

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



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Acronyms

AHJ	Authority Having Jurisdiction
ASME	American Society of Mechanical Engineers
ASTM	ASTM International
ATS	Automatic Transfer Switch
BNI	Bechtel National, Inc.
BOF	Balance of Facilities
CAERR	Corrective Action Effectiveness Review Report
CAMP	Corrective Action Management Program
CDR	Construction Deficiency Report
CFR	Code of Federal Regulations
CM	Commercial Grade
CON	BNI Construction
CR	Condition Report
CRAD	Criteria and Review Approach Document
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EA-31	Office of Nuclear Safety and Environmental Assessments
EMF	Effluent Management Facility
FE	Field Engineer
HLW	High-Level Waste Facility
HVAC	Heating, Ventilation, and Air Conditioning
ID	Identification Number
LAB	Analytical Laboratory
LAW	Low-Activity Waste Facility
MSOW	Management Suspension of Work
NCR	Non-Conformance Report
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
ORP	Office of River Protection
PICA	Post Installed Concrete Anchor
PIER	Project Issues Evaluation Report
PMTF	Periodic Maintenance and Surveillance Task Form
PTF	Pretreatment Facility
PvM	Preservation Maintenance
Q	Quality Related
QA	Quality Assurance
QAM	Quality Assurance Manual
SSCs	Structures, Systems, and Components
TIRB	Technical Issues Resolution Board
WCD	ORP WTP Construction Oversight and Assurance Division
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 (QA) program at the Hanford Site Waste Treatment and Immobilization Plant (WTP) from March 6 to 9, 2017. 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 work activities, reviewing the Bechtel National, Inc. (BNI), program for controlling non-conforming conditions, examining the implementation of certain requirements in the BNI QA program, and following up on issues identified during previous assessments. EA reviewed the AECOM preservation maintenance program for stored and installed equipment. AECOM is the operations contractor responsible for preservation maintenance for equipment and systems completed by Construction and turned over to Operations. EA also reviewed BNI's corrective actions to resolve deficiencies in the QA and corrective action programs.

For the most part, construction quality is satisfactory in the areas of pressure testing of piping, installation of pipe supports, electrical cable pulling, cable termination, most areas of equipment installation, and BNI's corrective action program activities related to non-conformance reports, construction deficiency reports, and condition reports. Exceptions are discussed below. Additionally, the BNI program for preserving installed equipment in structures where construction activities have been deferred is satisfactory. AECOM's procedures and work processes are adequate for preservation maintenance of installed equipment and systems following construction completion and turnover to Operations. Based on the limited sample reviewed, the scheduling and performance of preservation maintenance activities are adequate.

The previously identified EA issue regarding BNI's technique for transitioning electrical cables from cable trays to cabinets or equipment remains unresolved. BNI's wiring method offers inadequate protection to the cables, increasing the potential for an electrical fault that could result in personal injury or equipment damage. The DOE Office of River Protection (ORP) established a process in 2013, the Technical Issues Resolution Board, to provide a method for BNI and ORP senior management to address and resolve significant technical issues to ensure successful completion of the WTP. BNI and ORP management have agreed to initiate the Technical Issues Resolution Board process to resolve their differences in interpreting the National Electrical Code regarding the method for transitioning electrical cables from cable trays to equipment and cabinets.

In 2003, ORP delegated BNI limited electrical Authority Having Jurisdiction responsibilities. Over time, BNI has incrementally expanded that delegation, without opposition from ORP, to full responsibilities. This expansion caused a clear BNI management conflict of interest. To correct this concern, ORP issued direction on March 2, 2017, clarifying BNI's limited electrical Authority Having Jurisdiction responsibilities. BNI can no longer unilaterally waive a mandatory Code requirement, but may recommend alternative methods to comply with the intent of the NEC. However, BNI must submit the alternative methods for ORP's approval, with full technical justifications demonstrating that the alternative method will establish and maintain electrical safety. BNI is also required to submit Code

interpretations to ORP for approval.

After reviewing BNI's actions to address systemic weaknesses in the QA program and the corrective action program, EA concluded that BNI has improved both programs.

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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 at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The onsite portion of this assessment was conducted from March 6 to 9, 2017. 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

This quarterly assessment evaluated construction quality by observing ongoing work activities; reviewing the Bechtel National, Inc. (BNI), program for controlling non-conforming conditions; and examining the implementation of certain requirements in the BNI quality assurance (QA) program and the BNI corrective action program. This assessment also evaluated the conduct of preservation maintenance (PvM) activities performed on installed equipment and systems by AECOM, the WTP operations contractor. Design and procurement programs were not included in this assessment.

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 and the WTP, an industrial complex for separating and vitrifying the radioactive and chemical waste in the underground tanks. The WTP is in the design and construction phase.

BNI manages design and construction activities at WTP under contract to ORP. The QA program requirements for design and construction of the WTP referenced in the preliminary documented safety analysis and cited in the BNI contract are American Society of Mechanical Engineers (ASME) Nuclear QA (NQA)-1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, and DOE Order 414.1C, *Quality Assurance*. BNI Document 245909-WTP-QAM-QA-06-001, *Quality Assurance Manual*, provides a detailed description of the application of the 18 NQA-1-2000 requirements to the WTP. The WTP QA Manual (QAM) establishes a management system of planned and systematic actions necessary to ensure that structures, systems, and components (SSCs) perform satisfactorily in service.

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) that will house support functions.

Construction work is essentially complete for the LAB and most BOF buildings. The BOF Electrical Distribution Building was turned over from BNI Construction (CON) to Operations in 2016. AECOM, the WTP operations contractor, is responsible for maintaining SSCs once construction is completed and the SSCs are turned over to Operations from CON. ORP staff members, primarily WTP Construction Oversight and Assurance Division (WCD) staff, provide oversight of construction activities at the WTP.

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 had been slowed in the HLW through late 2016 pending resolution of technical issues involving the waste treatment process. However, DOE decided to curtail construction of the HLW in late 2016 and concentrate on completing the LAW and the Effluent Management Facility (EMF) to start processing low-activity waste in 2022.

The EMF is an additional facility being constructed to process the non-radioactive liquid byproducts resulting from the low-activity waste processed in the LAW. Any radioactive byproducts remaining after processing of low-activity waste will be transferred via a designated piping system back to the tank farm. Initial design of the EMF is completed, and some preliminary construction work is in progress, such as relocating fire service water piping, isolating systems necessary to facilitate operation of the LAW before completion of the HLW and PTF, placing reinforcing steel for the EMF foundation, and preparing for procurement of equipment. The first concrete placement for the EMF was completed on March 14, 2017.

