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

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Office of Environment, Safety and Health Assessments
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Acronyms

ASD	Adjustable Speed Drive
ASME	American Society of Mechanical Engineers
BNI	Bechtel National, Inc.
BOF	Balance of Facilities
CDR	Construction Deficiency Report
CM	Commercial Grade
CRAD	Criteria, Review and Approach Document
DIW	Demineralized Water System
DOE	U.S. Department of Energy
DOW	Domestic (Potable) Water System
EA	Office of Enterprise Assessments
HLW	High-Level Waste Facility
HSS	Office of Health, Safety and Security
ICBO	International Conference of Building Officials
KV	Kilovolts (1000 volts)
LAB	Analytical Laboratory
LAW	Low-Activity Waste Facility
M&TE	Measurements and Test Equipment
MCC	Motor Control Center
NCR	Nonconformance Report
NEC	National Electrical Code
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
ORP	Office of River Protection
P&ID	Piping and Instrumentation Diagram
PDSA	Preliminary Documented Safety Analysis
PICA	Post Installed Concrete Anchor
PIER	Project Issues Evaluation Report
psi	Pounds per Square Inch
PSW	Process Service Water System
PTF	Pretreatment Facility
Q	Quality Related
QA	Quality Assurance
QAM	Quality Assurance Manual
QC	Quality Control
ORP	Office of River Protection
SSC	Structure, System, and Component
WCD	WTP Construction Oversight and Assurance Division
WTP	Waste Treatment and Immobilization Plant

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

1.0 PURPOSE

The U.S. Department of Energy (DOE) independent Office of Enterprise Assessments (EA) conducted an assessment of selected aspects of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP). This assessment was conducted by EA's Office of Environment, Safety and Health Assessments during May 5-8, 2014. The assessment continued a series of ongoing quarterly independent assessments of construction since 2011 at the WTP construction site.

2.0 BACKGROUND

The Office of River Protection (ORP) was established in 1998 to manage the 56 million gallons of liquid or semi-solid radioactive and chemical waste stored in 177 underground tanks at the Hanford Site. ORP serves as DOE line management for two functions: the Tank Farms, which maintain the 177 underground storage tanks; and the WTP, which is an industrial complex for separating and vitrifying the radioactive and chemical waste in the underground tanks. The WTP complex consists of five major components: the Pretreatment Facility (PTF) for separating the waste; the High-Level Waste (HLW) and Low-Activity Waste (LAW) facilities where the waste will be immobilized in glass; the Analytical Laboratory (LAB) for sample testing; and the balance of facilities (BOF) that will house support functions. WTP is currently in the design and construction phase. Design and construction activities at WTP are managed by Bechtel National, Inc. (BNI) under contract to ORP. BNI prepared a preliminary documented safety analysis (PDSA) for the WTP that describes the facility design codes, safety systems, design basis accident analysis, pre-operational testing program, operational safety, and the quality assurance (QA) program. The QA program requirements for design, construction, and operation of the WTP, referenced in the PDSA and cited in the BNI contract, are specified in 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*. Construction work is classified as essentially complete for the BOF and LAB. The estimated date for essential completion of the LAW is mid 2015. All construction work activities have been deferred in the PTF due to questions regarding separation and processing of the waste and the design life of equipment. Construction continues in the HLW, but at a slow pace because of reductions in construction craft staffing. Construction oversight is provided by ORP staff, specifically by the ORP WTP Construction Oversight and Assurance Division (WCD). Because of the safety significance of WTP facilities, EA will continue to conduct quarterly reviews to assess the quality of ongoing construction.

3.0 SCOPE

The scope of this quarterly assessment of construction quality included observations of ongoing work activities, review of the BNI corrective action program, examination of implementation of selected requirements in the BNI QA program, and follow-up on issues identified during previous assessments. Design and procurement programs are not included in the scope of these reviews. Ongoing work activities have been affected by reductions in construction craft staffing and design concerns that may result in redesign of some systems and/or structures.

Work activities observed during EA's May 2014 review included one pneumatic and two hydrostatic pressure tests, electrical cable installation, installed electrical equipment, and preservation and maintenance of installed equipment. EA examined nonconformance reports (NCRs) and construction deficiency reports (CDRs) identified by BNI under its corrective action program, as well as ongoing corrective actions to address deficiencies identified in installation of post installed concrete anchors (PICAs). EA also reviewed the results of quality control (QC) tests performed on samples of concrete placed in the HLW, the BNI construction organization's self-assessment program, and BNI QA and QC surveillance reports.

EA reviewed various construction quality documents and conducted several construction site walkthroughs, concurrent with WCD staff. During the walkthroughs, EA observed pressure testing of piping connected to water storage tanks adjacent to the water treatment building and examined electrical equipment, cable tray and cable installation, and preservation of electrical equipment. EA also examined drawings, specifications, and procedures that control installation of PICAs, pressure testing of piping and instrument tubing, manufacture of concrete, and installation of electrical cables.

4.0 METHODOLOGY

EA conducted this independent assessment of the WTP construction quality processes in accordance with the *Plan for the Independent Oversight Review of the Hanford Site Waste Treatment and Immobilization Plant Construction Quality*, dated May 2014. The review included examining documents (e.g., work instructions, procedures, specifications, drawings, and records); interviewing key personnel responsible for constructing and inspecting work activities; and site walk-downs to observe work activities and inspect WTP components. The review considered the requirements of 10 CFR 830, Subpart A, *Quality Assurance Requirement*, and DOE Order 414.1C, *Quality Assurance*. Title 10 CFR 830 and DOE Order 414.1C require the contractor to utilize appropriate national consensus standards to implement DOE QA requirements. The PDSA references ASME NQA-1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, as the national consensus standard for BNI to follow as the basis for the WTP QA program. The QA requirements in ASME NQA-1 are specified in 18 basic and supplemental criteria. BNI Document 245909-WTP-QAM-QA-06-001, *Quality Assurance Manual*, provides a detailed description of the application of the 18 NQA-1 requirements to the WTP. The QA Manual (QAM) establishes the planned and systematic actions necessary to provide adequate confidence that a structure, system, and component (SSC) will perform satisfactorily in service. The WTP QAM incorporates the basic and amplified requirements of the supplemental criteria from NQA-1.

