Office of Enterprise Assessments
Assessment of the Hanford Site
Waste Treatment and Immobilization Plant
Construction Quality

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Acronyms

Apollo	Apollo Mechanical
ASME	American Society of Mechanical Engineers
BNI	Bechtel National, Inc.
BOF	Balance of Facilities
CDG	Carbon Dioxide Gas
CFR	Code of Federal Regulations
CM	Commercial Grade
CR	Condition Report
CRAD	Criteria and Review Approach Document
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
EMF	Effluent Management Facility
HLW	High-Level Waste Facility
HSC	Hirschfield Steel Company
HVAC	Heating, Ventilation, and Air Conditioning
Intermech	Intermech, Inc.
LAB	Analytical Laboratory
LAW	Low-Activity Waste Facility
LCP	LAW Concentrate Receipt System
LFP	LAW Melter Feed Preparation Process
MRR	Material Receiving Report
MTR	Material Test Report
NCR	Nonconformance Report
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
ORP	Office of River Protection
PSV	Pressure Safety Valve
PTF	Pretreatment Facility
PVS	Paxton & Vierling Steel Company
Q	Quality Related
QA	Quality Assurance
QAM	BNI Quality Assurance Manual
QC	Quality Control
SBS	Submerged Bed Scrubber
SS	Safety Significant
SSC	Structure, System, and Component
WTCC	Waste Treatment Completion Company
WTP	Waste Treatment and Immobilization Plant

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of construction quality and the implementation of the quality assurance program at the Hanford Site Waste Treatment and Immobilization Plant (WTP) from June 17 to 27, 2018. EA performed this assessment in the broader context of an ongoing program of quarterly assessments of construction quality at the WTP construction site.

The scope of this EA assessment included observing ongoing structural and mechanical construction work activities and testing, and reviewing Bechtel National, Inc. (BNI) quality pedigree documentation for a sample of safety significant structures, systems, and components (SSCs). Additionally, EA evaluated the effectiveness of the DOE Office of River Protection's and BNI's issues management processes to address deficiencies identified during previous EA assessments of WTP construction quality and deficiencies regarding quality records for structural steel.

Overall, construction quality is satisfactory in the areas of pressure testing; cleaning and flushing piping and instrument systems; concrete placement; and heating, ventilation, and air conditioning system leak testing.

In the area of SSC quality pedigree documentation, BNI has developed and implemented an overall adequate engineering redraft process that conveys the engineering basis for upgrading the safety classification of SSCs from non-safety to Q (quality). However, the BNI redraft analyses for two EA-sampled SSCs with upgraded safety classifications lacked some details to support the upgraded quality levels.

EA's follow-up review of previously identified deficiencies and the effectiveness of their resolution identified weaknesses in both the Office of River Protection's and BNI's processes for capturing, analyzing, resolving, and tracking deficiencies. Corrective actions to resolve deficiencies regarding the quality records for structural steel are adequate.

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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 a focused assessment of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The onsite portion of this assessment was conducted from June 17 to 27, 2018. This EA assessment was performed within the broader context of an ongoing program of assessments of construction quality at DOE major construction projects. Because of the safety significance of WTP facilities, EA plans to continue these ongoing quarterly 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 processes in accordance with the *Plan for the Office of Enterprise Assessments Assessment of the Hanford Site Waste Treatment and Immobilization Plant Construction Quality, June 2018*. This quarterly assessment evaluated construction quality by observing ongoing structural and mechanical construction work activities and testing, and by reviewing Bechtel National, Inc. (BNI) quality pedigree documentation for a sample of safety significant (SS) structures, systems, and components (SSCs). Additionally, EA evaluated the effectiveness of the DOE Office of River Protection's (ORP's) and BNI's issues management processes in addressing deficiencies identified during previous EA WTP construction quality assessments.

3.0 BACKGROUND

ORP manages the 56 million gallons of liquid or semi-solid radioactive and chemical waste, stored in 177 underground tanks at the Hanford Site, and WTP, an industrial complex for separating and vitrifying the radioactive and chemical waste in the underground tanks. WTP is in the design and construction phase. ORP staff members, primarily WTP Construction Oversight and Assurance Division staff, provide oversight of construction activities at WTP.

BNI manages design and construction activities at WTP under contract to ORP. The quality assurance (QA) program requirements for design and construction 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* (in the contract). BNI Document 24590-WTP-QAM-QA-06-001, *Quality Assurance Manual*, provides a detailed description of the application of the 18 NQA-1-2000 requirements at WTP. The BNI Quality Assurance Manual (QAM) establishes a management system of planned and systematic actions necessary to ensure that SSCs perform satisfactorily in service.

In March 2017, BNI Construction and AECOM, the contractor responsible for maintenance and commissioning systems after turnover from BNI Construction, formed a joint venture. The new organization, Waste Treatment Completion Company (WTCC), is a subcontractor to BNI and is

contracted to complete construction, conduct startup, and commission WTP. WTCC is required to follow the QAM. BNI Construction personnel, including craft personnel, field engineers, quality control (QC) inspectors, administrative personnel, and managers, became employees of WTCC on March 31, 2017. 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. Administrative changes have been implemented to transition BNI Construction procedures into WTCC construction procedures for control of site work activities.

The WTP complex consists of the Pretreatment Facility (PTF), for separating the waste into low-activity waste and high-activity waste; the High-Level Waste Facility (HLW), where the high-level 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 the LAB and most BOF buildings. The majority of the electrical equipment in BOF Buildings 87 and 91 has been turned over from Construction to Startup.

Construction work activities are deferred in the 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; however, in late 2016 DOE decided to curtail construction of HLW and concentrate on completing LAW and the Effluent Management Facility (EMF) in order to begin processing low-activity waste using direct feed from the Tank Farms by 2022.

Construction of EMF began in 2016 to process the effluent remaining after the low-activity waste is processed in LAW. Effluent from LAW will be transferred via buried piping to EMF, where it will be processed to separate non-radioactive liquids' byproducts from radioactive byproducts. Radioactive byproducts will be transferred from EMF, via a designated piping system, back to LAW for vitrification or return to the Tank Farms.

4.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*. EA implements the independent oversight program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. Organizations and programs within DOE use varying terms to document specific assessment results. In this report, EA uses the terms "deficiencies, findings, and opportunities for improvement (OFIs)" as defined in DOE Order 227.1A. In accordance with DOE Order 227.1A, DOE line management and/or contractor organizations must develop and implement corrective action plans for 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 QA requirements.

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

- CRAD-45-52, *Nuclear Facility Construction – Piping and Pipe Supports*

- CRAD-45-53, *Nuclear Facility Construction – Mechanical Equipment Installation*
- CRAD-31-17, *Nuclear Facility Construction – Structural Concrete*
- CRAD-64-16, *Nuclear Facility Construction – Structural Steel*
- CRAD-31-31, *Receipt Inspection and Control of Items*.