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 addressed consistent with site-specific issues management procedures. EA identified no findings or deficiencies during this assessment.

EA conducted this assessment of WTP construction quality processes in accordance with the *Plan for the Office of Enterprise Assessments Review of the Hanford Site Waste Treatment and Immobilization Plant Construction Quality*, March 2017. 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, *Construction – Piping and Pipe Supports*;
- CRAD-45-53, *Construction – Mechanical Equipment Installation*; and
- CRAD 64-20, *Feedback and Continuous Improvement Inspection Criteria and Approach – Contractor*.

CRADS are under development for installation of electrical cables and equipment, along with instrumentation. In the interim, electrical construction and quality requirements will be based on the approved contractor design criteria and specifications and national standards included in the contract.

EA reviewed procedures, specifications, drawings, and records; interviewed key personnel responsible for equipment preservation, construction, and inspection work activities; and, conducted site walkdowns to observe work activities and inspect WTP components. EA conducted several walkdowns at the WTP construction site with BNI and the WCD staff to determine whether work activities were completed in accordance with the appropriate design drawings, specifications, and procedures. EA observed a piping pressure test; inspected pipe supports and installed electrical equipment in the LAW; performed a walkdown to examine sections of the completed heating, ventilation, and air conditioning (HVAC) ductwork in the LAW; and, examined the PvM program in the PTF and HLW. EA also reviewed non-conformance reports (NCRs) and construction deficiency reports (CDRs) that BNI identified under its corrective action program and BNI's actions to resolve QA and corrective action program deficiencies concerning the method to transition electrical cables from cable trays to cabinets and equipment.

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

5.0 RESULTS

5.1 BNI Corrective Action Program

Criteria:

A process shall be established to promptly identify, control, document, evaluate, and correct conditions adverse to quality. Records shall be maintained documenting the corrective action program, including documentation of objective evidence of satisfactory implementation of corrective actions. (NQA-1, Requirement 16; Policy Q-15.1, Policy Q-16.1, and Appendix A Policy Q-15.1 of the WTP QAM; and DOE Order 414.1C)

BNI Procedure 24590-WTP-GPP-MGT-044, *Nonconformance Reporting and Control*, adequately defines the requirements for identifying, documenting, reporting, controlling, and dispositioning non-conforming conditions associated with Q (previously classified as Quality-List or QL) and commercial grade (CM) SSCs at the WTP. This procedure requires NCRs to be issued to document and disposition non-conforming conditions associated with Q SSCs, while CDRs are required to document and disposition non-conforming conditions associated with CM SSCs.

The process for determining quality levels is specified in BNI Procedure 24590-WTP-3DP-G04T-00905, *Determination of Quality Levels*. This procedure references other supporting, interfacing project documents regarding identification of items/services subject to the QA program and procurement requirements. SSCs designated as Q in the design documents must be constructed or manufactured in accordance with the WTP QA program and the ASME NQA-1 standard. SSCs designated in the design documents as non-Q (i.e., CM) are constructed in accordance with CM standards, such as the Uniform Building Code, or purchased as CM items from vendors who are qualified CM suppliers.

EA reviewed the 27 NCRs that BNI issued between December 21, 2016, and March 6, 2017, and the 56 CDRs that BNI issued in between January 4 and March 6, 2017, to ascertain the types of non-conforming issues and their apparent causes. Most of these NCRs and CDRs required an evaluation by BNI Design Engineering and were still open.

The NCRs included 3 related to construction or installation errors; 1 for an engineering design deficiency; 4 for failure of procurement engineering to properly review or document evaluation of commercial grade dedication for Q components; 4 for materials handling issues, such as expired shelf life or storage deficiencies; 2 for subcontractor errors; and 13 for procurement/supplier deficiencies. BNI categorized the 56 CDRs as follows: 10 for BNI construction deficiencies, 17 for procurement/supplier deficiencies, 9 for engineering design errors, 7 for material maintenance or expired shelf life, and 13 for deficiencies in subcontractor work.

Records for the closed NCRs and CDRs that EA reviewed document the completed corrective actions and provide evidence that corrective actions were satisfactorily implemented. Closure of the CDRs and NCRs initiated to document procurement/supplier and/or inadequate commercial grade dedication evaluations continues to challenge the BNI Design Engineering organization.

5.2 Deficiencies in Installation of Post Installed Concrete Anchors

Criterion:

A process shall be established to identify, control, document, evaluate, and correct conditions adverse to quality. Management shall determine the extent of the adverse condition and complete corrective action, including assigning responsibilities and establishing milestones to ensure timely completion of corrective actions. Records shall be maintained documenting the corrective action program, including documentation of objective evidence of satisfactory implementation of corrective actions. (NQA-1, Requirement 16; Policy Q-16.1, and Appendix A Policy Q-15.1 of the WTP QAM; and DOE Order 414.1C)

EA reviewed the current status of BNI's ongoing corrective actions to identify and evaluate installation and documentation deficiencies involving post installed concrete anchors (PICAs) installed in various structures at WTP. PICAs are installed in the concrete structure after the concrete has hardened and attained its design strength to provide anchorage for equipment in locations where embedded plates and cast in-place anchor bolts are unavailable. The types of hardware and components supported by PICAs include structural steel platforms, pipe supports, instrument racks, transformers, electrical components, and conduit and instrument supports. During a review of CM pipe support installation records in September 2011, DOE WCD personnel identified incorrect or missing data in the documentation related to the installation of CM PICAs. On September 21, 2011, BNI issued Project Issues Evaluation Report (PIER) 24590-WTP-PIER-MGT-11-0918-C, *Post Installed Concrete Anchor (PICA) Documentation*, to follow up on concerns identified by WCD. The action items for this PIER required review of the PICA records for all anchors installed between July 19, 2010, and May 2011. After completing this review, BNI Construction Field Engineering determined that physical inspections of PICA installations were needed to resolve questions related to PICA documentation deficiencies and possible installation errors. BNI then issued PIER 24590-WTP-PIER-MGT-12-1246-B, *Post Installed Anchor Bolt Installation and Documentation*, on October 16, 2012 to review installation documentation and re-inspect all CM PICAs installed on the WTP project, as well as other actions.