This EA assessment focused on electrical cable installation, installed electrical equipment, and certain portions of the following criteria, review and approach documents (CRADs):

- HSS-CRAD 64-15, *Construction – Structural Concrete*
- HSS-CRAD 45-52, *Construction – Piping and Pipe Supports*
- HSS-CRAD 64-20, *Feedback and Continuous Improvement Inspection Criteria and Approach – Contractor.*

Supplemental information on the review, including the members of the EA team, the Quality Review Board, and EA management, is provided in Appendix A. Listings of key documents reviewed, interviews conducted, and evolutions observed are provided in Appendix B.

5.0 RESULTS

The Results section includes a brief description of activities examined by EA during the assessment, followed by a discussion of the review performed by EA. Conclusions are summarized in Section 6; opportunities for improvement (OFIs) are included in Section 7; and items for follow-up are discussed in Section 8.

Corrective Action Program

Criteria: *A process shall be established to 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-16.1 of the WTP QAM; and DOE Order 414.1C)*

BNI Procedure 24590-WTP-GPP-MGT-044, *Nonconformance Reporting and Control*, defines the requirements for identifying, documenting, reporting, controlling, and dispositioning nonconforming conditions at the WTP associated with quality related (Q) and commercial grade (CM) SSCs. NCRs are issued to document and disposition Q nonconforming conditions, while CDRs are used to document and disposition CM nonconforming conditions. SSCs designated as Q (previously classified as Quality-List or QL) 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 are purchased as CM items from vendors who are qualified CM suppliers.

EA reviewed the 22 NCRs issued by BNI between March 10 and May 5, 2014, and a sample of the CDRs issued by BNI in March, April, and May 2014 to evaluate the types of nonconforming issues that were identified, their apparent causes, and subsequent corrective actions. The categories of the NCRs were as follows: four NCRs related to construction or installation errors, including damage to installed components resulting from construction activities; fourteen NCRs for procurement and supplier deficiencies; three NCRs for design engineering issues; and one NCR for Q materials stored in the warehouse with expired shelf life. The procurement problems included hardware/components that were delivered to the site without the required supporting documentation demonstrating compliance with purchase specifications, improperly labeled hardware, hardware/equipment that did not comply with project specification requirements, and missing parts or damage that occurred during shipping. Design engineering issues include drawing or design errors or failure of engineering to perform independent quality verification on equipment delivered to the WTP project.

EA reviewed a sample of approximately 120 CDRs initiated between March 10 and May 5, 2014. A majority of the CDRs reviewed were initiated for deficiencies in installation of PICAs, for procurement and supplier problems, and for issues identified with electrical equipment. The CM PICA installation deficiencies are discussed in the next section. The types of procurement problems were similar to those documented on NCRs. The majority of the issues related to electrical equipment fell into three categories: 1) equipment that lacked proper Nationally Recognized Testing Laboratory labeling, 2) equipment damaged by other construction activities, and 3) improper clearances of electrical equipment as required by the National Electrical Code (NEC).

The BNI engineering organizations have developed appropriate corrective actions to disposition the specific problems identified in the completed NCRs and CDRs that EA reviewed. The corrective action program and implementation appears adequate to address and resolve specific construction quality deficiencies.

Deficiencies in Installation of PICAs

Criteria: *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 of the WTP QAM; and DOE Order 414.1C)*

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 of 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 2012. After completing this review, BNI Construction Field Engineering determined that actual physical inspections of PICA installations were needed to resolve the questions regarding PICA documentation deficiencies and possible installation errors. BNI issued PIER 24590-WTP-PIER-MGT-12-1246-B, Rev. 0, *Post Installed Anchor Bolt Installation and Documentation*, to perform additional actions, including reviewing installation documentation and re-inspecting all CM PICAs installed on the WTP project.

EA reviewed the status of the CM PICA re-inspection program and found that, as of April 30, 2014, BNI Field Engineering identified 2024 records documenting installation of CM PICAs in the LAW (1234), the LAB (310), and BOF (480). An additional 177 records document CM PICAs installed in the HLW that will be inspected at a later date. The number of PICAs represented by each record varies, typically between 4 and 10. Re-inspections of the PICA installations documented on 1954 records were completed as of April 30, 2014. These re-inspections included 1178 records in the LAW, 305 records in the LAB, and 471 records in the BOF. Installation errors were identified with one or more PICAs documented on 778 of these records. The majority of the errors consisted of either PICAs inadequately embedded or installed too close to other embedded items. BNI initiated 778 CDRs (one for each record that contained an installation error) related to PICA deficiencies since September 2011 to disposition the discrepancies. BNI Design Engineering has completed evaluation of over half the CDRs. In most cases, BNI Design Engineering determined that the installed PICAs could support the applied loads ("Use-as-is"), but some additional rework has been required to restore the design margin and required safety factors for PICA deficiencies documented in some (less than 10 percent) of the CDRs. 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 QC inspectors perform independent inspections of 100 percent of the Q PICAs to verify the location, correct anchor type, and appropriate installation method. QC inspectors do not inspect CM PICAs.

EA reviewed the Apparent Causes Evaluation, Document 24590-WTP-ACEF-CON-12-0037, Post Installed Anchor Bolt Installation and Documentation, dated May 7, 2013. The apparent causes of the deficiencies in PICA installation and inspection practices, including inadequate documentation were attributed to confusing specifications, installation instructions, and drawings; complacency on the part of the craft installers and field engineers; and inadequate training of both the installers and field engineers. In addition to the re-inspection of the previously installed PICAs, discussed above, corrective actions included issuing a management suspension of work to control installation of new PICAs, revising the engineering specification and installation procedure to clarify PICA installation requirements, and retraining of installers and field engineers.

BNI Specification 24590-WTP-3PS-FA02-T0004, *Engineering Specification for Installation and Testing Post Installed Concrete Anchors and Drilling/Coring of Concrete*, establishes the technical requirements for installation, inspection, and testing of PICAs. Revision 6 of the BNI specification was issued on October 7, 2013, to incorporate lessons learned from the walk-down inspections and the corrective actions necessary to close out PIER 24590-WTP-PIER-MGT-12-1246-B and 24590-WTP-PIER-MGT-11-0918-C. Revision 6 updated and replaced Revision 5, dated July 7, 2010. The changes to the BNI specification in Revision 6 required increased involvement of field engineers in selection of the type and size of non-structural CM PICAs, amended installation and testing instructions for PICAs, and added inspection and acceptance criteria for CM PICAs. Details pertaining to edge distances, embedment depth, and minimum spacing between adjacent PICAs or between PICAs and cast in place anchors, such as Nelson studs or deformed bar anchors, necessary to develop the full capacity of the PICA were clarified in Revision 6 of the BNI specification. Revision 7 to BNI Specification 24590-WTP-3PS-FA02-T0004 was issued on April 29, 2014. Additional details on spacing and edge distance, and a series of sketches showing examples on how to determine the correct spacing and edge distance for PICAs were incorporated into Revision 7 of the BNI specification. The method used to measure the minimum spacing between adjacent PICAs was also revised in Revision 7.