EA reviewed procedures, specifications, drawings, and records and interviewed personnel responsible for construction and inspection work activities. EA also interviewed WTCC personnel and the WTP Construction Oversight and Assurance Division staff to determine whether work activities were completed in accordance with the appropriate design drawings, specifications, and procedures.

EA observed six pneumatic pressure tests; a hydrostatic pressure test; two concrete placement activities; and a heating, ventilation, and air conditioning (HVAC) leak rate test. EA also reviewed three records documenting completed cleaning and flushing operations, concreate batch tickets, quality pedigree documentation for SSC's; and followed-up on previous WTP deficiencies.

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

5.0 RESULTS

5.1 Pressure Testing Program

This section discusses EA's assessment of the pressure testing of commercial grade (CM) piping that 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 procedure was approved by BNI design engineering. EA's evaluation of the procedure determined that it is adequate.

EA observed WTCC site personnel performing six pneumatic and one hydrostatic pressure tests. The specified test pressures were 110 percent of the piping system design pressure for the pneumatic tests and 1.5 times the design pressure for the hydrostatic test as specified in BNI Design Guide 24590-WTP-3DG-M40T-00001, *Design Parameters & Test Pressures for Equipment and Piping*. The pressure testing procedure references the appropriate code requirements (ASME Code B31.3, Paragraph 345.5, *Pneumatic Testing*, and American Water Works Association C600-93, *AWWA Standard for Ductile-Iron Water Mains and Their Appurtenances*).

The pneumatic pressure tests observed by EA were performed on sections of the outer pipe of the double wall coaxial pipe that is being fabricated to transfer effluent from the LAW to the EMF. The coaxial pipe 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 this quarterly assessment. After the hydrostatic tests on the inner pipe were completed and declared successful, fittings were field welded to complete the outer pipe. The pneumatic pressure tests were performed on the outer pipe after the field welds were inspected and accepted by WTCC welding engineers. The pipe sections tested included two for the LAW concentrate receipt system (LCP), two for the LAW secondary offgas/vessel vent system, and two for the radioactive liquid waste disposal system. No leaks were observed.

The hydrostatic pressure test observed by EA was performed on a section of CM domestic water system piping. This pressure test was a retest on a section of buried water piping that required replacement of a coupling that was leaking during the initial test. All the joints/couplings in the test boundary were uncovered for inspection during the hydrostatic pressure test, as required by the American Water Works Association standard. No leaks were observed during the retest.

EA attended the pre-test briefings, reviewed drawings and test data sheets, examined the testing apparatus, and 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 and 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. For the pneumatic pressure tests, 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 verified that the test pressure was maintained during the walkdowns. For the hydrostatic test, EA verified that the hydrostatic pressure was maintained for the duration of the test.

EA observed the walkdowns and inspections performed by the WTCC field engineers. There were no leaks during these walkdowns and tests, so the WTCC test engineers declared that the tests were successful. EA's review of the completed test records verified that the test data was accurately recorded and approved by qualified personnel. The WTCC pressure testing program is satisfactory based on the observed pneumatic and hydrostatic pressure tests.

EA also observed a subcontractor, Apollo Mechanical (Apollo), performing a pneumatic pressure test on the high purity gas system in the LAW. This system supplies high purity gases for gloveboxes and other equipment in the LAB. EA reviewed Apollo QC Procedure QCP-03, *Pneumatic Testing*, which specifies QC inspection requirements for pressure tests performed by Apollo. EA attended the pre-test briefing, reviewed drawings and the test procedure, verified that the digital pressure gauges used by Apollo had current calibration stickers, verified that the test pressures were maintained for the required hold time, and witnessed some walkdowns of the system. The Apollo leak test program is adequate, based on the sample reviewed.

5.2 Cleaning and Flushing of Piping and Instrument Systems

This section discusses EA's assessment of the engineering specification and startup test procedures for cleaning and flushing piping and instrument systems, and review of records documenting completed cleaning and flushing operations on selected 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 cleanliness 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. Cleanliness and flushing operations shall be performed by qualified personnel, and 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)

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 generic 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 cleanliness requirements, hold points, inspection requirements, instructions for recording and evaluating data, acceptance criteria for cleanliness, and system restoration requirements. The type of cleaning fluids/air is specified based on the type of materials used in construction and system function. The specification references ASME NQA-1, Subpart 2.1, Section 300, for the requirements for Class A through D system cleanliness. The specification defines a fifth cleanliness class, Class E, for some systems that specifies the system is to be flushed until the discharge from the outlet is clear. EA's evaluation of this specification determined that it is adequate.

WTCC startup engineers prepare an individual cleaning and flushing startup test procedure for each system that specifies the class of cleanliness required to be achieved, system configuration during flushing, and sequence for performing flushing. EA reviewed WTCC Startup Procedure 24590-WTP-GPP-RASU-SU-0003, *Certification of Startup Personnel*, which specifies the qualifications for certification as a startup engineer. The procedure also specifies the quality records that must be completed and maintained to document that an individual has been certified. EA's evaluation of this procedure determined that it is adequate.

EA reviewed the following records (test results packages) that document completed cleaning and flushing:

- Test Procedure 24590-BOF-DIW-FTP-001, *Demineralized Water System (DIW-B-01) Flush*
- Test Procedure 24590-BOF-DIW-TRP-002, *Demineralized Water System (DIW-B-02) Flush*
- Test Procedure 24590-BOF-PSW-FPT-0003, *Process Service Water (PSW-B-01) Flush*.

EA determined that these records are adequate and approved by qualified personnel.

5.3 Concrete Placement Activities

This section discusses EA's assessment of concrete placement for two topping slabs in the EMF to verify that these operations were performed in accordance with the design specification requirements and industry standards of American Concrete Institute recommended practices.

Criterion:

Work, such as concrete construction, shall be performed in accordance with approved procedures, design drawings, manufacturer's instructions, and other design basis documents, including applicable codes and standards. The procedures, instructions, and drawings shall include or reference appropriate quantitative or qualitative acceptance criteria for determining that prescribed results have been satisfactorily attained. (NQA-1, Requirement 5; Policy Q-5.1 of the QAM; and DOE Order 414.1C)

EA observed two CM concrete placements in the EMF, placement numbers EMF 18-031 and 18-032. Specification No. 24590-WTP-3PS-DB01-T0001, *Engineering Specification for Furnishing and Delivering Ready-Mix Concrete*, and Specification No. 24590-WTP-3PS-D000-T0001, *Engineering Specification for Concrete Work*, cite the requirements for concrete quality and concrete work activities at WTP. Specification No. 24590-BOF-3PS-C000-T0001, *Engineering Specification for Material Testing Services*, cites the frequencies for sampling and testing the freshly mixed concrete to verify that the concrete conforms with project quality and design requirements. The codes and standards for testing the concrete are referenced in this specification. EA's evaluation of the three specifications determined that they are adequate.