A management suspension of work (MSOW) was issued by BNI to control installation of new PICAs. The MSOW limited installation of new PICAs pending revision of Engineering Specification 24590-WTP-3PS-FA02-T0004, *Engineering Specification for Installation and Testing of Post Installed Concrete Anchors and Drilling/Coring of Concrete*. Under the MSOW, installation of new PICAs were restricted unless the location and type of PICA were approved by BNI Design Engineering and BNI Construction Management. After the Specification was revised on April 24, 2014, and craftsmen and field engineers (FEs) were trained on the revised installation criteria, the MSOW was cancelled. EA reviewed the revised specification (Revision 7) during previous assessments and noted that the criteria for determining

the minimum spacing between PICAs were complex and more conservative than in previous revisions of the Engineering Specification. Since the PICA spacing criteria were changed by Revision 7 of the Engineering Specification, the PICAs that were previously inspected and found acceptable required re-inspection to determine whether they complied with the new, more conservative criteria. It was also necessary to inspect the PICAs installed in 2013 and 2014 under the management suspension of work to determine whether those PICAs complied with the revised spacing criteria.

Since 2012, BNI Field Engineering has been preparing a monthly report that summarizes the status of the PICA re-inspection program. EA reviewed the March 7, 2017, report, which indicates that BNI Field Engineering identified 2,778 records for CM PICAs in the LAW, the LAB, and BOF that required re-inspection. An additional 177 records for CM PICAs installed in the HLW are slated for inspection at a later date. The number of PICAs represented by each record varies, typically between four and ten. The latest summary report shows that re-inspections of the PICA installations documented on approximately 94% of the records have been completed, and installation errors were identified for one or more PICAs documented on approximately 36% of these records. EA has reviewed more than 400 of the records for PICAs that had installation errors and the corresponding CDRs initiated to document and correct the errors. Most of the errors consisted of either PICAs with missing hardware (washers), inadequate embedment, incomplete records, or PICAs installed too close to other embedded items. BNI initiated a CDR for each record that contained a PICA installation error to disposition the discrepancies. BNI Construction either corrected the installation error or transmitted the CDR to BNI Design Engineering for evaluation. The records that EA reviewed indicated that for most of the PICA installation errors requiring review by BNI Design Engineering, BNI Design Engineering determined that the installed PICAs could support the applied loads (“use-as-is”). However, for the PICA installations that BNI Design Engineering concluded could not support the design loads (less than 2% of installed PICAs), rework has been required to restore the design margin and required safety factors. PICAs used in Q applications were not included in the re-inspection program because the location and anchor type (diameter and length) are shown on the design drawings, so the spacing between Q PICAs is controlled, and quality control inspectors perform independent inspections of 100% of the Q PICAs to verify the location, correct anchor type, and appropriate installation method. The inspection requirements for CM PICAs are specified in Construction Procedure 24590-WTP-GPP-CON-3205, *Post Installed Concrete Anchors*. Quality control inspectors do not inspect CM PICAs; FEs perform the acceptance inspections for CM PICAs.

EA reviewed three CDRs (CDRs 24590-CON-17-0001, -0007, and -0027) that were initiated in early 2017 to resolve PICA spacing errors. The PICAs covered by these CDRs had been installed in late 2016. The spacing for these installations had been approved by a BNI FE and independently reviewed by a second BNI FE. An independent review by a third FE disclosed the fact that the PICA spacing criteria did not comply with Revision 7 of the Engineering Specification. EA agrees with the third FE’s conclusion and has a concern that two of the three BNI FEs did not recognize the non-compliance of the PICA spacing with the Engineering Specification. These types of errors result in part from the complex criteria for determining minimum spacing between PICAs established in the Engineering Specification.

BNI’s approach to determining the extent of condition and the corrective actions necessary to correct the PICA installation deficiencies was adequate. However, corrective actions have not been timely. BNI’s delays in revising the PICA installation criteria and issuing Revision 7 of the Engineering Specification (more than 30 months after PICA deficiencies were identified) made it necessary to re-inspect and re-evaluate thousands of PICAs after they had been previously inspected and found to be acceptable. In addition, BNI has not set a firm date for completing the corrective actions for the PICAs.

5.3 Pressure Testing Program

Criterion:

Construction and pre-operational tests, such as pressure testing operations for piping 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 WTP QAM; and DOE Order 414.1C)

EA observed one hydrostatic pressure test performed on a section of piping in the demineralized water system. BNI 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, test prerequisites, hold points, inspection requirements, test sequence, instructions for recording and evaluating data, and acceptance criteria. This procedure references the appropriate codes and documents approved by BNI Design Engineering for conduct of pressure testing. The required test pressure was 188 psi with a 10 minute hold. Code requirements are specified in ASME Code B31.3, Paragraph 345.4, *Hydrostatic Testing*. The procedure is adequate.

In observing this test, 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 test, EA examined the section of the piping system, the valve lineup, and the pressure test tags attached to the valves. EA witnessed the test pressurization sequence, verified that the piping was pressurized to the designated test pressure, verified that the required test pressure was maintained for the required hold time before the BNI FEs examined the piping section for leakage, and verified that pressure was maintained during the piping inspection.

No leaks were identified during the pressure test, and the test was declared to be successful. EA reviewed the test record and verified that qualified personnel had recorded and evaluated the test results. The test data was recorded on document number 24590-BOF-PPTR-CON-17-0011. The pressure testing program was satisfactory for the sample that EA reviewed.

5.4 Piping and Pipe Supports

Criterion:

Piping systems that perform a safety function shall be installed 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 WTP QAM; and DOE Order 414.1C)

EA reviewed two BNI construction procedures and two BNI specifications that define the requirements for installation of piping and instrument tubing and their supports (see Appendix B). The specifications for piping and pipe supports reference applicable codes, design documents, and drawings, and specify: (1) piping and support material requirements, including material traceability; (2) receiving, handling, and storage requirements; (3) installation details and tolerances; (4) welding requirements, including workmanship and inspection; (5) instructions for installation of flanged connections, gaskets, valves, and other specialty items, such as expansion joints and strainers; (6) bolting, painting, and other installation

tolerances; and, (7) examination, test and inspection requirements. The piping and pipe support specifications also apply to instrument tubing and supports.

The construction procedures describe the process for installation and quality verification for piping and pipe supports, including instrument tubing. Appendices to the construction procedures describe the required inspection activities and provide forms to document required quality inspections and other required supporting documentation. The specifications and procedures for fabrication and installation of piping and pipe supports are adequate and reference appropriate acceptance criteria.

EA examined four Q pipe supports in the LAW (support numbers are listed in Appendix B) and verified that the completed supports were fabricated and installed in accordance with design documents. Attributes inspected included member type and size, configuration, weld sizes and types, and method of attachment to the building structure. EA examined records documenting inspection of the completed pipe supports, including pipe support inspection records, field welding checklists, and post installed anchor records for two supports.