Appendix C in the BNI Specification 24590-WTP-3PS-FA02-T0004 contains a series of Tables that lists the minimum embedment, edge distance, spacing, installation torque, and tension test data for CM anchors (i.e., PICAs). The values in theses Tables were obtained from Evaluation Reports published by the International Conference of Building Officials (ICBO). The values shown are those required to obtain maximum working load. The data in the ICBO Evaluation reports are based upon test and/or technical data submitted by manufacturers of various types of concrete anchors (PICAs). A disclaimer in the ICBO reports states that the ICBO has not performed independent testing to verify the manufacturer's data. EA reviewed the ICBO reports referenced in the BNI Specification. The Findings summarized in the ICBO reports, in part, state the data complies with the 1997 Uniform Building Code, subject to the following conditions: (1) Special inspection is required during anchor installation; (2) Anchors are not subjected to vibratory loads; and (3) Calculations are submitted showing that applied loads on anchors comply with those published in the ICBO Reports. As an example, special inspection for wedge anchors is defined in the ICBO Evaluation Report ER-1372, *ITW Ramset/Red Head Self-Drilling, TruBolt Wedge, and Multi-Set II Concrete Anchors,* as continuous inspection to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, anchor spacing, edge distances, slab thickness, anchor embedment, and tightening torque.

The TruBolt Wedge Anchor is the most common type of PICA used on the WTP project. EA reviewed ICBO Evaluation Report ER-1372, and compared the data in the ICBO report to Table C.1 in Appendix C in the BNI Specification. No discrepancies were identified between the data in BNI Specification Table C.1and the ICBO report. However, EA noted that there appeared to be some inconsistencies in some of the edge distance and spacing data. For example, for .75 inch diameter wedge anchors, the minimum spacing between anchors with 3.25 inches of embedment is listed as 11.375 inches; for 6.625 inches of embedment, the minimum spacing between anchors is listed as 10.0 inches and for 10.0 inches of embedment, the minimum spacing between anchors is listed as 15.0 inches. There are several other examples in Table C.1 where the minimum spacing between adjacent anchors required to develop full anchor capacity decreased with increasing embedment depth. The minimum spacing between anchors is established to prevent the theoretical concrete breakout failure cones from intersecting, and the diameter of the failure cone increases as anchor embedment depth deepens. The minimum spacing therefore should be expected to increase with increasing embedment depth.

In addition, a note in Paragraph 3.16.1 states: "Note: For a Non-structural Anchor adjacent to a Non-structural Anchor, exceptions to the spacing requirement do not require engineering approval." Following the note there is a paragraph with the heading "Spacing Exceptions" listing seven statements to provide alternate spacing exceptions different from Appendix C. This note is unclear. (See **OFI-WTP-1.**)

The design capacity of each size (length and diameter) and type of anchor (PICA) is not specified in BNI Specification 24590-WTP-3PS-FA02-T0004. Two sets of allowable shear and tension values are listed in the ICBO Reports. One set of values is based on anchors subjected to special inspection, and a second set of lower allowable shear and tension values are for anchors without special inspection. Since paragraph 5.1 of the BNI Specification requires inspection of all structural CM PICAs by the responsible field engineer, the higher values would apply for CM structural PICAs, provided they are not subjected to vibratory loads, design calculations are provided, and the other limitations discussed under Findings in the ICBO Reports are met. The allowable design capacity of each size and type of PICA used in design calculations should be based on the use of appropriate safety factors to account for possible installation or manufacturing deficiencies, similar to those used at commercial nuclear power plants. EA noted the following discrepancy regarding inspection frequency in the BNI Specification. One of the inspection criteria listed in Paragraph 5.1 of the Specification is testing by either the torque method or a direct tensioning method, depending on the type PICA. However Paragraph 5.2.3 of the BNI Specification implies that only 10 percent of CM PICA installations are required to be tested and witnessed by the responsible field engineer. In addition to specifying the design capacity of each size and type PICA, the test frequency for PICAs should be clarified. (See **OFI-WTP-2.)**

Paragraph 1.4.1 of BNI Specification 24590-WTP-3PS-FA02-T0004 states that the field engineer may choose any approved anchor listed in Appendix C of the BNI specification for a non-structural CM anchor (PICA) application and that the diameter chosen shall be consistent with the size of the hole in the attachment. The diameter of the hole in the component may not be large enough to use a PICA with sufficient capacity to support the component. Also the length of the PICA required to support a component weighing 400 pounds or less is not specified, and the number of PICAs required for attaching the component to a wall is also not specified (Reference Paragraph 1.4.1.1 of the BNI specification). The required anchor capacity to adequately support a component weighing 400 pounds or less during a seismic event depends on the location and elevation where the component is to be installed. The horizontal accelerations and forces resulting from a seismic event generally increase with increasing height in a structure. These forces are determined by using seismic response spectra analysis, which includes calculations that reflect structure geometry and stiffness. CM components must be designed to resist seismic forces if there is the potential of seismic interactions between the CM components and Q components. In cases where a design drawing is not provided for installation of a CM component, the current BNI specification requires the field engineer and/or craft supervisor to determine CM component weight and the location of its center of gravity. If the CM component weighs less than 400 pounds and the center of gravity is less than four feet above the floor or platform, the PICAs used to anchor the component are classified as non-structural. The anchor diameter to be used depends on diameter of the hole, if any, in the component. The type, length, number and configuration of anchors are determined by the field engineer or craft supervisor. (See **OFI-WTP-3**.)