EA's review of the concrete pour card verified that it was signed to document that all required construction work and inspections were completed before the start of concrete placement. EA observed the review of concrete batch tickets and acceptance test results by the WTCC QC inspector, placement of the concrete, and consolidation of the concrete. Because the EMF facility is classified as CM, in accordance with WTP project procedures, WTCC field engineers performed the inspection of concrete placement and consolidation activities.

EA reviewed the concrete batch tickets. The concrete batch tickets indicated that the proper concrete was being delivered. Test results showed that the delivered concrete met project requirements for slump, entrained air content, and temperature. Concrete was sampled by the WTCC subcontractor testing laboratory personnel for molding of cylinders for unconfined compression testing.

The areas where concrete was to be placed were cleaned (debris removed) and kept moist prior to concrete placement. The equipment used to deliver the concrete to the forms was suitable. Enough vibrators were used to consolidate the concrete. There was suitable access to the placement for vibrator operators, other construction craftsmen, and WTCC field engineers. Concrete drop distances were within specification requirements, vibrators were properly used, and excess water did not accumulate during placement and consolidation.

Based on the observed EMF concrete placements, the concrete placement activities, including preparation and planning, delivery of the concrete, and concrete placement and consolidation, are satisfactory.

5.4 HVAC System Leak Testing

This section discusses EA's assessment of leak testing and structural capability testing of completed HVAC housing and ductwork that is performed to verify that the installed HVAC housing and ductwork are leak tight.

Criterion:

Construction and pre-operational tests, such as leak testing of housing and ductwork for HVAC 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)

Design, installation, and testing of the HVAC system for WTP is subcontracted by BNI to Intermech, Inc. (Intermech). Construction craft personnel employed by Intermech use Intermech installation procedures that were approved by BNI. Intermech is responsible for maintaining a QA program that complies with NQA-1 and for performing QC inspections of the work performed by its construction workers. BNI QC and QA personnel perform surveillances of Intermech work activities to confirm that Intermech complies with its contract and QA program requirements.

Intermech Procedure W\IP-WTP 11.30, *HVAC Housing/Ductwork Structural Capability and Leak Testing*, provides the instructions for performing leak tightness and structural capability of HVAC housings and ducts and specifies the test method and prerequisites, qualifications of test personnel, acceptance criteria, and documentation requirements. EA's review of the Intermech procedure for performing the leak test determined that it is adequate.

EA observed a leak rate test performed on a section of the auto sampling system ductwork and a high efficiency particulate air filter housing in the LAB under Work Data Package 366034C. EA verified that the test instruments had current calibration stickers and the test instrument identification/serial numbers were recorded on the test data sheets. EA also observed the instrument readings and data recording during the test and reviewed the completed test data record. The test demonstrated that the housing and section of ductwork meet the allowable leakage rate and that the measured leakage was approximately half of the allowable leakage. Qualified personnel reviewed and approved the test record.

For the sample reviewed, EA determined that the HVAC leak testing program is adequate.

5.5 Structural Steel Material Certifications

This section discusses EA's assessment of actions completed by BNI and the ORP WTP Performance Assessment Division to resolve deficiencies concerning missing or non-retrievable records that document the quality of steel used to fabricate quality-related (Q) structural steel members for the LAB, LAW, and HLW.

Criterion:

A process shall be established to identify, document, evaluate, and correct conditions adverse to quality. Records shall be maintained documenting the corrective actions, including documentation of objective evidence of satisfactory implementation of corrective actions. (NQA-1, Requirement 16; Policy Q-16.1 of the QAM; and DOE Order 414.1C)

The Q structural steel members were supplied to BNI by two steel fabrication companies, Hirschfield Steel Company (HSC) and Paxton & Vierling Steel Company (PVS). HSC and PVS were required to maintain a QA program that complied with ASME NQA-1 and DOE Order 414.1C. HSC and PVS purchased structural steel shapes that they used to fabricate individual structural steel members from qualified steel suppliers who provide material test reports (MTRs) that document steel quality. An MTR is issued for each specific heat number of the steel used to fabricate the steel member and includes physical and chemical test results for individual structural steel members. HSC and PVS were required to maintain traceability of the MTRs throughout the fabrication process so that the MTRs for each structural steel shape used to fabricate individual structural steel members would be documented and retrievable in the WTP project quality records.

In March 2013, BNI initiated nonconformance report (NCR) 24590-WTP-NCR-CON-13-0057, *LAW Missing Mill Test Reports for Pour Cave and Process Cell Hatch Plates*, to document that MTRs for Q structural steel plates for installation in the HLW had not been submitted in the quality verification documentation packages that were included with the shipping documentation for the steel plates. The MTRs were missing from the material receiving reports (MRRs) that had been completed by BNI receiving inspection personnel when the steel plate shipments were received because the MTRs were not included with the shipping documentation. Consequently, the MTRs were not retrievable in the BNI quality records system.

BNI's initial investigation of this issue disclosed that the purchase specifications had provisions that permitted the structural steel fabricators to either include the MTRs in the shipping documentation or to submit the MTRs separately before shipment of the steel. Additional review performed by BNI of this issue disclosed that when the MTRs were submitted before the steel shipment, the MTRs were not easily retrievable and BNI could not always determine which MTR was applicable to a specific structural steel member.

BNI initiated CR-24590-WTP-PIER-13-00440, *MTRs not found in MRR Packages*, to investigate the extent of this condition. BNI developed spreadsheets listing the structural steel piece marks (unique identification numbers assigned by the steel fabricator to each steel member that is cross-referenced against a structural steel design drawing) and the MTR number. BNI's investigation disclosed that the MTRs were not retrievable for a large number of structural steel members used to construct the LAB, LAW, and HLW.

In 2017, BNI initiated CR-24590-WTP-GCA-MGT-17-01863, *Structural Steel Mill Test Reports Missing from LAB Structural Steel Material Receiving Reports*, and CR-24590-WTP-GCA-MGT-17-01864, *Structural Steel Mill Test Reports Missing from LAW Structural Steel Material Receiving Reports*, to address the missing MTRs for the structural steel members used to construct the LAB and LAW.