The pipe supports were installed in accordance with the design drawings. The inspection records were complete and documented installation activities, traceability for welding work activities, completion of inspection attributes, and design references. For the sample examined, pipe support installation was adequate.

5.5 HVAC System Walkdown

EA and a WCD site inspector accompanied BNI construction and HVAC subcontractor, Intermech, personnel during an acceptance walkdown for turnover of ten divisions of HVAC supply or exhaust ductwork in the LAW. Seven divisions are classified CM, while the remaining three are Q. A few minor discrepancies were identified during the walkdown by either BNI or subcontractor personnel, such as loose jam nuts on a support, a few out-of-plumb all-thread rod supports, and a piece of duct tape on a support. BNI documented these discrepancies on the BNI Subcontract Walkdown Report, and the subcontractor corrected them within 24 hours after completion of the walkdown.

Fabrication and installation of the HVAC ductwork were completed in a good, workmanlike manner. BNI adequately performed the turnover walkdown.

5.6 Backfill Placement and Testing

EA observed performance of a field density test on backfill being placed over ammonia reagent system piping adjacent to the fire water storage tanks. A subcontractor materials testing technician performed the test using the nuclear density test, ASTM D 6938, *Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)*. The test results complied with the requirements of BNI Construction Procedure 24590-WTP-GPP-CON-3202, *Excavation and Backfill*. The density of the compacted fill exceeded 95% of the maximum dry density specified in the Construction Procedure, and the backfill moisture content was within the optimum limits specified in the procedure. The maximum dry density and optimum moisture content is determined using ASTM 1557, *Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort*.

EA also reviewed the results of field correlation testing performed to validate density test results determined using the nuclear method, ASTM D 6938, by using another standard density test method as recommended in the referenced ASTM test method: ASTM D1556, *Standard Test Method for Density and Unit Weight of Soil In-Place by Sand Cone Method*. BNI Specification No. 24590-WTP-3PS-C000-T0001, *Engineering Specification for Material Testing Services*, requires the materials testing

subcontractor to perform a minimum of one field correlation sand cone test for every 50 field nuclear density tests. (NOTE: The current revision of BNI Specification No. 24590-WTP-3PS-C000-T0001, Revision 6, effective January 18, 2011, references ASTM 2922 as the ASTM standard for the nuclear density test method. ASTM D2922 was withdrawn in 2007 and replaced by ASTM D6938.) EA reviewed a sample of the correlation tests performed in 2016 and 2017. The soil density and moisture content results obtained using the sand cone method were consistent with those obtained using the nuclear method.

The backfill testing program and nuclear test method correlation program were acceptable for the sample reviewed. The current ASTM test method, ASTM D6938, should be included in the next revision of BNI Specification No. 24590-WTP-3PS-C000-T0001.

5.7 WCD Welding Inspection Program

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 inspection attributes on approximately 5% of Q welds they select at random. Welds selected for inspection include structural steel, piping, pipe supports, vessel (tank) welds, and weld repairs. Most welds that WCD examines are Q, but the WCD staff also includes some CM welds in its independent sample. The site inspectors also select for examination some welds that have unique configurations or geometry and differ in some respect from routine site welds.

EA observed a WCD site inspector performing an independent final visual inspection of two welds, one on the LAW melter feed process system and one on the BOF steam condensate system. The WCD site inspector had pre-selected these welds as DOE designated witness points. The WCD inspector also performed a final visual inspection of an additional weld on the LAW melter feed process system that he selected at random; the specific welds are identified in the Observations section in Appendix B of this report. The WCD site inspector verified that the acceptance criteria for visual examination of the piping welds specified in *Bechtel Nondestructive Examination Standard, Visual Examination VT-ASME* were met; reviewed the field welding checklists, weld wire draw slips, and drawings associated with the welds inspected; and 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. During previous EA assessments, EA reviewed the welding procedures and welder qualification records, which indicated that the welding procedures were pre-qualified and the welder qualifications met ASME Code requirements.

The implementation of the WCD welding inspection program was satisfactory for the sample that EA reviewed.

5.8 Electrical Construction Activities

Criterion:

Electrical equipment that performs a safety function shall be installed 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 WTP QAM; and DOE Order 414.1C)

Clarification of Electrical Authority Having Jurisdiction

EA identified a potential conflict of interest during the September 2015 Construction Quality assessment regarding the assignment of the Electrical Authority Having Jurisdiction (AHJ) to BNI at the WTP site. The role of the AHJ is to interpret the National Electrical Code (NEC) in areas that are unclear or provide exceptions when a requirement cannot be met. The AHJ is usually the function of the regional governmental agency (building officials), the owners, or an independent third-party organization. There is a clear conflict of interest when the design and construction contractor also acts as the AHJ. In 2003, ORP delegated a partial AHJ role to BNI, but that role had expanded into full autonomy for BNI, and BNI had used this arrangement to interpret or waive NEC requirements in cases where their design may not comply with the Code.

During the December 2016 EA Construction Quality assessment, EA identified a deficiency in that ORP was unable to resolve in a timely manner the conflict of interest resulting from BNI acting as AHJ. On March 2, 2017, ORP issued a letter to BNI clarifying the delegation and implementation of the AHJ. BNI will continue to have this authority, but it is now limited to recommending alternative methods for complying with the NEC. BNI must submit its recommended alternative methods for complying with the intent of the NEC to ORP for approval, with full technical justifications demonstrating that the alternative method will establish and maintain electrical safety. BNI is also required to submit Code interpretations to ORP for approval. BNI may not unilaterally waive a mandatory Code requirement. ORP remains the final authority to interpret or waive NEC requirements.

Method for Transition of Cables from Cable Trays to Electrical Components

During the May 2014 Construction Quality assessment, EA identified a concern about the method BNI design engineers had prescribed in the design documents for transitioning electrical cables between cable trays and electrical equipment or enclosures. BNI, WCD, and ORP electrical design engineers have discussed this issue extensively since then but have not reached a mutually agreeable resolution due to differing opinions on interpreting the NEC. The question regarding the method for transitioning cables from cable trays to cabinets and equipment is an example of differences in NEC interpretations. The inability to reach a decision on this methodology has caused delays in completing cable installation and terminations. This issue is an example of the technical questions that the AHJ should have resolved in a manner satisfactory to the owners (DOE) with sufficient documentation to show that a thorough technical evaluation of the issue had been performed to demonstrate compliance with the intent of the NEC.

After issuing the March 2, 2017, letter to BNI clarifying BNI's role in serving as AHJ discussed above, ORP management decided to send the matter to the Technical Issues Resolution Board (TIRB) for resolution. The TIRB was established in 2013 to provide a way for BNI and ORP senior management to address and resolve significant technical and project challenges to ensure successful completion of the WTP. BNI and ORP management stated that they will initiate the TIRB process to address this issue. EA will follow up on resolution of this issue.