BNI Construction Procedure 24590-WTP-GPP-CON-3205, *Post Installed Concrete Anchors*, describes the process for installation and quality verification activities for PICAs. The BNI construction procedure has been revised six times (Revisions 3B, 3C, 3D, 4, 4A, and 4B) since PIER 24590-WTP-PIER-MGT-11-0918-C was initiated in September 2011, primarily to clarify PICA installation criteria, improve the quality verification process for CM PICAs, incorporate lessons learned from PIER 24590-WTP-PIER-MGT-12-1246-B and 24590-WTP-PIER-MGT-11-0918-C, and address corrective actions necessary to prevent recurrence of the errors found during re-inspections of the PICAs. Revision 4, issued on October

8, 2013, to BNI Construction Procedure 24590-WTP-GPP-CON-3205 was a complete rewrite to address the changes in Revision 6 of the BNI Specification 24590-WTP-3PS-FA02-T0004. Revision 4A, issued on January 6, 2014, to the BNI construction procedure revised installation and quality verification requirements, and included addition of a new process for CM Non-Structural PICAs, changes to the minimum spacing criteria, new requirements and responsibilities for technical reviews of inspection records, and clarification of inspection and testing requirements for all PICAs. BNI Construction Procedure 24590-WTP-GPP-CON-3205, Revision 4B, was generated on April 30, 2014, to incorporate changes to installation and testing of PICAs addressed in Revision 7 of BNI Specification 24590-WTP-3PS-FA02-T0004.

Subcontractors use their own construction procedures for installing CM PICAs. Any Q anchors required to support equipment and hardware in the subcontractor's scope of work are installed by BNI and inspected by BNI QC inspectors. The subcontractors were in the process of revising their PICA installation procedures during EA's May 2014 review to incorporate the changes to the minimum spacing requirements between adjacent CM PICAs, between CM PICAs and Q PICAs, and between CM PICAs and embed plates amended by Revision 7 to BNI Specification 24590-WTP-3PS-FA02-T0004. The subcontractor's revised procedures will be submitted to BNI for review and approval.

BNI's approach to determine the extent of condition and the corrective actions necessary to correct the PICA installation deficiencies were adequate. However, corrective actions were not timely (more than 30 months to date). BNI delayed the initial revision of BNI Specification 24590-WTP-3PS-FA02-T0004 to incorporate the changes necessary to clarify PICA installation criteria and to address issues such as PICA spacing requirements that resulted in the previously identified PICA installation errors for more than two years after the problems were identified. Completion of the re-inspection program was impeded by incomplete or deficient records for CM PICAs installed before the PICA installation errors were identified.

Pressure Testing of Piping

Criteria: *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 pneumatic and two hydrostatic pressure tests on piping connected to water storage tanks adjacent to the water treatment building. The piping had been previously pressure tested successfully. The current pressure tests were performed to verify the integrity of spool pieces that had been installed in piping sections for performance of cleaning and flushing operations. The WTP site work process for conducting leak testing is specified in Construction Procedure 24590-WTP-GPP-CON-3504, *Pressure Testing of Piping, Tubing and Components*. The requirements for hydrostatic pressure testing are specified in ASME Code B31.3, Paragraph 345.4, Hydrostatic Testing. The requirements for pneumatic pressure testing are specified in ASME Code B31.3, Paragraph 345.5, Pneumatic Testing.

EA attended the pre-test briefings, reviewed drawings and test data sheets, observed pressurization of the systems to the specified test pressure, observed the minimum hold times, and witnessed the system walk-down and inspection of the piping within the test boundary. Pre-job briefings were well conducted and addressed safety guidelines, the emergency plan, the size and setting of the pressure relief valve, test sequence, test boundaries, test pressure, system pressurization and de-pressurization, inspection activities, and work completion.

The requirements for the hydrostatic pressure tests of the BOF process service water system (PSW) piping connected to PSW tanks 00002 and 00003 and demineralized water system (DIW) piping connected to DIW tank 00004 observed by EA were specified in System Pressure Test Package 24590-BOF-PPTR-CON-14-0030 and -0031. The requirements for the pneumatic pressure test of the BOF domestic (potable) water system (DOW) piping connected to DOW tank 00001 observed by EA were specified in System Pressure Test Package 24590-BOF-PPTR-CON-14-0029. The test packages included the test data sheets, test information, test requirements, valve lineup sheets, and marked-up piping and instrumentation diagrams (P&IDs) for the pressure tests. The pressure test and inspection boundaries were shown on the marked-up P&IDs, and the attached valve lineup sheets listed the test valve position and referenced test plug or blind flange locations. The piping within the pressure test boundaries is classified as CM. Before the pressure tests, EA walked down the piping systems and examined the valve lineup and pressure test tags attached to the valves. The tags are placed on components to caution that a pressure test is in progress, to indicate the test position of the component (open, closed, or N/A), and to state that operation of the component is restricted to authorized test personnel. No discrepancies were identified.

The minimum test pressures for the hydrostatic tests were 188 pounds per square inch (psi) for the DIW piping system and 162 psi for the PSW piping. For the pneumatic test, the minimum test pressure was 50 psi. The test pressures were based on the individual piping design pressures. The BNI construction procedure specifies a minimum hold time of 10 minutes for the test pressure. EA verified that the calibration stickers on the test pressure gauges were current and that whip restraints were installed on pressure hoses. EA witnessed the pressurization sequence and verified that each system tested was pressurized to the designated test pressure and held for a minimum of 10 minutes prior to initiating the system walk-down to inspect the piping for leakage. Walk-downs and inspections of the piping and other components were performed by BNI Field Engineering personnel. EA observed the walk-downs and inspections. No leaks were identified in the welds or piping within the pressure test boundary, and the tests were declared successful. Two minor packing leaks on valves outside the test boundary on the DIW and PSW piping will be corrected as part of the routine system maintenance program. Following completion of the pressure tests, EA reviewed the post-test calibration checks performed in the onsite Measurement and Test Equipment (M&TE) facility on the four pressure gauges used during the pressure tests, and the calibration records for the gauges. The M&TE data showed that the gauges used in the pressure tests were accurate. The pressure testing program was found to be satisfactory for the sample reviewed by IEA.

WCD Welding Inspection Program

Criteria: *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)*

The WCD staff performs independent inspections of one or more inspection attributes for approximately five percent of Q welds and is currently reviewing all the weld records. WCD randomly selects the welds they examine. In addition to randomly selected welds, WCD places witness points on weld inspection documentation to ensure a variety of welds are inspected by WCD across all facilities. The witness point requires BNI Construction to notify WCD when work is scheduled to be performed. The work activity cannot be performed or proceed past that point unless the construction process is inspected by WCD, or WCD waives the witness point. Welds selected by WCD for inspection include structural steel, piping, pipe supports, vessel (tank) welds, and weld repairs. The majority of the welds examined by WCD are Q, but the WCD staff also includes CM welds in their independent sample.