BNI's corrective actions to resolve the CRs included a review of the quality records (MRRs) for all 22,671 Q structural steel members. This initial review disclosed that MTRs were not retrievable, and possibly missing, for 6,923 of the 22,671 Q structural steel members in the LAW and LAB because the MTRs had not been included with the MRR documentation. BNI then conducted a review of emails from HSC and PVS to identify MTRs associated with the 6,923 structural members. The results of the review of the emails identified MTRs that were applicable to all but 714 structural steel members (piece marks). HSC and PVS were subsequently able to provide copies of MTRs that were applicable to 564 of the 714 structural steel members that had not been retrievable in BNI's quality records system.

BNI initiated NCR 24590-WTP-NCR-CON-18-0050, *Mill Test Reports (MTR) are not provided by the supplier for miscellaneous structural steel*, to document and disposition the non-retrievable MTRs for the remaining 150 structural steel members in the LAB and LAW. BNI obtained additional MTRs from the fabricators for 53 of the 150 structural steel members. BNI determined that the remaining 97 structural steel members had been purchased from approved CM steel suppliers who furnished certificates of compliance for the steel to complete the corrective actions for this NCR. EA's review of this NCR concluded that the corrective actions to disposition the NCR are adequate.

BNI's review of MTRs determined that 81 Q structural angles installed in the LAB were misclassified as CM and, therefore, were purchased by PVS from a CM steel supplier. These angles are installed on the foundation basemat and function as girt supports for attaching (anchoring) sheet metal siding. No MTRs are available for these Q structural angles. BNI initiated NCR 24590-WTP-NCR-CON-18-0049, *Mill Test Reports (MTR) are not provided by the supplier for base angle*, to document and disposition this issue. BNI dispositioned the NCR "use-as-is" resolution based on the results of hardness tests performed

on only one base angle, concluding that testing of one base angle was sufficient based on the low amount of stress acting on the base angles. ORP concluded in its review of this NCR that there was insufficient technical justification to support the use-as-is resolution.

BNI initiated NCR 24590-WTP-NCR-CON-18-0087, *Inadequate Justification to Support Use-as-is resolution of LAB base angle*, to address the lack of adequate resolution of NCR 24590-WTP-NCR-CON-18-0049. Disposition of NCR 24590-WTP-NCR-CON-18-0087 was accepted by ORP in an email dated June 19, 2018. EA reviewed the corrective actions to disposition this NCR that are summarized in the ORP report. The corrective actions included hardness tests on 22 additional base angles and a technical evaluation performed by BNI using the results of the hardness tests to estimate the approximate tensile strength of the base angles. BNI's evaluation showed that the base angles had more than adequate strength to function as girt supports. EA concluded that the corrective actions to disposition the NCR are adequate.

The ORP WTP Performance Assessment Division performed a surveillance that assessed BNI's corrective actions for resolving the missing or non-retrievable structural steel MTRs. The surveillance reviewed the extent of the condition, the causes of the problem, and the effectiveness of BNI's program to locate the MTRs. The results of the ORP surveillance are documented in ORP Performance Assurance Report 18-WTP-0075, *Procurement Documentation Review of Structural Steel*. ORP identified several instances where BNI did not follow approved procedures or processes that may have contributed to the original issue, insufficient technical adequacy of engineering reviews to address identified deficiencies, and lack of timely corrective actions to address a potentially widespread quality-related issue (deficiencies were identified by BNI, documented in NCR 24590-WTP-NCR-CON-13-0057), resulting in five findings, one OFI, and one item for follow-up.

EA reviewed ORP Performance Assurance Report 18-WTP-0075. The ORP assessors performed detailed reviews of the CRs and NCRs related to the missing or non-retrievable MTRs and assessed design specifications and drawings, purchase specifications, industry standards, and randomly selected MRRs. The ORP assessors met frequently with BNI engineers to review BNI's ongoing corrective actions and identified areas where additional reviews were necessary. The ORP assessment team independently verified that MTRs that were originally reported as missing or non-retrievable had been located in the BNI quality records system or resubmitted by HSC or PVS. EA concluded that the surveillance of BNI's correction actions pertaining to missing or non-retrievable documentation for LAB and LAW structural steel performed by the ORP WTP Performance Assessment Division is adequate.

ORP and BNI's corrective actions to resolve questions concerning the quality of structural steel used to construct the LAB and LAW are adequate. BNI initiated CR 24590-WTP-GCA-MGT-17-01862, *Structural Steel Mill Test Reports Missing from HLW Structural Steel Material Receiving Reports*, to perform a similar review to identify missing or non-retrievable MTRs for the structural steel used to construct the HLW. Concerning the PTF, when construction restarts, BNI and ORP will initiate reviews of the PTF MTRs for structural steel.

5.6 SSC Quality Pedigree

This section discusses EA's assessment of BNI quality pedigree documentation for a sample of SS SSCs.

Criterion:

Specify, review, approve, and maintain records. (10 CFR 830.122, Criterion 4 and DOE O 414.1D)

The DSA Chapter IV, *Safety Significant Systems, Structures, and Components*, designates 8 systems with a total of 40 SS SSCs; there are no designated safety class SSCs. EA examined the quality pedigree documentation supporting components of the following SS SSCs, two of which BNI upgraded the safety classifications identified as non-safety in the LAW *Preliminary Safety Analysis Report* to SS in the DSA:

- Submerged Bed Scrubber (SBS) Chilled Water Cooling Coil Pressure Safety Valves (PSVs)
- Melter/Melter Offgas System SSC Room L-0322A Differential Pressure Gauge
- Melter Feed SSCs LCP/LAW Melter Feed Preparation Process (LFP) Vessels (upgraded from non-safety to SS)
- Carbon Dioxide Gas (CDG) Reagent System SSC One-inch liquid CDG piping/inline components and Carbon Dioxide transfer Hosing and Vapor Return Hosing (upgraded from non-safety to SS).

EA reviewed DSA performance criteria, the BNI quality classification upgrade process (redraft process), relevant upgraded SSCs redraft analyses, design calculations, equipment data sheets, drawings, procurement documents, qualified supplier history, receipt inspections, commercial grade dedication plans, construction deficiency reports, NCRs, installation inspections, and performance test reports. EA walked down each installed system, verified proper equipment storage conditions, and interviewed various BNI and WTCC personnel, including system engineers and management, assigned to each SSC from design engineering, field engineering, and plant engineering.

BNI Engineering Redraft Process and Implementation

Anticipating the elevation of some SSC safety classifications and in collaboration with ORP, BNI design engineering developed engineering instruction 24590-WTP-3DI-G04W-00006, *Engineering Redraft Process*, which states that the engineering redraft process is "not intended to perform a gap analysis between quality level CM and Q procurements" but is to provide "reasonable assurance" that the SSC can perform its credited safety function. Elevating safety classifications of installed CM SSCs requires an NCR since CM SSCs would not have the extensive quality documentation required of Q level SSCs. The engineering redraft process provides for the development of an engineering basis for upgrading the safety classification of SSCs from non-safety to Q but does not provide for QA involvement, resulting in some inadequate explanation/communication of important QA acceptance information as further discussed below.