Onsite NEC Inspectors

BNI recently transferred several NEC inspectors to the WTP site from the offsite BNI Richland offices. Individuals classified as NEC inspectors receive certification through programs that are recognized by state or other governmental agencies. Requirements to become a certified NEC inspector include two or more years of work experience performing electrical inspections or three or more years of work

experience as a licensed electrician, attending a training program, passing a written examination, and then demonstrating the ability to perform inspections through a practical examination.

The NEC inspectors are now available to assist the electricians and electrical FEs and address questions concerning Code compliance. BNI managers stated that they are seeking to improve the qualifications of the electrical FEs by providing more on-the-job training opportunities with the NEC inspectors.

Automatic Transfer Switch for Ventilation Fan

Power is supplied to variable speed drive LAW-EV-C2V-ASD-00001C for air handling unit C2V on the 48' elevation of the LAW from two different sources to provide better reliability. An Automatic Transfer Switch (ATS), number LVE-ATS-20301, automatically switches power from the primary electrical supply to the backup electrical supply when the primary power supply fails.

EA and a WCD site electrical inspector examined the routing of the electrical cables into the ATS cabinet. The power sources for this ATS are supplied by switchboard LVE-SWBD-20201 and by switchboard LVE-SWBD-20202. EA and the WCD site inspector observed that the cables are currently pulled into the ATS cabinet but have not been connected to the ATS. The cables are routed in a cable tray, exit the vertical cable tray directly above the cabinet, and enter the cabinet through two chase nipples. The cabinet (enclosure) is required to meet the requirements of NEMA 12 as specified by the National Electrical Manufacturer's Association (NEMA). (NOTE: A NEMA rating is used as a standard to define the type of environment where an electrical device can be used.) A NEMA 12 enclosure is required to protect equipment against ingress of foreign objects (dirt, dust, lint, fibers, etc.) and dripping water. That is, NEMA 12 enclosures are required to be dust-proof and drip-proof. Routing electrical cables through chase nipples into a NEMA 12 enclosure leaves openings in the top of the enclosure, thereby compromising the dust-proof and drip-proof integrity of the NEMA 12 enclosure.

EA and a WCD site electrical inspector questioned the BNI electrical FE and a BNI NEC inspector about the current installation with the chase nipples installed in top of the NEMA 12 enclosure. The installation method for routing the cables into the NEMA 12 enclosure through chase nipples was detailed on the design drawings. The BNI FE and NEC inspector stated that they would correct this design error by initiating a field change document to modify the cable tray and install conduit for the transition between the cable tray and cabinet in order to better protect the cables and maintain the NEMA 12 rating of the cabinet. EA concurs with this resolution. The FE promptly initiated Field Change 24590-WTP-FC-E-17-0070, which BNI Design Engineering has approved.

Welding Receptacle and Junction Box

EA and a WCD site electrical inspector observed BNI electricians terminating cables in junction box LVE-JB-20304, which will supply power to welding receptacles on the 48' elevation of the LAW. The cables had been pulled previously and only needed to be terminated within the junction box and on two different welding receptacles. The electrician and the FE had the work package at the work site. In inspecting the junction box, EA and the WCD site inspector determined that the terminal block where the ground wires were to be connected was smaller than indicated on the design documents in the work package. When the WCD site inspector asked the electrician why a smaller terminal block had been installed in the junction box, the electrician said that he had installed the terminal block but could not immediately produce the documentation that authorized the change. The FE was not aware that the electrician had installed a smaller terminal block in the junction box and was not aware of any design document that authorized changing the size of the terminal block.

After terminating the cables in the junction box, the electrician attempted to terminate the cable at the weld receptacles. When the electrician examined the terminals in the two weld receptacles, he determined that they were both labeled differently than indicated in the design documents. The electrician stopped work and consulted with the FE to determine the proper way to correct the labeling of the terminals. The WCD site electrical inspector planned to follow up on this issue.

Cable Pulling

Most electrical cable pulling is done on the night shift when there is less interference with other craft personnel. EA and the WCD site electrical inspectors observed two cable pulls on the night shift. One job was to pull fiber-optic cables between two cabinets. Sufficient electrical personnel were present to ensure that the cable was not kinked, over-stressed, or otherwise damaged during the pull. There was good communication between all team members, and this cable pull was successfully completed as planned.

A second cable pull involved pulling seven cables through a single conduit. These cables had to be pulled simultaneously grouped together since there was not enough space in the conduit to allow the cables to be pulled individually. The electrician pulled the cables by hand, using adequate lubricants to minimize strain on the cable and a sufficient number of electrical personnel to pull and feed the cables. The electricians performed the cable pull satisfactorily, without incident.

5.9 Preservation Maintenance Implementation

Criterion:

Equipment that performs a safety function shall be sufficiently maintained before, during, and following installation to ensure it provides the necessary reliability and availability to perform its intended safety function, and to prevent damage, loss, or deterioration. Preservation of items shall be controlled to prevent damage or loss and to minimize deterioration. (NQA -1 Requirement 13; Policy Q -13.1 of the WTP QAM; and DOE Order 414.1C)

EA reviewed the Delinquent PvM metric and implementation of new periodic maintenance and surveillance procedure, number 24590-WTP-GPP-RAMN-WC-0004; performed a walkdown in the HLW and PTF; and reviewed reports documenting monthly preservation inspections in the PTF during the past year.

During the December 2016 EA WTP Construction Quality assessment, EA could not observe scheduled PvM work performance because of a site work shutdown due to inclement weather. A PvM work order scheduled to be performed during the current EA assessment was canceled due to a sitewide lockout/tagout issue. EA confirmed that the cancellation resulted from the revisions to the PvM work package procedural instructions addressing the lockout/tagout issue.

AECOM implemented a new procedure, GPP-RAMN-WC-0004, *Periodic Maintenance/Surveillance and Administrative Tickler Process*, on February 27, 2017. AECOM management indicated that PvM planning staff are meeting expectations for managing PvM to the due date and minimizing routine use of maintenance grace periods. This practice was implemented in August 2016 and is now required by the new procedure. EA reviewed the current Delinquent PvM metric, which showed evidence of improvement. Only one delinquent PvM activity has been reported since August 2016, resulting from the inclement weather work shutdown in December 2016. The AECOM work control manager provided the supporting CHAMPS® Computerized Maintenance Management System data to substantiate the accuracy of the current Delinquent PvM metric. The AECOM CHAMPS® administrator explained that

the data for the report is generated by a simple date range query of the CHAMPS® database; a hardcopy printout each month provides the data incorporated into the metric.