EA observed final visual inspections of two completed CM welds by a WCD site inspector that were pre-selected by WCD site inspectors during a review of welding documentation. The welds were a structural weld; FW-01, on a pipe support, on drawing 24590-BOF-DIW-WE-04095002 and piping weld GB-008 on a 2.0 inch diameter diesel fuel oil pipe on drawing 24590-BOF-P#-DFO-XM00085001. Acceptance criteria for visual examination of support and structural steel welds are specified in Bechtel Nondestructive Examination Standard, Visual Examination VT-AWS D1.1. Acceptance criteria for visual examination of piping welds are specified in Bechtel Nondestructive Examination Standard, Visual Examination VT-ASME. The WCD site inspector also reviewed the field welding checklists, weld wire draw slips, and drawings associated with the welds. The WCD welding inspection program was found to be satisfactory for the sample reviewed by Independent Oversight.

Concrete Placement Records

Criteria: *Work, such as concrete construction, shall be performed in accordance with approved procedures, design drawings, 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, Criterion 5; Policy Q-5.1 of the WTP QAM; and DOE Order 414.1C). Records shall furnish documentary evidence that items or activities meet specified quality requirements (NQA-1, Requirement 17; Policy Q-17.1 of the WTP QAM; and DOE Order 414.1C.).*

EA reviewed the results of QC tests performed on concrete samples from the four Q concrete pours that were placed in the HLW facility, two in March 2014 and two in April 2014. These tests included slump, temperature, and unit weight testing performed on the freshly mixed concrete and unconfined compression tests performed on concrete cylinders cured in the concrete laboratory. The unconfined compression test results are used to verify the concrete quality and demonstrate that the concrete meets the design strength requirements based on the unconfined compression strength test results. The concrete strength is determined by casting samples of concrete in cylindrical molds, either 4.0 inches in diameter and 8.0 inches high or 6.0 inches in diameter and 12.0 inches high, moist curing them in a field laboratory for a specified period, and then subjecting them to an unconfined compression test. At WTP, the concrete design strength is based on the results of the unconfined compression tests performed on concrete test cylinders that were moist cured in the concrete field laboratory for 28 days. The numbers of concrete cylinders tested are one at 7 days and a set of two at 28 days. The 7 day test result provides an early indication of the 28 day concrete strength and shows that the concrete that was placed can be expected to meet design requirements. The unconfined compression strength of concrete increases approximately 20 to 25 percent between an age of 7 days and 28 days. Additional cylinders are cast and tested at other intervals for providing information on when concrete forms can be removed or when additional strength tests may be necessary. The methods for sampling the concrete, casting and curing the cylinders, and performing the unconfined compression tests are specified in American Society for Testing and Materials International standards.

The unconfined compression tests performed on seven sets of concrete cylinders from the two concrete wall pours placed in March 2014 showed that the concrete strength at an age of 28 days in these placements ranged between 5000 and 6820 psi. The average strength for the seven sets of test cylinders was 6150 psi. The required (design) strength for the concrete is 5000 psi. For the two concrete pours placed in April 2014, EA reviewed the results from concrete strength tests performed on the four test cylinders tested at an age of 7 days. The concrete poured in April did not attain an age of 28 days during the review so only the 7 day compression test results were available for review. The unconfined compressive strength at an age of 7 days for the two placements ranged between 4400 and 5210 psi. The average strength for the test cylinders tested at the age of 7 days was 4870 psi. The quality of concrete at the WTP plant is satisfactory. The results of the unconfined compression strength of the concrete at 28 days continues to exceed the specified design strength by 1000 psi or more for all classes of structural concrete placed at WTP.

Installation of Electrical Equipment

<u>Criteria:</u> *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)*

EA examined construction activities in several of the WTP buildings, including the HLW, LAB, LAW, and several BOF buildings, inspecting ongoing cable pulling operations to verify that cable pulling was performed in accordance with design documents (i.e., specifications and drawings), and to verify that as-built configurations of installed electrical switchgear, electrical control panels, and cables were consistent with the design documents. EA's observations are discussed in more detail below.

Cable Pulling

EA attended a pre-job briefing, observed preparations for installation of a main power cable between the BOF electrical building (Building 87) and the LAB, and observed installation of some communication cables and grounding cables. The technical requirements for electrical cable installation are detailed in BNI Specification 24590-WTP-3PS-E00X-T0004, *Engineering Specification for Installation of Cables*. The WTP site work process for installation of electrical cables is specified in Construction Procedure 24590-WTP-GPP-CON-3304, *Electrical Cable Installation*.

The electrical craft were planning for installation of the main power cables from Building 87 to the LAB. This is a distance of approximately 800 feet through underground conduit. Two sets of cables feed the LAB. One set connects the 13.8 kilovolt (KV) SWGR MVE-SWGR-870001A in Building 87 to LVE-LC-60001 in the LAB. The other set of cables connects 13.8 KV SWGR MVE-SWGR-870001B in Building 87 to LVE-LC-60002 in the LAB. Each set of these cables is made up of 3 – single conductor 4/0 – 15 KV cables.

The work was scheduled for the week of May 12, 2014, (after the EA onsite review) and planning is well under way. EA attended the pre-job briefing and examined the material and work staging areas. The pre-job briefing was well attended by the electrical craft and supervisors. The technical aspects of the job were discussed during the briefing, as well as safety, including required personal protective equipment, confined space requirements, and electrical safety. Test procedures were discussed including the need for continuity checks, megger checks, and hi-pot testing. Since a few large cables are being pulled over a long distance, BNI plans to use a cable tugger and tension monitoring equipment. Both were discussed during the pre-job briefing. The cable installation plans specified that the cables were to be pulled off the cable spools through a manhole toward Building 87 and then a long enough tail would be pulled off the spools to go from the manhole into the LAB. A work platform was constructed adjacent to the manhole to give a clean, level work area and a place to coil the cable tail that would then be pulled into the LAB. The cables were staged near the manhole and work platform. EA verified that the cables were the proper type specified in the design drawings and were consistent with the inventory control labels.

In anticipation of the connection of the LAB to permanent power, EA, in conjunction with WCD, performed a detailed walk-down of the electrical switchgear in the LAB electrical room, between the 13.8KV/480V transformer and the motor control center (MCC) distribution panels. EA and WCD determined that the installation and the workmanship of the existing hardware and cables were satisfactory. The entrance of service conductors into the electrical cabinets was a concern identified during the walk-down. The service conductors (electrical cables) between the cable trays and top of the electrical cabinets are not routed in conduit or vertical cable trays, but drop unprotected in the open air from cable trays into the top of the cabinets. This concern has been previously raised by the WCD site electrical inspector and is under discussion with BNI.