Q SSC Quality Pedigree

The LAW PSAR and DSA designated two of the sampled SS SSCs as quality level Q: the Submerged Bed Scrubber Pressure Safety Valves (SBS PSVs) and Melter/Melter Offgas SSC Room L-0322A Differential Pressure Gauge. Design and procurement documentation (e.g., component data sheets, drawings, calculations, purchase orders from a BNI qualified supplier, MRRs, supplier certificates of conformance) are consistent with the DSA performance criteria. BNI installed all the valves as a "dry fit" to ensure constructability and then removed the valves for storage in an onsite environment-controlled construction storage warehouse pending startup pipe flushing. EA confirmed completion of all associated piping inspection reports. EA confirmed that BNI properly tagged all valves stored in a designated storage location. The Q pedigree for this SSC is adequate.

EA reviewed the quality pedigree for the Melter/Melter Offgas System SS SSC Differential Pressure Gauge. It has not been installed in the LAW. BNI initiated the purchase of the Differential Pressure Gauge on February 8, 2018, as a CM purchase subject to BNI's CM Dedication process. The 24590-WTP-MRR-PROC-0031176, *Material Receiving Report*, indicates that BNI received the gauge and initiated NCR-CON-18-0089 to maintain quality control while BNI submits the gauge to independent testing by an outside Nationally Recognized Testing Laboratory as specified in the CM Dedication plan. However, EA noted that the design drawing, component data sheet, and procurement documents specify SC-IV, which conflicts with the DSA specification of SC-III, a more stringent seismic standard. The responsible safety basis engineer has initiated efforts to correct this DSA typographical error through a DOE approved procedure similar to the Unresolved Safety Question process. The Q pedigree for this SSC is adequate.

Overall, the LAW SBS PSV and Melter/Melter Offgas Differential Pressure Gauge records adequately support the Q pedigree.

Upgraded (CM to Q) SSC Quality Pedigree

Appendix E of the LAW DSA indicates that BNI upgraded the quality level of two EA sample SSC installed systems from CM to Q: the Melter Feed SSCs LCP/LFP Vessels and the CDG Reagent System SSC Carbon Dioxide transfer Hosing and Vapor Return Hosing and One-inch liquid CDG piping and Inline Components.

The LAW DSA, Section 4.4.2.2, identifies as SS the LCP/LFP vessels and associated nozzles, supports, and anchorages. Design criteria include ASME Boiler and Pressure Vessel Code (ASME BPVC), Section VIII, Division 1 design requirements and SC-III seismic loads. 24590-LAW-ES-ENG-17-003, *Engineering Redraft Study - LAW LCP-VSL-00001/00002 and LFP-VSL-00001/00002/00003/00004*, defines the engineering basis for accepting the installed CM SSCs as Q SSCs in accordance with 3DI-G04W-00006. The LCP/LFP vessel acceptance basis was based predominately on the supplier's ASME code stamp and supplier QA records. The ASME code stamp indicates that the manufacturer maintains a QA program in accordance with NQA -1-2000. ORP concurred with this analysis.

The engineering redraft study, Section 2.2 *Recommendations*, commits BNI to perform a "seismic interaction evaluation on the vessels and attachments in accordance with 24290-WTP-GPG-EMG-033, *Evaluation for Seismic Interaction Effects*." EA confirmed that BNI is tracking this action through the BNI Design Engineering requirements verification. However, EA identified the following concerns with the engineering redraft study for upgrading the LCP/LFP vessels:

- The document states that the piping and instrumentation diagram identifies the vessel as SC-IV in contrast to all other referenced documents with no explanation.

- There is no discussion of the acceptability of the imbedded anchor bolts since ENG-17-003 identifies the vessel lower boundary as the interface between the skirt and anchorages.

- There is no discussion of the LCP/LFP vessels fabricator's (Eaton Metal Products Company) ASME Section VIII certification at the time of vessels' fabrication and acceptance of Eaton's quality records (i.e., fabrication QA records, testing records, Certificates of Compliance, and Material Test Reports) individually stamped by an ASME authorized inspector. ASME Section VIII certification documentation and ASME authorized inspector stamped records contain valuable quality construction perspective.

- The document states, "Inspection attributes for the CM component were examined by a Field Engineer rather than a Quality Control inspector, as required for a Q component." However, there is no discussion of the BNI Field Engineer's (FE) inspector's training/qualification in comparison to a Quality Control inspector, which are the same. BNI procedures (24590-WTP-MN-CON-01-001-09, *Nondestructive Examination Standard Visual Examination*) requires that all BNI personnel performing visual weld inspections are qualified to the same standard.

- There is no discussion of BNI's FEs' and BNI's subcontracted ASME Authorized Inspectors' verifications of BNI CM welding repairs of the vessel nozzles required to satisfy BNI's revised seismic calculations. CDR-16-007, CDR-16-0013, CDR-16-0017, and CDR-16-0014 provide adequate evidence of these inspections. These inspections are equivalent to QC inspections.

The lack of this important quality information detracts from BNI's ability to communicate a comprehensive SSC quality pedigree to provide reasonable assurance that the SSC can perform its credited safety function and support the upgraded quality level from CM to Q.

The LAW DSA, Section 4.4.7.1, identifies SS CO2 Storage Vessel Vapor Return Hose CDG-HOSE-00036 and CO2 Storage Vessel Fill Hose CDG-HOSE-00037 as capable of providing confinement of carbon dioxide. The LAW DSA, Appendix E, indicates that BNI upgraded the quality level of these installed CDG SSCs from CM to Q. 24590-WTP-LAW-ES-ENG-17-012, *Engineering Redraft Study – LAW Carbon Dioxide Gas System, External*, specifies that CDG-HOSE-00036 and 00037 need to "be replaced before startup as Q item as they are approaching their ten-year shelf life" and couplings re-purchased as Q. ORP concurred with this analysis. An EA system walkdown confirmed that WTCC appropriately tagged-out the system with NCR tag 24590-WTP-NCR-18-0077*, CDG System Installed "CM", Upgraded to "Q."*

ORP's concurrence with the engineering redraft study required BNI to track and complete the recommended actions identified in the analysis. The transmittal documentation indicated that BNI would track recommended actions through NRC-18-0077. EA confirmed that an NCR-18-0077 attached EXCEL spreadsheet adequately addresses these hoses. EA noted that the WTCC Plant Engineering organization has anticipated the need to reexamine all expendable items (e.g., lubrications, gaskets, hoses such as CDG-HOSE-00036 and 00037), to determine replacement needs prior to operations, demonstrating an effective approach to managing expendable items.