Since the suspension of construction work in the HLW and PTF, work performed by BNI construction personnel in these two facilities has been limited to facility preservation and any necessary PvM activities, such as water/ice removal, bird netting maintenance, entry tarps, and equipment tarps. EA and a BNI FE performed a walkdown in the HLW and PTF. Housekeeping in the HLW and PTF was good. Stored materials were properly covered and placed on dunnage to raise them off the floor. EA observed a few water puddle areas within the buildings, but nearby squeegees and powered water vacuum equipment provided evidence that water is usually promptly removed. Tarps protected installed equipment, with one observed exception: Two transformers (Equipment Identification Number: MVE-XFMR-30004 A and B) in one location were not covered (tarps pulled back), the enclosure front panels were loosely secured, and a heater fan was blowing warm air on the exposed front surfaces.

Upon further investigation, BNI confirmed that the transformers were not energized and that this equipment had no associated open construction, modification, or PvM work orders. PvM Task Form number 24590-WTP-PMTF-12-0490 indicates a two-year inspection frequency. AECOM Work Control confirmed that this PvM package is in planning and targeted for completion before May 28, 2017. EA notified BNI of this improper storage condition.

EA's walkdown escort, a BNI FE, stated that the monthly PTF inspections were performed using a desk instruction with a prescribed checklist. EA reviewed the Desk Instruction, 24590-WTP-PTF-DI-13-0001, *PTF Long Term Layup and Preventive Maintenance*; BNI has not developed an instruction for the HLW walkdowns. EA also reviewed the PTF monthly preservation walkdown inspection records for the previous 12 months, which are maintained in BNI's automated record system; however, there were no records of monthly inspections in the HLW for the previous 12 months. After discussions with EA about the lack of monthly documented preservation inspections in the HLW, BNI management resolved this issue immediately by expanding the PTF FE's assignment for monthly PTF preservation inspections to include HLW. BNI is currently conducting a Six Sigma evaluation of the PTF, Condition Report (CR) 15-00812. (See **OFI-WTP-01**.)

Overall, BNI is preserving installed and stored equipment to prevent damage or loss and to minimize deterioration. Before August 2016, PvM activities were routinely scheduled to be performed prior to the end of the grace period instead of by the PvM due date, resulting in delinquent PvM work. A new AECOM work control manager changed this work practice in August 2016 and implemented a new PvM procedure that requires PvM work activities to be performed by the due date and minimize routine use of maintenance grace periods. AECOM has recorded only one delinquent PvM work activity since then, and that was delayed by a weather shutdown. EA verified the automated generation of this metric data from the CHAMPS® database. BNI has assigned dedicated construction personnel to preserve the HLW and PTF. Housekeeping in the HLW and PTF was good, with one exception. A BNI FE routinely inspects preservation in the PTF, but no FEs were assigned to perform routine periodic preservation inspections in the HLW. After EA discussed this issue with BNI managers, an FE was assigned to perform the HLW monthly preservation inspections.

5.10 Resolution of QA and Corrective Action Program Deficiencies

Criterion:

Contractor management has established a comprehensive, structured issues management system that provides for the timely and effective resolution of deficiencies and meets the requirements of DOE Order 226.1 and DOE Order 414.1C. (NQA-1, Requirement 16; Policy Q-16.1 of the WTP QAM; and DOE

Order 414.1C).

In 2015, BNI initiated efforts to resolve systemic weaknesses with the implementation of the QA program and the corrective action program. The Office of Nuclear Safety and Environmental Assessments (EA-31) reviewed BNI's documentation of the corrective action closures, effectiveness reviews, and root cause resolutions.

BNI QA Program

BNI entered CR 13-1331, *BNI's overall QAP [QA program] has not been implemented to requirements and is not fully effective*, into the Corrective Action Management Program (CAMP) tracking system on October 31, 2013, as a Level A issue (Level A CR is the highest significance category). 24590-WTP-CMCA-MGT-14-0001, *Common Cause Analysis [CCA] of Quality Assurance Program Implementation and Effectiveness Issues*, identified the root cause, "WTP leadership has not consistently demonstrated quality as a core value."

EA-31 reviewed the closure documentation for CR 13-1331, which was complete and responsive. BNI's independent effectiveness review of CR 13-1331 identified 4 new findings and 59 recommendations, which resulted in 26 new CRs. The BNI review also concluded that the corrective actions had generally been effectively implemented. EA-31 reviewed the documentation for the 26 additional CRs and found the closure documentation provides an adequate basis for closure, appropriate closure documentation, and an adequate closure approval statement. Two issues remained open and were integrated into other CRs: a Level B Suspect/Counterfeit Item issue (CR 15-01315) and a Level A Commercial Grade Dedication issue (CR 15-00338). BNI also provided justification for 23 recommendations that were determined not to require further action. The closure documentation provides an adequate basis for the closure of CR 13-1331. EA-31 will follow up with a sampling of CR 13-1331 corrective actions to verify field implementation.

Corrective Action Program

BNI initiated CR 13-1048, *Ineffective Implementation of the Corrective Action Program* and subsequently identified the root cause as "Management does not uniformly recognize the value of a rigorous CAP (corrective action program) culture in meeting cost, schedule, and mission." BNI used an independent team to verify CR 13-1048 corrective action effectiveness, as documented in BNI report number 24590-WTP-SAR-OE-15-0004, *Corrective Action Management Program (CAMP) Effectiveness*. This was a thorough, performance-based program assessment that used an appropriately balanced sampling strategy. EA-31 will follow up with a sampling of BNI corrective actions to verify field implementation.

EA-31's review of BNI's closure documentation for CR 13-1048 and completed corrective actions, as well as interviews with construction senior management, identified documented evidence of management's efforts to drive a rigorous corrective action program. For example:

- BNI developed a computer based training module to improve CAMP process expertise. BNI identified 1,059 non-manual construction site and off-site employees that are required to complete this training. EA-31 confirmed 98 percent are current on this training.
- BNI managers receive a quarterly CAMP Performance Bulletin with metrics that provide detailed information on CR closure quality performance collectively and from an organizational perspective. The trend since October 2016 is favorable and the feedback information provides meaningful data to support organizational improvements.
- BNI construction managers were well aware of the CAMP metrics documented in the quarterly

CAMP Performance Bulletin and on the Project Health Dashboard. Each interviewed manager could clearly identify and address the most concerning issues, which they are following.

