containment pipes, test number 24590-BOF-PPTR-CON-18-0201
- Observed performance of a pneumatic pressure test performed on modified instrument lines associated with pumps on the PCW system, test number 24590-BOF-PPTR-CON-18-0107
- Observed portions of flushing and cleaning performed on AMR piping at the ammonia storage facility
- Observed the three-week walkdown for the LAW BSA system on Elevation 3-0
- Observed the three-week walkdown for the LAW C2 ventilation system
- Observed the eight-week walkdown for the PCW cooling water supply to the LAW melter power supply units
- Observed three AMR flushing operations
- Performed walkdown of Fire Water and Demineralized Water systems
- Startup Plan of the Day meetings (3)
- Plant Management Plan of the Day meeting
- Startup Joint Test Group meetings (2)
- SSW Performance
- Startup tests on LAW Annex power panels
- Startup of LAW Annex C1V Humidifiers
- Pre-job briefs
- BOF/LAB Completion meeting
- Three-Week Rolling Schedule Status meeting

## 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.

- The Class E cleanness criteria used to determine that piping and instrument tubing systems have been satisfactorily cleaned are not in accordance with ASME NQA-1 Subpart 2.1. The criteria for measuring cleanness are not adequately defined, and although the determination is dependent on lighting conditions at the flush effluent discharge point and the visual acuity of the observer, the procedures do not specify requirements for lighting and visual acuity.