EA observed electricians pulling CAT-6 communication cables in the LAB. These cables were pulled between the data processing room and various input/output points in the LAB. The craft were conscientious in their efforts to ensure that kinks were avoided, pull-bys and pull-backs were avoided, and conduit fill was acceptable.

EA also observed the electricians pulling ground cables for the isolated instrumentation ground system in the LAW. The isolated ground system connects the many instrumentation racks to an isolated ground that is separate from the building ground system. Some of the instrument ground cables had been supported incorrectly and were re-worked to ensure code compliance. This was a BNI self-identified and self-corrected issue. These pulls were individual cables and were routed by hand. EA also toured the HLW building where some cable trays have been installed, but very little permanent cable has been pulled. Most of the installed cables are for temporary use.

With the exception of the concern discussed above regarding the entrance of service conductors into the electrical cabinets, cable pulling activities and installation of electrical cables were satisfactory.

Equipment Labeling

During the March 3-6, 2014, quarterly WTP construction quality review, EA identified an OFI concerning the lack of consistency between the labeling of electrical control panels and color of indicator lights. The indicator light colors and labeling on the control panels were found to be inconsistent with the design drawings and design specifications. The labeling and color of indicator lights on some adjacent panels were inconsistent with each other. BNI action addressing labelling inconsistencies will be reviewed during EA's September 2014 review of WTP Construction Quality.

During the May 2014 construction quality review, EA, in conjunction with WCD, observed that labeling on the compartments on MCC LVE-MCC-60004 in the LAB to be confusing. For example, compartment 3F is labeled "C2V-FAN-00014, C2 EXHAUST FAN." This compartment ultimately controls that fan, however, it first goes through adjustable speed drive (ASD) C2V-ASD-00 010 which controls power to motor C2V-MTR-00050, which powers the exhaust fan, C2V-FAN-00014. Section 110-22 of the NEC states that "Each disconnecting means required by this code for motors and appliances, and each service, feeder or branch circuit at the point where it originates, shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident." BNI failed to meet the recommendations of the NEC since these MCC compartments have not been clearly labeled to eliminate confusion about their downstream components. The labeling scheme does not include the adjustable speed drive number, the motor number and the exhaust fan number. Without such information, it is not clear which of the downstream components are controlled by this disconnect switch. WCD has written a Surveillance Report documenting that MCC labeling could be improved. An OFI, S-14-WCD-RPPWTP-005-O02 was identified by WCD to BNI to consider changing the labeling of the MCC to include all the downstream components, in accordance with the recommendations of the NEC. This particular switch is in cubicle 3F of MCC-60004. Cubicles 2F, 2M, and 3M also have the similar issue.

Another labeling issue identified by EA during the inspection of MCC LVE-MCC-60004 is the confusing labeling for each of these fan/ASD/motor groupings. The fan in question is designated as C2V-FAN-

00014, the adjustable speed drive is designated C2V-ASD-00010, and the motor as C2V-MTR-00050. The use of non-sequential identifiers for the train instead of a sequential identifier for the whole train (e.g., C2V-FAN-00014, C2V-ASD-00014, and C2V-MTR-00014 could increase the possibility for future confusion and errors. This non-sequential labeling is common to all of the fans controlled by this MCC and may be common to other MCCs as well. **(See OFI-WTP-4.)**

Maintenance, Preservation, and Protection of Stored and Installed Equipment

<u>Criteria:</u> *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. Handling, storage, cleaning, packaging, shipping, housekeeping, and 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)*

During the March 3-6, 2014, quarterly construction quality review, EA observed that some installed electrical motors and instrument racks in the LAW were not adequately protected from construction activities. EA identified an OFI concerning the BNI program for protection of equipment installed at the WTP site. While openings in pipes, pumps, tanks/vessels, and instrument lines were closed with caps or tape to maintain cleanliness and most of the mechanical equipment was protected from construction activities, several electric motors were observed to be covered with dust. EA found the electric motors were totally-enclosed fan-cooled motors during the May 2014 visit. Although less important for the totally-enclosed fan-cooled motors, a good construction practice is to cover motors with tarps or plastic sheets. EA identified several instrument panels in the LAW with installed instruments and spur blocks that were not protected from construction activities. The spur blocks are used to provide an interface between field instrumentation (typically transmitters) and the main control network. These spur blocks have 4, 6, or 8 input sockets and a single output socket to the control network. These input and output sockets require a plug to be installed on the connecting cables. Paragraph 3.4.3 of BNI Specification 24590-WTP-3PS-JQ08-T0001, *Engineering Specification for Construction and Installation of Controls and Instrumentation*, states that when an input socket is not used, a cap is required to be installed on the socket to prevent dust and debris from getting into the connection ports. During the March 3-6, 2014, quarterly construction quality review, EA identified several examples in the LAW where spur blocks have been installed but open sockets were not covered with caps. Discussions about this issue with the BNI lead electrical field engineer for LAW revealed that he was aware of the problem and that BNI had ordered caps to cover the open sockets. While waiting for these caps, EA recommended covering the exposed sockets, even with electrical tape, to protect the instruments from possible debris contamination.

During this May 2014 construction quality review, EA observed that most of the electric motors had been covered with tarps or wrapped with plastic covers and that most of these open spurblock connections have been covered with tape awaiting the permanent installation of cables or caps. EA also noted that housekeeping in the LAW had improved since the March 2014 quarterly construction quality review.

Self-Assessment Program

<u>Criteria:</u> *Line and support organizations shall perform self assessments of their performance and the adequacy of their processes. Self-assessments shall be used to evaluate performance at all levels periodically and to determine the effectiveness of policies, requirements, and standards and implementation status. Self-assessment results must be documented in sufficient detail to identify the activity covered, identify the individuals performing the surveillance, and document results and any necessary corrective actions. (Policy Q-02.2 of the WTP QAM; DOE Order 226.1A; DOE Order 226.1B;*

and DOE Order 414.1C) Note: DOE Order 226.1A was superseded by DOE Order 2261B by Contract Modification 310, dated January 28, 2014.