- The BNI Quality and Functions Deputy Manager indicated that management attention to CAMP has improved as demonstrated by senior management participation in the Performance Improvement Review Board (PIRB). EA-31 confirmed this observation in interviews with the Construction Quality Control Manager and PIRB meeting minutes.

EA-31's review of over 100 recent Level B, C and D CRs provides confidence that BNI has improved the CAMP. However, EA-31's review of the current (March 2017) CAMP status noted that even though the CAMP closure quality metric shows a positive trend, the CAMP Timeliness metric shows a negative trend since May 2016. Also, the CAMP Backlog metric shows an overall negative trend since May 2016; the data indicates a growing CR backlog of about 12 per month of Level A, B, and C CRs, most of which are Level C CRs. Extensive CR processing is occurring before BNI makes a "no action" decision for low-risk issues, resulting in inefficient use of resources and a growing CR backlog. DOE Guide 414.1-2B, *Quality Assurance Guide*, recommends insignificant problems are simply logged and analyzed as part of a collection to identify systemic quality problems and opportunities for process improvement. (See **OFI-WTP-02.**)

Overall, the documentation that EA-31 reviewed provides confidence that BNI has improved the QA program and the corrective action program, but EA-31 must still acquire additional evidence regarding the effectiveness of corrective actions. BNI's comprehensive CAMP process ensures that every CR receives an evaluation and justifiable disposition. CAMP quality reviews ensure continuous monitoring of CR process quality conformance. However, the CAMP program requires managers to evaluate each CR extensively, regardless of its safety significance or its effect on project value or cost, resulting in inefficient use of resources.

6.0 FINDINGS

EA identified no findings during this assessment.

7.0 OPPORTUNITIES FOR IMPROVEMENT

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

OFI-WTP-01: BNI should consider issuing an instruction or procedure to control performance of monthly preservation and preventive maintenance walkdowns in the HLW.

OFI-WTP-02: BNI should consider revising its procedures to implement a more efficient CR screening and closure process for issues that have little to no impact on project quality.

8.0 ITEMS FOR FOLLOW-UP

EA will follow up on the TIRB's determination concerning the acceptable method for transitioning cables from the cable trays into various equipment, enclosures, and cabinets.

EA will continue to evaluate the effectiveness of the BNI corrective action program and review the resolution of NCRs, CDRs, and CRs. EA plans to continue to review welding inspection activities, piping and pipe supports, structural steel erection, pressure testing of piping, cable pulling, and installation of electrical and mechanical equipment. EA also intends to perform additional assessments of the construction turnover program and the preservation and maintenance of installed equipment and equipment in long-term storage.

Appendix A Supplemental Information

Assessment Dates

Onsite visit: March 6-9, 2017

Office of Enterprise Assessments (EA) Management

Glenn S. Podonsky, Director, Office of Enterprise Assessments
William A. Eckroade, Deputy 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, Acting Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

Quality Review Board

William A. Eckroade
John S. Boulden III
Thomas R. Staker
William E. Miller
C.E. (Gene) Carpenter, Jr.
Michael A. Kilpatrick

EA Site Lead for Hanford Site

Ronald G. Bostic

EA Team Composition

Ronald G. Bostic – Team Lead
James M. Boyd
Joseph J. Lenahan
Michael A. Marelli

Appendix B

Documents Reviewed, Interviews, and Observations

Documents Reviewed

- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 14, Pressure Testing of Piping, Tubing and Components, February 28, 2017
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 5, Post Installed Concrete Anchors, January 28, 2016
- Construction Procedure 24590-WTP-GPP-CON-3509, Rev. 3A, Pipe Support Installation, March 4, 2014
- Specification No. 24590-WTP-3PS-FA02-T0004, Rev. 7, Engineering Specification for Installation and Testing of Post Installed Concrete Anchors and Drilling/Coring of Concrete, April 29, 2014
- Specification No. 24590-WTP-3PS-FO00-T0002, Rev. 2, Engineering Specification for Fastener Torque and Tensioning, April 17, 2015
- Construction Procedure 24590-WTP-GPP-CON-3202, Rev. 8, Excavation and Backfill, October 26, 2016
- Specification No. 24590-WTP-3PS-C000-T0001, Rev. 6, Engineering Specification for Material Testing Services, January 11, 2011
- Specification No. 24590-WTP-3PS-MD00-T0001, Rev. 9, Engineering Specification for HVAC System Installation, June 9, 2016
- Construction Procedure 24590-WTP-GPP-CON-3503, Rev. 6C, Above Ground Piping Installation, August 29, 2013
- Specification No. 24590-WTP-3PS-PS02-T0003, Rev. 10, Engineering Specification for Field Fabrication and Installation of Piping, November 20, 2013
- Specification No. 24590-WTP-73PS-PH01-T0002, Rev. 6, Engineering Specification for Installation of Pipe Supports, July 13, 2011
- Document number 24590-WTP-MN-CON-01-001-10-10, Rev 6, Bechtel Nondestructive Examination Standard Visual Examination VT-ASME, August 8, 2013
- Procedure 24590-WTP-GPP-MGT-044, Rev. 8, Nonconformance Reporting and Control, November 11, 2016
- Document number 24590-WTP-3DP-G041-00905, Rev 14, Determination of Quality Levels, February 24, 2016
- Document number 24590-WTP-QAM-QA-06-001, Rev. 17, Quality Assurance Manual, August 22, 2016
- Construction Deficiency Report numbers 24590-WTP-CDR-CON-17-0001 through -0056.
- Nonconformance Report numbers 24590-WTP-NCR-CON-16-0275 through -0278 and 24590-WTP-NCR-CON-17-001 through -023
- Construction Procedure 24590-WTP-GPP-CON-7101, Rev 12 Construction Quality Control Program, June 6, 2016
- Procedure 24590-WTP-GPP-MGT-031, Rev 4, Asset Preservation Maintenance, December 21, 2015
- Pipe Support Drawing No. 24590-LAW-LMP-H10534, Rev 0
- Pipe Support Drawing No. 24590-LAW-LVP-H30115, Rev 0
- Pipe Support Drawing No. 24590-LAW-LVP- H30116, Rev 1
- Pipe Support Drawing No. 24590-LAW-LMP-H10613, Rev 0
- Letter from W. F. Hamel, ORP to J. M. St. Julian, BNI, dated 3/2/2017, Subject: Contract No. 27-01RV14136-Reiteration and Clarification of Electrical Authority Having Jurisdiction
- Drawing 24590-LAW-E2-E53T-00306, Rev 6, LAW Vitrification Building Electrical Power Conduit Layout Plan at EL. 48'