The 24590-LAWWTP-ES-ENG-17-013, Engineering Redraft Study – LAW Carbon Dioxide Gas System, Internal, documents the basis for accepting the one-inch liquid CDG piping and inline components installed as CM SSCs and upgraded to Q SSCs in accordance with 3DI-G04W-00006. ORP concurred with this analysis. Referenced quality documentation for receipt inspection and installation testing was mostly adequate. However, EA noted that ENG-17-013 does not discuss the BNI FE's welding inspector's training/qualification per MN-CON-01-001-09, who performed adequate CDG piping installation welding inspections in accordance with CM installation requirements. The FE welding inspector's training/ qualification is equivalent to a QC inspector (also subject to MN-CON-01-001-09) who would have performed the inspection had the piping been Q level. This is important quality assurance information regarding welding pedigree. An EA system walkdown of the Pelletizer rooms confirmed that WTCC appropriately tagged-out these components with NCR tag 24590-WTP-NCR-18-0077.

BNI has developed and implemented a mostly adequate engineering redraft process that communicates the engineering basis for upgrading the safety classification of SSCs from non-safety to Q. The quality records of the two EA-sampled Q SSCs provide much documentation supporting the required quality

pedigree. However, for the two EA-sampled upgraded Q SSCs, the completed engineering redraft studies omit some important QA details that support the upgraded quality levels.

5.7 Follow-up Review of Previous Deficiencies

This section discusses EA's assessment of the effectiveness of ORP's and BNI's issues management systems in addressing deficiencies previously identified by EA.

Criteria:

A comprehensive, structured issues management system is implemented that provides for the timely and effective resolution of deficiencies and meets the requirements of DOE Order 226.1B. A corrective action system is established to ensure that deficiencies are fully corrected and prevent recurrence. (DOE Order 226.1B; DOE Order 226.1B CRD 2.b(3))

The issues management system effectively captures program and performance issues from many sources, and issues are appropriately categorized to ensure problems are evaluated, reported, and corrected (including compensatory actions when needed) on a timely basis. Program and performance deficiencies, regardless of their source, are captured in a system or systems that provide for effective analysis, resolution, and tracking. (DOE Order 226.1B; DOE Order 226.1B CRD 2.b(3))

EA reviewed the effectiveness of ORP's and BNI's issues management processes to address eight deficiencies identified during six past EA WTP construction quality assessments. These previous assessments were conducted from 2016 to 2018. One of the eight deficiencies reviewed by EA noted a weakness in ORP's performance. EA determined that although ORP received the EA report and some members of the ORP organization were aware of the deficiency, ORP did not enter the deficiency into its issues management system. DOE Order 227.1A requires the site to use its local issues management system to address EA-identified deficiencies. ORP had not taken any action to analyze the deficiency, determine causes, and establish and complete necessary corrective actions in accordance with ORP procedure TRS-ISS-IP-02, *Issue Reporting and Resolution*. The ORP personnel who typically enter issues into its issues management system did not recognize that the EA report included a deficiency, and the ORP personnel who were aware of the deficiency did not follow up on the deficiency to ensure that it had been entered into the issues management system.

The seven remaining deficiencies that EA reviewed were against BNI and were identified in four EA assessment reports. ORP did not formally transmit three of the four reports to BNI. The three reports that were not transmitted contained six of the seven BNI deficiencies. As a result, BNI had not entered any of these six deficiencies into its issues management system. For the one deficiency that was formally transmitted from ORP to BNI, BNI did not enter the deficiency into its issues management system as required by DOE Order 227.1A.

Both ORP and BNI have mature issues management systems that implement the requirements of DOE Order 226.1 B, *Implementation of Department of Energy Oversight Policy*. However, the inaction of ORP and BNI to enter these EA-identified deficiencies into their respective issues management system indicates potential weaknesses in both ORP's and BNI's processes for capturing identified deficiencies.

EA concluded that both ORP and BNI did not meet an essential element of an effective issues management system by which program and performance deficiencies, regardless of their source, are captured, analyzed, resolved, and tracked. **(Deficiency)** EA is planning to conduct a follow-on assessment to more extensively evaluate the effectiveness of ORP's and BNI's issues management processes.

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 is planning a 2019 assessment that will focus on the ORP and BNI issues management processes in order to follow up on the issues management weaknesses identified in this report and to support a request by the ORP Manager to more broadly evaluate the timeliness and effectiveness of the resolution of significant issues.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: June 17-27, 2018

Office of Enterprise Assessments (EA) Management

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

Quality Review Board

Steven C. Simonson
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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
Joseph J. Lenahan
Michael A. Marelli

Appendix B
Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

- 24590-LAW-DSA-NS-18-0001, Rev 0a, *Documented Safety Analysis for the Low-Activity Waste Facility*, May 22, 2018
- 24590-WTP-PSAR-ESH-01-002-03, Rev6, *Preliminary Safety Analysis [PSAR] to Support Construction Authorization: LAW Facility Specific Information*, April 28, 2016
- 24590-WTP-3DI-G04W-00006, *Engineering Redraft Process*, October 26, 2017
- 24590-QL-POA-JV03-00004-04-00007, Rev00D, *Instrument data Sheet - Pressure Relief Valve-LOP-PSV-1084*, October 15, 2015
- 24590-QL-POA-JV03-00004-04-00001, Rev00E, *Instrument data Sheet - Pressure Relief Valve-LOP-PSV-1149*, October 15, 2015
- 24590-QL-POA-JV03-00004-04-00008, Rev00D, *Instrument data Sheet - Pressure Relief Valve-LOP-PSV-1086*, October 15, 2015
- 24590-QL-POA-JV03-00004-04-00002, Rev00D, *Instrument data Sheet - Pressure Relief Valve-LOP-PSV-1150*, October 15, 2015
- 24590-QL-POA-JV03-00004-04-00010, Rev00D, *Instrument data Sheet - Pressure Relief Valve-LOP-PSV-2084*, October 15, 2015
- 24590-QL-POA-JV03-00004-04-00004, Rev00D, *Instrument data Sheet - Pressure Relief Valve-LOP-PSV-2149*, October 15, 2015
- 24590-QL-POA-JV03-00004-04-00011, Rev00D, *Instrument data Sheet - Pressure Relief Valve-LOP-PSV-2086*, October 15, 2015
- 24590-QL-POA-JV3-00004-04-00005, Rev00D, *Instrument data Sheet - Pressure Relief Valve-LOP-PSV-2150*, October 15, 2015
- 24590-WTP-QL-POA-JV03-00004-02-00008, Rev00G, *Drawing, Valve Assembly 27CA23-120/S4/SP, (Butt Weld) 3/4 Inch-150# RF X1 Inch - 150#RF*, August 11, 2016
- 24590-WTP-LAW-M6C-CHW-00007, Rev1, *LAW Calculation Chilled Water System (CHW) Overpressure Protection*, September 20, 2013
- 24590-WTP-3PS-FB01-T0001, Rev6, *Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks*, October 26, 2014
- 24590-WTP-QL-POA-JV03-00004, *Purchase Order*, January 2005
- 24590-WTP-SRR-PROC-0047101, *Material Receiving Report*, September 29, 2016
- 24590-WTP-QL-POA-JV03-00004-07-00008, Rev00E, *Seismic Qualification Test Report for Farris engineering Model 26HA12L-120/S4/SP and 27CA23-120/S4/SP Pressure Relief Valves*, July 13, 2016
- 24590-WTP-QL-POA-JV04-00004-10-00001, *Certificate of Compliance*, August 5, 2016
- 24590-WTP-LAW-ITIR-CON-12-1310, *Instrument Tubing and Inspection Report, LOP-PSV-1084 - Pressure Relief Valve*, November 21, 2016
- 24590-WTP-LAW-ITIR-CON-12-1313, *Instrument Tubing and Inspection Report, LOP-PSV-1149 - Pressure Relief Valve*, November 21, 2016
- 24590-WTP-LAW-ITIR-CON-12-1311, *Instrument Tubing and Inspection Report, LOP-PSV-1086 - Pressure Relief Valve*, November 21, 2016
- 24590-WTP-LAW-ITIR-CON-12-1314, *Instrument Tubing and Inspection Report, LOP-PSV-1150 - Pressure Relief Valve*, December 27, 2016
- 24590-WTP-LAW-ITIR-CON-12-1316, *Instrument Tubing and Inspection Report, LOP-PSV-2084 - Pressure Relief Valve*, November 21, 2016
- 24590-WTP-LAW-ITIR-CON-12-1319, *Instrument Tubing and Inspection Report, LOP-PSV-2149 - Pressure Relief Valve*, November 21, 2016