Self-assessments are self-critical evaluations of work processes and activities to ensure that work is performed as expected, to monitor work results to ensure that completed work meets project requirements, and to evaluate performance at all levels to identify problems with work processes and completed work activities. In the construction quality quarterly report issued on May 22, 2013, EA identified an OFI specifying that the self-assessment process within the BNI Construction Field Engineering organization could rely more on performance-based assessments and/or complete a higher percentage of performance-based self-assessments. BNI Procedure 24590-WTP-GPP-MGT-036, *WTP Self-assessment*, the implementing procedure for performing the self-assessments necessary to comply with the BNI QA program and DOE QA requirements, described a self-assessment that included compliance-based and performance-based self-assessments. A compliance-based assessment was defined as one that focuses primarily on determining whether work items were completed in accordance with a procedure, requirement, standard, or other implementing document. A compliance-based assessment typically included a review of documentation to measure whether those performing the task are following the prescribed method or rule, with only minimal observations of work. A performance-based assessment evaluates work being performed. In addition to ensuring that work items are completed in accordance with a procedure, requirement, standard, or other implementing document, a key objective of a performance-based assessment is actual observation of ongoing work activities, followed by an evaluation focused on improving the performance of that activity.

BNI initiated PIER 24590-WTP-PIER-MGT-13-0743-D to address this OFI in June 2013. During a previous quarterly assessment, EA reviewed the PIER, which was closed on July 31, 2013. The closure statement for the PIER states that discussion of the OFI with the WTP BNI field engineering manager determined that reviews of work in progress are part of the normal work process for BNI Field Engineering, and although they are not formally documented as assessments, these work process assessments accomplish the same purpose. However, Paragraph 2.2.2.2.3 of BNI QAM Policy Q-02.2 states that self-assessment results are to be documented consistent with the significance of risks associated with the activities being evaluated.

Between January 1 and August 1, 2013, the BNI Field Engineering organization performed 21 compliance-based self-assessments limited to reviewing completed construction records to determine whether the records were complete and accurate. No additional self-assessments were completed by BNI Field Engineering between August 1 and March 6, 2014. BNI Field Engineering did not complete any performance-based self-assessments in 2013 to observe ongoing work activities and to evaluate performance in construction activities, such as piping and pipe support installation, instrument tubing and support installation, and electrical cable and component installation. With the exception of a self-assessment to review the construction turnover process, the performance-based self-assessments performed in 2011 and 2012 to review field engineering activities were reactive, i.e., in response to issues identified by the BNI QA organization or WCD. The majority of the field engineering self-assessments performed in 2011 and 2012 could be classified as compliance-based assessments.

The self-assessment program in the BNI Construction Field Engineering organization was recently revised to focus more on performance-based assessments. EA reviewed the WTP self-assessment report titled Pre-Test Requirements for Leak Tests, dated March 13, 2014. This was a performance based self-assessment to evaluate the piping pressure test program. The scope of this self-assessment was to evaluate test pre-requisites and hardware readiness, M&TE, and pre-test signoffs. Eleven pressure tests were evaluated during the self-assessment. No discrepancies were identified. EA reviewed the schedule for BNI Field Engineering self-assessments planned for 2014. One performance based self-assessment of electrical cable installation was in progress during the EA's May 2014 review. Approximately eight additional performance-based self-assessments are planned for 2014, covering several work activities including liner plate installation, pump alignments, cable terminations, structural steel erection, pressure testing, and nondestructive examination of welding. EA will continue to evaluate the implementation of the self-assessment program by the field engineering organization in future quarterly construction quality reviews.

Quality Assurance Surveillance Activities

Criteria: Quality Assurance surveillances shall be performed by knowledgeable personnel and shall be scheduled in a manner to provide coverage, consistency and co-ordination of ongoing work. Surveillance results shall be documented in sufficient detail to identify the activity covered, identify the individuals performing the surveillance, and document results and any necessary corrective actions. (NQA-1 Criterion 18; Policy Q-02.3 of the WTP QAM; and DOE Order 414.1C)

BNI Procedure 24590-WTP-GPP-QA-601, *Quality Assurance Surveillance*, describes the process used to plan, conduct, and document surveillances of work activities at WTP. The surveillances focus on observations of work activities to determine whether procedures are followed and provide feedback to management on organizational performance. These surveillances, which supplement QA audits that are conducted by the offsite QA staff, are performed by the onsite QA and QC staffs. Surveillances performed by the QA staff are titled QA Surveillances, while those performed by the QC staff are titled QC Surveillances.

EA reviewed QA and QC surveillances completed in March and April 2014. These surveillances covered observations of a cross section of ongoing work activities at the WTP site. BNI surveillances identified a few minor deficiencies, which were documented in the BNI corrective action program. The BNI QA surveillance program was found to be satisfactory for the sample reviewed by EA. The surveillances reviewed by EA provided good coverage of the full range of ongoing work activities, including some work activities performed on the second (night) shift. EA concluded that the BNI QA surveillance program is acceptable.

6.0 CONCLUSIONS

EA determined that construction quality at WTP is adequate in the areas that were reviewed (design and procurement programs were not included in the scope of this quarterly construction quality review). BNI Engineering has developed appropriate corrective actions to resolve specific deficiencies for construction quality NCRs and CDRs reviewed by EA, and BNI continues to implement corrective actions necessary to address errors in installation of PICAs. BNI's approach to determining the extent of condition was adequate. However, corrective actions have not been timely to resolve the PICA installation errors; more than 30 months have elapsed since the problems were identified, and corrective actions had yet to be completed as of May 8, 2014.

Overall, installation of electrical equipment was satisfactory. However, labeling on the compartments on some MCCs in the LAB is confusing.

In response to previous EA concerns regarding the lack of performance based self-assessments, the focus of the self-assessment program in BNI Construction Field Engineering has been adjusted to include more performance-based self-assessments. One performance based self-assessment was recently completed, another was in progress during the review, and approximately eight others are scheduled to be performed in calendar year 2014.

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified four OFIs. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are suggestions offered by the EA assessment team that may assist site management in implementing best practices, or provide potential solutions to minor issues identified during the review. In some cases, OFIs address areas where program or process improvements can be achieved through minimal effort. These OFIs should be evaluated by the responsible line management organizations and either accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

OFI-WTP-1: BNI should perform an independent review of the edge distance and anchor spacing versus anchor embedment data listed in BNI Specification 24590-WTP-3PS-FA02-T0004 Appendix C to verify that spacing requirements listed in the Appendix C Tables are accurate, and that limitations (listed as Findings in the ICBO Reports) were considered when the Appendix C spacing data was established. The discussion in BNI Specification 24590-WTP-3PS-FA02-T0004 Paragraph 3.16.1 regarding spacing exceptions should be clarified.