- Drawing 24590-LAW-E2-E53T-00305, Rev 4, LAW Vitrification Building Electrical Power Conduit Layout Plan at EL. 48'
- Drawing 24590-LAW-E1-LVE-00005, Rev 8, LAW Vitrification Building 480V Switchboard LVE-SWBD-20201 Single Line Diagram
- Drawing 24590-LAW-E2-E53T-00326, Rev 1, LAW Vitrification Building Electrical Cable Tray Plan at EL 48'
- Specification 24590-WTP-3DP-G04B-00049, Engineering Specification for 480V Dual Automatic Transfer Switches and Panelboards
- Field Change 24590-WTP-FC-E-17-0070, LAW +48 Maintain NEMA Rating of LVE-ATS-20301
- National Electrical Code – National Fire Protection Association 70-1999
- Document number 24590-WTP-PL-MGT-14-006, Management Improvement Plan
- 24590-WTP-GPP-RAMN-WC-0004, Rev 0, Periodic Maintenance/ Surveillance and Administrative Tickler Process, February 27, 2017
- 24590-WTP-PMTF-12-0490, Periodic Maintenance and Surveillance Task Form for Equipment ID: MVE-XFMR-30004 A and B, April 2, 2012
- Desk Instruction 24590-WTP-PTF-DI-13-00001, PTF Long Term Layup and Preventative Maintenance
- ORP Audit Report, U-13-QAT-RPPWTP-001, Bechtel National, Inc. Quality Assurance Program Requirements 3, 4, 5, 8, 15, and 16, October 28, 2013
- Document 24590-WTP-G63-RAQA-QA-0001, BNI Quality Policy
- Document 24590-WTP-GPG-RACA-CR-0130, Cause Analysis Practitioner Guide
- 24590-WTP-CMCA-MGT-14-0001, Common Cause Analysis [CCA] of Quality Assurance Program Implementation and Effectiveness Issues, March 27, 2014
- 24590-GPP-RACA-CR-0114, Rev 2, Condition Report Effectiveness Review, October 22, 2015
- 24590-WTP-SAR-QA-15-0014, Rev 0, WTP Sponsored Assessment Report, January 4, 2016 & *QUALITY ASSURANCE PROGRAM IMPLEMENTATION ASSESSMENT*, October 26, 2015
- [CR 13-1331] Corrective Action Effectiveness Review Report [CAERR], January 23, 2016
- 24590-WTP-CMCA-MGT-13-0003, Rev 1, Common Cause Analysis of Inadequate Implementation of the WTP Corrective Action Program, July 21, 2014
- 24590-WTP-SAR-OE-15-0004, Rev 2, Corrective Action Management Program (CAMP Effectiveness), September 9, 2015
- CR Backlog, Levels A, B, and C, excluding Long Term Corrective Actions
- 24590-WTP-GPP-RAQA-QA-1000, Rev 3, Quality Assurance Surveillances, December 20, 2016
- 24590-WTP-GPP-RACA-AM-0002, Rev 0, WTP Assessments, February 1, 2017
- Procedure 24590-WTP-GPP-RARA-RA-0007, Rev 1, Management Self-Assessment Process, January 6, 2017
- DOE Guide 414.1-2B, Quality Assurance Guide, May 8, 2013
- Procedure 24590-WTP-GPP-RACA-CR-0111, Condition Report Screening, September 30, 2016
- GPP-RACA-CR-0112 Rev 5, Condition Report Evaluation and Action Plan Development, September 30, 2016
- ORP Audit Report, Effectiveness Determination Of Bechtel National, Inc. Project Office Corrective Actions Related To Audit Findings U-13-QAP-RPPWTP-O1-F01 And U-13-QAP- RPPWTP-001-F02, and Overall Adequacy, Implementation, And Effectiveness Of Bechtel National, Inc.'s Quality Assurance Program, April 20, 2016
- S-14-QAD-RPPWTP-010, Bechtel National, Inc. Level 1 Findings Surveillance, January 15, 2015
- S-15-QAD-RPPWTP-001, Review of Corrective Actions Associated with Priority Level 1 Findings U-13-QAT-RPPWTP-F01 and F02, March 9, 2015

- S-15-QAD-RPPWTP-002, Corrective Actions Associated with the Level 1 Findings from Quality Assurance Division Audit Findings U-13-QAT-RPPWTP-001-F01 and U-13-QAT-RPPWTP-001-F02, July 6, 2015
- S-15-QAD-RPPWTP-004, Real-Time Field Surveillance Report, October 1, 2015
- Condition Report CR 13-1048, Ineffective Implementation of the Corrective Action Program
- Condition Report CR 13-1331, BNI's Overall [QA Program] Has Not Been Implemented to Requirements and Is Not Fully Effective

Interviews

- BNI Deputy Manager for Quality and Functions
- BNI Corrective Action Program Manager
- BNI Human Performance Improvement/Performance Based Quality Program Manager
- BNI Regulatory Interface Manager
- BNI Six Sigma Black Belt
- BNI Civil Superintendent
- BNI Senior Field Engineer, Piping
- BNI Senior Field Engineer, Fire Protection
- AECOM Work Control Manager
- AECOM Work Week Coordinator
- AECOM CHAMPS® Administrator
- BNI Manager of Construction
- BNI Project Superintendent
- BNI Field Engineering Manager
- BNI Field Subcontract Coordinator Manager
- BNI Field Quality Control Manager
- BNI Procurement Specialist
- BNI Field Engineers
- BNI Quality Control Inspectors
- BNI Electricians and Foremen
- WCD Site Inspectors and Facility Representatives
- ORP Design Electrical Engineers

Observations

- Observed electricians pulling cables in the LAW
- Observed electricians making cable terminations in the LAW
- Performed walkdown of HLW and PTF
- Observed performance of a hydrostatic pressure test performed on a CM piping section in the demineralized water system, hydro test package BPT 0058, recorded on document numbers 24590-BOF-PPTR-CON-17-0011
- Observed a WCD site inspector performing final visual inspections of two DOE designated piping welds: weld GB001 on FWCL 24590-LAW-FWCL-CON-17-00128 and weld GB002 on FWCL 24590-BOF-FWCL-CON-16-00548, and a selected at random weld GB003 on FWCL 24590-LAW-FWCL-CON-17-120
- Observed performance of a field soil density test (nuclear method) on backfill over the ammonia reagent system piping in proximity to the fire water tanks

- Examined pipe support numbers 24590-LAW-LMP-H10534, 24590-LAW-LMP-H10613, 24590-LAW-LVP-H30115, and 24590-LAW-LVP-H30116
- Performed a walkdown of sections of CM and Q HVAC ductwork in the LAW