- 24590-WTP-LAW-ITIR-CON-12-1317, *Instrument Tubing and Inspection Report, LOP-PSV-2086 - Pressure Relief Valve*, November 21, 2016
- 24590-WTP-LAW-ITIR-CON-12-1320, *Instrument Tubing and Inspection Report, LOP-PSV-2150 - Pressure Relief Valve*, November 21, 2016
- 24590-WTP-LAW-M8-C2V-00002002, Rev 11, *Law Vitrification Building Volumetric V&ID C2 Air Distribution El 48-0 & EL 68-0*, November 20, 2017
- 24590-WTP-CM-POA-JP01-00013, *Purchase Order*, February 8, 2018
- 24590-WTP-MRR-PROC-0031176, Rev0, *Material Receiving Report*, May 25, 2018
- NCR-CON-18-0089, *Unable to Complete CGD Activities during Receipt Inspection (MRR-31176)*
- 24590-WTP-LAW-JPD-C2V-22460, Rev1, *Data Sheet C2V-PDI-2246*, May 17, 2018
- CCN 304839: *Contract N0 DE-AC27-01RV14136 – Bechtel National, Inc., Early Limited Procurement and Upgrading of Existing Structures, Systems, And Components In Support Of Direct Feed Low-Activity Waste*, February 28, 2018
- 25490-WTP-CGD-PROE-18-0002, Rev0, *CGD Plan for LAW Room L-0322A Differential Pressure Gauge*, May 15, 2018
- 24590-WTP-ES-ENG-17-003, Rev 00A, *Engineering Redraft Study - LAW LCP-VSL-00001/00002 and LFP-VSL-00001/00002/00003/00004*, November 27, 2017
- 24590-LAW-3YV-LFP-00001, Rev6, *Requirements Verification Matrix for the LAW Melter Feed Process (LFP) and Concentrate Receipt Process (LCP) System Design Description*, May 24, 2018
- 24590-CM-POA-MVA0-00002-02-02_00E, Rev D, *Calculation, COMPRESS Pressure Vessel Design Calculations*, August 2, 2004
- 24590-LAW-DD-S13T-00009, Rev 6*, LAW Process and Effluent Cell Vessel Anchorage/ Support Ring Schedule & Details*, September 30, 2009
- 24590-WTP-CDR-16-0007, LAW-LCP-VSL-00001: *Flange Mounted Insert Welds not Properly Sized to Code*
- 24590-WTP-CDR-16-0013, LAW-LCP-VSL-00002: *Flange Mounted Insert Welds not Properly Sized to Code*
- 24590-WTP-CDR-16-0017, LAW-LFP-VSL-00004: *Flange Mounted Insert Welds not Properly Sized to Code*
- 24590-WTP-CDR-16-0014, LAW-LFP-VSL-00002: *Flange Mounted Insert Welds not Properly Sized to Code*
- 24590-LAW-ES-ENG-17-012, Rev0, *Engineering Redraft Study - LAW Carbon Dioxide Gas System, External,* May 16, 2018
- CCN 306932: *Contract No. DE-AC27-01RV1413 6 - The U.S. Department of Energy, Office of River Protection Conditional Concurrence on The Engineering Redraft Study For The Low-Activity Waste Carbon Dioxide Gas System, External*, May 15, 2018
- 24590-WTP-NCR-18-0077*, CDG System Installed "CM", Upgraded to "Q."*
- 24590-3YV-CDG-00002, Rev3, *Requirements Verification for the LAW Carbon Dioxide Gas (CDG) System Design Description*, July 18, 2017
- CCN 303322, *Management Directive Regarding CDG LAW Refurbishment and Spare Parts*, February 12, 2018
- 24590-WTP-ES-ENG-17-013, Rev 0, *Engineering Redraft Study - LAW Carbon Dioxide Gas System, Internal,* April 18, 2017
- CCN 305829: *Contract No. DE-AC27-01RV1413 6 - The U.S. Department of Energy, Office of River Protection Conditional Concurrence on The Engineering Redraft Study For The Low-Activity Waste Carbon Dioxide Gas System, Internal*, March 28, 2018
- 24590-WTP-CD-PS-01-001, Rev 9, *Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"*, July 28, 2016
- 24590-WTP-SRR-PROC-0033595, *Material Receiving Report*, July 16, 2012