OFI-WTP-2: BNI should consider listing the allowable design capacities for each size and type of PICA, or adding a reference to the appropriate design document that lists the PICA design capacities. The testing frequency in Paragraph 5.2.3 of BNI Specification24590-WTP-3PS-FA02-T0004 should be clarified.

OFI-WTP-3: WTP should consider providing sketches or drawings that provide typical details for anchoring all CM components instead of requiring field engineers or craft supervisors to provide anchorage details.

OFI-WTP-4: **The use of non-sequential identifiers instead of sequential identifiers for a whole equipment train may increase the possibility for future confusion and errors. This non-sequential labeling is common to all of the fans reviewed may be common to other MCCs as well. An example of a sequential numbering system is C2V-FAN-00014, C2V-ASD-00014, and C2V-MTR-00014.**

8.0 ITEMS FOR FOLLOW-UP

EA will continue to follow up on inspection of welding activities, piping and pipe supports, pressure testing of piping, cable pulling, cable terminations, and installation of electrical equipment. EA will also continue to review corrective actions to address identified discrepancies in the PICA installation process and will perform additional reviews of self-assessments conducted by BNI Field Engineering. Additionally, EA will review actions taken by BNI to resolve equipment labelling inconsistencies identified in the EA review of WTP Construction Quality conducted in March 2014.

Appendix A
Supplemental Information

Review Dates

May 5-8, 2014

Office of Enterprise Assessments 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, Director, Office of Nuclear Safety and Environmental Assessments

Quality Review Board

William A. Eckroade
Thomas R. Staker
William E. Miller
Michael A. Kilpatrick

EA Site Lead for Hanford Site

Robert Farrell

EA Team Composition

Joseph Lenahan
James Boyd

Appendix B
Documents Reviewed, Interviews, and Observations

Documents Reviewed

- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 9D, Pressure Testing of Piping, Tubing and Components, April 16, 2014
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 4B, Post Installed Concrete Anchors, April 30, 2014
- Specification 24590-WTP-3PS-DB01-T0001, Rev. 8, Engineering Specification for Furnishing and Delivering Ready-Mix Concrete, March 26, 2007
- 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
- Procedure 24590-WTP-GPP-MGT-043, Rev. 5C, Corrective Action Management, March 14, 2014
- Procedure 24590-WTP-GPP-MGT-044, Rev. 2, Nonconformance Reporting and Control, December 4, 2013
- Procedure 24590-WTP-GPP-MGT-036, Rev. 3A, WTP Self Assessment and Line Surveillance, February 26, 2014
- Procedure 24590-WTP-GPP-QA-601, Rev. 6C, Quality Assurance Surveillance, May 1, 2013
- Document No. 24590-WTP-MN-CON-01-001-10-10, Rev. 6, Bechtel Nondestructive Examination Standard, Visual Examination VT-AWS D1.1, August 15, 2006
- Document No. 24590-WTP-MN-CON-01-001-10-09, Rev. 8, Bechtel Nondestructive Examination Standard, Visual Examination VT-ASME, August 8, 2013
- Document No. 24590-WTP-QAM-QA-06-001, Rev. 13, Quality Assurance Manual, September 20, 2013
- Nonconformance Report numbers 24590-WTP-NCR-CON-14-042 through -063
- WTP Self Assessment Report 24590-WTP-SAR-CON-14-0002, Pre-Test Requirements for Leak Test, Focus Area: Piping Pressure Testing
- System Pressure Test Document Numbers 24590-BOF-PPTR-CON-14-0029, -0030 and -0341
- Drawing Number 24590-BOF-M6-DOW-00002001, Rev. 0, P&ID – BOF Domestic (Potable) Water System Storage and Pumps
- Drawing Number 24590-BOF-M6-PSW-00001003, Rev. 1, P&ID – BOF Process Service Water Feed Tank and Distribution Pumps
- Drawing Number 24590-BOF-M6-DIW-00001001, Rev. 0, P&ID – BOF Demineralized Water System (DIW) Storage and Pumps
- Document No. 24590-WTP-ACEF-CON-12-0037, Apparent Cause Evaluation for PIER No. 24590-WTP-PIER-MGT-12-1246-B, Post Installed Anchor Bolt Installation and Documentation
- Specification No. 24590-WTP-3PS-E00X-T0004 Rev. 8, Engineering Specification for Installation of Cables, September 17, 2013
- Specification No. 24590-WTP-3PS-E00X-T0005 Rev. 5, Engineering Specification for Electrical Raceway and Cable Identification, October 27, 2011
- Specification No. 24590-WTP-3PS-EW00-T0001 Rev. 3, Engineering Specification for Power, Control, and Instrumentation Cable, Medium Voltage Power Cable and Fiber Optic Cable (Safety), July 1, 2011
- Construction Procedure 24950-WTP-GPP-CON-3304 Rev. 2D, Electrical Cable Installation, September 23, 2013
- National Electric Code – 1999
- Drawing Number, 24590-BOF-E1-MVE-00002, Rev. 11, Switchgear Building 13.8KV Switchgear

- Drawing Number, 24590-LAB-E1CT-LVE-00001, Rev. 0, Single Line Diagram Analytical Laboratory
- Drawing Number, 24590-LAB-E2-E53T-00017, Rev. 6, Analytical Laboratory Cable Tray and Power Conduit Plan
- Drawing Number, 24590-LAB-E2-E53T-00011, Rev. 7, Analytical Laboratory Cable Tray and Power Conduit Plan
- Drawing Number, 24590-LAB-EC-LVE-00004 Sh. 1, Rev. 3, Motor Control Center Schedule LVE-MCC-60004
- WCD Surveillance Report, S-14-WCD-RPPWTP-005-09
- ICBO Evaluation Report ER-1372, ITW Ramset/Red Head Self-Drilling, TruBolt Wedge, and Multi-Set II Concrete Anchors

Interviews

- Field Engineering Manager
- Field Engineers
- QC Manager
- QC Inspectors
- Subcontract Technical Representatives

Observations

- Hydrostatic pressure tests
- Installation of Electrical Cables
- In-process welding inspections
- Preservation of installed equipment
- Installed electrical equipment and control panels