- 24590-QL-POA-MS00-00012-09-00032-00B, Rev 00B, *Flanged Ball Valves, ANSI Class 150 & 300*, November 30, 2009
- 24590-WTP-MN-CON-01-001-09, *Nondestructive Examination Standard Visual Examination,* August 8, 2013
- 24590-LAW-PPTR-CON-13-0042, *Pressure Test Data Sheet*, January 17, 2014
- 24590-WTP-CDR-CON-13-0900, *LAW - Leaking O-rings on CDG Valves*, February 23, 2015
- 24590-LAW-PPTR-CON-14-0218, *Pressure Test Data Sheet*, February 13, 2015
- 24590-LAW-P6C-CDG-00001, *Pipe Stress Analysis for WTP LAW Plant CDG System*, February 23, 2016
- 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
- Specification No. 24590-WTP-3PS-DB01-T0001, Rev. 8, *Engineering Specification for Furnishing and Delivering Ready Mixed Concrete*, March 30, 2007
- Specification No. 24590-WTP-3PS-D000-T0001, Rev. 8, *Engineering Specification for Concrete Work*, September 20, 2012
- Specification No. 24590-BOF-3PS-C000-T0001, Rev. 6, *Engineering Specification for Material Testing Services*, January 11, 2011
- Specification No. 24590-WTP-3PS-SS01-T0002, Rev. 6, *Engineering Specification for Purchase of Structural Steel*, January 11, 2011
- 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 Startup Procedure 24590-WTP-GPP-RASU-SU-0003, Rev. 2, *Certification of Startup Personnel*, December 21, 2017
- Test Procedure 24590-BOF-DIW-FTP-001 *Demineralized Water System (DIW-B-01) Flush*
- Test Procedure 24590-BOF-DIW-TRP-002 *Demineralized Water System (DIW-B-02) Flush*
- Test Procedure 24590-BOF-PSW-FPT-0003 *Process Service Water (PSW-B-01) Flush*
- 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. 10, *Nonconformance Reporting and Control*, January 31, 2018
- Document number 24590-WTP-QAM-QA-06-001, Rev. 18, *Quality Assurance Manual*, January 30, 2018
- Intermech Procedure W\IP-WTP 11.30, *HVAC Housing/Ductwork Structural Capability and Leak Testing*, Rev. 6, April 7, 2010
- Work Data Package 366034C for HVAC Leak test
- Apollo Mechanical QC Procedure QCP-03, *Pneumatic Testing*, Rev. 13, January 12, 2018
- CR-24590-WTP-PIER-13-00440, *MTRs not found in MRR Packages*
- CR 24590-WTP-GCA-MGT-17-01863, *Structural Steel Mill Test Reports Missing from LAB Structural Steel Material Receiving Reports*
- CR 24590-WTP-GCA-MGT-17-01864, *Structural Steel Mill Test Reports Missing from LAW Structural Steel Material Receiving Reports*
- CR 24590-WTP-GCA-MGT-17-00348, *Steel Material Test Report Retrievability Follow-on*
- CR 24590-WTP-GCA-MGT-17-01862, *Structural Steel Mill Test Reports Missing from HLW Structural Steel Material Receiving Reports*
- (NCR) 24590-WTP-NCR-CON-13-0057, *LAW Missing Mill Test Reports for Pour Cave and Process Cell Hatch Plates*

- NCR 24590-WTP-NCR-CON-18-0049, *Mill Test Reports (MTR) are not provided by the supplier for base angle*
- NCR 24590-WTP-NCR-CON-18-0050, *Mill Test Reports (MTR) are not provided by the supplier for miscellaneous structural steel*
- NCR 24590-WTP-NCR-CON-18-0087, *Inadequate Justification to Support Use-as-is resolution of LAB base angle*
- ORP Performance Assurance Report 18-WTP-0075, *Procurement Documentation Review of Structural Steel*, performed from March 28 through June 12, 2018
- TRS-ISS-IP-02, *Issue Reporting and Resolution*, Rev. 4, 10/1/2016

Interviews
- BNI Manager of Engineering
- BNI LAW Project Engineering Manager
- BNI Systems Engineering Manager
- BNI Engineering/System Engineer
- ORP/NSD Nuclear Safety Division Director
- ORP/NSD Nuclear Safety Engineers (2)
- ORP/WED Engineers (2)
- ORP QA Engineer
- BNI Material Management Supervisor
- WTCC Field Engineer
- WTCC Field Engineering Manager
- WTCC Deputy QC Manager
- WTCC QC Welding Inspector
- WTCC CDG Field Engineer
- WTCC Plant Engineer System Engineer
- BNI CDG System Engineer
- BNI LCP/LFP Vessels Mechanical Systems Supervisor
- BNI Safety Basis Engineer
- WTCC Mechanical Field Engineers (2)
- WTCC Civil Field Engineers (3)
- WTCC Startup Engineer
- WTCC Quality Civil Control Inspector
- Two Intermech and two Apollo Mechanical QC Inspectors
- BNI Resident Engineering Manager
- WTP Construction Oversight and Assurance Division Site Inspectors and Facility Representatives
- WTP Construction Oversight and Assurance Division Acting Director
- ORP Performance Assurance Manager
- WTP Construction Oversight and Assurance Division Facility Representatives

Observations
- SBS PSV Walkdown
- T47 Storage Warehouse Walkdown
- Melter/Melter Offgas SSC: Room L-0322A Differential Pressure Gauge Walkdown
- Melter Feed SSCs: LCP/LFP Vessels Walkdown
- Carbon Dioxide Gas (CDG) Reagent System SSC: Carbon Dioxide transfer Hosing and Vapor Return Hosing and One-inch liquid CDG piping and Inline Components Walkdown

- Observed two concrete placements in the EMF, placement number 18-031, topping slabs in the DEP-VSL-00002, 3A, 3B, and 3C ring beams, and placement number 18-032, a topping slab, EMF 1208-S
- Observed performance of two pneumatic pressure tests performed on two sections of coaxial LCP containment pipes, test numbers 24590-BOF-PPTR-CON-17-0071 and 24590-BOF-PPTR-CON-17-0074
- Observed performance of two pneumatic pressure tests performed on two sections of coaxial LAW secondary offgas/vessel vent system containment pipes, test numbers 24590-BOF-PPTR-CON-17-0084 and 24590-BOF-PPTR-CON-17-0091
- Observed performance of two pneumatic pressure tests performed on two sections of coaxial radioactive liquid waste disposal system containment pipes, test numbers 24590-BOF-PPTR-CON-17-0081 and 24590-BOF-PPTR-CON-17-0094
- Observed performance of part of a pneumatic pressure test performed by Apollo Mechanical on CM tubing that supplies high purity gas from the bottled argon system to gloveboxes and other equipment in the LAB
- Observed performance of a hydrostatic pressure test on a section of domestic water system piping, test number 24590-BOF-PPTR-CON-16-0020
- Observed a leak rate test performed by Intermech on a section of HVAC auto sampling system ductwork and high efficiency particulate air filter housing in the LAB, test number ASX-HEPA-00032A

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.

- Both ORP and BNI did not meet an element of an effective issues management system by which program and performance deficiencies, regardless of their source, are captured, analyzed, resolved, and tracked, as required by DOE Orders 227.1A and 226.1B.